DETERMINANTS of SMALLHOLDER POTATO FARMERS’ COMMERCIALIZATION in CENTRAL HIGHLANDS of ETHIOPIA

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Ethiopian agricultural sector is dominated by traditional technologies dependent on low input, rain-fed and mixed farming. A shift from subsistence-oriented production to market-oriented agricultural production is essential to meet the food needs of a growing and urbanizing population. The study was carried out in Central Highlands of Ethiopia to determine the level of household commercialization index (HCI) and to identify factors that determine variation in the level of commercialization. The study used household level cross sectional data collected from 196 smallholder farmers selected by multistage sampling technique using a structured questionnaire. Output commercialization indices were derived for all the participating farmers and the mean HCI during the survey period was 61 percent. Tobit regression model were employed to determine factors that affect smallholder commercialization. The model revealed that level of commercialization was positively and significantly affected by higher levels of potato production, educated household heads and household heads who owned larger number of livestock (TLU) whereas household heads with highest family size, old aged household heads and distant market from farm negatively and significantly affected commercialization. The study concludes that smallholder farmers have a great potential for HCI that can be developed. Younger peoples are comparatively more business-minded, produced beyond home consumption and participated in selling than their older counterparts. Nowadays the farming population is growing older and younger people are migrating to urban areas choosing city life. Therefore, attracting the young generation to engage in agriculture is necessary. The study suggested the need for policies to encourage the participation of young peoples in agriculture sector and the development of market facilities in the area. Since the consumer demand is shifting from fresh tubers to processed products the study also recommends the policy to encourage farmers to sell processed products than fresh tubers.

Key Words: Commercialization, commercialization index, Smallholders, Potato, Determinants, Market participation, Ethiopia.

INTRODUCTION

The world’s population currently (2020) reached 7.8 billion and about 81 million people will be added to the world’s population every year (Worldometer, 2020). The report shows that 56.2% of these populations live in urban areas. Meeting the food needs of a growing and urbanizing population will be difficult for the world’s agricultural production and trading systems in coming decades. In Ethiopia, small-scale subsistence-oriented farmers dependent on low input, rain-fed and mixed farming agriculture dominated with traditional technologies accounted for about 95 per cent of the output (Pender et al. 2004). A small-scale farmer produces more for their own consumption and participates in the market as both buyers and sellers.

Market-oriented agricultural production by these farmers to improve productivity, economic development, social welfare, income distribution and food security of...
developing countries is a challenge and need a policy intervention. Therefore, to shift subsistence-oriented production to market-oriented agricultural production, a well-functioning policy options is important.

Smallholder commercialization is part of an agricultural transformation process in which individual farms shift from a highly subsistence-oriented production towards more specialized production targeting markets both for their input procurement and output supply (Jaleta et al., 2009). Commercialization of agricultural systems leads to greater market orientation of farm production; progressive substitution out of non-traded inputs in favor of purchased inputs; and the gradual decline of integrated farming systems and their replacement by specialized enterprises. Agricultural commercialization can broadly be seen from two perspectives: a rise in the share of marketed output and of purchased inputs per unit of output (Jaleta et al. 2009). Commercialization of smallholder farming can bring about benefits to rural based households. Certain factors influence its potential success or a farm household’s decision to participate in the market is put in place. Factors determining smallholder commercialization can be broadly categorized as external and internal. External factors are beyond the smallholder’s control. (Von Braun et al., 1994; Pingali and Rosegrant, 1995; Pender et al., 2006). On the other hand, factors like smallholder resource endowments are household specific and considered to be internal determinants (Jaleta et al., 2009).

Potato (Solanum tuberosum L.) is the third most important food crop after rice and wheat for human consumption and over a billion people on earth eat potatoes (Derek Stewart and Gordon McDougall, 2012). According to FAO (2009) potato is grown in more than 125 countries and hundreds of millions of people in developing countries depend on potatoes for their survival. From 2005, for the first time, the developing world’s potato production exceeded that of the developed, world developing countries are the world’s biggest potato producers and importers FAO (2008). Potato has been highly recommended by the Food and Agriculture Organization (FAO) as a food security crop as the world faces not only uncertainties in food supply, but also steady hunger rates, a growing population, and an increasing demand for food (FAO 2009).

Ethiopia is one of the principal potato producing countries in Africa and probably displays a unique position for having the highest potential area for cultivating potatoes (Tadesse et al. 2018). Over 1.3 million highland farmers could grow Potatoes in Ethiopia. The Ethiopian highlands are densely populated and home to millions of smallholder farmers. The area under potato production in Ethiopia in the year 2016 was about 70,131 hectares with an average national yield of 134.5 quintal (1.3 tons) per hectare for the main cropping season and per capita consumption in 2016 was 10.3 kg per person.

