Information and Knowledge Management
ISSN 2224-5758 (Paper) ISSN 2224-896X (Online)
Vol.7, No.10, 2017

Effect of Access to Market Information Services on Supply of Major Vegetables: Evidence from Farm Households' of Ambo and Toke-Kutaye Districts, West Shewa, Ethiopia

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Abstract
This study aimed to examine factors influence access to market information service and quantity of vegetables marketed. A total of 150 sample households were randomly selected for an interview. Both descriptive statistics and Heckman maximum likelihood regression were used for data analysis. The descriptive statistics result revealed that 48% of sampled households were access to market information using mobile phone while 52% were not. Results of Heckman ML showed that sex, sex, dummy model farmer, and educational level increases the likelihood of access to market information using mobile phone while access to credit services decreases its likelihood. Nevertheless, land size, family size, and access to nearest market increases the likelihood of both access to market information and volume of onion and tomato supplied. The dummy use of donkey for transportation, and area of land covered by onion and tomato also increases the likelihood of the volume of onion and tomato supplied to market. Finally, the study suggested these factors to enhance smallholder's capacity to produce vegetables that aligned to improve vegetables value chain in the study areas.
Keywords: Access to market Information, Heckman ML model, Major Vegetables, Mobile phone

1. INTRODUCTION

1.1. Background of the Study

In Africa, 75 percent of the people who live in rural areas depend on agricultural livelihood (Kwadwo and Daniel, 2012). However, Lack of technological and market information has been given as the major reason for the low productivity in African agriculture (Kwadwo and Daniel, 2012). To improve the efficiency in agricultural productivity, market information services was initiated in eastern Africa countries during late 1990th by International Institute of Tropical Agriculture (IITA), with assistance from the Technical Center for Agriculture (CTA) based in Wageningen in the Netherlands (Ferris and Peter, 2004). In addition, FAO and other organizations involved with the development of agricultural marketing have advocated the establishment of Market Information Services (MIS) as a means of increasing the efficiency of marketing systems and promoting improved price formation (Andrew W. 1997).

In Ethiopia, information communication technology (ICT) enables the novel Commodity Exchange (ECX) to transmit commodity price information to farmers in real time - within two minutes of a deal being made at ECX from Addis Ababa. But in many parts of the developing world, the most common way of obtaining information remains personal travel which is costly both in terms of time and money (World Bank, 2011). Other channels also have their limitations, such as newspapers (which tend to be concentrated in urban areas and require literacy), internet (low access) or TV and radio (limited information range and one-way communication) (Aker and Mbiti, 2010). With this regard, the use of local radio, mobile phones and the internet, has increased the avenues for timely and wider delivery of useful market information (Adeleke *et al*., 2010; Furuholt and Matotay ,2011). However, the cost of obtaining reliable market information to an individual farmer becomes high due to imperfection in market which creating welfare loss (DFID, 2005).

On the other hand, the degree of market participation may be constrained because larger buyers tend to favor scale and may be unwilling to pay the transaction costs associated with sourcing from a large number of small dispersed farms (Pingali *et al*., 2005; and Molony, 2006). For example, in the study districts of *Ambo* and *Toke Kutaye* tomato and onion attract good price, but suffer from high price volatility. Particularly the existing market condition and production planning doesn't suit the nature of vegetable products where farmers reported extremely low prices for onion and tomato (Bezabih *et al*., 2014). In addition, brokers and wholesalers interested to buy on stand and determine prices and even sometimes refuse buying harvested products. Hence, producers are forced to sell their produce to middlemen or may be required to sell to their creditors at pre-arranged prices (Bezabih *et al*., 2015). In general, no study had conducted regarding to the effect of market information service in the study areas though there are exceptional study by Getaw and Godfrey, 2014, about how farmers' decide to use mobile phone and role of ICT in agriculture by Dereje *et al*., 2014 in Ethiopia. Therefore, no study has conducted previously in the study area regarding to role of market information service and this study is aimed to fill the literature gap on market information services by identifying the effect of market information service on quantity marketed of major vegetables (Onion and Tomato).

2. METHODOLOGY

2.1. Description of the Study Areas

This study was carried out in Ambo and Toke Kutaye districts of West Shewa zone of Oromia National Regional State. *Ambo district* is situated at 8°56'30" - 8°59'30" N latitude and 37° 47'30" -37°55'15" E longitude in central Oromia, Ethiopia, 110 km west of Addis Ababa. The district has 34 rural kebeles of which 23 of them are vegetable producers, and Ambo is the capital of the district. The 2007 national census reported total populations for this district is 108,406, of whom 54,186 were men and 54,220 were women; 865 (CSA, 2007). On the other hand, *Toke Kuatye* is located between latitude of 08° 59' 01.1' N and longitude of 37° 46' 27.6' E. The district has 31 rural kebeles of which 20 of them are vegetables producer, and *Gude*r is the capital town. The total human population of the district is 119,999, of which 59,798 were men and 60,201 were women; and 15,952 or 13.29% of its population were urban dwellers (CSA, 2007).

