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Determinants of Volume Sales among Smallholders Potato Farmers in Ejere District, West Shoa Zone, Oromia Region of Ethiopia

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Abstract
This research attempted to analyze the determinants of potato in Ejere district, Oromia Region of Ethiopia. Potato plays a significant role in increasing food security and income for the poor farmers of Ethiopia. Data for the study were collected from both primary and secondary sources. The primary data were generated by household survey using a pre-tested structured questionnaire and key informant interview using checklists. The data were collected from 78 farmers and analyzed using STATA software. The two-stage least square regression model results showed that five variables such as productivity of potato, sex of household head, distance to nearest market, off/non-farm income and area of land allocated for potato significantly affect the volume of potato supplied to the market. Policy implications drawn from the study findings include the need to improve farmers' knowledge and experience on vegetable production, encouraging off/non-farm income, improving productivity and intensification of land for potato, encouraging female in production of potato and expanding accessibility of market infrastructure and strengthening supportive institutions.
Keywords: Volume sales; Potato; Two stage least square regressions; Smallholder; Ejere.

1. INTRODUCTION

Ethiopia has diverse climate and altitude conditions which are conducive to various agricultural activities. There are several lakes and perennial rivers that have great potentials for irrigated agriculture. The groundwater potential of the country is about 2.6 billion cubic meters. Groundwater in the country is generally of good quality and it is frequently used to supply homes and farmsteads. The potentially irrigable land area of the country is estimated at 10 million hectares, out of which only about 1% is currently under irrigation. Most of the soil types in fruits and vegetables producing regions of the country range from light clay to loam and are well suited for horticultural production (EIA, 2012).

Vegetable production is becoming an increasingly important activity in the agricultural sector of the country following the development of irrigation and increased emphases given by the government to small scale commercial farmers. Recently, due to their high nutritional value vegetable do have ever rising demand both in local and foreign markets, and are classified among those export commodities' that generate considerable amount of foreign currency earnings to the country. As a matter of these facts commercial farms in Ethiopia used to grow vegetables over a considerable land area for years (CSA, 2015). Major vegetable types produced in West Shoa Zone are onion, potato and cabbage. Commodities that are exclusively focused on vegetable and fruit production by irrigation were ranked as potential intervention area in west shoa (Fanos, 2012).

Potato is the fourth most important world food crop after wheat, rice, and maize. The plant species belongs to the *Solanaceae* family of flowering plants, and shares the genus *Solanum* with at least 1,000 other species, including tomato and eggplant (Joshi and Gurung, 2009). Potato first introduced to Ethiopia by Schimper, a German Botanist in 1858 is now an important crop for smallholder farmers in the highlands, serving as both cash and food security crop. It is one of the crops with the highest growth rates in the country as a result of increasing markets especially in urban areas, change in eating habits of the youth (Tesfaye *et al.,* 2010).

In Ethiopia, potato can potentially be grown on about 70% of the 10 million hectares of arable land (FAO, 2008). In 10 years, potato productivity has progressed from 7 to 11 tons per hectares. In 2014/15 cropping season in Ethiopia, approximately 1,288,146 million farmers grew the crop in mid and highland of the country in which the crop covered more than 0.45% of the area under all crops and contributed 2.24% to the total production of all crops in the country. Nevertheless, potato account for 31.05% of the total area of the root crop and 16.88% of the total root crop production (CSA, 2015). Moreover, in 2013/14, the area under potato production in Ethiopia was about 66,745 hectares with an average national yield of 117 quintal per hectare for the main cropping season (CSA, 2014). Currently potato is a widely grown crop in the country because of the favorable climatic and edaphic conditions. Potato production has the potential to fill the gap in food supply during the „hungry months" of September-November before grain harvests in December.

In west Shoa zone, vegetables such as potato, onion, Ethiopian mustard, cabbage and beetroot together make the largest share (85%) of the total vegetables under the rainfed system whereas the amount of Swiss-chard, carrot and lettuce is only 1% of the total production. Irish potato is the most important vegetable produced in

West Shoa zones (Bezabih *et.al, 2014*). Vegetables are produced for different purposes. Vegetables in the study sites are produced for sales, consumption/nutritional, social and medicinal values. This paper focuses on potatoes because (1) this crop is very important in the country's agricultural sector because of its high potential to generate profits to smallholder farmers; (2) there is a large unmet demand for potatoes in large cities of the country. However, smallholders' farmers were constrained by limited access to market facilities, less exposure for market information, infrastructural problems, lack of storage facility, inadequate support and transportation services are some of the problems resulting in low supply of potato products to market by smallholder farmers. More importantly marketed supply of *potato* in the study areas is subjected to seasonal variations where surplus supply at the harvest time is the main feature. Therefore, understanding the variables affecting volume sales of potato can be of great importance in the development of sound policies with respect to potato marketing and prices and overall rural and national development objectives of the country. Hence, it was important to determine the factors that influence the level of potato smallholder farmers' market participation and point out potential factors policy should focus in.