Figure 1: Trends of potato production, population and per capita consumption.

![Figure 1: Trends of potato production, population and per capita consumption.](image)

Source: Own computation, data from CSA (2005-2016).

Potato can play an important role in improving food security and cash income of smallholder potato growers in Ethiopia. Potato produces more dry matter per hectare than the major cereal crops in the world, more protein per unit area than any other crop except soybeans and more food per unit of water than any other major crop. It’s relatively short crop cycle (3-4 months) and water efficient qualities further magnify potato’s use value in intensification and mitigation of prevailing climate change challenging long cycled cereals. Despite its importance as a staple food and in combating hunger and poverty, potato has been neglected in agricultural development policies for food crops. Potatoes are commonly regarded as a bulky, perishable commodity with high transport costs and limited export potential, confined mostly to cross-border transactions. The increased demand in the food processing industry acts as a major driving force behind the growth of the potato market. Therefore, study on agricultural sales play an
important role in improving food security and cash income of smallholder potato growers in Ethiopia.

Objectives of the Study

The general objective of this study was to describe the characteristics of farm household’s market participation in potato and explore strategies to promote smallholder farmers’ participation in market oriented potato in the study area. The specific objectives were:

- To describe the characteristics of farm household’s market participation in potato
- To determine the level of the smallholder farmers’ market participation (HCI).
- To identify factors that determines the level of commercialization.

MATERIALS AND METHODS

The Study Area

The study was conducted in central highlands of Ethiopia. The district is known in potato production and source of potato supply for Addis Ababa and other urban markets. Welmera is the district where the study was conducted and located 29 km away from the capital city of Addis Ababa. The area ranges in elevation from 2,000 to 3,000 masl.

Sampling Techniques

Multistage sampling procedure combining both purposive and simple random sampling was used to identify farmers to include in the sample. District and peasant associations were selected purposively based on potential potato production, cultivated land and number of potato farmers. Finally, respondents were selected proportionally from each peasant associations using systematic random sampling techniques.

Sample Size Determination

The sample size was computed by Statistics Canada (2010): that is a step-by-step approach where, first an initial sample size is calculated and then it is adjusted for the population, design effect and the response rate. Based on the formulation, sample sizes of 196 respondents were selected through random sampling.

Data Type and Sources

Data was obtained from both primary and secondary sources using appropriate data collection instruments. Primary data was collected from 2015/16 cropping season using personally administered structured questionnaires. Secondary data was gathered from country's statistical report, crop variety register, annual reports, research papers, website, books and unpublished reports.

Method of Data Analysis

Descriptive statistics, Household Commercialization Index (HCI) and Tobit model were used to analyze the primary data collected from smallholder household heads using structured questionnaire. Descriptive statistics was used to describe and analyze the socioeconomic characteristics of small holder farmers. The HCI was used to determine household level of commercialization. Finally, Tobit model was used to analyze factors determining level of potato commercialization.

Descriptive Statistics

The collected data from 196 smallholder farmers are analyzed to describe the relevant demographic, social, economic and farm specific features of the farmers.

Household Commercialization Index (HCI)

To analyze the commercialization level of households, household agricultural output marketed index was used as proxy of degree of commercialization. The index of commercialization is calculated by taking the ratio of total value of agricultural sales in the market by household in a year to total value of agricultural production by the same household in the same year. According to Von Braun et al, (1994) HCI will be computed by:

\[
\text{Market Participation} / \text{HCI} = \frac{\text{Total value of crop sales}}{\text{Total value of crop production}}
\]

The index measures the extent to which household crop production is oriented toward the market. A value of zero would signify a totally subsistence oriented household where a value closer to 1 implies the higher degree of commercialization.

A two-limit Tobit regression model

Tobit regression model, originally formulated by Tobin in 1958, with a hybrid of the discrete and continuous dependent variables was used to analyze determinants in the potato producers’ level of commercialization. The use of the Tobit model is intuitive because the parameter estimates will be biased and inconsistent if OLS is used (Gujarati, 2004). This is because OLS underestimates the true effect of the parameters by reducing the slope. The degree of bias will also increase as the number of observations that take on the value of zero increases. This suggests that OLS regression was not appropriate and estimation with OLS would have led to biased parameters estimates. Probit and Logit models could not be used in this case because they are only used when the dependent variable takes two values (Gujarati, 2006). Tobit model was used because the dependent variable commercialization index is censored and treated as continuous values that range between 0 (subsistence producers) and 100 (fully commercialized farmers).
by avoiding crude distinction between commercialized and non-commercialized household. Therefore, Tobit regression model offered the most preferred option.