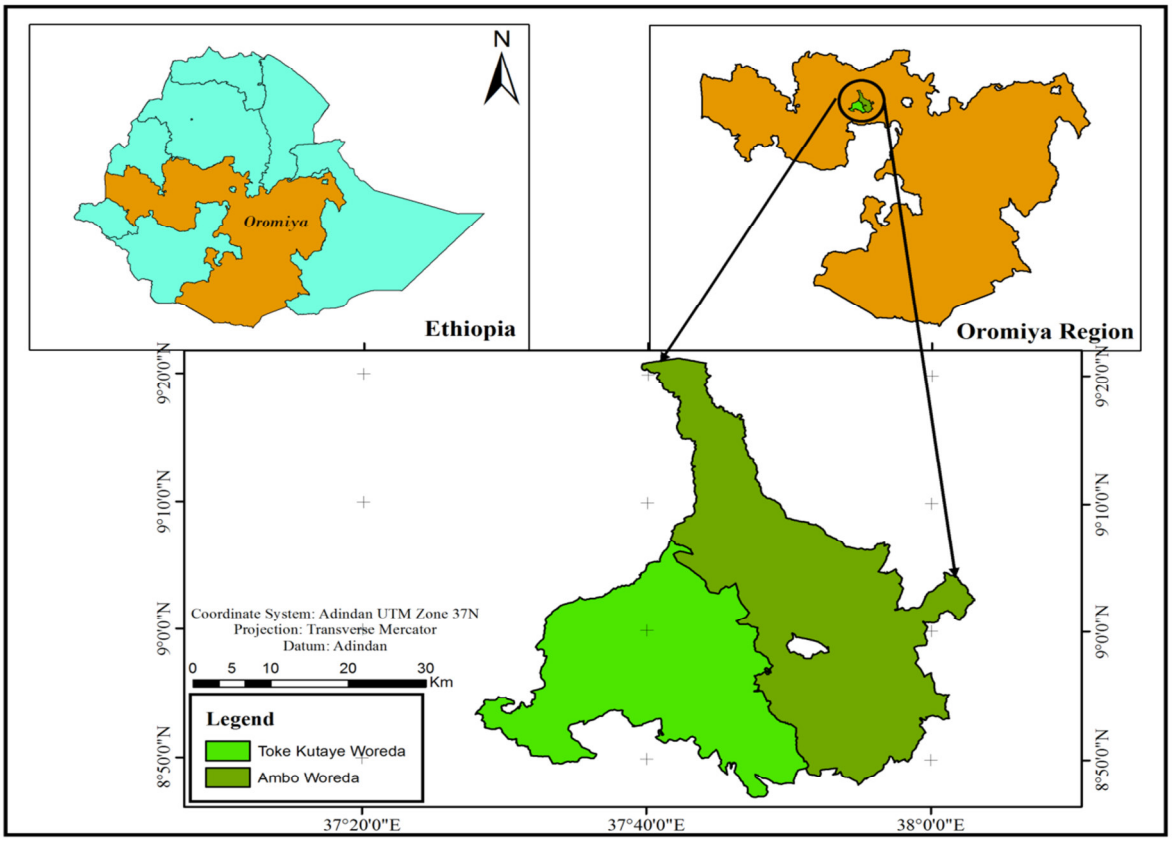

Figure 1. Map of the Study Areas
Source: College of Agriculture and Veterinary Science GIS Team

2.2. Sampling Methods and Procedures

For this study, three-stage sampling technique was employed. At first stage, sample districts were selected purposively based on the potential production of vegetables crops. Secondly, based on major producer of onion and tomato, four kebeles namely *Kiba*, *Billo*, *ImalaDawoAajo* and *Birbirsa* were randomly selected using 10% sampling intensity. Thirdly, 150 farm households who are irrigation users were selected randomly using Probability Proportional to Sample Size (PPS) using Yamane, 1967.

$n=\frac{N}{1+N(e^2)}$; Here the sampling error is 8% (0.08) considering the budget, accuracy and time utilization for the research.

Table 1. Summary of sample kebeles by respective sample households

S/N	*District*	*Sampled Kebele*	*Total Irrigation Vegetable producers*	*Sample Size using PPS*
1	Ambo	Billo	809	35
		Kiba	610	26
2	Toke-Kutaye	ImalaDawoAajo	1585	68
		Birbirsa	496	21
Total			**3,500**	**150**

Source: Ambo and Toke-Kutaye District Agricultural Office (DAO, 2016)

2.3. Methods of Data Collection and Data Sources

In this study, both primary and secondary data was used. Primary data was used for result analysis that consists of a semi structured questionnaire. The questionnaire was designed to capture information on household socio-economic characteristics, institutional factors, market information services variables. Hence, to build the result discussion personnel observation and focus group discussion was used. However, for methodological purpose and empirical reviews, secondary information was used that includes about the major vegetables production, land size, location, and population data that are relevant for this study. These were collected from district agricultural office (DAO), Central Statistically Agency (CSA), and from published and unpublished sources.

2.4. Methods of Data Analysis

2.4.1. Descriptive analysis

To describe the socio-economic characteristics of the respondents, descriptive statistics such as frequency, percentages, mean, and standard deviation was used. In the analysis, households' specific characteristics, wealth characteristics, and institutional characteristics were used and presented in tabular. And inferential statistics, *t*-test and $\chi 2$ were used to compare whether there are significant mean and proportional differencesbetween households who use mobile phone and not use to acquire market information.