2. Methodology of the study

Description of the study area

The study was conducted in West Shoa Zone, specifically, in Ejere District. Ejere district, having an area of 592.19 square km, is located in West Shoa Zone of Oromia National Regional State, with the capital located at 50 km west of Addis Ababa. The district has a total of 30 kebeles of which 27 are rural based kebele administration areas and 3 are town kebele. Total human population of the district is estimated at 89,168 of whom 45,352 are males and 43,816 females. Of the total households 88.36% are rural agricultural households (CSA, 2014). The altitude of the district varies from 2,060 meters to 3,185 meters above sea level. It receives an annual rainfall of 900-1,200 mm, and has an annual temperature range of 9^0c-18^0c. The district has two agro-ecologies which is Dega (45%) and Weina Dega (55%) (Fanos, 2012). The soils types in the district are predominantly red (58%), black (32%) and mixed (10%). The district is characterized by subsistence mixed farming system in which production of both crops and livestock is common economic activity. The total land of the district is estimated to be 56,918 ha, out of which 40,985 ha is cultivated land, 4,446 ha is grazing land, 4,456 ha is forest and 7,031 ha is covered with others (EWAO, 2015). The district is known for its high production potential of crops and livestock. Crop production takes the lion's share of consumption and income generation of the household. Cereals crops widely produced in the area include *teff*, wheat, barley and maize, pulse crops like chickpea, haricot bean, fababeans and noug are the major crops grown. Moreover, vegetables and root crops produced in the area include onions, potato, tomato, pepper, cabbage and sweet potato.

Sampling technique and sample size

A combination of purposive and simple random sampling was used. Ejere district was selected purposively based on the potential it has for potato production. From the district four kebeles namely Amaro, Hora, Arebsa and Kimoye based with higher production, both from nearest and farthest distances to market were selected. Finally, the study used a total of 78 respondents which was selected using simple random sampling technique. Field level data was collected with the aid of semi structured interview.

Data and Sources

Both primary and secondary data were used for this study. Secondary data sources include Ejere District Irrigation and Development Authority, Ejere District Bureaus of Agriculture, District Trade and Market Development Office and its associated primary cooperatives and Central Statistical Authority (CSA), published and unpublished reports, bulletins, and websites. Primary data sources were smallholder farmers from four purposively selected kebele and wholesalers, collectors, retailers and consumers. Primary data were collected using informal and formal surveys and key informants interviews. For informal survey Rapid Market Appraisal (RMA) technique like focus group discussion and key informant interview was used with checklists. The formal survey was undertaken through formal interviews with randomly selected farmers and purposively selected traders using a pre-tested structured questionnaire for each group. Focus group discussions were held with two groups based on predetermined checklists and a total of 15 key informants were interviewed from different organizations and institutions.

Both qualitative and quantitative data were collected and used for the study. Qualitative information from farmers and key informants was collected from each kebeles. Quantitative data incorporated information on demographic and socio-economic characteristics, distances to key production-enhancing facilities, land holdings, farming practices, potato production, sales and consumption and institutional factors.

Analytical Methods

Descriptive statistics such as frequency, mean, percentage, and standard deviation was used. For econometrics analysis multiple linear regression model (OLS) was appropriate to analyze factors affecting volume sales because all sampled households producing potato participated in marketing. However, when some of the assumptions of the Classical Linear Regression (CLR) model are violated, the parameter estimates of the above

model may not be Best Linear Unbiased Estimator (BLUE). Thus, it is important to check the presence of heteroscedasticity, multicolliniarity and endogeniety problem before fitting important variables into the regression models for analysis.

