Gender Perspective in Determinants of Market Supply of Tomato Using Multiple Linear Regression Models

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Abstract

A clear understanding of the determinant factors of market supply in gender perspective helps policy makers. Knowing the determinants among male-headed and female-headed farmers means knowing where to focus to boost production and to improve volume supply. The estimated volume of production of tomato was about 2777.5 tons and 2759 tons of tomatoes were sold in Dugda District, Ethiopia in 2016. Sampled respondents indicated that 99.33 per cent of tomato produced was marketed and the remaining was accounted for by spoilage, seed and home consumption. Out of the total tomato marketed, 79.9 per cent and 20.1 per cent of tomato was marketed by male-headed and female-headed household heads. The multiple linear regression model results indicate that distance from the nearest market center, tomato farming experience, quantity of tomato produced, ownership of water pump, extension service, and social participation played a significant role in tomato quantity supply to the market among female-headed household heads. Family labour and quantity of tomato produced played a significant role in tomato quantity supply to the market among male-headed household heads. Therefore, policy makers should take into account determinants of quantity supplied to the market by female-headed and male-headed farmers separately for taking up appropriate interventions.

Key words: Determinants, Female-headed, Male-headed, Market supply, Tomato, Vegetables

Introduction

Agriculture is the mainstay of the Ethiopian economy. This particular sector determines the growth of all other sectors. It is the most important sector of the national economy and the main source of livelihood for 79.3 per cent of the population (FAO, 2015). Moreover, it accounts for nearly 46 per cent of the GDP and supplies 70 per cent of the raw material requirements of local industries. It also serves as the main source of food and generates 90 per cent of the foreign exchange earnings (ATA, 2016).

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Received on: 08/08/2017 Accepted on: 04/10/2017

In both developing and developed countries, vegetables are principal cash crops for both commercial and small-scale farmers. They also contribute to the attainment of *Millennium Development Goal* (MDG) - 1 (poverty reduction) by helping farmers to increase their productivity, and MDG 3 (women empowerment) since almost half of smallholder beneficiaries are female-headed households (Africa Progress Panel, 2010).

According to EHDA (2011) Ethiopia's vegetable exports have been increasing over the years. Hence, the Government of Ethiopia has highlighted further commercializing of the vegetables in its policy. It also uses the production of vegetables as a means to attain food security and economic growth to achieve the continuing goal of reaching "middle-income" country by 2025. Moreover, vegetables have high potential for the contribution to poverty reduction, hunger alleviation, income generation and even in the attainment of Millennium Development Goals (MDGs) which ensures sustainable development in the agricultural sector. Tomatoes are major vegetable products that are exported as cash crops and are important crops in the context of development of Ethiopian agricultural economy (EHDA, 2015).

In support of stimulating growth, economic development, food security and alleviating poverty, the analysis of marketing of tomato in gender perspective plays an important role in an ongoing or future development plan. In spite of the policy options provided by the Ethiopian government, there is very little empirical evidence on the female-headed and male-headed farmers' tomato marketing system to design appropriate policies for its improvement of tomato marketing in the study area. It is, therefore, significant to identify factors that determine market supply of tomato in male-headed and female-headed farmers. Knowing the determinants of male-headed and female-headed farmers means knowing where to focus to boost production and to improve volumes of supply. To date, considerable work has been conducted in Ethiopia on factors affecting market supply of vegetables and other agricultural commodities by households (Abay, 2007; Almaz, 2012; Ayelech, 2011; Adugna, 2009; Bosena, 2008; Kindie, 2007; Rehima, 2007). Nevertheless, none of these studies has focused on factors affecting female-headed and male-headed farmers' market supply of tomato in Dugda district, East Shewa, Ethiopia. Hence, this study was conceived so that it helps to formulate appropriate policies to improve the livelihood of female-headed and male-headed farmers; to design appropriate policies for the improvement of tomato marketing and to empower women farmers.

