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Determinants of commercialization by smallholder onion farmers in Fogera district, South Gondar Zone, Amhara national regional State, Ethiopia

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Onion crop is one of the most important commercialized horticultural crops among smallholder farmers because they derive benefits such as income, source of food, health care and rural employment. In developing countries like Ethiopia, most smallholder farmers are characterized by poor market participation due to lack of market information, price volatility related to seasonality of supply, and poor performance of the vegetable market. This study has identified household level determinants of the output side commercialization decision and level of commercialization in onion crops in Fogera district of Amhara Region in Northwestern Ethiopia. A stratified random sampling technique was employed to select 150 onion producers from four sample kebeles in the study area. Both descriptive and econometric methods were used to analyze the data. Heckman's two step sample selection model was applied to analyze the determinants of the commercialization decision and level of commercialization in the onion market. The first-stage probit model estimation results revealed that age of household head, literacy status, distance to nearest urban center, access to training, onion yield, access to extension service and contract marketing affected probability of market participation. Second-stage Heckman selection estimation indicated that livestock holding, literacy status, land allotted to onion, non/off farm income, onion yield, ownership of communication device, contract marketing, agro ecology and marketing group significantly determined volume of onion supply. The results also showed that most of the factors determining decision of participation in onion farm also determine level of participation, suggesting that the two decisions were made simultaneously by onion producers. The study recommends that local and regional government strength formal and informal education, strengthening the existing onion production system, encouraging the use of labour saving technologies, improving extension system, strengthening the existing rural-telecom and rural-urban infrastructure development, and improving crop-livestock production.

Key words: Heckman two step, onion, smallholder, commercialization, market participation.

INTRODUCTION

Agriculture is the main stay of Ethiopian economy contributing about 43% of the GDP, 80% of employment and 90% of the export (MoFED, 2011). However, the agricultural productivity is low due to use of low level of improved agricultural technologies, risks associated with weather conditions, diseases and pests, lack of appropriate land use system resulting in soil and other natural resources degradation, the predominance of subsistence agriculture and lack and/or absence of business oriented agricultural production system, limited

or no access to market facilities resulting in low participation of the smallholder farmers in value chain or value addition of their produces etc. Moreover, due to the ever-increasing population pressure, the land holding per household is declining leading to low level of production to meet the consumption requirement of the households. As a result, intensive production is becoming a means of promoting agro-enterprise development in order to increase the land productivity. Horticulture production gives an opportunity for intensive production and increases smallholder farmers' participation in the market (Bezabih and Hadar, 2007).

Varieties of vegetable crops are grown in different agro-ecological zones through commercial and small farmers of Ethiopia as a source of income and for food. Various types of vegetable crops are grown in Ethiopia under rain-fed and/or irrigation systems (Alemayehu et al., 2010). The major economically important vegetables include hot and sweet peppers, onion (*Allium cepa*), tomato (*Solanum lycopersicum*), carrot, garlic (*A. sativum*) and cabbage (*B. oleracea* var. c*apitata*). According to the Ethiopian Investment Agency (2012), green beans and peas, okra, asparagus, cauliflower, broccoli, celery, eggplant and cucumbers have also recently emerged as important export vegetables. In 2013 for example, Ethiopia exported 220,213 tons of vegetables and generated USD 438 million (Ethiopian Revenue and Customs Authority, 2013). Ethiopia has favorable climate and edaphic conditions for the production of tropical, sub-tropical and temperate vegetables in the lowlands, midlands, and highlands, respectively (EHDA, 2011, 2012). Commercial production of horticultural crops, including vegetables, has also been increasing in recent years because of expansion of state farms (e.g., Ethiopian Horticulture Development Corporation) and increasing private investment in the sector by national and international entrepreneurs (EHDA, 2011, 2012).

Onion (*Allium cepa*) is a recently introduced commercialized horticultural crop and one of the few widely-grown vegetable crops in Ethiopia. According to CSA (2008), 453,608.8 ha was covered by vegetable of which Onion covered 15,628.44 of the total (ha).The estimated annual production of vegetable was 18,124,613.5 quintal (Qt). Among these, onion constituted 1,488,548.9Qt; it is significant to identify, prioritize and analyze onion production and market constraints. The majority of small-scale farmers in Ethiopia have ventured into horticultural crops due to the high market value associated with the crops (Anderson, 2003).

Fogera districts, where the study focused, are endowed with suitable diverse natural resources, with the capacity to grow different annual and perennial crops. Two major rivers are of great importance to the Districts, Gumara and Rib. They are used for irrigation during the dry season for the production of horticultural crops, mainly vegetables. Major types of vegetable crops currently growing in the area include potato, onion, tomato, garlic, green peppers and some leafy vegetables. The entire vegetable production in the Districts is mainly for market except potato, which is utilized most for home consumption. The nature of vegetable production is very fragmented and uncoordinated since all growers produce similar type of crop resulting in glut (mainly onion and tomato) (IPMS, 2005; Fogera district Agricultural office, 2015). Farmers living in the Fogera district produce large amount of vegetables every year. For instance, in 2014 production year, the district contributed 4, 067,908 quintals vegetables with 31,258 ha of land coverage of vegetable crop. According to the Fogera district Agricultural office, in 2015 production season, the district contributed 2,167,880 quintal of onion with 9854 hectares. This indicates that the district contributes to the regional onion production.