The problem of endogeniety occurs when an explanatory variable is correlated with the error term in the population data generating process, which causes, the ordinary least squares estimators of the relevant model parameters to be biased and inconsistent. The source of endogeneity could be omitted variables, measurement error and simultaneity (Maddala, 2001). Both Hausman test and Durbin-Wu-Hausman (DWH) test were applied to check the productivity of potato included in the explanatory variables that could cause endogeneity bias if OLS is applied. Therefore, in identifying the determinants of farm level marketed surplus of potato and onion, a two-stage least square (2SLS) model was used. Two-stage least square is similar to OLS except that uses two completely separate stages during the analysis phase in order to avoid problems of endogeneity (Wooldridge, 2010).

Econometric model specification of supply function in matrix notation is as follows:-

$$\text{Structural equations: } Y = \beta_0 + X_k'\beta_1 + \delta Y_1 + U \quad (1)$$

where; Y is a vector of quantity of potato supplied to market, X' is exogenous variable that is assumed to affect potato marketed surplus, Y_1 is a vector of endogenous variables which are productivity of potato, β_0, β_1 and δ are a vector of parameters to be estimated, and U is a vector of disturbance terms.

As the name suggests 2SLS involves using OLS regression in two stages, in the first stage a reduced form of the structural equations is estimated where the endogenous variable productivity of both crops is regressed on all the exogenous variables in the system separately.

$$\text{Reduced form: } Y_{1i} = \pi_0 + \pi_1 X_i + \pi_2 Z_i + v \quad (2)$$

where, Y_{1i} is endogenous variable (productivity of, X_i is vector of exogenous variables (SHH, EduHH, famsz, DNMKT, exper, offarm, areapotato, ownmotor and Extcontact), Z_i is a vector of excluded instruments (amount of fertilizer applied for potato and improved seed); π is the coefficients to be estimated; and v is the errors terms, symmetrically distributed around zero. In order to obtain consistent estimators in this case, we need some additional information. These instruments (in this case Z) must satisfy two conditions; uncorrelated with U, also called orthogonal to the error process (exogeneity condition i.e. Cov (Z, U) =0) and correlated with Y_1 the endogenous variable (relevance condition i.e. Cov (Y_1 , Z) ≠ 0) (Wooldridge, 2010). This means Z is a variable directly affecting the endogenous variable and may not directly be related to the dependent variable Y.

By subtracting the residual of the regression of equation (2) from the actual value of productivity variable (YILDPOT), a fitted value $\hat{Y}$ of the productivity variable is obtained that is uncorrelated with the error term. In the second stage, by substituting the yield variable in structural equations (1) with the fitted value of yield, the right-hand side of the equations no longer contains any endogenous variables. It is vital to make different tests before 2SLS estimations. Furthers, multicolliniarity problem among explanatory variables had been checked using the Variance Inflation Factor (VIF). As a rule of thumb, if the VIF is greater than 10 (this will happen if R^2 is greater than 0.90), the variable is said to be highly collinear (Gujarati, 2003). A measure of multicolliniarity associated with the variance inflation factors is computed as:

$$\text{VIF}(X_j)X = \frac{1}{1 - R_j^{\,2}} \quad (3)$$

where; R_j^2 represents a coefficient for determining the subsidiary or auxiliary regression of each independent continuous variable X. Conversely, test for heteroscedasticity had been undertaken for this study. There are a number of test statistics for the detect heteroscedasticity. For this study, Robust method of was employed for correcting the problem.

Definition of Variables and Working Hypothesis

Dependent variables

Quantity Supplied to Market (VVS): A continuous variable that represents the actual supply of potato by individual households to the market during the survey year, measured in quintals (100kg).

Independent Variables

In order to identify factors influencing potato volume sales and market outlets choice both continuous and discrete variables were hypothesized based on economic theories and the findings of different empirical studies. Accordingly, in order to investigate the determinants of market supply the following variables were constructed. The explanatory variables that are expected to influence the dependent variable(s) are the following:-

Productivity (YILDPOT): It is an economic factor and continuous variable that can affect the household level volume sales and measured in quintals per hectare during survey year. Productivity is assumed to affect the volume supply positively, because a farmer that obtains high yield can supply more to the market than a producer who had fewer yields. Bosena (2008) found that productivity of cotton influenced marketable supply of cotton positively and significantly. Berhanu *et al*. (2014) found that milk yield per day has positive and significant influence on volume of milk supply per day per household.