Hypotheses

1. There is a positive relationship between socio-economic variables and quantity of agricultural commodity supplied to the market
2. There is a positive relationship between psychological variables and Quantity supplied to the market

Data and Methodology

The study was conducted in Dugda district, Ethiopia. Multistage sampling technique was used to draw the sampling units of the study. Formal survey was conducted with tomato producers. At the first stage, Dugda district was selected purposively due to extensive coverage and production of tomatoes in the district: Melkasa and Adami Tulu Agricultural Research Centres have released improved tomato varieties particularly for the study district and improved agricultural inputs utilization as well as conducting wide demonstrations on tomato cultivation in Dugda district. Tomatoes were selected as the most important crop to be considered for the purpose of this study due to the fact that it is a high-value commodity and mainly produced in Dugda district and in Ethiopia as a whole. Tomatoes are major vegetable products that are exported as cash crops. In 2015/2016 production season, out of the total area of the district *i.e*. 95,945 ha, the total cultivated land was 55,828 ha of which 11,289 ha were covered by tomatoes implying that relatively it covered a large area compared to other vegetables (BoARD, 2015).

Dugda district has 37 kebeles[2] out of which 17 kebeles are major growers of tomato. In the second stage, eight kebeles in the district were selected randomly. The sampling frame of this study was freshly prepared in consultation with Development Agents of the selected kebeles and it was to include the producers of tomato in the kebeles of Dugda district. In the third stage of the sampling procedure, respective sampling frame was stratified as male-headed and female-headed households. Finally, the number of respondents were determined by using probability proportional to size sampling procedure. A total of 46 female-headed and 123 male-headed households were selected using simple random sampling method. Then the predetermined size of the sample farmers from each kebele was randomly selected using systematic random sampling technique. To determine the required sample size, this study used a simplified formula developed by Yamane (1967) at 95 per cent confidence level and 10 per cent non-response rate. A pilot

[2]Under Ethiopian government structure, "kebele" is the smallest administrative unit below district and consists of a number of villages (*i.e*. it is a collection of villages). It is part of a district.

survey was carried out on 20 non-sampled respondents on tomato farmers to check suitability of interview schedule to socioeconomic and cultural setups. Interviews were conducted from November 2015 to February 2016 using structured interview schedule, by trained interviewers.

The analysis was done with the help of descriptive and econometric tools using Stata SE-version, window-12 software. Data analysis was done to derive descriptive statistics (such as percentage and mean comparison), Univariate analysis such as t-test, chi-square to describe differences between male-headed and female-headed farmers and multiple linear regression econometric model was used to identify determinants of tomato quantity supplied. Different studies employed different models in order to identify the factors that determine market supply (Rehima, 2007; Kindie, 2006; Bosena, 2008; Abay, 2007; Adugna 2009; Ayelech, 2011; Almaz, 2012). The commonly used ones are the well-known multiple linear regression model.

Among the different variables that would explain market supply, the most important variables, according to the reviewed literature, include family labour, educational level, extension service, ownership of water pump, production level, irrigable land holding, distance to market, achievement motivation, level of aspiration, participation in non-farm activities, experience, utilization of credit, participation in social organization and market information which were found to be important determinants (Gizachew, 2006; Abay, 2007; Kindei, 2007; Rehima, 2007; Bosena, 2008; Ayelech, 2011; and Almaz, 2012).

Following Green (2003), the multiple linear regression model is specified as

Yi=F(X1, X2, X3,X4, X5, X6, X7, X8, X9, X10, X11,X12,X13,X14)

Where Yi= quantity of tomato supplied to market

X1=Education level of HHH (Head of Household); X2=Family labour; X3= Utilization of Credit; X4=Quantity of production; X5=Extension contact; X6=Access to market information; X7=Distance to the nearest markets; X8= Experience in tomato farming; X9=Irrigable land in tomato; X10=Achievement motivation; X11=Level of Aspiration; X12=Participation in social organization; X13=Participation in non-farm activities; X14=Ownership of water pump.

Econometric model specification of supply function in matrix notation is the following.

$Yi = \alpha i + BiXi + Ui$

Where:

Yi = tomato supplied to the market

β = a vector of estimated coefficient of the explanatory variables

X = a vector of explanatory variables

Ui = disturbance term

Before running the model all the hypothesized explanatory variables are checked for the existence of multi-collinearity and heteroscedasticity. There are two measures that are often suggested to test the existence of multi-collinearity. Namely: VIF (variance inflation factor), Contingency coefficients.

In order to identify factors influencing tomato marketable supply both continuous and discrete variables were hypothesized based on economic theories and the findings of different empirical studies. The dependent and exogenous variables, their definitions, symbols and hypothesized signs are shown in Table 1.