Based on information obtained from Fogera district Agricultural office(2015), vegetable marketing in the district is characterized by inefficient market, even if there is an increasing trend in the production of vegetables for one season (fluctuated production based on price signals). It has been constrained with lots of problems such as unstable prices, lack of storage facilities, lack of transportation facilities, poor linkages with traders, low quality controlling mechanisms, weak market information (outdated market information) and other factors need to be further investigated thoroughly and alternative solution need to be suggested and implemented so as to benefit producers and other marketing agents involved in the production of vegetables. Despite the potential of the District for vegetable production, its productivity is low due to use of low level of improved agricultural technologies, risks associated with climatic conditions, diseases and pests. Moreover, the nature of the product on one hand and lack of organized market system on the other hand frequently resulted in low producers' price (profit margin).

These poor prices among small-scale onion farmers have led to low household income. Thus one may appreciate the paradox (high potential for onion production against low income level) and it is natural and rational thinking to posing questions as "why the contribution of vegetable production to the livelihood of rural families is not as expected? What has happened to the income from the sub-sector to move out the rural households from poverty and household food security? In the district, it is common to see some households who

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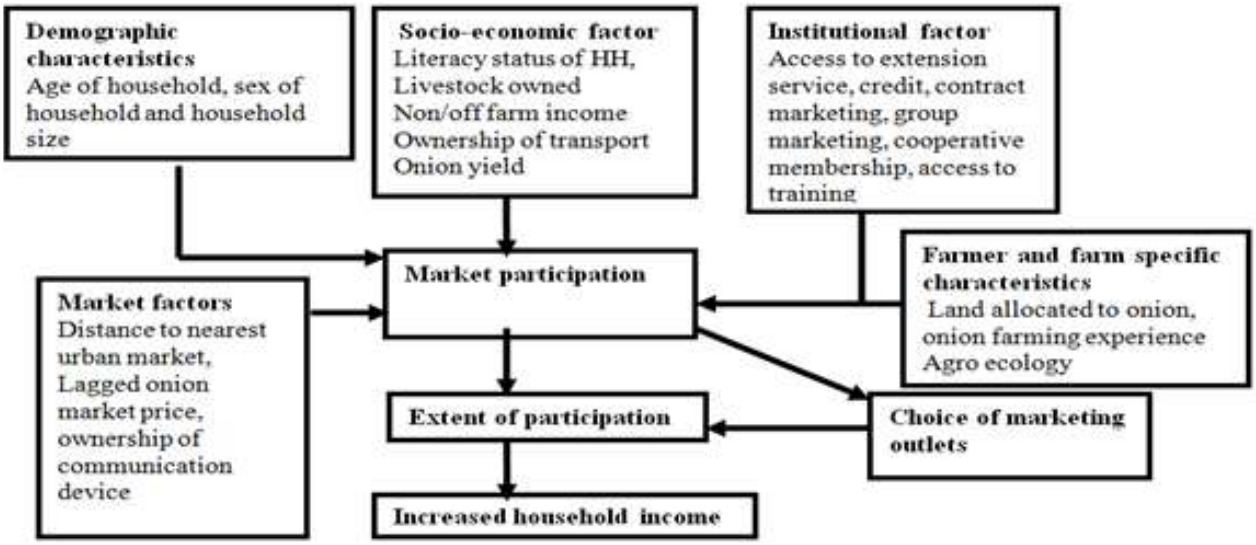

Figure 1. Conceptual Framework of study.
Source: Adopted from Tadesse (2008), Berhanu (2012), Geoffrey (2014) with modification.

participate in onion markets and choice among onion market outlets. Then, what motivates some households to produce onion and participate in markets while others are not in the study area?"

These are currently pressing and critical to the study area in particular, and needs to be researched, and measures have to be taken to help the producers assume a fair income from the sector and help them improve their living standard. This, therefore, demands an intensive study of the sector in the form of market opportunities, constraints; and the social, cultural and institutional factors that determine level of commercialization for onions have to be identified and analyzed to provide solutions for the aforementioned questions. The general objective of this study is to identify determinants of market supply by smallholder onion farmers. The specific objectives are:

(i) To identify factors affecting the smallholder farmers' market participate decision in onion output;
(ii) To identify the determinants for the level of commercialization among smallholder onion crop market participant in the study area.

Conceptual framework

The conceptual framework given in Figure 1 is based on literature and empirical evidence that indicates the interrelationships in the study, the key variables involved and how they are interrelated. Socioeconomic and demographic characteristics are the background factors like (age, literacy status, gender, transport ownership, livestock owned, non/off farm income, onion yield and household size), institutional factors like (group marketing, contract marketing, access to extension service, credit and training), farmer and farm specific characteristics (like land allocated to onion, onion farming experience and agro ecology) and market factors like (lagged onion market price, distance to nearest urban center and ownership of communication device) had an influence on market participation. The participation leads to the level of participation. The level of participation (amount of onions sales) in turn increased the household income.

METHODOLOGY

Descriptions of study area

The study was conducted in Fogera district of south Gondar zone of Amhara National regional state. Fogera district is one of the 126 districts of the Amhara Regional State, found in South Gondar Zone. It is situated at 11° 58 N latitude and 37° 41 E longitude. Woreta is the capital of the Dstrict and is located 625 km from Addis Ababa and 55 km from the Regional capital, Bahir Dar. The woreda is bordered by LiboKemkem Woreda in the North, Dera Woreda in the South, Lake Tana in the West and Farta woreda in the East (Figure 2). The Woreda is divided into 30 rural kebeles and 2 urban Kebeles (Fogera district agriculture office, 2015). The district is characterized by subsistence mixed farming system in which production of both crops and livestock is common economic activity. The current land use pattern includes 59.03% cultivated land, 22.73% pastureland, 18.24% water bodies and the rest for others. Most of the farmland was allocated for annual crops where cereals covered 52,759.99 ha; pulses covered 9819.98 ha; oil seeds, 6137 ha; root crops, 1034.29 ha; and vegetables, 882.08 ha. Crop production takes the lion's share of consumption and income generation of the households. Cereals crops widely produced in the area include teff, finger millet, rice and maize, pulse crops like chickpea and noug are the major crops grown. Moreover, vegetables and root crops produced in the area include onions, potato, tomato, pepper, cabbage and sweet potato (Fogera district agriculture office, 2015).