Sex of the Household Head (SHH): This is a dummy variable (takes a value of 1 if the household head is male and 0 otherwise). The variable is expected to have either a positive or negative relation with volume of potato marketed. Tewodros (2014) found that household head sex influenced chickpea market orientation negatively and significantly.

Family Size (famsz): This variable is a continuous explanatory variable and refers to the total number of family in the household. In this study it is assumed that any family member might decide to participate in potato production and marketing. Since production is the function of labour, availability of labour is assumed to have positive relation with potato, but larger family size requires larger amounts for consumption, reducing volume sales. A study conducted by Wolday (1994) showed that household size had significant positive effect on quantity of teff marketed and negative effect on quantity of maize marketed. In this context family size is expected to have positive or negative impact on volume of sale.

Education Level of the Household Head (EduHH): This is a dummy variable with a value of one if a household head had attended formal education and zero otherwise. The educational status of the farmer determines the speed with which he/she likely to adopt agricultural technologies. Those who can read and write stand a better chance of understanding things faster. Moreover, better educated farmers tend to be more innovative and are therefore more likely to adopt the marketing systems. Therefore, it is hypothesized to affect positively volume of supply of potato. Astewel (2010) who found that if paddy producer gets educated, the amount of paddy supplied to the market increases, which suggests that education improves level of sales and that affects the marketable surplus.

Distance from Nearest Market (DNMkt): Distance to the nearest market is a continuous variable measured in walking minutes from the household residence to the nearest market. The closer the market, the lesser would be the transportation charges, reduced walking time, and reduced other marketing costs, better access to market information and facilities. Farmers living closer to markets were found to participate and sell more livestock products (Holloway *et al*., 2000). In this study, distance from nearest market is hypothesized to influence volume supply negatively.

Farming Experience (exper): This is a continuous variable measured in number of years. A household with better experience in potato farming is potato to market. Toyiba *et al*. (2014) found that experience in papaya production had a positive and significant effect on papaya volume marketed.

Non/Off Farm Income (offarm): It is a dummy variable measured in terms of whether the household obtained income from off and non-farming activities. It is one if the household is involved in non/off-farm activities and zero otherwise. The study has hypothesized that if the earning from the non/off-farm income is higher than the potato production mostly the farmer's shift towards the non-farm income activities. Rehima (2006) found that the amount of pepper supplied to the market decreases as pepper producer have engaged on non-farm income. Therefore, in this study, Off/non-farm income has expected to influence the volume of potato supply to market negatively

Motor Pump Ownership (ownmotor): It is a dummy variable which takes a value of 1 if the farmers had own motor pump for irrigation 0 otherwise; this one is the most important inputs for potato production is assumed to produce more amounts of potato and, hence have hypothesized to influence on potato production and there by volume supply positive. The study of Moti (2007) showed that area allocation to onion and kale production around Ziway as well as beetroot and leek production around Haro-Maya are positively and significantly affected by motor pump ownership.

Extension Contact Frequency (Extcontact): This is continuous variable which is the number of days that farmer had contact with extension agent for agricultural work supervision in a year. The objective of the extension service is introducing farmers to improved agricultural inputs and to better methods of production. In this regard, extension is assumed to have positive contribution to farm level volume supply of potato. Farmers that have frequent contact with extension agent have better access potato. Ayelech (2011) found that if fruit producer gets extension, the amount of fruits supplied to the market increases.

Land Size Allocated (areapotato): This variable is assumed to have a positive relation with the dependent variable and is continuous variable measured in hectare. Potato is cash crop having a direct relation volume sale of potato. Hence, area allocated for potato is hypothesized to influence positively volume supply to market. Kindie (2007) found that land allocated to sesame production influenced marketable supply of sesame positively.

Table 1: Description of dependent and independent variables used in 2SLS models

Variable	Measurement	Expected effect on outcome
Quantity supply	Continuous (qt)	
Productivity	Continuous (qt/ha)	+ve
Sex of households head	1 if Male, 0 if Female	+/-ve
Family size	Continuous (number)	+/-ve
Education level of households	1 if Follow formal education, 0 if Illiterate	+ve
Distance to nearest market	Continuous (walking minutes)	-ve
Farming experience	Continuous (years)	+ve
Access to off/on farm income	1 Yes, 0 Otherwise	_ve
Motor pump Ownership	1 Yes, 0 Otherwise	+ve
Extension Contact	Continuous (number)	+ve
Land allocated for potato	Continuous (hectares)	+ve