2.4.2. Econometric Model

Effect of Market Information Services using Heckman ML model

This was approached by dichotomous dependent variable of access to market information services using mobile phone in selection equation as proxy variable. Thus, the analysis of the effect of access to market information services on an outcome variable using regression analysis can lead to biased estimate if the underlying process which governs selection into access to market information service is not incorporated in the empirical framework.

$$Y = X\beta + \alpha I + U_1 \quad (1)$$

Where Y is the outcome X is a vector of personal exogenous characteristics and I is a dummy variable (I=1, if the individual access market information service using mobile phone and 0 otherwise). From this model, the effect of market information is measured by the estimate of α. However, the dummy variables 'I' cannot be treated asexogenous if the likelihood of an individual access it or not based on an unobserved selection process (Maddala, 1983). Some studies have shown the limitations of applying the classical linear regression methodology to the analysis of samples with selectivity bias (Heckman, 1979;Maddala, 1992; Dardis *et al*., 1994; and Sigelman and Zeng, 1999). Application of the classical linear regression model does not guarantee consistent and unbiased estimates of the parameter. One solution to this problem in econometrics is the application of Heckman ML procedures. It is considered as an appropriate tool to test and control for sample selection biases (Wooldrige, 2002).The Heckman ML procedures involves two equations. The first equation (i.e., the selection equation) attempts to capture the factors governing access to market information services using mobile phone. This equation is used to construct a selectivity term known as the 'Mills ratio' which is included as independent variable to the second equation known as response or outcome equation.

If the coefficient of the 'selectivity' term is significant then the hypothesis that the selection equation is governed by anunobserved selection process or selectivity bias is confirmed. Moreover, with the inclusion of extra term, the coefficient in the second stage 'selectivity corrected' equation is unbiased (Zaman, 2010). Therefore, to evaluate the effect of access to market information services on production of vegetables product, we use the Heckman two-stepprocedure. Following Green (2003), the models were specified as:

i) *Access to Market Information Service/Prbit equation model is:*

$$Z_i^* = \sum_{k=1}^{k} \gamma_k W_{ki} + U_i \quad (2)$$

Z_i= 1 if z* > 0 and Zi= 0 if z* ≤ 0

ii) *Outcome equation/supply of Vegetables* is:

$$Y_i = \sum_{s=1}^{s} \beta_s X_{si} + \varepsilon_i ; \quad (3)$$

Y_i = is observed only if $Z^*_i > 0$ and the disturbance $U_i \; and \; \varepsilon_i$ follows a normal distribution with zero means and constant variances and covariance's (δ_{ue}).

Where,

Z^*_i = is Access to market information services which has dichotomous realization on Z_i (unobservable)

γ_k = is unknown parameter of the K^{th} variables to be estimated in the first equation;

W_{ik}= variables determining the probability of access to market information services;

Y_i = Outcome equation i.e. quantity of major vegetables (onion and tomato) marketed

X_{is} = S^{th} variables determining quantity marketed of vegetables in the second equations;

β_s = vectors of unknown parameters of the second equation/quantity of vegetables marketed;

$U_i \varepsilon_i$ = disturbance terms of the first and second equations, respectively.

Lambda was constructed as;

$$\lambda(-\gamma W_i) = \frac{-\phi(\gamma W_i)}{1-\varphi(\gamma W_i)} \quad (4)$$

Where,

$\lambda(-\gamma W_i)$= probability density function; $\frac{-\phi(\gamma W_i)}{1-\varphi(\gamma W_i)}$= Cumulative normal distribution function

2.5. Variables Definition and Measurement

2.5.1. Dependent Variables

Access to Market Information Services (AcMKTSE): It is a dummy dependent variable represents typical households' access market information on quantity of product supplied to market using mobile phone. Use of mobile phone is a proxy variable to access market information that takes value '1' if households' use mobile phone; otherwise '0'.

Quantity of onion and tomato supplied (QtySUP): It is continuous variable representing the quantity (volume) of major vegetables i.e. onion and tomato supplied to market by household at specified period of production season and measured in kilogram.

2.5.2. Independent Variables

Age of the Household (Age): It is a continuous variable representing the age of households in years. It is hypothesized that as age of households increases the probability to access market information using mobile phone increases with a given wealth of households. Similarly it increases the quantity of vegetables supplied to market given technology of production adopted. According to, Getaw and Godfrey, 2014 in their study in Ethiopia they found that there is positive relationship between age of the households and use of mobile phone.

Sex of the Household (Sex): It is a dummy variable takes value '1' if male; otherwise '0'. It is hypothesized that positively affecting both access to market information and quantity supplied. It shows that males have opportunity to acquire productive resources that capable them to accumulate wealth and leads them to buy mobile phone and get market information than females. Souter *et al*., 2005 showed average women tend to be more marginalized than men and similar finding from Uganda also suggest that male has positive effect on access to market information service (Agnes, 2010).

Educational level (EDUCA). It is a dummy variable takes value '1' if literate; otherwise '0'. It is hypothesized that as households' being literate the tendency to access market information using mobile phone will increases in such a way increases the quantity of marketed supply of onion and tomato. That means education provides more awareness about better production, searching market information and use of mobile phone. Dereje *et al*., 2014 in their study found positive sign and significant in their study of role of ICT in agriculture and similar study was argued by Getaw and Godfrey, 2014; Okello *et al*. (2010) found positive sign.

Family Size (FMSIZE): It is discrete variable representing the number of member of the households. It is hypothesized that the more family adult equivalent ratio, the more contributing agricultural family labor that induced to generate more income that helps to use mobile phone and increases surplus production of onion and tomato supplied to market keeping other things remains constant. Dereje *et al*., 2014 found family size has positive sign and significant in affecting access to market information.

Land Size (LANDSI): It is continuous variable representing the total land size holding of the households

measured in hectare basis. It is hypothesized that land size increases the probability to access market information services using mobile phone. It shows that more land size means more diversified agricultural livelihood carried out on it which tends to increases households' income and fortunate to buy mobile phone. Anselme *et al*., 2010 in which he found positive relationship between land size and use of ICT by rice farmers in Benin.

