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Crop commercialization and smallholder farmers` livelihood in Tigray region, Ethiopia

Gebreslassie Hailua[1*], Kebede Manjureb[2] and Kiros-Meles Aymutc[3]

[1]Department of Natural Resource Economics and Management, Mekelle University, P. O. Box 231, Mekelle, Ethiopia.
[2]Department of Rural Development and Agricultural Extension, Mekelle University, P. O. Box 231, Mekelle, Ethiopia.
[3]Department of Dryland Crop and Horticultural Science, Mekelle University, P. O. Box 231, Mekelle, Ethiopia.

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This study examined the household level factors affecting the intensity of crop commercialization[a] and its impacts on livelihood of smallholder farmers. The study was conducted in six villages/tabias[b] in the Tigray Region, Ethiopia. The estimated results showed that ownership of oxen, amount and quality of yield harvested, and training on crop marketing have a positive and significant effect on intensity of crop commercialization. Outstanding debt and off- farm income were also identified among the driving forces of increased crop commercialization. However, family size, shortage of family labor, unreliable rainfall, costs of farm inputs such as fertilizers, crop pests and diseases, distance to market have a negative and significant effect on the intensity of crop commercialization. The study results indicated that the average crop commercialization index was about 19% of the total produce in the study area which shows the livelihood of the smallholder farm households is almost subsistence oriented. The crop commercialization index for cereals was lower than that of pulses and vegetable and fruits production, implying that in the dryland areas of Ethiopia, cereal production is more of subsistence nature than pulses and horticultural crops. Nevertheless, participation in crop commercialization has a positive and significant impact on smallholder livelihoods through improved income and asset holdings.

Key words: Crop commercialization, household level factors, livelihood, matching and smallholder farmers.

INTRODUCTION

There is a general agreement that agriculture is central to the economic growth in countries of sub-Saharan Africa since it accounts for 70% of total employment, 40% of total merchandize exports, and one-third of GDP (DFID, 2002; Rahman and Manprasert, 2006). More than 85% of Ethiopia's population lives in rural areas and depend on agriculture for their livelihood and most are classified as smallholders that are vulnerable to the impacts of climate change. Smallholders cultivate over 96% of the total agricultural land with the average smallholder cultivating less than one hectare of arable land and consuming more

[a] Sokoni (2007:3) defined commercialization of smallholder production as "a process involving the transformation from production for the household's subsistence to production for the market.'' Hazell et al. (2007:3) found that most definitions refer to agricultural consumption as "the degree of participation in the output market with the focus very much on cash income

[b] tabia is the smallest administrative hierarchy in Tigray (Region-Zone-Wereda/District-tabia)

than 65% of the total production within the household (EEA, 2006).

In many parts of the country, market participation of smallholder family farms is limited and agricultural markets are fragmented and not well integrated into wider market systems which increases transaction costs and reduces farmers' incentive to produce for the market (Mitku, 2014). It is commonly argued that productivity growth in smallholder agriculture will require a more commercialized orientation. With the ever increasing population and the limited farmland, increasing productivity will increasingly entail the intensification and commercialization of smallholder agriculture, involving more intensive use of productivity enhancing inputs, and more market oriented patterns of crop production.

Mitku (2014) indicated that commercial transformation of subsistence agriculture is an indispensible pathway towards economic growth and development for many agriculture dependent famers in developing countries. Sustainable household food security and welfare also requires commercial transformation of subsistence agriculture (Pingai, 1997). Commercialization enhances the links between the input and output sides of agricultural markets and entails market orientations and market participations (Jaleta et al., 2009). Empirical evidences indicate that commercialization of smallholder farmers has the potential to enhance incomes and welfare outcomes and take them out of poverty if constraining factors such as lack of capital, farming and commercialization skills, high transaction costs, lack of infrastructure, lack of information and lack of education could be eliminated (Lerman, 2004).