3. Results and Discussions

Descriptive analysis

Socio-economic characteristics of the sampled potato households

As shown in Table 2, out of total households head interviewed 83.33% were male headed households while 16.67% were female headed households. The survey result shows that about 41.03% of the sampled household heads were illiterate while 58.97% were attended formal education. The mean family size of the total sample households was 6.93 persons ranging from 1 to 15 and this might assist them for a better participation of households in the potato markets. From sampled households about 43.59% were participating on off/non-farm income activities and 56.41% were not participating on off/non-farm income activities. Distance from producer's house to nearest market was also the factor which determines potato supply to marketming experience in potato production with a standard deviation of 2.51 years.

Table 2: Demographic and socio-economic characteristics of sampled producers

Variables	Indicators		freq	Percent
Sex of households head	Male		65	83.33
	Female		13	16.67
Education level of households	Formal education		46	58.97
	Illiterate		32	41.03
Access to off/on farm income	Yes		34	43.59
	No		44	56.41
Motor pump Ownership	Yes		41	52.56
	No		37	47.44
	Mean	SD	min	Max
Productivity (Qt/ha)	77.43	31.77	16	152
Extension Contact (years)	18.03	12.09	1	36
Family size (number)	6.93	2.82	1	15
Distance to nearest market (walking minutes)	143.77	63.89	10	240
Farming experience (years)	4.25	2.51	1	15
Land allocated for potato (hectare)	0.29	0.14	0.01	0.5

Source: Own computation from survey result, 2015.

As observed from Table 2, the average distance needed for producer's to travel to nearest market place was took average walking minutes of 143.77 with range from 10 to 240 walking minutes. The result also shows that the land allocated for potato is an average per household allocation of 0.29 hectares and the standard deviation of 0.14 and ranges from 0.01 to 0.5 hectares during survey year. The mean productivity of potato was 77.43 qt/ha and ranges from 16 qt/ha to 152 qt/ha during survey year. The respondents have an average of 4.25 years of far

Determinants of volume supplied to market

Analysis of determinants affecting farm level volume supply of potato was found to be important to identify factors constraining potato supply to market. Prior to fitting multiple linear regressions, the hypothesized explanatory variables were checked for existence of multicolliniarity, heteroscedasticity and endogeniety problem.

Test of multicolliniarity: All VIF values are less than 10. This indicates absence of serious multicollinearity problem among independent variables. If there is presence of multicolliniarity between independent variables, it

is impossible to separate the effect of each parameter estimate in the dependent variables. It is thus, important to test multicolliniarity between explanatory variables (Appendix Table 1).

Test of heteroscedasticity: Since there is heteroscedasticity problem in the data set, the parameter estimates of the coefficients of the independent variables cannot be BLUE. Therefore, to overcome the problem, Robust OLS analysis with heteroscedasticity consistent covariance matrix was estimated.

Test of endogeneity: When a variable is endogenous, it will be correlated with the disturbance term, hence violating the OLS assumptions and making our OLS estimates biased. Testing for endogeneity of productivity of potato was carried out in the model using both Hausman test and Durbin-Wu-Hausman (DWH) test and endogeneity problem were found in productivity variable in both potatoes. Hausman test result indicated that, the predicted productivity was statistically significant with (p= 0.084) when included as additional explanatory variable in structural model which implies hypothesized productivity variables endogenous due to correlated with error term. Durbin Wu-Hausman test results also shows that the null hypothesis of exogeneity of the productivity of potato was rejected at 10% probability level (χ^2 =3.011 and P-value = 0.082) using estat endogenous STATA command after ivregress (Appendix Table 2). Therefore, two stages least square (2SLS) method was used to address the endogeneity problem.

Two-stage least squares is a poor strategy for estimation and hypothesis testing when instruments are weak and the model is over-identified. To overcome the endogeneity issue that two stage least technique requires valid instrumentals variables. Therefore, for this study relevance tests of excluded variables were made using F statistic from the first stage regression using estat firststage STATA command. The F test result for productivity of potato was"24.14" (a general rule of thumb is that if F test is less than 10 there is cause for concern) (Appendix table 2). So we should reject the null hypothesis presence of weak instruments hence our statistics greatly exceeded the critical values. Overidentifying restrictions test was also tested using Hansen-Sargan test and Basmann test using estat overid command. The results of Basmann test show a P-value of 0.6133 and which indicated the model is correctly specified and the instruments are valid (Appendix table 2).

