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Farm-Level Determinants of output Commercialization: In Haricot Bean based Farming Systems

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ይህ ጥናት በዝናብ አጠር አካባቢ በቦሎቄ ስብጥር ግብርና ስርዓት የሚያመርቱ አርሶ አደሮችን የእህል ሽያጭ ገቢያ ተሳትፎ ለመገምገም ብሎም የእህል ሽያጭ ተሳትፏአቸውን የሚያነለብቱና ማነቆ የሆኑባቸውን ዋና ጉዳዮች በመለየት የመፍትሔ አቅጣጫዎችን ለመጠቆም የታለመ ነው። የመረጃ ማቀነባበሪያና የቶቢት የትንተና ዘዴዎችን መሰረት በማድረግ በተገኘው የጥናቱ ውጤት መሰረት ሊቃለ መጠይቅ ከተመረጡት 180 አርሶ አደሮች መካከል 90 ከመቶው በእህል ሽያጭ ገቢያ የተሳተፉና እነዚህም ካመረቱዋቸው ሰብሎች 45 ከመቶ የሚሆነውን ለሽያጭ ያቀረቡ መሆኑ ታውቋል። እንዲሁም የአርሶ አደሮቹን የእህል ሽያጭ ተሳትፎ የሚወስኑት በዋናነት የቤተሰብ አባላት ብዛት፣ የእርሻ ማሳስፋት፣ የእባወራ ዕድሜ ሁኔታ፣ የከብት መጠንና ተቀላቢ የቤተሰብ አባላት መጣኔ እንደሆኑ የተለዩ ሲሆን የጥናቱ ግምገማ ውጤት የአርሶ አደሩን የገቢያ ተሳትፎ ለማሻሻልና ገቢውን በማዳበር ለግብርና ዕድገት ያላቸውን አስተዋጽኦ ለማጎልበት የፖሊሲ አውጭዎችና የልማት አካላት በአርሶ አደሩ የሰው ጉልበትና የግብርና ማሳ ትስስርና የአሴት ግንባታ ሂደት ላይ ማተኮር እንዳለባቸው ያመላክታል።

Abstract

This study assesses the commercial behavior of smallholder farmers in the moisture-stress haricot bean based farming systems of central Ethiopia along with the determinants of smallholder farmers' engagement in the sales of most important crops. Descriptive and Tobit regression analyses are used to determine the key factors that influence household participation in the market in terms of volumes of product sales. The study identified that among the interviewed farmers 90% have participated in selling out their crops and the level of participation was 45%. The key determinants of commercialization among haricot bean based farmers are family size, land size, age, livestock holding and dependency ratio. The study recommends that policy makers and development organizations should target on improving labor and land efficiency and asset accumulation in order to promote smallholder farmers' participation in greater crop sales and income generation and contribute to acceleration of agricultural production growth.

Introduction

In Ethiopia, in spite of the policy decision of the government to commercialize subsistence agriculture and promote commercial farming, there is a dearth of information on the process and marketing behavior of participating parties. Studies on

agricultural commercialization lack focus and are not up-to-date. Agro-ecology and niche-specific recommendations are rare for effective policy-making. There is lack of information to be used as a benchmark for launching research and/or development activities in the country.

The untapped knowledge of the farm operators should be considered when designing any agricultural development policy.

This paper tries to contribute to redressing this gap of knowledge in agricultural business by assessing the nature of commercialization among smallholder farmers in the moisture-stress areas of the country.

The objective of the study is improved understanding of the practices, challenges and opportunities that are associated with smallholder commercialization. Household level commercialization is generally defined and analyzed in this study (following von Braun, et. al. 1994) as the extent of participation of households in the marketing of their products (crops). More specifically the study analyses household level determinants of haricot bean output commercialization among smallholder farmers in moisture-stress areas of East Shewa and West Arsi Zones, in Oromia National regional state.

Methodology

The study area and sampling

The study was conducted in East Shoa and West Arsi zones, representing the lowland agro-ecologies and mixed-farming smallholder agriculture commercialization system of Oromia The system constitutes a good proportion of the mixed agriculture. It covers the haricot bean based moisture-stressed farming system districts of Boset, Dugda, AdamiTuluJidoKombolcha and Shalla. The study addresses most important categories of crops consistent with the farming systems of the farming communities for improved agricultural performance. Haricot beans, maize, *tef*, sorghum, barley and wheat have been found as most important crops in the study area.