Promoting agricultural commercialization is a basis for rural development and poverty reduction although its impact is dependent on the local context and policy environment (von Braun and Kennedy, 1994). A review of case studies conducted in ten countries in Africa, Asia and Latin America found that commercialization increased household income as a result of increased labor and land productivity as well as increased employment opportunities for hired labor (von Braun and Kennedy, 1994). In most cases, increased incomes resulting from commercialization led to increased food consumption (Bouis, 1994) and improved nutrition (Kennedy, 1994).

There have been efforts to develop agricultural production through input use, promotion of small scale irrigation based horticultural crops production and provision of training to farmers so as to increase farm output and enhance crop commercialization towards achieving increased household income and food security. Some information is available in the literature on the household income and livelihood in areas of relatively abundant rains and better to markets access (Mitiku, 2014; Aman et al., 2014). However, little information is available on the existing level of agricultural commercialization and its impact on the livelihood and income of smallholder farmers in the dryland areas of Northern Ethiopia. Thus, this study was conducted with the objectives of:

1. Identifying the factors that affect the intensity of crop commercialization;
2. Verifying the challenges and constraints to participation in crop commercialization;
3. Evaluating the impact of crop commercialization on the livelihood of small holder households in the cereal based dry land farming areas of northern Ethiopia.

MATERIALS AND METHODS

Description of the study area and sample designe

The study was conducted in 2013 in Enderta and Kilteawlaelo weredas (districts) of the Eastern Zone of Tigray in Ethiopia that are characterized by erratic and unreliable rains, drought prone subsistence farming, and exposure to threats of household food insecurity (BoARD, 2012). The level of participation in agricultural marketing, availability of infrastructure, and closeness to regional/wereda markets were the criteria used to select the study areas

Primary data were collected through a household survey and field observations. A stratified multi-stage sampling design was employed for the household survey in the sample weredas in which names of tabias were listed, and then three tabias from each of the sample weredas were purposively selected based on the existing level of participation in agricultural marketing and overall agricultural productivity. A total of 191 sample respondent household heads were selected using probability sampling proportional to the size of the population. Discussions were held with local administrators, traders/farmers cooperatives and development agents in each of the sample weredas during an exploratory survey.

About 49% (95) of the households included in the survey were participating on crop commercialization (e.g. cereals, pulses, vegetables and fruits) while the remaining 51% (96) of the households were not directly participating in crop commercialization. About 21% of the respondents were female headed households while the remaining 79% were male headed households. The distribution of sample respondents by tabias and crop commercialization participations is summarized in Table 1.

A structured questionnaire was used to collect quantitative data on household production, consumption, and marketing of farm produce, demographics, resource ownership, and nonfarm and off-farm activities.

Analytical procedure

Both descriptive and econometrics methods were employed to assess the overall intensities and impact of crop commercialization. Descriptive methods including t and chi-square tests were used to disclose the scale of commercialization of agriculture and to test the

*Corresponding author email: dfeam4e@gmail.com. Tel: +251-914 789581.

Table 1. Distribution of sample respondents by Tabia and participation in crop marketing.

Sample Tabias	Participation in crop marketing		Total
	Participants	Non-participants	
Adiksandid	23	14	37
Arato	31	24	55
Aynalem	13	20	33
Didiba	12	18	30
Genfel	14	12	26
Mahbere Genet	3	7	10
Total	96	95	191

existence of any statistically verifiable differences among farmers participating on crop commercialization and their counterfactuals. Results from the discrete analysis were further examined through crop commercialization index (CCI)[1] to identify the intensity of crop commercialization. Gabre-Madhin et al. (2001) used four approaches to measure the level of household commercialization: Sales-to-output and sales-to-income ratios, net and absolute market positions (either as a net buyer, net seller or autarkic/self-sufficient household), and income diversification or level of specialization in agricultural production.

The sales-to-output ratio measures the gross value of all agricultural sales by a household as a percentage of the total gross value of its agricultural production (Ibid). This ratio is similar to what has been developed earlier by different authors (von Braun et al., 1994) as the percentage of agricultural output sold to total agricultural production.