Determinants of volume of sales of potato

Table 3: Determinants of farm level volume sales of potato (2SLS estimates)

Variables	Coef.	Robust Std.Err	t-value
Constant	-12.248***	3.772	-3.25
Productivity of potato	0.270***	0.031	8.66
Sex of households heads	4.563**	1.855	2.46
Education status of households	-1.105	1.458	-0.76
Family size	-0.380	0.294	-1.29
Distance from nearest market	0.033***	0.011	3.04
Farming experience	0.251	0.383	0.66
Off/non-farm income	2.611*	1.479	1.77
Land allocated for potato	84.561***	6.829	12.38
Ownership of motor pump	1.701	2.188	0.78
Extension contact	0.032	0.057	0.56
Number of observation		78	
F(10, 67)		32.21	
Prob>F		0.0000***	
R-Squared		0.8480	

Note: Dependent variable is quantity of potato supplied to market in quintal in 2015.
***, ** and * are Significant at 1%, 5% and 10% level of probability, respectively.
Source: Own computation from survey result, 2015.

Two stages least square (2SLS) method was used to identify factors affecting the volume of potato sold to the market by potato farmers in the study area. In the first stage of 2SLS method, regressions was run and analyzed using eleven explanatory variables including instrumentals variables and the result shows that, amount fertilizer application, improved seed and sex of the households head were affects positively and significantly the productivity of potato (Appendix Table 3). Amount of fertilizer applied for potato production and improved seed were used as instruments for productivity. In second stage of 2SLS from hypothesized ten explanatory variables five variables productivity, sex of households, distance from nearest market, access of off/non-farm income and land allocated for potato significantly influence volume sales of potato.

As depicted in Table 3, the model was statistically significant at 1% probability level indicating the goodness of fit of the model to explain the relationships of the hypothesized variables. Coefficient of multiple determinations (R^2) was used to check goodness of fit for the regression model. Hence, R^2 indicates that 85 percent of the variation in the quantity of potato supplied to market was explained by the variables included in the model. The explanation on the effect of the significant explanatory variables is discussed below.

Productivity (YILDPOT): As hypothesized the regression coefficient of potato productivity was positively and significantly related with potato quantity supplied to market at 1% probability level. The positive and significant relationships between the two variables indicate that potato productivity household is very important variable affecting household head volume of potato supply. The coefficient for productivity of potato implies that an increase in productivity of potato by one quintal per hectare resulted in an increase in farm level marketed surplus of potato by 0.270 quintals, keeping other factors constant. Previous studies for example, Rehima, (2006); Kindie, (2007) and Bosena, (2008) showed that the amount of red pepper, sesame, and cotton produced by households significantly and positively affected the marketable supply of each of the commodities, respectively. Ele *et al*. (2013) also found that total quantity of crops produced have a significant and positive relationship with the degree of commercialization.

Sex of Household Head (famsz): This variable was found to be positive and statistically significant influence on potato volume supply to market at 5% level of significance. The positive sign shows being a male head of a household significantly increase potato quantity supplied to market by 4.563 quintals as compared to that of female-headed households, keeping other variables constant. The reason behind male headed households supplied more potato to market than female headed households, is that females can take higher care than males about households consumption by saving from produce to feed household; this can reduce the quantity to be sold. This is consistent with the finding of Mahlet *et al*. (2015) who found that gender of the household head positively and significantly influenced potato marketed supply of potato. The authors stated as the reason that male headed households have better financial capability, better land size, better extension contacts, and better access to market information than female headed households. Toyiba *et al*. (2014) also found that the sex of the household head had a positive and significant effect on the volumes of papaya sold in to the market.

Distance from the Nearest Market (DNMKT): This variables result contrary to the hypothesis, showed distance from the nearest market was found to be positive and significant influence on the volume of potato supplied to market at 1% probability level. As the distance from the nearest market increases by one walking minutes, it resulted in increased farm level marketed surplus of potato by 0.033 quintals, keeping other factors constant. These variable affected dependent variables positively because of the households far from nearest markets have more access of irrigation water use and have large size of farmland which assist them to increase their potato production and sales of the crops compared to households closer to market. Similar to this, the results by Sebatta (2013) and Habtamu (2015) found that distance from the nearest market had a positive and significant effect on potato farmer's decision to participate in the market in Uganda and Hadiya Zone of Ethiopia, respectively.