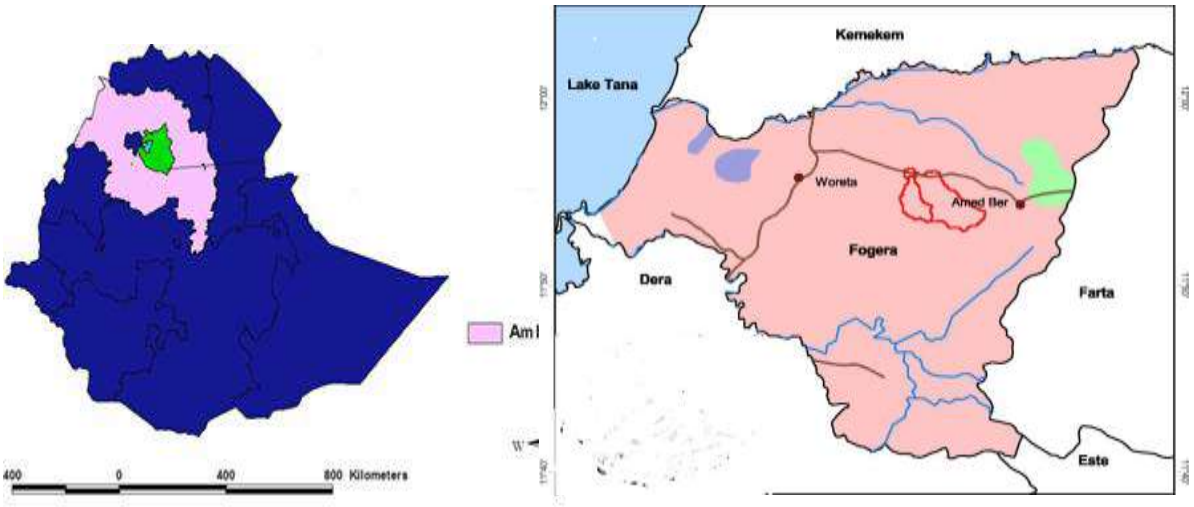

Figure 2. Map of the Study Area; Source of Data: Source: ILRI 2010.

Table 1. Distribution of sample households across sample Kebeles.

S/N	Sample kebeles	No of onion growers	Samples
1	Bubks	1539	64
2	Shaga	487	21
3	Woreta Zuria	800	33
4	Kuhar Micheal	780	32
5	Total	3606	150

Source: Own computation results.

Sampling procedure

To select onion producers, a two stage sampling technique was used to draw sample units. In the selection process district agricultural office experts were consulted. In the Fogera dstrict, there are 2 urban and 30 rural kebeles. Out of 30 rural kebeles, 12 administrative kebeles produce onion. These were selected purposively and is stratified based on the existing rice production farming system (up land and low land rice producing system). From each farming system, two PAs were selected randomly (a total of 4 PAs were selected). Then samples of respondents from each farming system were selected randomly proportional to its household size. The sample frame of the study is the list of household obtained in the Fogera district of agricultural office. Hence, total number of 150 farmers was selected using systematic random sampling technique and interviewed for the study (Table 1).

In calculating sample size, if there is no previous related work, pilot survey is recommendable and will provide necessary information to fix the value of P. However, for the current study, due to budget and time constraint, the researcher could not carryout pilot survey. Therefore, the following assumption is used regarding the value of P. When calculating sample size for proportion, there are two situations to consider. First, if some approximation of P is known (example, from a previous study), that value can be used in the formula. Second, if no approximation of P is known, one should use P= 0.5. This value will give a sample size sufficiently large to guarantee an accurate prediction (Ott and Longnecker, 2010).

In this study, P=0.11 is taken from a previous work (Geoffrey, 2014); unfortunately the p value is consistent to the researcher's work. The required sample size was determined by Cochran's (1977) proportionate to size sampling methodology.

$$n = \frac{Z^2 pq}{e^2} \quad (1)$$

Where; n = Sample size; Z= confidence level (α = 0.05); p = proportion of the population containing the major interest, q = *1-p* and e = allowable error. Hence, Z = 1.96;

$$P = 0.11 = \left(\frac{26{,}277}{233{,}529}\right), q = 0.89 \qquad \frac{1.96^2 \times 0.11 \times 0.89}{0.05^2} = 150.4 \quad (2)$$

And e=0.05 this resulted in a sample population of 150.4 respondents.

Data source and method of data collection

The study used household survey data that were collected from Fogera district during 2015/2016 production season. Both qualitative and quantitative data were collected from secondary and primary sources. Primary data included the whole situations of the marketing system from the producing farmer. This study is designed

to undertake a cross-sectional survey during 2015/2016 production survey. The cross-sectional survey was conducted using structured questionnaire, key informant interviews, and focus-group discussions. Both closed and open-ended semi-structured questionnaire were prepared to generate the required information. The semi-structured questionnaire that had been prepared in English was translated into Amharic, which is the official and widely spoken language in the study areas. Besides, secondary data on total land size, price data, area coverage, and challenges, onion crops growing peasant associations and population types were collected from Fogera district office of agriculture and from published and unpublished sources.