Propensity Score Matching (PSM) was also applied to analyze the impact of commercialization on the livelihoods of smallholder farmers. PSM provides reliable estimates of program impact provided that: (1) a comparable group of non-beneficiary households is available; and (2) there is access to carefully collected household survey data with many variables that are correlated with program participation and the outcome variable (Heckman et al., 1998). This involves estimating a logit model that predict the probability of each household participating in crop commercialization as a function of observed households and community characteristics using a sample of participants and non-participants. Rosenbaum and Rubin (1983) defined the PSM as the conditional probability of receiving a treatment given pre-treatment characteristics'

$$p(X) = pr(D=1|X) = E(D|X)$$

Where D = (0, 1) is the indicator of exposure to treatment and X is the multidimensional vector of pre-treatment character. Rosenbaum and Rubin (1983) showed that if the exposure to treatment is random within cells defined by X, it is also random within cells defined by values of the mono-dimensional variable p (X). As a result, given a population of units denoted by *i,* if the propensity score p (X_i) is known the average effect of Treatment on the Treated (ATT) can be estimated as follow:

$$\tau = E(Y_1 - Y_0|D=1)$$
$$= E(E(Y_1 - Y_0|D=1, p(X))$$
$$= E(E(Y_1 - Y_0|D=1, p(X)) - E(Y_0|D=0, p(X))|D=1)$$

[1] Household Crop Commercialization Index (CCI) = (gross crop sales / gross crop production)*100. A value of zero would signify a totally subsistence-oriented household: the closer the index is to 100, the higher the degree of commercialization.

Where Y_{1i} and Y_{0i} are the annual incomes of the participants and non-participants, respectively. To compare the outcome, kernel matching estimator was applied; all treated were matched with weighted average of all controls with weights that are inversely proportional to the distance between the propensity score of the treated and controls. The kernel matching estimator is given by:

$$t^k = \frac{1}{N^T}\sum_{i\in T}\left(Y_i^T - \frac{\sum_{j\in C} Y_j^C G\frac{(Pj - Pi)}{hn}}{\sum_{K\in C} G\frac{(Pk - Pi)}{hn}(pk - pi)}\right)$$

Where G(·) is a kernel function and h_n is a bandwidth parameter. Under standard conditions on the bandwidth and kernel,

$$\frac{\sum_{j\in C} Y_j{}^C G\frac{(Pj - Pi)}{hn}}{\sum_{K\in C} G\frac{(Pk - Pi)}{hn}(pk - pi)}$$

is a consistent estimator of the counterfactual outcome Y_{0i} and standard errors are also obtained by bootstrapping (Beker and Ichino, 2002). The choice of the bandwidth parameter is important because it defines the fitness of the model or the outcome value. The variance and the bias of the estimation should be considered at the same time while choosing the bandwidth parameter (Caliendo and Kopeinig, 2008; Bhattarai et al., 2007).

RESULTS AND DISCUSSION

Descriptive result

The descriptive statistics for variables used in the regression analysis are given in Table 2. About 79% of the sample households were male-headed with an average age of 45 years. About 50% of the respondents were literate and had either formal or informal education (like religious school, and adult education). Farm household heads participating in crop markets were on average 2 years younger than the non-participants. The average family size in the study area was about 6 and slightly higher than the regional average family size of 5 reported by BoARD (2012).

A two sample t-test indicated that participants and non-participants did not significantly differ in family sizes as

Table 2. Characteristics of market participants and non-participants.

Variables	Participants'	Non-participants	Total sample	χ^2
Chi-square independence test				
Male headed households	49%	51%	51%	-1.1562
Literate households	51.04%	48.96%	50.26%	0.1312
Irrigation participants	32.63 %	53.13%	42.93%	8.18***
Participants on credit and savings	27.37%	25%	26.18%	0.13
Two-sample independence t-test			***t-value***	
Household age	45.5	43.6	44.56	-1.156
Family size	5.9	6	6	0.314
Years of schooling	2.09	2.14	2.12	0.125
Livestock (TLU)[i]	2.24	1.74	2	-1.726*
Farm size in tsimad[ii]	3.16	2.55	2.86	2.816***
Distance to local market	35.21	81.73	64.59	4.792***
Time taken to FTC	46.84	46.83	46.84	-0.0024
Annual mean income in birr	9314.55	5105.43	7198.97	-5.412***
Off farm income	7290.105	2970.66	5119.07	-1.548 **