Table 1. Symbol, Definition and Hypothesized sign of Variables

Sl. No.	Definition	Symbol	Type of variable	Hypothesized sign (influence on dependent variable)
1	Tomato quantity supplied (2016) in quintals	QUANS	Continuous	Dependent
2	Education level of household head (1=illiterate, 2=read & write, 3=primary cycle, 4=secondary cycle, 5= tertiary cycle, 6=preparatory, 7=higher)	EDUCA	Discreet	(+)
3	Family Labor (man equivalent).	LABOR	Continuous	(-)
4	Farm experience of household (years).	EXPER	Continuous	(+)
5	Utilization of credit (1=if yes; 0=otherwise)	UTLCR	Dummy	(+)
6	Farmers' participation in social organization in score.	PRTSC	Continuous	(+)
7	Participation in income generating non-farm activities (1=Yes, 0=No)	OFFRM	Dummy	(+)
8	Distance of the respondents' house from input and output market (km).	DSTNT	Continuous	(-)
9	Actors getting extension service (1=yes; 0=no)	EXSINC	Dummy	(+)
10	Awareness of price information (1=Yes, 0=No)	MRTINF	Dummy	(+)
11	Ownership of water pump	H_2OPU	Dummy	(+)
12	Irrigable landholding of the respondents in hectare	IRRGL	Continuous	(+)
13	Quantity produced in quintal	PRODU	Continuous	(+)

14	Achievement motivation (1=low, 2=medium,3=high)	ACHIV	Discrete	(+)
15	The level of aspiration (1=low, 2=medium,3=high)	LEVEL	Discrete	(+)

Results and Discussions

The estimated volume of production of tomato was about 2777.5 tons and 2759 tons of tomato were sold (only for sample farmers studied). Sampled respondents indicated that 99.33 per cent of tomato produced was marketed and the remaining percentage of total production was accounted for by spoilage, seed and home consumption. Out of the total tomato marketed, 79.9 per cent and 20.1 per cent of tomato was marketed by male and female headed household heads, respectively. The average production of tomato for FHH[1] and MHH[2] was about 120.97 and 180.58 quintals, respectively, which is statistically significant at 1 per cent probability level (t=2.66). MHH have on the average about 2.83 man-equivalent of family labour while FHH had 2.11 man-equivalents. The average total land sizes under tomato were about 0.54 and 0.32 ha for MHH and FHH, respectively. MHH have on the average about 16 years of tomato farming experience while FHH have 5 years of experience, which was significant at 1 per cent probability level (t=8.57). This indicates that MHH had higher tomato farming experience compared to FHH (Table 2). The analysis of field data shows that there is significant difference between FHH and MHH producers in participation in different social organizations (t=9.39***). The average age of male household heads was 38.32 years compared to 40.22 years for female heads. This difference was not statistically significant. Although not significant statistically (t=0.58), female-headed households have travelled shortest distance from the nearest market (6.86 km) than the male-headed households (7.34 km).

Table 2. Socio-demographic Characteristics of Tomato Producers

Lists of Variables	FHH (N=46)	MHH (N=123)	All cases (N= 169)	t-value
Age of the respondent (yrs)	40.22	38.32	38.83	-1.13
Family labor (no./hh)	2.11	2.83	2.63	2.78***
Distance (km)	6.86	7.34	7.21	0.74
Experience in tomato farming (yrs)	4.96	15.89	12.91	8.57***
Total land holding (ha)	0.90	2.51	2.07	4.68***
Total land covered by tomato (ha)	.3157	.5372	.7567	3.43***
Production of tomato (q)	120.97	180.58	164.35	2.66***
Sold tomato (q)	120.30	179.31	163.25	2.65***
Participation in social org. (no.)	3.65	6.96	6.06	9.39***

*Source: Own survey (2016) ***=Significant at 1% probability level, respectively.*

[1]Female-headed households.
[2]Male-headed households.

About 89.1 per cent of FHH and 78.9 per cent of MHH had visits from extension agents during the last production season. Majority of the FHHs (89.1%) did not take credit compared to their MHH counterparts. Regarding ownership of water pump, 52.2 per cent and 21.1 per cent of FHH and MHH respondents had water pump, respectively. In the case of market information, 23.9 per cent of FHH and 6.5 per cent of MHH respondents had got market information. This shows that FHH has more access to market information and ownership of water pump as compared to MHH in the area. The Chi-square statistics is evidence for the presence of statistical difference between the two groups at less than 1 per cent significance level. The chi-square test also indicates that there is a significant difference regarding participation in non-farm activities at 5 per cent significant level ($\chi 2=5.07$) between the two groups. Eighty-nine per cent and seventy-nine per cent of FHH and MHH respondents had extension contact (Table 3). There is no significant difference between the two groups in contact with extension agent.