Distance from Public Road (DPROAD): It is continuous variable representing average two way distances from households' home to public road measured in hours. It is hypothesized that the far away distance in hours from public road the more to use mobile phone to acquire market information given that reducing cost of obtaining market information. According to Getaw and Godfrey, 2014 distance from main weather road negatively affecting the use of mobile phone to obtain market information.

Current Land Covered Under Onion Production (LDN2015): It is continuous variable representing area of land covered under onion production during the survey time i.e.2015/16 measured in hectare. . It is hypothesized that the more land covered under onion production the more quantity supplied to market having high expected price and demand for onion.

Current Land Covered Under Tomato Production (LDTM2015): It is continuous variable representing area of land covered under tomato production during the survey time i.e. 2015/16 and measured in hectare. It is hypothesized that the more land covered under tomato production the more quantity supplied to market having high expected price and demand for tomato.

Village Level Status of the Household (VLSHH): It is a dummy variable that takes value '1' if the particular household is model farmer; otherwise '0'. It is hypothesized that, model famer has more farming experience and which give guarantee to accumulate more asset which positively affect the use of mobile phone to obtain market information as well as producing surplus onion and tomato product that supplied to market. That means, the more household participated to use improved agricultural technologies and generating other fixed assets the more they participated in commercialization of vegetables.

Position in the Village (PVILLAGE): It is a dummy variable that takes value '1' if the farmer has position in the village; otherwise '0'. It is hypothesized that having position in the village opens opportunity for social interaction and capable him/her to use mobile phone for administration purpose. This is fortunate to access market information from different areas and affects positively access to market information.

Access to Credit Service (ACREDIT): It is a dummy variable that takes value '1' if the particular farmer is obtain credit for vegetables production; otherwise '0'. It is hypothesized that the access to credit the increases volume of onion and tomato that are marketed and positively affects use of mobile phone to obtain market information. Because credit helps them to invest on productive assets via generating more income and gradually increases the use of mobile phone to get market information keeping other factors remain constant.

Access to the Nearest Market (ACMARKET): It is a dummy variable that takes value '1' if the particular farmer is access it; otherwise '0'. It is hypothesized that the nearest the household to market area the more obtaining market information using mobile phone and supplied more volume of onion and tomato. That means those who are near to market area access daily demand and supply status of onion and tomato which induced them to regulate volume of supply at market. Access to the nearest market reduces the probability to use mobile phone (Getaw and Godfrey, 2014).

Use of Donkey for Onion and Tomato Transportation (USDONKEY): It is a dummy variable that takes value '1' if a farmer own donkey; otherwise '0'. It is hypothesized that, own donkey for onion and tomato transportation, increases volume supplied to market that induced by acquiring market information via mobile phone. It shows that those households who own more donkeys would supply the bulk of onion and tomato that simultaneously geared by accessing market information using mobile phone.

Table 2. Summary of the variables hypothesis for Heckman ML model

Independent Variables			**Heckman-ML Model (Sample-Selection Model)**		
Definitions	***Variable Code***	***Type of variable***	***Expected sign in 1st hekt (Access to Market information services)***	***Expected sign in 2nd step Quantity of Onion marketed***	***Expected sign in 2nd step Quantity of Tomato marketed***
Age of the households in Years	AGE	Continuous	+	+	+
Educational Level of the households in years of schooling	EDUCA	Dummy	+	+	+
Total Number of Family Size	FMSIZE	Discrete	+	+	+
Total Land Size Owned in hectare	LANDSI	Continuous	+	+	+
Distance from the public road in hours	DISROAD	Continuous	-	-	-
Current area of land covered by onion crop by 2015 in *hectare*	LDON2015	Continuous		+	
Current area of land covered by tomato crop by 2015 in *hectare*	LDTM2015	Continuous			+
Sex of the Respondents (1=male, 0=female)	SEX	Dummy	+	+	+
Village level status of the HH (1=model farmers; 0=non-model farmer)	VLSHH	Dummy	+		
Do you have Position in village (1=Yes; 0=No)	PVILLAGE	Dummy	+		
Access to Credit Services (1=Yes; 0=No)	ACREDIT	Dummy	+	+	+
Access to the Nearest Market (1=Yes, 0=No)	ACMARKET	Dummy	+	+	+
Owning Donkey for Vegetables Transportation (1=Yes; 0=No)	OWDONKEY	Dummy	+	+	+

3. RESULT AND DISCUSSION

3.1. Proportion of Households by Access to Market Information Service

Rural households devoid of acquiring market information about price and quantity delivered to market which stemmed to illiteracy level and the underdevelopment of market infrastructure. Despite of this limitations, household acquire market information from formal and informal combine sources using radio, friends, neighbor, brokers, traders, and mobile. Among this means, mobile phone is recently at advance level of communication that smallholders are using it. Accordingly, as depicted on (table 4), 48% (n=72) of the farm households use mobile phone to access market information while 52 % (n=78) did not use. Among the total mobile phone users, 62.5% (n=45) of them were from Ambo district while 37.5% (n=27) were from Toke-kutaye district. More or less similar figures of non-mobile users were obtained in both districts (table 3).

Table 3. The Number of households who access to market information service

Access to Market Information Service	**Districts**				**Total**	
	Ambo		**Toke-Kutaye**			
	Freq.	**Percent**	**Freq.**	**Percent**	**Freq.**	**Percent**
Use mobile phone	45	62.5%	27	37.5%	72	48%
Not use mobile phone	37	47.4%	41	52.6%	78	52%

Source: Own survey data computation (2016/17).