*, ** and ***, significance at 10, 5 and 1% respectively.
[i] TLU (Tropical Livestock Unit) is international animal resources measurement unit wherein 1 TLU equals 1 camel, 0.7 cows, 0.8 oxen, 0.1 sheep/goat, 0.5 donkeys, 0.45 heifer/bull, 0.7 mule/ horse, 0.2 bee colonies or 0.01 chickens (Randela et al. 2000).
[ii] Tsimad is 0.25 Hectare.

well as in the average year of schooling. The average operated/cultivated land size of the market participants was statistically significantly higher than the non-participants by 0.61 tsimad (1 tsimad is 0.25 ha). This is expected as participants can allocate the income from market participation for renting in or sharing in of farm lands from nonparticipants.

Market distance and frequency of access to extension services are also important variables in commercialization process. The average time taken to the local and wereda market on foot was 65.03 and 106.62 min respectively and the mean frequency of development agents' contact was 15 days/year. More than 26% of the sample respondents were participating in rural institutions like savings, credit and farmer cooperatives; and the rural institutions are an opportunity for crop commercialization as these institutions are sources of finance and information on transaction of agricultural produces.

The study has found that the average annual income of a crop market participant in the study area was 4209 Birr[2] higher than those of the non-participants. Similarly, Gebreselassie et al. (2007) found that farmers who participated in crop output markets gained significantly higher proportion of their income from non-participants.

From among the sampled respondents, about 42% were also engaged in non/off-farm activities while the remaining 58% were dependent only in agricultural production. The level of participation in crop marketing was significantly higher among respondents that are involved in off-farm activities than those dependent only in agricultural production. Household participation in non-farm activities, especially the share of non-farm income to the total household income, seemed to have an impact on their market entry decision.

Rural farm households and extent of crop commercialization

About 45% of the respondents were involved in vegetables and 10% in pulses production. The survey results showed that about half of the farm households operated at full subsistence level (that is, consumed 100% of their production) with the other half involved in marketing at varying levels. All vegetables and fruits producer respondents were market participants as these crops are mainly produced for the market. On the other hand, about 57 and 48% of the cereal and pulse producers, respectively, were crop marketing participants.

About 3% of the respondents sold more than 50% of the total quantity they produced and 96% of the respondents consumed more than the quantity they marketed while the remaining 1% consumed and marketed on equal proportion. Denoting that there were no farmers that were operating at full commercial level (that is, no farmer sold 100% of his/her produce).

The average commercialization index for vegetables/fruits, cereals and pulses were 80, 15 and 25% of the total production, respectively; indicating that

[2] On average , 1USD= 18.6635 Ethiopian Birr during the survey in 2013

Table 3. Crop commercialization and crop commercialization index of the main crops types in the study area.

Crop type	Sample respondent participated in crop production (%)	Sample respondent participated in marketing (%)	Commercialization index
Cereals	100	57	15
Pulses	11	47.6	25
Vegetables/fruits	45	100	80

most of the vegetables and fruits produced is marketed while cereals and pulses are mostly produced for household consumption in the study area. This finding clearly shows that the level of crop commercialization depends on the type of the crops produced. The overall estimated average crop commercialization index for the sample households is 19%[3] of the total produce. The fact that the level of commercialization in the study area is considerably lower than the national average, which is 35% according to a 2006 assessment by the Ethiopian Economic Association (EEA, 2006) and Gebre-ab (2006). This is possibly an indication of the existing lower agricultural production and marketing in the relatively drier areas of the country as compared to areas that are better endowed with institutional and biophysical resources. The crop commercialization participation and commercialization index of the study area is summarized in Table 3.

Challenges and constraints of crop commercialization

Identifying challenges and constraints that farmers face in crop commercialization would help to design appropriate policy interventions that foster agricultural productivity. In the current study, resource related challenges such as shortage of money, household labor, and draught power were identified as the most significant challenges that limit participation of subsistence farmers in crop commercialization. Awareness related problems such as lack of interest to engage in commercialization was also mentioned as a bottleneck to crop commercialization though not statistically significant (Table 4).