Table 3. Socio-economic characteristics of Tomato Producers

Lists of Variables		FHH (N=46)	MHH (N=123)	All cases (N=169)	χ^2-value
Extension	Yes	89.1%	78.9%	81.7	2.36
	No	10.9%	21.1%	18.3	
Credit	Yes	10.9%	30.1%	24.9	6.62***
	No	89.1%	69.9%	75.1	
Water pump	Yes	52.2%	21.1%	29.6	15.48***
	No	47.8%	78.9%	70.4	
Market information	Yes	23.9%	6.5%	11.2	10.17***
	No	76.1%	93.5%	88.8	
Non-farm	Yes	39.1%	58.5%	53.3	5.07**
	No	60.9%	41.5%	46.7	

*Source: Own survey (2016) ***, *=Significant at 1% and 10% probability level, respectively.*

The result of this study indicated that, level of aspiration is a strong desire or an ambition to achieve something. FHH respondents were put under three categories of level of aspiration. Based on this, 23.9 per cent, 15.2 per cent and 60.9 per cent had low, medium and high level of aspiration, respectively. MHH were rated as low (52.0%), medium (22.8%) and high (25.2%) level of aspiration. Achievement motivation was defined as the need in an individual to perform different roles with some degree of excellence. As presented in Table 4, the MHH respondents were put under three categories of achievement motivation. Based on this, 35.8 per cent were under low achievement motivation, 21.1 per cent under medium achievement motivation and 43.1 per cent were identified as high achievement

motivated categories. This indicates the existence of difference between them with respect to level of aspiration and achievement motivation, which is significantly different at 1 per cent and 10 per cent probability level, respectively. The findings of this study concur with the study done by Derbie (2007).

Table 4. Psychological Characteristics of Tomato Producers

Lists of Variables		FHH (N=46)	MHH (N=123)	All cases (N=169)	χ^2-value
ACHVE	Low	54.3%	35.8%	40.8	4.78*
	Medium	15.2%	21.1%	19.5	
	High	30.4%	43.1%	39.6	
LEVEL	Low	23.9%	52.0%	44.4	19.09***
	Medium	15.2%	22.8%	20.7	
	High	60.9%	25.2%	34.9	

*Source: Own survey (2016) ***=Significant at 1% probability level, respectively.*

As indicated in Table 5, the majority (41.3%) of FHH are illiterate while only 2.4 per cent of MHH are illiterate. The Chi-square statistics is evidence of presence of statistical difference between the two groups ($\chi 2=60.97$, $p=0.000$). This is in agreement with most studies (Derbie, 2007).

Table 5. Educational Level of the Sampled Tomato Producers

Education of HHH	FHH (N=46)	MHH (N=123)	All cases (N=169)	χ^2-value
Illiterate	41.3%	2.4%	13.0	
Read & write	30.4%	13.0%	17.8	
Primary cycle	15.2%	31.7%	27.2	
Secondary cycle	10.9%	34.1%	27.8	60.97***
Tertiary cycle	2.2%	13.0%	10.1	
Preparatory	0	2.4%	1.8	
Higher	0	3.3%	2.4	

*Source: Own survey (2016) ***=Significant at 1% probability level, respectively.*

The estimates of the multiple linear regression models for male and female headed households are presented in Table 6. All the market supply functions were found to be significant as evidenced by significant F-value at 1% level of probability (Table 6), implying the null hypothesis stating that all the coefficients of explanatory variables are zero is rejected. The adjusted coefficients of multiple determinations indicate that the variation in tomato quantity sold per quintal associated with the factors of market supply specified in the models was 99 per cent, in MHH, FHH and pooled data set.