The sampling procedure followed multistage stratified random sampling in which case haricot bean growing districts were first identified and subsequently a list of haricot bean producing villages was prepared for selecting villages based on their production potential. List of *kebeles* representing the major haricot bean based farming systems in the districts was then prepared. Six and eight *kebeles* (villages) were selected randomly from each district (summing up 26) based on the relative size of the population. A total sample of 180 households were randomly selected from a fresh list of farmers after determining the number of sampled farmers in each *kebele* based on proportion to size of households in the respective locations. Proportionate sampling was done sequentially at district and then at *kebele* levels and 28 percent of the farmers were drawn from Shalla, 27 percent from Adami Tulu, 25 percent from Boset and the remaining 20 percent from Dugda districts.

Data type

The study used direct observations, secondary data and data generated through direct administration of pretested structured questionnaire through experienced and well-trained enumerators. The main content of the questionnaires was related to issues that would help address the specific objectives of the present study. Broadly, it captured the major factors used in the analysis that includes household level demographic characteristics such as socio-economic characteristics, market, access to extension services, and positional variations, which are hypothesized to influence farm-level activities. The market distance is used as a proxy for fixed transaction costs and the variable traders is assumed to cater for access to market information and options or diversified outlets for selling agricultural products.

The analytical setup of the determinant factors included in this study has benefited from field observations and the various crop output market participation studies (Pender and Dawit, 2007; Goitom, 2009; Tufa, et. al., 2014) conducted elsewhere in the country. However, it should be noted that other factors related to the natural and institutional environment that are important determinants of market participation are unaddressed by this study due to data limitations.

Analytical method

The analytical approaches applied here are meant to describe key relationships between crop commercialization and factors influencing the commercialization process. In this study, crop commercialization, taken as synonym for farmers' participation in crop market was measured in terms of volume of sales; i.e. the share of the value of output sold in total output sales.The concept used in this study is also supported by other studies made on commercialization of agriculture (von Braun, 1994; Farouque and Tekeya, 2008; Chukwukere *et al*. 2012). Such studies generally define output commercialization of smallholder agriculture in terms of not only cash crop but also food crops sales. Therefore, based on the above mentioned framework, the analytical model was developed on the hypotheses that farmers level of participation could be influenced by a set of farm and non-farm characteristics.

As the data is censored due to lack of crop output market participation on the part of the respondents, and to assess the intensity of participation, the Tobit framework was employed. The model is widely used under the conditions of simultaneous market participation decision (Omiti, 2009; Berhanu and Moti, 2012), the attribute which the selectivity models, such as the Heckman (1976). A potential limitation of the Tobit model is that it assumes that the effects of the independent variables are closely linked in both the binary choice decision and the conventional regression.

The model was developed by Tobin (1958) to capture situations in which the dependent variable under study is observed for values greater than 0, i.e. for participation in crop sales, but is not observed, i.e. censored or non-participation for values of 0 or less.

Accordingly, the standard Tobit model is defined by

$$y_i = \begin{cases} y_i^* & \text{if } y_i^* > 0 \\ 0 & \text{if } y_i^* \leq 0 \end{cases}$$

Where, y_i is observed variable and y_i^*, is a latent variable. The observable variable is defined to be equal to the latent variable whenever the latent variable is above zero and zero otherwise. The latent variable (the dependent variable) is defined in terms of the following relationships:

$$y_i^* = \beta x_i + u_i \sim N(0, \sigma^2)$$

Where, x_i is the hypothesized independent variables, β is a vector of parameters to be estimated by the model, which determines the relationship between the independent variable (or vector) and the latent variable, u_i is a normally distributed error term to capture random influences on this relationship.

McDonald and Moffit (1980) approach was also followed to decompose marginal effects in order to assess the effect of a change in the explanatory variables on the explained variable. Therefore, the three types considered in the analysis of the Tobit model are shown below. These are:

a) The marginal effect on the latent variable (unconditional expected value)

$$\frac{\partial E(y \mid x)}{\partial x_k} = \beta_k \Phi\left(\frac{x\beta}{\sigma}\right)$$

b) The marginal effect on the expected value of observations conditional on being uncensored

$$\frac{\partial E(y \mid x, y > 0)}{\partial x_k} = \beta_k + \beta_k \frac{\partial \lambda(c)}{\partial c} = \beta_k \{1 - \lambda(c)[c + \lambda(c)]\} < \beta_k$$