As depicted in Table 4, agricultural input and output market related problems were among the other major constraints to crop commercialization. In this regard, absence of market for the produce (inability of the local market to absorb the quantity produced, particularly for vegetables and fruits), fall in price and high input prices(improved seeds), were mentioned as bottlenecks to crop commercialization as these factors have an impact on agricultural productivity. A fall in price of crops occurs during the harvesting season as most of the farmers take their produce to the market during the same period, creating market surplus and reduced prices with eventual fall in household income. As a result, farmers may be discouraged from producing market oriented crops. Besides, limitations in the quantity and quality of the products and lack of transportation facilities, particularly in localities that are far from market centers, were also identified as the challenges that limit the participation of producers in crop marketing.

Lack of access to market information, especially price information which is essential to enhance the bargaining power and ability of farmers to produce demand oriented crops, and price volatility of agricultural commodities over time are considered as factor that affect agricultural commercialization in the study area. The absence of postharvest technologies and facilities in the area also limited the production of market oriented agricultural products. Barrett (2008) and Pingali (2010) similarly found that lack of appropriate technology and poor infrastructure development can significantly improve inefficiency, increase transaction costs and discourage commercialization.

Bio-physical problems such as unreliable rainfall, crop pests and diseases, and low soil fertility were mentioned as constraints to crop commercialization. In the study area, rain fall variability induced drought under extreme situation causes total crop failure. Nevertheless, lack of access to irrigation water was not identified as a statistically important constraint to commercialization between the participants and non-participants.

From among the different factors that were used to identify the challenges and constraints to crop commercialization, the price of fertilizers, limitations in land size, level of awareness, and access to irrigation water had no statistically significant difference between crop commercialization participants and none-participants (Table 4).

Almost all of the respondents (99%) showed interest to engage in crop commercialization if these and other related challenges and constraints are resolved. This indicates that there is a strong interest among the farming community in the study area towards transforming the subsistence mode of production to more market oriented and commercialized agricultural production which in turn is an attitudinal change in the community.

Determinants of crop commercialization intensity

The intensity/extent of commercialization showed

[3] Household Crop Commercialization Index (CCI) = (gross crop sales / gross crop production)*100.

Table 4. Challenges and constraints of crop commercialization by of sample households (mean).

Variables	Participants (%)	Non-participants (%)	Sample (%)	χ^2
Resources related variables				
Shortage of money	75.79	95.83	85.86	15.8***
Limited farm size	77.89	75	76.44	0.222
Draught power	80.00	52.08	65.97	16.576***
Labor shortage	34.74	54.17	44.5	7.297***
Lack of awareness	50.39	49.61	66.84	0.891
Input- output market variables				
Lack of market for produce	66.32	37.5	51.83	15.88***
Lack of price information	21.04	36.46	28.8	5.527**
Low price of output	73.68	54.17	63.87	7.88***
Expensiveness of fertilizer price	86.32	87.5	86.91	0.058
Expensive improved seed price	40	53.13	46.6	3.305*
Low quality of produce	45.26	82.29	63.87	28.372***
Low quantity of produce	30.55	67.71	49.21	26.47***
Too far market distance	74.74	50	62.3	12.44***
Transportation problem	83.16	69.79	76.44	4.736**
Post harvesting problem	12.6	29.17	21.72	8.25**
Bio-physical variables				
Lack of irrigation access	34.74	37.54	36.13	0.158
Unreliable rain fall	79.89	91.67	94.76	3.733*
Crop pest and diseases	48.42	83.33	65.97	25.92***
Low soil fertility	64.21	51	57.06	4.191**

*, ** and *** denote significance at 10, 5 and 1% respectively.

variation among the marketing participants and therefore, identifying the marginal effect of the factors becomes important (Table 5). The amount of outstanding debt was the variable that significantly enhanced market participation: as the amount of debt increased by one birr, the intensity of marketing increased by 18% on the average. This is due to the fact that households who have debt sell their agricultural produce to repay their loans. Off farm income and drought animal power were the factors that had the higher marginal effect after outstanding debt and the marginal effect of off farm income and draught power were 6 and 4%, respectively. Lack of household labour and access to training in marketing were factors that had marginal effect of 3% each. Age of household head, size of farm land, quantity of crop harvested, and livestock holding, were some of the factors that had very low but significant positive marginal effect on extent of marketing. Access to training in crop marketing and production had a significant effect on intensity of crop marketing, with more involvement in crop commercialization after getting training. Age of the household head had a significant effect on the extent of commercialization, an increase in age of household age by one year level commercialization increased by about 0.6% on the average. Age is a proxy for measuring farming experiences.