The study followed Makhura (2001) and Bellemare and Barrett (2006) who used Tobit model to specify a market participation decision function. The Tobit model is specified in Maddala (2001) and Hobbs (1997) as follows:  

\[ Y^* = \beta x + \mu \]  

(1)

Where, \( y^* \) is the latent variable, and \( x \) is a vector of independent factors, \( \beta \) is the corresponding vector of parameters and \( \mu \) is the error term. Following Amemiya (1981) and Endrias et al., (2013), the two-limit Tobit model was defined as:

\[ Y_{HCI}^* = \delta_0 + \sum_{j=1}^{n} \delta_j x_{ij} + u_i \]  

(2)

The Marginal Effects

Tobit model parameters cannot be directly interpreted as changes in the dependent variable brought about by changes in independent variables. A Tobit model provides a single coefficient for each independent variable despite two distinct types of dependent variables censored and uncensored. The marginal effects also account for the probability of being commercialized.

The marginal effects of changes in explanatory variables from Tobit regression analysis were computed following the procedure proposed by McDonald and Moffitt (1980) and later developed by Gould et al. (1989). McDonald and Moffitt showed that a change in the independent variable \( x \) has three effects on the dependent variable: The marginal effects of these conditional expectations respectively are given as:

1) The unconditional expected value of the dependent variable: The marginal effects for the unconditional expected value of the dependent variable.

\[ \frac{\partial E(y \mid \chi)}{\partial \chi} = \beta \Phi \left( \frac{\chi \beta}{\sigma} \right) \]  

(5)

2) The expected value of the dependent variable conditional upon being between the limits: The influence of explanatory variables on the expected value of the dependent variable conditional on it being larger than the lower bound.

\[ \frac{\partial E(y^* \mid \chi)}{\partial \chi} = \beta \]  

(6)

3) The probability of being between the limits: The influence of explanatory variables on the probability of dependent variable to fall in the uncensored part of the distribution.

\[ \frac{\partial \Pr(y > 0 \mid \chi)}{\partial \chi} = \phi \left( \frac{\chi \beta}{\sigma} \right) \frac{\beta}{\sigma} \]  

(7)

RESULTS AND DISCUSSION

Descriptive Results

This sub-section presents the demographic and socioeconomic characteristics of the 196 respondents. The results of descriptive statistics analysis indicated that, the majority of respondents were relatively old. Sampled age of respondents was between 18 to 73 years. About 52.5% of the total sampled HHs had at least 6 persons in the household. The results of this study show that only 27% of the farmers in the study area received off-farm income. Average livestock holding per household in the study area was 8.7 TLU. Contracted land (rented, sharecropped, gifted or borrowed) covered 51.2 percent of the potato farm in the production period which is substantially larger than the size of owner-operated land. About 52 percent of respondents participated in farmer groups or cooperatives that facilitate agricultural production and marketing process.

In the production period, 98.5 percent of the potato producer participated in the markets. As shown in the Table 1, 85 percent of the farmers sold potato during the
postharvest period (November to February) and also 91% of the marketing performed on the farm.

**Table 1: Preferred period of selling by farmer**

<table>
<thead>
<tr>
<th>Time of selling</th>
<th>Freq.</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>March</td>
<td>14</td>
<td>7</td>
</tr>
<tr>
<td>April</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>October</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>November</td>
<td>40</td>
<td>20</td>
</tr>
<tr>
<td>December</td>
<td>36</td>
<td>18</td>
</tr>
<tr>
<td>January</td>
<td>56</td>
<td>29</td>
</tr>
<tr>
<td>February</td>
<td>36</td>
<td>18</td>
</tr>
<tr>
<td>Total</td>
<td>196</td>
<td>100</td>
</tr>
</tbody>
</table>

*Source: own computation*

**Why Farmers Grow Potato?** The statistical summary provided in Figure 2 shows that the larger proportion (86%) of the farmers produces potato for selling purpose, which indicates producers in the area were business-minded.

**Figure 2. Target for growing potato**

![Pie chart showing potato production target](image)

The average annual crop harvest of the households was 0.99 ton. As shown in the table 2 below, 69% of the total harvest of potato was marketed. High quantity of harvest could lead households to higher level of commercialization.