Where, λ(c) is called the inverse mill's ratio. It captures the change in the dependent variable (conditioned on y>0) when changing x.

c) The marginal effect on the probability that the observations are uncensored

$$\frac{\partial \Pr(y > 0 \mid x)}{\partial x_k} = \phi\left(\frac{x\beta}{\sigma}\right)\frac{\beta_k}{\sigma}$$

Results and Discussion

Table 1 shows that sampled households. On average, sold 45 percent of all crops produced during the survey period. However, it shows that there were households (10 percent of the total respondents) who did not participate in sale of any one of the crops. Most of the respondents are mature enough (40 years old) and 94 percent of the respondents are male. About 54 percent of the respondents are educated at various levels of education. Each household has at least 3 members of working age and more number of dependent family members to be taken care of by the rest of the family members for any means of living, i.e., an increased burden on the productive members. On average, each household has 4.14 hectares cultivated land and 5.91 livestock in TLU. Livestock provide wellbeing to the farmers and play important role as store of value (Chilot, 2007). The respondents generally know four traders who could buy their agricultural products and provide market information. In spite of the close distance of the extension office, the farmers reported that on average they had less than one time of contact with the extension workers to receive agricultural related support over a year. Though agricultural input sources are located within 20 minutes distance, farmers have to travel over two hours to reach the main market for selling their production, adding more weight to the imposition of heavy transaction cost on most of the subsistence farmers.

Table 1. Descriptive statistics on model variables

Variable	Mean	SD	Min	Max
Dependent variable				
Proportion of crops sold	0.45	0.24	0.00	0.90
Independent variables				
Age of household head	41.12	12.39	20.00	76.00
Sex of household head (0=female)	0.94	0.24	0.00	1.00
Education dummy (0=illiterate)	0.54	0.50	0.00	1.00
Dependency ratio	1.38	0.89	0.00	3.33
Family labor in man equivalent)	3.09	1.48	0.80	10.80
Cultivated crop land (ln)	1.42	0.59	-0.69	2.60
TLU	5.91	3.70	0.00	17.20
Traders known	4.43	2.63	1.00	13.50
Extension contact	0.74	0.44	0.00	1.00
Distance to input source (min)	19.89	25.15	0.00	97.50
Distance to extension office (min)	26.92	19.52	2.00	120.00
Distance to main market (min)	119.53	72.71	10.00	300.00
Boset district	0.25	0.44	0.00	1.00
Dugda district	0.20	0.40	0.00	1.00
Adami Tulu district	0.27	0.45	0.00	1.00
Shala district	0.28	0.45	0.00	1.00

Results from estimation of the Tobit model (Table 2) shows that the model was statistically significant (at $p<0.01$), implying that the model can be used to estimate the relationship between the dependent and at least one of the explanatory variables that

are included in the model. The result was obtained after dropping 3 observations which had incomplete data records, checking for collinearity, and transforming one of the variables into its natural logarithm form.The model estimation resultwas also subjected to tests for omitted variables and heteroscedasticity as suggested by Arabmazer and Schmidt (1984). Accordingly, the null hypothesis of constant variance was accepted (Chi^2=1.5, *P*=0.*2206*) following Breusch and Pagan (1979) test for heteroscedasticity. On the other hand, using the link test, the null hypothesis for model specification error was rejected i.e., the test of *_hatsq* was not statistically significant, *p=0.566*. Therefore, it indicates that the model is specified correctly.

The maximum likelihood (ML) results on 177 (17 left censored and 160 uncensored) observationsshow that from the hypothesized variables age of household head, dependency ratio, family size, cultivated land and livestock ownership statistically significantly determined the level of participation of smallholder farm households in the study area. Family size, age and dependency ratio were negatively affecting the response variable at less than 1, 5 and 10 percent levels of statistical significance in that order. None of the market and location related variables were statistically significant.

The implication of age is that as the household head of the family gets old, the productivity and efficiency of the head tends to decrease (Workneh and Michael, 2002) resulting in declining labor productivity leading to low marketable surplus.

The dependency ratio tells us that in a given family there are less number of active age family members to support the family and the volume of sales decreases as their number decreases, probably becausethe output generated by the active members become insufficient to feed the whole family. This is also verified by the descriptive analysis presented above.The negative effect of household size on market participation corroborates with Edmeades (2006). Family size is measured in terms of the number of adults in a household.The implication could be that as the number of adultpeople increases the level of consumption of adults will increase to the extent that it will have noticeable negative impact on the available output, with the consequences of limitedproduce available for sale due to increased consumption and diseconomies of scale. A study by Croppenstedt et. al. (2003) has found a different result endorsing the efficiency gain from large family. The man-equivalent weighted family size did not have serious collinearity problem with the dependency ratio (r=-0.38).