Method of data analysis

Econometric model was used to identify the factors that affect farmer's participation decision in onion marketing in one hand and extent of participation in onion marketing in the other hand. Most recent literatures adopt, Tobit, Heckman's two stage and Double hurdle models to examine crop market participation (Komarek, 2010 cited in Geofferey, 2014). The choice of Heckman two stage models is related with the advantages compared to Tobit model and it allows the determinant factors to vary for participation and level of participation. So that to determine the factors influencing participation and extent of participation in onion marketing, the Heckman two-stage selection models were used. The decisions to either participate in the market or not and level of participation were dependent variables and were estimated simultaneously. Heckman two-step model involved estimation of two equations: first, is whether a household participated in the onion market or not, and the second is the extent of market participation (proportion of onion sales). The proportion of onion sales is conditional on the decision to participate in the market. Heckman procedure is a relatively simple procedure for correcting sample selection bias with the popular usage. The specifications for Heckman's two stage selection models are as follows:

(i) The participation Equation: The Probit model is specified as:

$$Y_i = X'_i \beta_{ii} + \varepsilon_i \qquad i = 1,2,\ldots n$$

$$Y_i^* = \begin{cases} 1 if, Y_i^* > 0 \\ 0 if Y_i^* \le 0 \end{cases} \qquad (3)$$

Where, Y_i* is the latent dependent variable which is not observed and Y_i is binary variables that assumes 1 if small scale onion farmers i, that participate in the marketing and 0 other wise.

X ' = is a vector of independent variables hypothesized to affect household decision to participate in onion market.

$\beta_i =$ is a vector of parameters to be estimated

$\varepsilon_i =$ is normally distributed disturbance with mean (0) and standard deviation of 1 , and captures all unmeasured variables

According to Leykun and Jemma (2014), in this study the market participation decision is estimated as Y = 1 if the household participates in output markets and Y = 0 otherwise. Following von Braun, Immink (1994), the researcher can compute household crop output market participation in annual crops as the proportion of the value of crop sales to total value of crop production, which can be computed as follows:

$$MP_i = \frac{PS}{PQ} \qquad (4)$$

Where MP is Market participation, PS is total value of onion sales and PQ is total value of onion produce.

Given the nature of market participation level, the farmers are said to be market participant if their proportion of value sold is more than 75% (Goletti, 2005; Ohen et al., 2013; Osman and Hossain, *2015*). Thus, the researcher defined the binary response variable as Y = 1 if the farmer's onion sales exceed a threshold or critical level of Y*(75%) and Y = 0 if Y ≤ Y*. Here, the proportion of onion sold (say, above 75%) out of the total production by the smallholder farmers in the production year used as the proxy of market participation during data collection period (Gebreselassie and Ludi, 2008; Moyo, 2010).

(ii) Regression (OLS): Selection model is specified as

$$Q_i = Z_i \alpha_i + \mu \lambda_i + \eta_i \qquad (5)$$

Where, Q_i is the proportion of onion supplied to market; α_i = is a vector of unknown parameter to be estimated in quantity supply equation,

Z_i =is vector of explanatory variables determining the quantity supplied;

μ_i = is parameter that helps to test if there is a self-selection bias in market participation;

$\eta_{i=}$ is the error term.

Lambda, which is related to the conditional probability that an individual household decide to participate (given a set of independent variables), is determined by the formula

$$\lambda_i = \frac{f(\chi\beta)}{1 - f(\chi\beta)} \qquad (6)$$

Where, $f(\chi\beta)$ is density function and is $1 - f(\chi\beta)$ distribution function.

Before fitting important variables in the models, it is necessary to test multicollinearity, heteroscedasticity and normality problem among the variables which seriously affects the parameter estimates. Several methods of detecting the problem of multicollinearity have been used in various studies. Two measures are often suggested in the discussion of multicollinearity which is the *variance –inflation (VIF)* factor and the condition number (Appendix Tables 1and 2).

RESULTS AND DISCUSSION

Characteristics of households by market participation

The mean characteristics of households by market participation who sold onion to market outlets available in the study area are given in Table 2. For the descriptive statistics, sampled households were divided into participants and non-participants of onion marketing. The objective is to assess the differences and similarities among participant and non-participants of onion producers in terms of their demographic and socio-economic, farm, institutional and market characteristics. Out of 150 households, 85.33% of households were market participant households, as they sold onion products to market outlets available in the study area at the time of survey; while the remaining 14.67%

Table 2. Mean Household characteristics by market participation status

Variable	Mean value of variable for			t-/z- statistics
	Market participants	Non-participants	Both	
Market supply by the household	50.65	25.57	45.97	-2.76***
Family size of household	5.9	6	5.9	0.24
Age of household head	43.02	46.91	43.6	0.12
Onion farming experience	6.38	7.09	6.49	0.98
Distance to the nearest urban market	2.85	1.51	2.65	-2.59**
Distance from production to main road	2.75	3.83	2.91	2.20**
Distance to development station	1.98	1.58	1.92	-1.06
Number of livestock owned in TLU	4.9	4.4	4.83	-0.86
Land covered by onion	0.58	0.43	0.55	-1.04
Total return from onion	71672.23	45449.05	66777.24	-3.24***
Income from onion	34524.14	13051.48	30515.91	-2.52**
Onion lagged price	582.36	611.36	587.77	0.99
Onion yield(productivity)	141.97	81.79	130.74	-1.93*

Source: computed from survey data, 2015. Note: *** significant at 1%, ** at 5% and * at 10%. Results in parenthesis are standard deviations.

households did not participate in selling onion products.