Off/Non-Farm Income (offarm): This variable was significant (10%) and positively influenced the household heads volume sales of potato. This is just a contrary to the hypothesis set earlier. The result shows that households who earn income from non/off-farm activity sold 2.611 quintals more potato than those who did not have access, by holding other factors constant. This may due to the fact that farmers who had cash from these sources used as supplementary income to purchase inputs like improved seed, fertilizers, chemicals and farm implements for vegetable production and thus supplied more potato to market than those who had not because they are business oriented. This result is consistent with Adenegan *et al*. (2012) who found that access to non-farm income influenced volume of maize supplied to market positively and significantly. They explain that farmers with an additional source of income will be willing to take risk in producing more for the market.

Land Allocated for Potato (areapotato): The result shows that land allocated for potato has significant effect on volume of sales of potato at 1% significant level with expected positive sign. The positive sign of the coefficient implies that the larger the land size allocated for potato production the larger the quantity produce and thereby increasing the quantity of produce available for sale. Thus, the per unit production costs will be lower due to the economics of scale. Increase in the size of one hectare of land allocated for potato is increase volume sales of potato by 84.561quintals, keeping other factors constant. In support of the finding here, Wubshet (2010), Alemnew (2011), and Toyiba *et al*. (2014) indicated that the area of land allocated for coffee, red pepper and papaya production affected farm level marketed supply of each commodity significantly and positively.

Conclusion and Recommendation

This paper examined the factors affecting potato volume sales, using the two-stage least squares regression model and data collected from the smallholders' farmers in Ejere district. Descriptive result showed that the mean land size allocated for potato by sampled households was 0.29 hectares during survey years. The results also showed that a mean potato yield of 77.43 qt per hectare per households was produced. Econometric result of the two stage least(2SLS) regression model indicated that yield of potato produced per hectare, sex of household head, distance to nearest market, access off/non-farm income and area of land allocated for potato are significantly determining the quantity of potato supplied to the market. The policy implication is that increasing the productivity of potato crops per unit area of land through promoting and providing; improved seeds, training on production skill, technical support to farmers in agronomy practices, technical support in post-

harvest handling that would increase productivity of smallholders and enables them to link up with crops output market. The distance to the market places has also become important determinants of farmers in the volume sales of potato. As a result, improving rural infrastructure in developing market infrastructure in the form of establishing produce collection points across rural areas would assist poor farmers for faster delivery of farm produces especially perishable commodities of potato. To improve the marketed surplus across farmers there is a need to focus on the female head households by improving, facilitating and giving priority for increasing production and market supply. Basing on the finding that smallholder off/non-farm incomes encourage volume of potato supplied to market, it is recommended, therefore, that potato farmers are promoted on investment of off/non-farm incomes as well as potato production.

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Appendix Table 1: Test for multicollinearity of explanatory variables

Variables used for potato marketed supply model		
Variable	VIF	1/VIF
YILDPOT	1.18	0.849
exper	1.24	0.805
famsz	1.13	0.886
SHH	1.25	0.802
EduHH	1.15	0.868
DNMKT	1.24	0.803
offarm	1.12	0.894
ownmotor	1.50	0.666
Extcontact	1.14	0.879
areapotato	1.28	0.781
Mean VIF	**1.22**	

Source: Own computation from survey result, 2015.

Appendix Table 2: First-stage regression summary statistics, endogeneity and overidentification test for productivity of potato

Variable	R-sq.	Adjusted R-sq.	Partial R-sq.	F(2,66)	Prob > F
YILDPOT	0.5095	0.4278	0.4225	24.1413	0.0000
Minimum eigenvalue statistic	=24.1413				
Critical Values		# of endogenous regressors:		1	
Ho: Instruments are weak		# of excluded instruments: 2			
		10%	15%	20%	25%
2SLS Size of nominal 5% Wald test		19.93	11.59	8.75	7.25
LIML Size of nominal 5% Wald test		8.68	5.33	4.42	3.92

Endogeneity test for yield of potato		Overidentifying restrictions test	
Durbin (score) chi2(1)	=3.012 (p =0.083)	Sargan chi2(1)	0.204 (p =0.652)
Wu-Hausman F(1,66)	=2.651 (p =0.108)	Basmann chi2(1)	0.173 (p =0.678)

Source: Own computation from survey result, 2015.