**Table 2: Household Decision on Production**

<table>
<thead>
<tr>
<th>Potato Varieties</th>
<th>Allocation of Production (Kg)</th>
<th>Percentage (sold/produced)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Quantity Consumed</td>
<td>Quantity Spoiled</td>
</tr>
<tr>
<td>Belete</td>
<td>3,200</td>
<td>1,800</td>
</tr>
<tr>
<td>Digemegn</td>
<td>250</td>
<td>100</td>
</tr>
<tr>
<td>Guasa</td>
<td>1,600</td>
<td>0</td>
</tr>
<tr>
<td>Guden</td>
<td>100,320</td>
<td>42,120</td>
</tr>
<tr>
<td>Jalene</td>
<td>3,000</td>
<td>1,300</td>
</tr>
<tr>
<td>Tolcha</td>
<td>150</td>
<td>0</td>
</tr>
</tbody>
</table>

**Table 3: Household Level commercialization Index (HCl)**

<table>
<thead>
<tr>
<th>Level of Commercialization</th>
<th>Freq.</th>
<th>Percentage</th>
<th>HCl</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>14</td>
<td>7.14</td>
<td>0.00</td>
</tr>
<tr>
<td>Medium</td>
<td>40</td>
<td>20.41</td>
<td>0.31</td>
</tr>
<tr>
<td>High</td>
<td>142</td>
<td>72.45</td>
<td>0.51</td>
</tr>
<tr>
<td>Total</td>
<td>196</td>
<td>100.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

**Econometric Results and Discussions**

**Determinants of smallholder commercialization**

Tobit regression model estimated to assess the determinants of commercialization. As shown in the table 4, among the farmer-specific characteristics, higher levels of potato production, educated household heads and household heads that possess large number of livestock (TLU) were a positive and significant effect on commercialization. However, household heads with highest family size, old aged household heads and distant market from farm were a negative and significance effect on commercialization.

**Table 4: Tobit regression results (determinants of smallholder commercialization)**

| Variables                   | Coef. (HCI) | Std. Err. | t     | P>|t| |
|-----------------------------|-------------|-----------|-------|-----|
| Age of HHH                  | -0.2969994*** | 0.0912179 | -3.26 | 0.001 |
| Production of Potato        | 0.0562684**  | 0.0241355 | 2.33  | 0.021 |
| Tropical Livestock Unit (TLU) | 0.0428146*** | 0.0123548 | 3.47  | 0.001 |
| Family Size in the HH       | -0.0409379*  | 0.0214026 | -1.91 | 0.057 |
The estimated parameters on the Tobit model presented in Table 4 only indicate the direction of the effects that the variables have on CHI levels. The results were subjected to post estimation test using marginal effect analysis in order to estimate the trivial change from each factor that influences commercialization.

The marginal effect analysis

Quantification of the marginal effects of these variables is important in order to estimate the change that will occur with respect to a change in one unit of that variable.

Table 5. The marginal effects of change in explanatory variables (CHI)

| Variables                        | dy/dx | \(\delta E(y|x)\) | \(\delta E(y'|x)\) |
|----------------------------------|-------|--------------------|--------------------|
| Age of HHH                       | -0.2937 | -0.2760            |
| Production of Potato             | 0.0556 | 0.0523             |
| Tropical Livestock Unit (TLU)    | 0.0423 | 0.0398             |
| Family Size in the HH            | -0.0405 | -0.0380            |
| Distance to the nearest market   | -0.0396 | -0.0372            |
| Education level of HHH           | 0.0093 | 0.0087             |
| Membership to cooperatives       | 0.0375 | 0.0353             |
| Land tenure status               | -0.0240 | -0.0226            |
| Market price of potato           | 0.0084 | 0.0079             |
| Credit service                   | 0.0038 | 0.0036             |
| Off-farm income                  | 0.0005 | 0.0005             |

Potato Production: Value of total farm outputs (potato) produced had a positive and significant effect on commercialization at 5% significant level. A unit change in the production of potato would increase the probability of a farmer to participate in the market by 5.6 percent and the mean level of commercialization by 5.2 percent. Results revealed that as the level of potato production increased, the amount of marketable surplus supplied to market is also increased. This is because when a farmer produces surplus of grain over food consumption, to reduce the postharvest losses or perishability they are obligated to sell their product to the market. Therefore, higher levels of crop production enhanced smallholders’ market participation. This result is in line with previous studies conducted by Tadele et al. (2017) and Gebreslassie et al. (2015).