Results as seen in Table 2 indicate that, the average onion producer's market supply of market participants per season was found to be 50.68 quintal while that for non-market participant was found to be 25.57 quintals. The mean of overall market supply was found to be 45.97 quintals. The result of the two-tailed tests showed that the market supply was statistically significant at 1% indicating that the market participants had more quantity of onion market supply than non-market participants did. The result is consistent with the findings of Geoffrey (2014) and Astewel (2010) who confirmed that increasing the volume of quantity of market supply will increase market participation. In the study area, onion-producing farmers travel a maximum of 15 km and a minimum of 0.1 km to reach the nearest market center (District capital Woreta). The average distance needed for farmer to travel to the market is about 2.65 km per trip (2.85 for market participant and 1.51 for non-market participant). The average distance from main road was reported 2.91 km per trip (2.75 km in market participant and 3.83 in non-market participant.

Out of 1.49 ha mean land owned per household, 0.55 ha was allocated for onion production. The land cultivated for onion production in market participation was about 0.58 hectare which was more than non-market participant 0.43 in all sampled households but the result of the two-tailed tests showed that the land allocated for onion was statistically insignificant between market participation. Finally Table 4 shows that the average income from onion producing households was ETB 30, 515.91 and the mean income from onion for market participant and nonparticipant households was ETB 34,524.14 and 13,051.48, respectively. The t-statistic value depicted that income from onion significantly and negatively affected market participation of households.

Table 3 presents the proportion characteristics of the sample respondents. The total sample size of farm respondents handled during the survey was 150. Of the total sample respondents, 89.33% were male-headed households of which 78% were market participants, while 11% of male were non participant. On the other hand, 10.67% were female-headed of which 3.33% of non-market participants were female, while 7.33% were market participant. The *chi*-square result showed that gender was statistically significant at 5% indicating that the male households who participate in the onion market were more than those who did not participate. Another attribute of importance is literacy status attained by the heads of the household, who, normally, are the decision-makers. Education also enables the person with ability to do basic communications for business purpose. From all household heads 43.33% were found to be illiterate, the remaining 56.67 % were able to read and write (adult education and religious school), they either attained primary or secondary school education.

About 52.67% of the market participants were found in upland while 32.67% were found in low land. On the other hand the Table 5 shows that 11.33% of the non market participants were found in upland while 3.33% were found in upland. This implies that the upland agro ecology in the study area is high. The *chi*-square result showed that agro ecology was statistically insignificant indicating that the farmers from low land are the same as farmers from upland in case of market participation. Farming was the main occupation and source of livelihood for all sample farmers (100%) in both agro ecology. Majority of respondents from low land agro ecology have been practicing mixed crop livestock production relative to up land. However, in addition to the

Table 3. Proportion of household characteristics by market participation.

Variable	Category	Market participants (%)	Non-participants (%)	Both	Chi-square value
Market participation by the household		128(85.33)	22(14.67)		
Sex of the household head	Male	117(78.0)	17(11.33)	134(89.33)	3.936**
	Female	11(7.33)	5(3.33)	16(10.67)	
Literacy status of household head	Literate	71(47.33)	14(9.33)	85(56.67)	0.510
	Illiterate	57(38)	8(5.33)	65(43.33)	
Membership to cooperatives	Yes	60(40.00)	15(10.00)	75(50.00)	3.409*
	No	68(45.33)	7(4.67)	75(50.00)	
Ownership of transport asset	Yes	37(24.67)	5(3.33)	42(28.00)	0.355
	No	91(60.67)	17(11.33)	108(72.00)	
Ownership of communication device	Yes	75(50.00)	7(4.67)	82(54.67)	5.431**
	No	53(35.33)	15(10.00)	68(45.33)	
Access to credit	Yes	31(20.67)	11(7.33)	42(28.00)	6.195**
	No	97(64.67)	11(7.33)	108(72.00)	
Marketing group	Yes	106(70.67)	19(12.67)	125(83.33)	0.170
	No	22(14.67)	3(2.00)	25(16.67)	
Contract arrangement	Yes	10(6.67)	7(4.67)	17(11.33)	10.67***
	No	118(78.67)	15(10.00)	133(88.67)	
Access to training	Yes	102(68)	16(10.77)	118(78.77)	0.542
	No	26(17.33)	6(4)	32(21.33)	
Non/off farm income	Yes	44(29.33)	5(3.33)	49(32.67)	1.158
	No	84(56)	17(11.33)	101(67.33)	
Agro ecology	Up land	79(52.67)	17(11.33)	96(64)	1.971
	Low land	49(32.67)	5(3.33)	54(36)	
Access to extension service	Yes	112(74.67)	21(14.00)	133(88.67)	1.182
	No	16(10.67)	1(0.67)	17(11.33)	

Source: computed from survey data, 2015. Note: *** significant at 1%, ** at 5% and * at 10%. Results in parenthesis are proportions.

farming activities, some respondents (32.67%) have also engaged in non/off-farm activities like in small trading activities.

Econometric model results

In this study, those factors that influence the decision to participant as well as volume of onion supplied to market are to be determined. About 20 variables were hypothesized to determine household level decision to participate in onion market and the volume of marketed surplus. The Probit and Heckman selection model results are depicted in Table 4.