3.2 Descriptive and Inferential Statistics Analysis

3.2.1. Mean and Proportional Comparison for Mobile users and Non-users

As illustrated on Table 4 there is mean difference between mobile users and non-users interms of households' wealth such as land holding size (LANDSI), land covered under vegetables (LUVEG), and LIVSTOCK. Thus, the mean of land size (LANDSI) is 3.33 ha, for mobile users and 2.53ha for non-mobile users and significant at 1% probability level. It may indicate that the more the land seized by the households, the more become diversifying livelihood prior to generating high farm income sources which put advantage to buy mobile phone. Besides to this, the total number of livestock owned (LIVSTOCK) in TLU showed significance mean difference between mobile users and non-users interms at 10% probability level. Thus, the mean in LIVSTOCK is 2.28 for mobile users and 1.84 for non-mobile users. This indicates that those households, who owned relatively more number of livestock, might be generating income from sell of animal and their products which helps them to buy mobile phone and use it. Regarding household's allocation of farm land for vegetables production (LUVEG), we found

significance mean difference between mobile users and non-mobile users at 5%probability level. Hence, the mean in LUVEG is 0.57 ha for mobile users and 0.48 ha for non-mobile users. This showed that the more farmers access to market information, the more they devoted to increase allocation of the land for vegetables production.

On the other hand, there is also mean and proportional difference between mobile users and non-mobile users' interms of households' characteristics such as age (AGE), family size (FMSIZE), and dummy model farmer (MOFARM). Accordingly, the mean age is 45.64 and 41.83 for mobile users and non-mobile users respectively and significant at 5% probability level. The mean family size is 6.76 and 5.56 for mobile users and non-users respectively and significant at 1% probability level. This showed that, more family size may provide more agricultural labour that helps to generate diversified income and fortunate to buy mobile phone keeping other things remain constant. Moreover, the dummy variable being the household is model farmer (MOFARM) showed proportional difference between mobile users and non-mobile users. The $\chi 2$= 17.683 test result at 1% probability level showed that 80.5% of households who use mobile phone were model farmers and who do not use mobile phone were 47.4%.

Finally, there is also mean difference between mobile users and non-mobile users' interms of quantity of Onion marketed by year 2016/17 E.C (ONQty09), and vegetables cropping intensity in a year (VEGCI). The mean quantity of onion traded by mobile users is 7.72 quintals and non-mobile users is 6.26 quintals and significant at 10% probability level. On the other hand, the mean of vegetables frequency production in one year is 2.17 for mobile users and 2.01 for non mobile users and it is significant at 10% probability level.

Table 4. Mean and Proportional Comparison for Socio-economic variables

Variables	Mobile User (n=72)		Non-Mobile User (n=78)			**Sig.test**
Dummy	Mean	SD	Mean	SD	Total	***χ2-value***
SEX	0.847	0.362	0.833	0.375	0.84	
EDUCA	0.903	0.298	0.885	0.321	0.893	
MFARM	0.805	0.398	0.474	0.503	0.633	17.683***
Continuous						***t-value***
AGE	45.638	9.266	41.833	9.284	43.66	-2.510**
FMSIZE	6.764	3.087	5.564	2.189	6.14	2.761***
DPRATIO	0.326	0.172	0.275	0.216	0.299	
LANDSI	3.318	2.244	2.531	0.137	2.909	-2.878***
LUVEG	0.576	0.279	0.487	0.204	0.53	-2.244**
LIVSTOCK	2.282	1.687	1.839	1.429	2.052	-1.738*
LDON2015	7.722	5.812	6.26	4.328	6.962	-1.756*
LDTM2015	3.412	4.606	3.722	3.558	3.573	
VEGCI	2.166	0.581	2.012	0.546	2.086	-1.671*

Source: Own survey data (2016/17)

3.3. The Effect of Market Information Services

3.3.1. Econometric Results

3.3.1.1. Probit estimation of effect of access to market information services

In the following section, we discussed the effect of market information services on quantity supply of major vegetables. To identify the effect of market information service, we employed the maximum likelihood estimation with restriction (ML) of Heckman-Two-Step and run 11 explanatory variables in selection equation and10 of the identical variables to the outcome equation. Following this, separate analysis for the dependent variables of the outcome equation i.e. quantity of Tomato marketed in 2007 (TOMQty07) and quantity of Onion marketed in 2007 (ONQty07) were estimated in the second stage. The Pseudo R2 values indicate that, the independent variables included in the regression explain 22.8% variations in the likelihood to access market information service. Considering the result of the ordinary least squares (OLS), the inverse Mills' ratio was not significant, confirming that there was no sample selection bias. This suggests that there was no serious unobservable factor which affected both selection and outcome equations simultaneously. This implies that the dependant variables were observed for unrestricted random samples and the error terms of selection and outcome equations are not correlated (Table 5). Moreover, the rho= -2.520 in the second step estimation of continuous dependent variable of TOMQty07 showed that the unobservable variables are negatively related to selection equation and positively related to outcome equation. Plus, rho = -0.513 in second step of ONQty07 estimation revealed that unobservable are negatively correlated to selection and outcome equation. Finally, the detection of heteroskedasticity in the Heckman ML model was captured by running the probit model independently using the regressors of selection equation by setting robust standard error unless with the simultaneous estimation of

Heckman ML with restriction yields the default standard error. Regarding to multicollinearity problem test, there is no serious correlation detected and the VIF (Variance Inflation Factor) is less than 10% for all explanatory variables.