Distance to nearest local market, as measured by time taken to reach the local market from homestead, family size, and price fertilizers had significant and negative impact on intensity agricultural commercialization. At the margin around the mean values, as time taken to local market increased by one minute, the degree of commercialization decreased by 0.4%. This could be due to the higher transaction cost for marketing and lower agricultural intensification as market distance increase.

von Braun et al. (1999), Rukuni et al. (2006), Hazell et al. (2007), Louw et al.(2008) and Kirsten et al., (2012), similarly found that lack of markets for the produce, low market information and technology, high transaction costs, poor agro-ecological conditions, and prevalence of diseases limited agricultural commercialization. Besides, they identified lack of supportive institutions, poor access to productive resources, and shrinking government investment and support as limiting factors to commercialization.

In this study, lack of access to market information, higher price of fertilizers, limited possession of draught power, and shortage of household labor and distance to local markets had negative effects on the intensity of commercialization. Pender et al. (2007) similarly reported

Table 5. Tobit estimation of the coefficients and its marginal effect.

Variables	Coef.	Marginal effect
Male household head	0.041 (.059)	0.014
Distance to local market	-0.002 (.006) **	-0.004
Lack of labor	-0.064 (.031)**	0.031
Age of household head	0.012 (.004) ***	0.006
Expensive fertilizer	-0.113 (.049) **	-0.002
Year of schooling	0.009 (.009)	0.003
Training on marketing	0.063 (.026) **	0.031
Family size	-0.036 (.017) **	-0.011
Lack of awareness	-0.038 (.063)	-0.012
Farm size in tsimad	0.024 (.016) *	0.007
Unreliable weather	-0.198 (.125)	-0.035
Outstanding debt	.154 (.008) ***	0.180
Frequency DA contact	0.007 (.002)	0.001
Crop harvested in Kg	0.001 (.000) ***	0.004
Off farm income	2.78 (1.74)**	0.086
Livestock holding (TLU)	0.024 (.012) **	0.008
Distance to FTC	-0.001 (.001)	-0.002
Draught power	0.102 (.032) **	0.044
Training on marketing	0.063 (.026) **	0.031

The values in the parenthesis are standard error. *, ** and *** denote significance at 10, 5 and 1% respectively.

that at local level commercialization was affected by many factors, some of which were access to markets, household resource and asset endowments, and input and factor markets.

The current study has also identified that the size of land cultivated and total livestock holding are very important in determining farmer participation in output markets. Those who participated on crop marketing cultivate lager farm land than non-participants that otherwise rented out most of their land and produced a small proportion of market oriented crops like vegetables and fruits. The amount of crop harvested has a positive effect on the quantity supplied to market, and in the intensity of participation in crop marketing. If households produce more crops, particularly if it is more than the quantity needed for household consumption, households are willing to supply the produce to the market. This finding is in line with that of Gebreslassie (2007), where the total value of farm production and the proportion of land allocated crop production had a positive and significant impact on a household's degree of market participation.

The impact of crop commercialization on the livelihood of farm households

After identifying factors influencing the intensity of market participation, assessing the impact of crop commercialization on farm household's livelihood is imperative. As indicated in Table 6, the estimates from the logit model of the propensity score shows that farm size, total crop harvested, and off farm income, have a positive and significant effect on the probability of household's participation on crop commercialization. However, low price of yield produced, post harvesting problems, and distance to local market have a negative and significant effect on the probability of the households to participate on crop commercialization.