Determinants of market participation and supply

Heckman two-step procedure was used to determine the factors influencing participation and extent of participation in onion marketing. The variables included in the model were agro ecology, distance to nearest urban market, distance to main road, sex, adult equivalent, age, literacy status of household, tropical livestock unit, land allocated

Table 4. First-stage probit estimation results of determinants of probability of onion market participation.

Variable	Coefficient	Standard error	Marginal effect $\frac{\partial P(Y=1/X)}{\partial X}$
Agro Ecology	-0.08	0.627	-0.005
Distance to nearest urban market	0.31*	0.165	0.022
Distance from production to main road	-0.09	0.098	-0.006
Age of household head	-0.04*	0.021	-0.002
Sex of household head	0.89	0.576	0.120
Adult equivalent	-0.09	0.108	-0.006
Tropical livestock unit	0.01	0.089	0.001
Literacy status of households	-0.71*	0.420	-0.048
Land allocated for onion	0.55	0.657	0.038
Productivity(Onion yield)	0.007**	0.003	0.0004
Non/ off farm income	-0.35	0.478	-0.027
Ownership of transport asset	0.38	0.485	0.023
Ownership of communication device	0.37	0.423	0.027
Access to credit	-0.15	0.426	-0.011
Marketing group	0.21	0.699	0.017
Onion farming experience	0.03	0.077	0.002
Log-Lagged onion market price	0.42	1.257	0.030
Contract marketing	-1.02*	0.554	-0.148
Access to training	0.96*	0.501	0.115
Access to extension service	-1.84**	0.846	-0.049
Constant	0.86	3.571	

Number of observations = 150
Log pseudo-likelihood = -38.730852 **
Wald Chi square (12) = 152.83
Pseudo R^2 = 0.3806
Observed probability = 0.813
Predicted probability = 0.968
Source: Model result Note: ***, ** and * show the values statistically significant at 1%, 5% and 10% probability level respectively.

for onion, productivity or onion yield, contract marketing, lagged onion market price, ownership of transport asset, ownership of communication device, onion farming experience, group marketing, access to training, extension service and non/off farm income. The data were analyzed and post estimation of the selection equation results was done to obtain the marginal effects. The marginal effects were used for interpretation, since the coefficients of selection equation have no direct interpretation. The reason is that they are just values that maximize the likelihood function. Marginal effects have a direct interpretation (Heckman, 1979).

Estimation results of first stage Heckman selection model: To determine the factors influencing market participation of onion in Fogera district, a probit model was estimated in the first step of the Heckman selection equation. Results of first-stage probit model estimation of the determinants of the probabilities of the farmer's participation in onion market are given in Table 4. Table 4 also contains the values of marginal effects which are evaluated at the means of all other independent variables. The overall goodness of fit for the probit model parameter estimates is assessed based on several criteria. First, the log likelihood ratio test is applied to assess the overall joint significance of the independent variables in explaining the variations in the onion farmer's likelihood to participate in the onion market. The null hypothesis for the log likelihood ratio test is that all coefficients are jointly zero. The model chi-square tests applying appropriate degrees of freedom indicate that the overall goodness of fit of the probit model is statistically significant at a probability of less than 1%. This shows that jointly the independent variables included in the probit model regression explain the variations in the farmer's probability to onion market. Second, the McFadden's Pseudo R2 is calculated and the obtained values indicate that the independent variables included in the regression explain significant proportion of the variations in the onion farmer's likelihood to participate in onion market. The probit model explains 81.3% of the variations in the likelihood of onion farmers to participate

Table 5. Results of second-stage Heckman selection estimation of determinants of volume of supply.

Variable	Coefficients	Std. Err.	P>z
Agro Ecology	-0.18**	0.072	0.013
Distance to nearest urban market	-0.01	0.012	0.265
Distance from production to main road	0.004	0.014	0.733
Sex of household head	-0.020	0.091	0.799
Adult equivalent	-0.006	0.015	0.669
Tropical livestock unit	0.050***	0.013	0.000
Literacy status of household	0.14**	0.056	0.012
Land allocated for onion	0.19***	0.056	0.002
Productivity(Onion yield)	0.001***	0.0001	0.000
Non/ off farm income	0.14**	0.059	0.024
Ownership of transport asset	-0.02	0.062	0.727
Ownership of communication device	0.110*	0.061	0.064
Access to credit	-0.008	0.064	0.901
Marketing group	-0.18**	0.075	0.018
Onion farming experience	0.002	0.010	0.825
Log-Lagged onion market price	-0.04	0.165	0.802
Contract marketing	0.33***	0.108	0.002
Access to training	0.06	0.083	0.454
Access to extension service	0.13	0.096	0.159
LAMDA	-0.275*	0.155	0.07
Constant	1.07	0.499	0.031

Number of observations = 150
Censored observations =22
Uncensored observations = 128
Wald chi2(12) = 152.83***
Rho = -1.00
Sigma = 0.275
Source: Model results Note**:** ***, ** and * show the values statistically significant at 1%, 5% and 10% probability level respectively.

in onion market. Third, the probit model predicts about 96.8% of the cases correctly. The model results indicated that out of 20 explanatory variables, seven variables explained probability of onion market participation. These variables are age of household head, distance to nearest urban market, literacy status of household, onion yield per hectare, contract farming, access to training and access to extension service.

Distance to nearest urban market: It was expected to adversely affect market participation. However, the opposite has been observed in the result. An increase in distance from house to nearest urban market by km indicated an increase in the probability of onion market participation by 2.2%. The reason is that it is likely better non-farm employment opportunities in addition to farming activity for households close to the markets may account for their smaller reliance on onion sale. This result is line with Rehima (2007), they showed that distance to nearest urban market was expected to adversely affect market participation and supply positively.