Farmers with more land and livestock are found to be engaged in increased sales. The probable reason could be that asset ownership could serve assecurity to the farmers in times of crop failure or shortages and encourage them to take a greater proportion of their produce to the market for a profit and in good time. Livestock improve productivity and increase marketable surplus (Solomon, et. al. 2010). Access to more arable land will also encourage farmers to grow and produce morecrops which leads to surplus production for the market (Aman, et. al., 2013). The size of operated farm is a crucial factor in the intensification and commercialization of smallholder farming systems in Ethiopia (Workneh and Michael, 2002).

Table 2.Tobit estimation results for crop output market participation

Variables	Coefficient	Std. Err.
Age of HHH	-0.0041**	0.0018
Sex of HHH	-0.0811	0.0766
Education of HHH	-0.0259	0.0414
Dependency ratio	-0.0470*	0.0243
Family size in man equivalent	-0.0434***	0.0167
Cultivated land (ln)	0.1208***	0.0383
TLU	0.0106*	0.0054
Traders known	-0.0003	0.0071
Extension contact	0.0449	0.0451
Distance to input source	-0.0008	0.0009
Distance to extension office	0.0005	0.0010
Distance to main market	0.0000	0.0003
Boset district	-0.0823	0.0567
Dugda district	-0.0077	0.0582
Adami Tulu district	-0.0351	0.0525
Constant	0.6639***	0.1174
Sigma	0.2309	0.0133
Number of observations	177	
Log likelihood	-13.56	
LR $chi^2(15)$	38.15	
Prob> chi^2	0.00	
Pseudo R^2	0.58	

Note: Base district is Shalla, *** indicates significant at 1%, ** at 5% and * at 10%

As the estimates of the marginal effects of the significant variables (Table 3) indicate, the cultivated land had greater positive impact on household's market participation whereas dependency ratio followed by family size had the greatest negative impact on household's market participation. For example, *ceteris paribus*, a one percent change in cultivated land would lead to 111.5, 109.1 and 109.3 percent increase in the proportion of crop sales of the unconditional (all observations), conditional (uncensored observations) and probability of uncensored observations in that order. On the other hand a one percent change in dependency ratio could lead to 4.25, 3.38 and 3.47 percent increase in the proportion of crop sales of the unconditional (all observations), conditional (uncensored observations) and probability of uncensored observations in that order.

Table 3. Results on marginal effects at observed censoring rate

Name	Unconditional expected value	Conditional on being uncensored	Probability uncensored
Age of HHH	-0.0037	-0.0029	-0.0030
Dependency ratio	-0.0425	-0.0338	-0.0347
Family size in man equivalent	-0.0392	-0.0312	-0.0320
Cultivated land (ln)	0.1092	0.0868	0.0891
Tropical livestock Unit	0.0096	0.0076	0.0078

Overall, the results suggest that most of the household heads fall within the upper active age group and have large family size. Also, there is a wide range of product flow to the market which could show the different levels of participation among farmers. Age of household heads, age dependency ratio and family size have been pull factors affecting the proportion of sales downwards whereas size of cultivated land and livestock ownership have been a push factors facilitating higher share of sales. Among the statistically significant determinant factors, size of cultivated land played the leading role in improving the volume of crop sales. This can indicate that improved proportion of sales was due to increase in the size of land. Existence of higher number of dependent and adultfamily members had significant negative impact on the sales share of the smallholder farmers. The results were consistent across the different scenarios, i.e, the whole and the market participant sampled farmers.

Therefore, improving asset ownership in terms of land and livestock and improving the volume of production through improved productivity of family labor and cultivated land is imperative in order to promote the contribution and profitability of smallholder farmers in the fulfillment of the agricultural development strategy of the country by way of commercialization. The role of policy makers and development agents in aligning their technical support strategy with farmers' efforts of asset building such as livestock and increased use of modern agricultural inputs and other land productivity measures is vital. Education of farmers is important for quick technology transfer and creation of employment. Consistent with the findings of Rios et. al. (2008) we recommend building the asset holding and technical capacity of households as crucial to improve market participation of the farmers.

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