Sex of the Household (SEX): The dummy sex (1=male) increases the likelihood of access market to information using mobile phone by 30.7% and significant at 5 percent probability level. This is expected sign for male and it may indicate that male owned and use mobile phone which helps them directly to acquire market information. The result in this study is consistent with Souter *et al*., 2005 in they found being a male had positively affecting access to market information

Family size (FAMSIZE): The total number of family size increases the likelihood of access to market information services using mobile phone by 5% and significant at 5 percent. Households with large adult equivalent ratio households have more access to use mobile phone that in-lined to the pursuits of having more number of family sizes may be fortunate to supply labor and diversify livelihood that possibly raise income. Subsequently, it capacitates to buy mobile phone and use to access market information. The result in this study is concise to Dereje *et al*., 2014 in which they found positive sign and significant in their study of ICT in agriculture.

Educational level (EDUCA): An increase in years of schooling of households, increases the likelihood of access to market information using mobile phone by 26.2% and significant at 10 percent probability level. Education helps households to use mobile phone and communicating different sort of market information sources. This finding is similar to case of other study by (Derej*eet al*.,2014; Okello *et al*, 2014) in their study of analyzing socio-economic factors affecting use of information. Similarly, there is also positive sign confirmed by Getaw and Godfrey, 2014.

Land Holding in Hectare (LANDSI): Household wealth characteristics like land holding (LNADSI) increases the likelihood of access to market information using mobile phone by 6.4% and significant at 10% probability level. This might show that an increase in landholding in hectare will increase vegetables production keeping other things remain constant. This results to production of surplus that calls for sale and encourage vegetables market participation.

Village level status of the Household (VLSHH): On the other hand, the dummy model farmer can also affect the degree of access to market information using mobile phone. The dummy model farmer increases the likelihood of access to market information using mobile phone by 37.9% and significant at 1 percent probability level. The relative categorization of a household as model farmer shows those who adopt and use full package of improved agricultural technology get advantage to increase agricultural productivity and consequently selling the surplus produced which raises farm income and capable to buy mobile phone to get market information.

Access to Credit Services (ACREDIT): Finally, the dummy access to credit services (ACREDIT) decreases the likelihood of access to market information services using mobile phone by 21.9 and significant at 5 percent probability level. This is clearly showed that in Ethiopia credit acquisition of mobile apparatus as well as SIM card is negligible. Thus, acquiring mobile phone and use it for accessing market information rests on own wealth of the households. This finding is consistent with Masuka *et al*., 2016 in which he found credit provides better access to market information.

Access to the Nearest Market Place (ACMARKET): On the hand, dummy access to market, increases the likelihood of access to market information service using mobile phone by 28% and significant at 5percent probability level. This indicate that those who are relatively access to market areas may get information, knowledge, and use of mobile phone that open an opportunity to use mobile phone for communication as if their scale of vegetables marketing increases. The result is similar to Getaw and Godfrey, 2014 in which they found distance to the nearest market negatively affecting access to market information.

Table 5: Marginal effect estimation from first probit estimation

Probit regression, reporting marginal effects Number of obs = 150

Wald chi2 (11) = 52.28
Prob > chi2 = 0.0000
Log pseudolikelihood = -80.176711 Pseudo R2 = 0.2280

USMOBILE	coef.	P>Z	dy/dx	Robust Std.Err.	P>Z
AGE	0.020	0.150	0.008	0.006	0.168
SEX(d)	0.809	0.062	0.307	0.112	0.014**
EDUCA	0.717	0.174	0.262	0.138	0.096*
LANDSI	0.161	0.069	0.064	0.035	0.070*
FMSIZE	0.126	0.022	0.050	0.024	0.034**
ACREDIT(d)	-0.568	0.039	-0.219	0.103	0.042**
ACREDIT(d)	0.729	0.187	0.265	0.149	0.131
ACMARKET(d)	0.743	0.020	0.280	0.104	0.013**
DISROAD	-0.014	0.855	-0.005	0.012	0.640
USDONKEY(d)	0.323	0.215	0.128	0.108	0.236
VLSHH (d)	1.007	0.000	0.379	0.091	0.000***

Source: Own computation,*** 1% significant level; ** 5% significant level; and * 10% significant level; ([d]) dy/dx is for discrete change of dummy variable from 0 and 1

3.3.1.2. Volume of major vegetables marketable supplied

Volume of major vegetables marketable supplied i.e. onion and tomato in the study area is affected by several factors. Accordingly, family size of farm households has positive effect on volume of tomato marketed though we found insignificant for onion. A unit increases in number of family size member, increases the volume of tomato marketed by 0.402 quintals and significant at 5% probability level. Large family size contributes more farm labor and helps to increase the scale of tomato farming that available for surplus sale. This finding is in line with (Ayelech, 2011) in their study on tomato, mango, avocado and papaya production by farming households.

Likewise, it was observed whether land allocation for major vegetables (LANDSI) i.e. onion and tomato affect volume of supply or not. Hence, a unit increases in hectareof land allocation for major vegetables crops, increases the volume of onion supplied by 4.52 quintals. This entails the more farmers' access to market information about the price, product type and quantity demanded on the market, the more area of land added and onion produced keeping other things remain constant. This finding is consistent with Mebrat, 2014 in her analysis of tomato value chain in central rift- valley of Dugdawereda and found positive sign to the variable. In addition, we estimate current land allocation for onion and tomato during the survey time (year 2015/16). Thus, we obtained land covered by onion by 2015/16 (LDON2015) was found insignificant though it is major vegetable produced in the study area. However, we found significant positive value for land allocation for tomato by year 2015/16 (LDTM2015). An increase in land allocation in hectare in the year 2015/16 for tomato increases the volume supplied by 12.22 quintals and significant at 1% probability level. It indicates that more land allocation for tomato during the survey period might be endorsed by the relative high price expected for tomato crop.