Age of household head: Age of household head as expected has negative and significant impact on onion market participation. The negative and significant relationship between the two variables indicates that older households tend to have more dependents causing more consumption, hence lowering probability of onion market participation. The result of this study coincides with the findings of Woldemichael (2008). The marginal effect also indicates that probability of participating in onion market decreases by 0.2% as age of household head increases by a year.

Literacy status of household head: It significantly and negatively influences market participation. This can be explained by the fact that as an individual access more education, he/she is empowered with the other skills and knowledge than onion farming which will spur individual to participate in the other professions. The marginal effect also confirmed that, if the household head is educated, the probability to participate in onion market decreases by 4.8%. The finding agrees with that of Meron (2015) who found that education of the household head has negative coefficient and inverse relationship on market participation decision.

Productivity (Onion yield): As hypothesized, onion yield influenced the farmers' decision to participate in onion market positively. This is explained by the fact that onion is the major cash crop for the majority of farmers and it shows that the higher the onion yield, the higher the farmer is willing to participate in the market. The marginal effect also confirms that, if onion yield increase by quintal per hectares, the probability to participate in onion market increases by 0.04%. This is in line with Abay (2007); Adugna (2009), Ayelech (2011) and Abraham (2013) who illustrated an increase of tomato, mango, avocado, and papaya production by farming households who augmented marketable supply of the commodities significantly.

Contract marketing: This variable significantly and negatively influences market participation at 10% significance level. This implies that as contract-marketing increase, the probability of participate it to onion market decrease by 14.8%. The reasons behind that most of farmers 88.66% respondent were under contract and the ready market did not absorb the whole products.

Access to training: The result indicated that access to agricultural training positively and significantly influence the market participation weekly. The implication is that participation households in agricultural training most likely increase the likelihood of onion market participation. The probable reason is that onion production marketing training given by experts to onion farmers enhances agricultural production skills, knowledge and experience of farmers. This situation helps farmers to get better production and this leads to more participants in onion market. The finding of the result depicts that, other things being constant, access to training increases the likelihood to participate in onion market by 11.5%. This result is in line with Anteneh (2011) and Mekonen (2015) they found the positive relationship between access to training and market outlet choice.

Access to extension service: It was negatively and significantly associated with onion market participation at less than 5% significant level. The result shows that, if onion producer gets extension service, the probability of onion supplied to the market will decrease by 4.9%. The possible reason could be due to those who have access to the extension service and do not appropriately apply the techniques and advices suggested by the extension agents such as the way using fertilizers, herbicides and pesticides. Since all these are chemicals, they can kill and destroy the product if they are not used wisely. This result is consistent with Abraham (2013), access to extension service was negatively and significantly associated with potato sale volume.

Estimation results of second stage Heckman selection model: The results of second-stage Heckman selection estimation for volume of supply are given in Table 5. The overall joint goodness of fit for the Heckman selection model parameter estimates is assessed based on the Wald chi-square test. The null hypothesis for the test is that all coefficients are jointly zero. The model chi-square tests applying appropriate degrees of freedom indicate that the overall goodness of fit for the Heckman selection model is statistically significant at a probability of less than 1%. This shows that jointly, the independent variables included in selection model regression explained volume of supply. In the second stage selection model, nine explanatory variables: Agro ecology, tropical livestock unit, literacy status, land allocated for onion, onion yield, Non/Off farm income, ownership of communication device, marketing group and contract marketing significantly affected volume of onion supply.

Agro ecology (AgroEco): As the agro ecology becomes lowland, it influences volume of onions sales significantly and negatively at less than 5% significance level. Lowland agro ecology as compared to upland ecology, the volume of onion sales decreased by about 0.18 quintals, being other variables held constant. This i may be due to the difference in topography, soil fertility, and access to markets, access to infrastructures and difference in socio-economic characteristics of the two agro ecology.

Tropical livestock unit: This variable affect onion market supply positively and statistically significant strongly. It is significant at 1%. This indicates that as livestock value increase the income of farmers also increase, since the area is wet land (bordered by Lake Tana), both crop and livestock production are integrated activities and are connected each other. Hence, owning of more of livestock helps to increase to purchase agricultural inputs for production and this indirectly increase the production and market supply of onion. This result consistent with Study by Astewel (2010) and Tufa et al (2014) on market participation and commercialization decisions respectively.

Literacy status of household head: Literacy has showed positive effect on onion quantity sold with significance level at 5%. On average, if onion producer gets educated, the amount of onion supplied to the market increases by 0.14 quintal. The result further indicated that, education has improved the producing household ability to acquire new idea in relation to market information and improved production, which in turn enhanced productivity and thereby increased marketable supply of onion. This is in line with Ayelech (2011) and Astewel (2010) who illustrated that if paddy producer gets educated, the amount of paddy supplied to the market increases, which suggests that education improves level of sales and thus affects marketable surplus.

Land cultivated for onion: As expected, was positively associated with the market supply in onion market with

statistical significant level of 1%. Farmers having large size land plot for onion can produce more onions and adopt new technologies for surplus amount of production and also encourage level of market supply. This result is in line with Assefa (2010) and Angula (2010) who postulated that land holding is directly linked to the ability to produce a marketable surplus.