Table 6. Determinants of Tomato Quantity supplied to the Market

Variables	Pooled (N=169)		MHH (N=123)		FHH (N=46)	
	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
EDUCA	0.046	0.8	0.090	1.12	0.059	0.83
LABOR	-0.130	-2.62***	-0.119	-1.94*	0.135	1.33
DSTNT	-0.031	-1.22	-0.015	-0.51	-0.099	-2.03**
EXPER	0.002	0.28	0.010	0.91	0.141	3.32***
IRRGL	-0.205	-0.97	-0.196	-0.87	-0.251	-0.83
PRODU	0.997	612.55***	0.997	587.08***	0.997	621.99***
EXSINC	0.134	0.47	0.125	0.37	0.650	2.11**
UTLCR	0.117	0.67	0.114	0.6	0.191	0.67
H2OPU	0.224	1.46	0.086	0.35	0.384	2.1**
MRTINF	0.095	0.54	0.297	0.95	0.081	0.48
OFFRM	-0.029	-0.17	0.005	0.03	0.064	0.31
PRTSC	0.0034	0.09	0.035	0.8	0.211	1.81*
ACHIV	0.032	0.41	0.049	0.42	0.187	1.41
LEVEL	0.116	1.44	0.037	0.34	0.084	1.06
Constant	-0.522	-1.42	-1.146	-1.71	-2.760	-2.79
Adjusted R^2		99%		99%		99%

*Source: Model Output, ***, **, and *significance at 1%, 5%, and 10%, respectively.*

As hypothesized, the regression coefficient of tomato production variable was positively related with quantity supplied (marketing) in the market and significantly at 1% probability level in both FHH and MHH. The result shows that a one quintal increase in the tomato production causes a 0.99 quintal increase in the amount of marketed supply among both male and female household heads. Total tomato production influenced the amount of marketed supply of tomato positively showing that farmers who produce more also sell more, which is consistent with the general expectation. This is in line with Abay (2007); Adugna (2009) and Ayelech (2011); who illustrated that an increase of tomato, papaya and avocado production by farming households has augmented marketable supply of the commodities significantly. Experience showed positive effect on tomato quantity sold with significance level at 1%. Thus, the result implied that, as FHH farmer's experience increased by one year, tomato supplied to the market increased by 14 $x10^{-2}$ quintals. This is in line with Abay (2007) and Ayelech (2011).

As expected, family labour had a significant and negative impact on tomato quantity sold of MHH. A one per cent increase in the amount of family labour resulted in 0.12 per cent decrease in tomato quantity sold in MHH, keeping other factors constant. This is well supported by Almaz (2012) who indicated that family labour have had significant negative effect on quantity of marketed potato and leafy vegetables.

Similarly as hypothesized, distance to the nearest market is negatively related to quantity of tomato sold by FHH. The results show that distance to the nearest market significantly and negatively affected marketable surplus at 5 per cent level. An increase in one kilometer indicated a decrease in the quantity supplied by 9.9×10^{-2} quintals in FHH. As expected, extension contact influenced marketed supply of tomato positively. On an average, if a FHH tomato producer gets extension contact the amount of tomato supplied to the market increases by 65×10^{-2} quintals. This suggests that access to extension service avails information regarding technology which improves production that affects the marketable surplus. On an average, if a female tomato producer had a water pump, the amount of tomato supplied to the market increased by 38×10^{-2} quintal. This suggests that ownership of water pump improves production status and thereby the level of sales that determines the marketable surplus. As hypothesized, participation of the household heads in social organization positively affected quantity supplied in FHH. An increase in membership in social organization resulted in 21×10^{-2} quintals increase in tomato quantity sold in FHH, keeping other factors constant.

Conclusion and Policy Implications

The study identified factors of tomato volume supply in male and female-headed households in Dugda district, Ethiopia. The data used in this study were collected from 123 male headed households and 46 female headed households randomly selected from eight kebeles of the district. Independent t-test was used to test the differences between MHH and FHH in terms of continuous variables and x^2-test for discrete variables. Moreover, multiple linear regression models were estimated to identify determinants of tomato volume supply in MHH and FHH.

The survey result indicates that male headed households had higher tomato farming experience, larger total land holding, higher family labour, better participation in social organization, higher production of tomato and more quintals of tomato sold in the market compared to FHH. The findings of this study also revealed that male headed households were found to have relatively higher achievement motivation, better educational level, better participated in non-farm activities and used more

credit than female headed households. The t-test and the chi-square test results confirmed that female headed households are found to have relatively had water pump, higher level of aspiration and better market information compared to their male counterparts.

The multiple linear regression model results indicate that distance from the nearest market center, tomato farming experience, quantity of tomato produced, ownership of water pump, extension service and social participation played a significant role in tomato quantity supply to the market among female headed household heads. Family labour and quantity of tomato produced played a significant role in tomato quantity supply to the market among male headed household heads.

The results of this study will benefit policy makers and implementers in indicating the area advantage for what should be done to improve tomato production and marketing. Therefore, policy makers should take into account determinants of quantity supplied to the market by female and male headed farmers.

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