The use of donkey (USDONKEY) for transportation purposes played significant role in the study areas. Thus, the use of donkey for transportation increases the volume of onion and tomato supplied by 5.37 and 4.38 quintals and significant at 5% and 1% probability level respectively. Hence, donkeys' are important in transporting vegetables in local market. Farmers' who have more numbers donkey can transport vegetables even long distance owing to the bulk nature of the produce as well as difficult in transporting by family labor.

On the other hand, physical factors like dummy access to nearest market area affect the volume of vegetables supplied. Access to market area increases the quantity of onion marketed by 3.55 quintals and significant at 10% probability level where it is also significant for volume of tomato marketable supplied by 3.3 quintals and significant at 5% probability level. It is obvious, that access to market area has advantageous position for households to produce marketable agricultural goods, which minimize transaction costs and loss of vegetables during transporting. This is in line with Ayelech (2011) in study of value chain analysis of vegetables who indicated that distance to market caused market surplus of avocado to decline in GommaWoreda and Habro and Kombolcha respectively.

Table 5. OLS Result from Estimation of Heckman- ML

Continuous Dependent variables								
Explanatory variables	**Volume of Onion Supplied**				**Volume of Tomato Supplied**			
	Coef.	**Std.Err.**	**Z**	**P>Z**	**Coef.**	**Std.Err.**	**Z**	**P>Z**
_CONS	-4.397	7.442	-0.59	0.555	-9.030	4.604	-1.96	0.050**
AGE	-0.056	0.085	-0.65	0.514	-0.019	0.0531	-0.36	0.716
SEX(d)	1.863	2.259	0.82	0.410	1.216	1.412	0.86	0.389
EDUCA(d)	-1.399	2.666	-0.52	0.600	-0.847	1.657	-0.51	0.609
FMSIZE	0.241	0.287	0.84	0.401	0.402	0.177	2.27	0.023**
LANDSI	4.524	2.691	1.68	0.093*	1.732	1.603	1.08	0.280
ACREDIT(d)	0.245	1.836	0.13	0.894	-0.998	1.162	-0.86	0.390
ACMARKET(d)	3.546	2.147	1.65	0.099*	3.291	1.357	2.42	0.015**
DISROAD	0.442	1.186	0.37	0.709	0.513	0.754	0.68	0.496
LDON2015	3.238	3.570	0.91	0.364				
LDTM2015					12.227	2.043	5.98	0.000***
USDONKEY(d)	5.374	2.416	2.22	0.026**	4.387	1.495	2.93	0.003***
/athrho	-0.567	0.279	-2.03	0.042	-0.257	0.295	-0.87	0.382
/insigma	1.685	0.093	18.08	0.000	1.244	0.091	13.59	0.000
Rho	-0.513	0.205			-2.520	0.276		
Sigma	5.390	0.502			3.470	0.317		
Lambda	-2.769	1.286			-.875	0.994		
Number of obs.	150				150			
Censored obs.	78				78			
Uncensored obs.	72				72			
Wald chi2 (10)	18.36				63.56			
Prob> chi2	0.049				0.000			
Chi2(1) = 3.28 Prob> chi2 = 0.0703					chi2(1)=0.60 Prob>chi2 = 0.438			

Source: Own computation from Heckman-ML regression
(***) 1% significant level; (**) 5% significant level; (*) 10% significant level
((d)) is dummy independent variable

4. Conclusion and Recommendations

4.1. Conclusion

Market information services have significant effect on volume of agricultural supply prior to enhancing efficiency on price, income and quantity. Hence, in the study areas vegetables producers' uses mobile to acquire market information. Accordingly, household specific variables such as (being a male, being literate, and being model farmer), the wealth characteristics (land size, use of donkey) as well as the institutional variables (Access market, and access to credit) have determinable effect tin accessing market information services and volume of vegetables supply.

4.2. Recommendations

Based on finding from the study the following recommendation is given. Accordingly, to encourage male use of mobile phone to acquire market information, training should be given on how to operate mobile phone effectively. Regarding literacy role in accessing market information, the existing access to basic education and formal education should be encouraged to be accessed by rural farmers. On the other hand, land size is important factor to access market information using mobile phone. Thus, the existing campaign on development of soil and stone bund should be encouraged to keep land fertility so as to increase vegetables production. On the other hand, having large family size and being a model farmer would improve household livelihood and diversifies farm income that helps to access better market information. Finally, access to market and access to credit helps to increase production capacity and reduce marketing costs. Therefore, the existing marketing infrastructure should be improved and monitored as if meeting the vegetables marketing efficiency.

5. ACKNOWLEDGMENT

First and foremost we would like to express our gratitude to almighty God for enabling us to complete this research work successfully Next, we have strong gratitude to Ambo University who gave us an opportunity to fund the research and make it smoothen to complete the work. Finally, we have also recognition for the deliberation of staff members of Agribusiness and Value Chain Management department for all achievements.

6. REFERENCES

Adeleke S., Abdul BK, Zuzana B (2010). Smallholder agriculture in east Africa: Trends, constraints and opportunities, ADBG (African Development Bank Group), working paper series No.105, April, 2010.

Andrew W.Sh (1997). Market information services. Theory and Practice, FAO (Food and Agricultural Organization) Agricultural services bulletin 125:ISSN 1010-1365, Rome.