Non/Off Farm Income: It influences volume of onion supply significantly and positively at less than 5% significance level. This is because most of non/off farm activities are done by farmers participating in livestock trading. Farmers participating in livestock trading are business oriented farmers and they produce onions completely for market and farmers who participate in non/off farm income purchase agricultural input and have better onion productivity than others. This result is consistent with Abraham (2013), that non/off farm income influences volume of cabbage supply significantly and positively.

Productivity (onion yield): As hypothesized, result shows that marketed surplus was significantly affected by onion yield at 1%. The positive coefficient indicates that a unit increase in onion yield produced will increase the marketable supply of farmers. The result also implies that, a unit increase in the onion yield produced can cause an increase of 0.01 qt of marketable onion.

Ownership of communication device: It was positively and significantly influenced by the extent onion market participation at 1% level of significances. This implies that households that own communication device can more likely supply in market. The finding is consistent with Taye et al. (2017), they found that ownership of communication device has a positive impact on market supply by facilitating market information to farmers

Contract marketing: The coefficient of contract marketing was found to be positive and strongly significant. Being in contract marketing increases the volume of onion sale by 0.33qt. This denotes that the farmers who were marketing under contract sold more of onion produce due to availability of ready market. The finding is in line with that of Geoffery (2014) who found an increase in formal market participation with the availability of contractual agreement amongst smallholder and emerging farmers in the Kat river valley, South Africa.

Group marketing: This variable was negatively and significantly influenced the extent of market participation. The result shows that an increase in group marketing by one person decreases the volume of onion sale by 0.18qt. The possible reason behind that in case disagreement emerges among group members, distorting market decisions.

LAMDA: The coefficient of Mills ratio (Lamda) in the Heckman two-stage estimation was significant at the probability of less than 10%. This indicates sample selection bias, existence of some unobservable household characteristics determining likelihood to participate in onion market and thereby affecting volume of supply.

CONCLUSION AND RECOMMENDATIONS

Transforming the subsistence-oriented production system into a market-oriented production system as a way to increase the smallholder farmer's income and reduce rural poverty has been in the policy spotlight of many developing countries, including Ethiopia. Hence it is imperative to improve the smallholder commercialization decision as well as the level of commercialization in order to facilitate stable incomes and sustainable livelihoods. Fogera district is one of the potential onion producing districts found in western part of the Amhara regional national state. However, the pr ductivity and market participation of onion is limited. This study has identified household level determinants of the output side commercialization decision and the level of commercialization in onion crop in Fogera district. In the case of Fogera district, the identified factors were distance to nearest urban market, access to training can increase the likelihood of household's decision to sell onion while age of household head, literacy status of household, contract marketing and access to extension service decreases the probability of households participation in the onion market. Moreover, the model showed that tropical livestock unit, literacy status of household, land allotted to onion, non/off farm income, onion yield, ownership of communication device and contract marketing affect volume of onion sale positively; while agro ecology and marketing group affect volume of onion sale negatively. Thus, some relevant policy implications can be drawn from the findings of this study that can help to design appropriate intervention mechanisms to improve the smallholder commercialization of onion crop at the farm level in Fogera district. In this respect, the regional and local government should strengthen the existing provision of formal and informal education through facilitating all necessary materials; improve the existing onion production and productivity system through introducing varieties that best fit into the onion calendar pattern, the rotation and enable efficient utilization of onion production cycle used by farmers, by identifying new technologies and management systems that would improve the production and productivity of the onion. The district should establish the vegetable market center nearest to the farmer's residence or production area. Moreover the study suggested strengthening the existing crop-livestock production system, reinforce communication device (ownership of radio, TV, mobile), solidification of existing rural telecom and rural-urban road, market etc.

development of the study areas by the regional and local government. Finally policies that can enhance efficient utilization of the existing limited farm land can be taken as an alternative. Improving farmer's income from onion is of great need for smallholder farmers. Thus, sufficient input supply which increases onion farm income in the rural areas can be underlined as a policy option to improve onion products market supply.

CONFLICT OF INTERESTS

The author has not declared any conflict of interests.

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Appendix Table 1. Multi-collinearity test with VIF.

Variable	VIF	Tolerance (1/VIF)
AGE	1.29	0.773241
AdEq	1.35	0.740094
OnionLsize	1.25	0.800723
TLU	1.43	0.697347
EXP	1.22	0.822705
Prodt	1.07	0.936859
LogLMP	1.06	0.940730
DISM	1.07	0.933832
DISR	1.06	0.944505
Mean VIF	1.2	

Source: Computed based on model output.

Appendix Table 2. Contingency coefficient.

Variable	Market participation	Agro	Sex	EDU	Nofar	ownT	ownCd	accCr	Training	Cont	MarG	AExt
Market participation	1											
AgroE	0.14	1										
sex	0.16	0.01	1									
EDU	0.11	0.22	0.13	1								
Noifarm	0.04	0.36	0.08	0.15	1							
OwnT	0.01	0.26	0.07	0.15	0.02	1						
OwnD	0.18	0.15	0.16	0.09	0.17	0.15	1					
AccCr	0.19	0.13	0.07	0.04	0.09	0.07	0.06	1				
Traning	0.04	0.27	0.03	0.04	0.19	0.04	0.11	0.01	1			
Contr	0.20	0.22	0.01	0.07	0.15	0.22	0.07	0.19	0.18	1		
MarkG	0.03	0.11	0.02	0.09	0.18	0.16	0.25	0.08	0.07	0.04	1	
AExtS	0.06	0.21	0.01	0.06	0.06	0.08	0.03	0.03	0.31	0.07	0.12	

Source: Computed based on model output.