The Kernel and Nearest neighbor Estimators of the propensity score matching indicated that participation in crop commercialization has a positive, robust and statistically significant effect on income and livestock holding (Table 7). The average annual income and livestock holding for the market participant was higher than control group by about Birr 3046 and 0.51 TLU, respectively. Hence, crop commercialization has a positive and significant effect on improving rural farmers' livelihoods[4]. Similar result was obtained by von Braun and Kennedy (1994) and World Bank (2008), where commercialization contributed to food security, poverty alleviation, and improved livelihoods. Hence, these findings indicate that commercializing smallholder agriculture is a necessary pathway towards economic growth and development for developing countries that rely on agricultural production.

4 Income, and TLU are the proxy measure for livelihoods in this study

Table 6. Estimation of the coefficient of the propensity score in logit regression algorithm.

Variables	Coef.
Male household head	0.880 (.909)
Age of household head	0.081 (.539)
Age square	-.007(.004) ***
Year of schooling	0.054 (.135)
Family size	-.328 (.224)
Farm size in tsimad	0.233(.019) **
Information access	0.376 (.255)
Low prices produce	-.063(.025) **
Crop pests and disease	-1.061(.100) *
Post-harvest problem	-1.635(.009) ***
Total crop harvested	0.021(.000) ***
Livestock holding (TLU)	0.227(.253)
Expensive seed	0.489(.737)
Off farm income	0.004(.001) ***
Distance to local market	-0.002(.002) ***
Distance to wereda market	-0.015(.004) ***
Illiterate head	-0.111(.347)
Obs.	191
LR chi^2 (21)	74.20
Prob > chi^2	0.0000
Log likelihood	-36.918924
Pseudo R^2	0.5012

The values in the parenthesis are standard error. ** and *** denote significance at 10, 5 and 1%, respectively.

Table 7. Average treatment effect for the treated group (ATT) from the PSM model.

Variables	Nearest neighbor Estimator	Kernel estimator
Treated observation	88	88
Control observation	21	24
Average income	3455.32(2.852) ***	3046.58(2.325) ***
TLU	0.620 (2.134) **	0.506(2.431) **

*, ** and ***, significance at 10, 5 and 1% respectively.

CONCLUSION AND RECOMMENDATION

Smallholders' decision to enter and participate in crop commercialization is influenced by many household and environmental factors: It is constrained by crop pests and diseases, unreliable rainfall, access to irrigation and socioeconomic factors (size of farmland, draught power and family labor). Agricultural input and output markets are among the major constraints of crop commercialization. In this regard, low quality and quantity of produce, absence of market for the produce, transportation problems, price fluctuation and rising prices of inputs like labor, fertilizer and associated inputs were mentioned as bottlenecks for crop commercialization.

In this study, the average commercialization index is only 19% and the extent of crop commercialization in the study area is almost subsistence oriented. However, the commercialization index of vegetables/fruits and pulses are about 80 and 25% respectively. Indicating that in the dryland areas of Ethiopia, cereal production is more of subsistence than the pulse and horticultural crops including vegetables and fruits production.

The amount of crop produce, draught power and training on marketing, debt had positive and significant impacts on intensity of crop commercialization.

Furthermore, family size, lack of price information, distance to local market and expensive farm inputs reduce the intensity of crop marketing. Despite all these

challenges and constraints, participating in crop commercialization helps to improve livelihoods of smallholder farmers. Hence, crop commercialization is one of the pathways towards economic growth by increasing agricultural productivity in most developing countries relying on agricultural production. Therefore, the following recommendations are forwarded:

1. Further attention should be given to rural infrastructure development; rural institution capacities building and awareness creation on producing market oriented products and crop commercialization.
2. Smallholder farmers who have larger livestock holding are more likely to participate in crop commercialization and improve their livelihoods. Therefore, farmers should be encouraged to engage on livestock husbandry as well by providing improved livestock technology to increase production and productivity of the agriculture sector.
3. This study is focused only on crop commercialization using cross sectional data. Further studies should also focus on agricultural commercialization using panel data to reveal the dynamics of agricultural commercialization.

Conflict of Interest

The authors have not declared any conflict of interest.

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