Agnes GM (2010). Information and communication technology for rural farmers market access in Tanzania. university of Dareselam, Tanzania, *J.* Information Technology Impact 10(2):111-128.

Aker JC, Mbiti IM (2010). Mobile phones and economic development in Africa, Washington D.C.: Center for Global Development.

Anselme BA, Romeo M, Faustin V, Desire A (2010). Determinants of ICT use by rice farmers in Benin: from the perception of ICT characteristics to the adoption of the technology. Department of Economics, Socio-Anthropology and Communication, Faculty of Agricultural Sciences, University of Abomey-Calavi, Benin. J. Research in International Business and Management. 2(11):273-284.

Ayelech T (2011). Market chain analysis of fruits for Gomma woreda, Jimma zone, Oromia National Regional State. An M.Sc thesis presented to School of Graduate Studies, Haramaya University.

Bezabih E, Amsalu A, Tesfaye B, Milkesa T (2014). Scoping study on vegetables seed systems and policy in Ethiopia. Final report, Addis Ababa, January 2014.

Bezabih E, Mengistu K, Jeffreyson KM, JemalY (2015). Factors affecting market outlet choice of potato producers in eastern Hararghe Zone, Ethiopia. J. Economics and Sustainable Development 5(15).

CSA (Central Statistical Authority) (2007). Summary and statistical report of 2007 population and housing census. Federal Democratic Republic of Ethiopia Population and Census Commission.

____DAO (District Agricultural Office) (2016). District agricultural office Annual report in October 2016.

Dardis R, Horacio SF, Dilip P (1994). Analysis of leisure expenditure in the United States. J. Leisure research. 26: 309-321.

Dereje D, Yared M, Jema H (2014).Analyzing socio-economic factors affecting the use of information and communication technologies among farmers in central highlands of Ethiopia. Afri. J. Agricultural Science and Technology. 2 (8):163-171.

DFID (Department for International Development) (2005). Making market systems work better for the poor (M4P): An Introduction to the concept. Discussion paper prepared for the ADB-DFID 'Learning event'. ADB Headquarters, Manila.

Ferris Sh, and Peter R, (2004). "Developing Marketing Information Services in Eastern Africa: The FOODNET Experience", International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria.

Furuholt B, Matotay E (2011). The developmental contribution from mobile phones across the agricultural value chain in rural Africa. The Electronic J. Information Systems in Developing Countries. 48 (7): 1-16.

Getaw T, Godfrey B (2015).Mobile phones and farmers' marketing decisions in Ethiopia. International Food Policy Research Institute, Addis Ababa, Ethiopia World Development.68: 296–307.

Greene W.H (2003). Econometric Analysis, 4th ed., Prentice Hall, pp.640 – 642.

Heckman JJ (1979). Sample Selection Bias as a Specification Econometrica. 47 (1) pp. 153-161 Published by: The Econometric Society Stable URL: http://www.jstor.org/stable/1912352 Accessed: 26/06/2017.

Kwadwo A, Daniel A (2012).The importance of ICTs in the provision of information for improving agricultural productivity and rural incomes in Africa. UNDP Africa Policy Notes 2012-015, United Nations Development Programme, Regional Bureau for Africa.

Maddala, G. S (1983). Limited-Dependent and Qualitative Variables in Econometrics. Cambridge: Cambridge University Press, 1983, pp 401.

Maddala G.S (1992). Limited dependent and qualitative variables in econometrics. Cambridge University press. pp. 175-181.

Masuka B, Matenda T, Chipomho J, Mapope N, Mupeti S, Tatsvarei S, Ngezimana W (2016). Mobile phone use by small-scale farmers: a potential to transform production and marketing in Zimbabwe. South African J. Agricultural Extension. 44(2):2413-3221.

Mebrat T (2014). Tomato value chain analysis in the central rift valley: The case of DugdaWereda, east Shoa Zone, Oromia National Regional State, Ethiopia. A thesis submitted to Haramaya University.

Molony T (2006). I don't trust the phone; It Always Lies': trust and information and communication technologies in Tanzanian Micro- and Small Enterprises'. J. Information Technologies and International Development. 3 (4): 67-83.

Okello JJ, Kirui OK, Gitonga, ZM, Njiraini GW (2010). Determinants of awareness and use ICT-based market information services in developing country agriculture: The Case of smallholder farmers in Kenya. Nzuma Agriculture. 53(3): 263-282.

Pingali P, Yasmeen K, Madelon M (2005). Commercializing small farms: Reducing transaction costs. Agriculture and development economic division, The Food and Agricultural Organization of the United

Nations. ESA working paper No.05-08.
Sigelman L, Zeng L (1999). "Analyzing Censored and Sample-Selected Data with Tobit and Heckit Models." Political Analysis 8:167–182.
Souter D, Scott N, Garforth C, Jain R, Mascarenhas O. McKemey K (2005) The Economic impact of Telecommunications on Rural Livelihoods and Poverty Reduction: A Study of Rural Communities in India (Gujarat), Mozambique and Tanzania (Commonwealth Telecommunications Organizations for UK Department for International Development).
World Bank (2011). ICT in agriculture: Connecting smallholders to knowledge, networks, and institutions, Washington D.C.: World Bank.
Wooldridge J (2002). Econometric Analysis of Cross Section and Panel Data. Cambridge: MIT Press.
Yamane, T. 1967. Statistics: An Introductory Analysis, 2nd Ed. New York: Harper and Row.
Zaman A (2010). Casual relations via econometrics. International econometric review (IER), Econometric research association. 2(1): 36-56.