Education Level of the Household Head: The result showed positive and significant relationship between the educational status of the household head and the decision to participate in potato market at 5% significance level. A unit change in the years of education level of households would increase the probability of a farmer to participate in the market by 0.9 percent the mean level of commercialization by 0.8 percent. Educated producers more attained on the training and understand faster those complex farming decisions and more effective in their processing of technical knowledge. Furthermore, such farmers adopt improved technologies faster because they understand the benefit associated with the technology, hence increasing the production and so that they can produces more surpluses for market. Thus more years of schooling of the household head would lead to higher participation in the market. The result is in conformity with the findings of Tadele et al. (2017) and Aman et al. (2014) that states education increases the ability of farmers to get and analyze relevant market information which would improve the managerial ability of the farmers in terms of better formulation and execution of farm plans, and acquiring better information to improve their marketing performance.

Possession of Livestock: Number of livestock owned in TLU was found to positively and significantly affect commercialization at 1% significant level. A unit change in the number of oxen owned by households would increase the probability of a farmer to participate in the market by 4.2 percent the mean level of commercialization by 4 percent. Results revealed that livestock holding size, which is a proxy for measuring wealth status of household head, enables farmers to overcome liquidity constraints to purchase and apply inputs and implement correct farm management practices on time and increases the ability to produce more as compared to non-holders. This result has been supported by the finding of Tadele et al. (2017) and Aman et al. (2014) who found 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.

Family Size: Household size measured in Adult-Equivalent (AE) affects level of participation in marketing negatively and significantly at 10% significant level. A unit change in the number of family size would decrease the probability of a farmer to participate in the market by 4 percent and the mean level of market participation by 3.8 percent. Results revealed that households with more members and higher dependency will consume more of the product. The negative impact of household size indicated that the higher the family size, the lower will be the amount of grain marketed. The result is consistent with that of Aman et al. (2014) and Benjamin et al. (2014) who
found households with large family sizes need to feed their family first and take the remaining small amount to the market.

**Age of the household heads:** Age of household heads which was measured in years was negatively and significantly affects level of household’s potato commercialization at 1% significance level. A unit change in the age of HHHs in an increase order would decrease the probability of a farmer to participate in the market by 29.4 percent the mean level of commercialization by 27.6 percent. Younger farm household heads participated more in output markets than the older farmers. This is because younger peoples are comparatively more educated than the older farmers, had more contacts with extension agent and avoid pre and post-harvest losses and are more business-minded to participate in selling than their older counterparts. The finding was consistent with Abafita et al. (2016) and Mabiratu Dangia et al. (2019).

**Distance of the market:** The time taken in minutes of walking time to the nearest market had negatively and significantly affected the amount of potato sold in the market at 5% significant level. A unit change in the distance of the nearest market would decrease the probability of a farmer to participate in the market by 4 percent the mean level of commercialization by 3.7 percent. This is because households living to the nearest market will have adequate price information and the benefit of marketing. The finding also shows that promotion of better access to infrastructure and institutional services may significantly contribute to promoting market participation and hence commercialization of smallholders. The finding was consistent with Aman et al. (2014) and N.M. Agwu et al. (2012) who found out that households that live far away from markets have low market orientation thus less commercialization.

**CONCLUSION AND RECOMMENDATION**

The Ethiopian highlands are densely populated and home to millions of smallholder farmers. Over 1.3 million highland farmers could grow Potatoes in Ethiopia. Despite potato played an important role in local food systems and for food security, the production and marketing constraints made the supply not to meet the demand. The area under potato production was about 70,131 hectares and more than 943,233 tones were produced in 2016 during the main cropping season. In Ethiopia per capita consumption was 10.3 kg per person which is very low as compared to world per capita consumption.

In the production period, 98.5 percent of the potato producer participated in the markets and 69% of the total harvest of potato was marketed. The average level of household commercialization in the study area was found to be 61%, which is significantly above the national commercialization average. Among the farmer-specific characteristics, higher levels of potato production, educated household heads and household heads that possess large number of livestock (TLU) were a positive and significant effect on commercialization. However, household heads with highest family size, old aged household heads and distant market from farm were a negative and significance effect on commercialization. The study concludes that smallholder farmers have a great potential for commercialization that can be developed in the study area.

The farming population is growing older because young people increasingly chose city life. Therefore, the study suggested the need for policies to encourage the participation younger generation to engage in agriculture sector and the development of market facilities in the area. Nowadays the consumer demand is shifting from fresh tubers to processed products; the study also recommends the policy to encourage farmers to sell processed products than fresh tubers.

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