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Determinants of Potato Marketed Surplus Among Smallholder Farmers in Banja District, Awi Zone of Amhara Region, Ethiopia

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Abstract: Potato is important for its contribution to food security and as source of cash income for a large proportion of the rural households. However, enhancing potato farmers to reach markets is a key issue needed in the study area. This paper was aimed to identify factors affecting marketed surplus potato farmers using survey data collected from randomly selected 120 farmers. Descriptive statistics was used for characterizing farmers and econometrics analysis was used for identifying determinants of marketed surplus. The distributional graph of household's log-marketed surplus data seem to be reasonably symmetric, though possibly left skewed. The multiple linear regression estimation result indicated that total livestock unit (number of livestocks owned), land size allocated for potato production, distance to all-weather road, irrigation access, other farm income and lagged price as significant predictors of potato marketed surplus. The study recommended expansion of irrigation access and further infrastructural development for policy implications.

Keywords: Potato, Marketed Surplus, Multiple Linear Regression

1. Introduction

Ethiopia has suitable edaphic and climatic condition for the production of high quality seed potato and ware potato. About 70% available agricultural land is located at an altitude of 1800-2500m which is suitable for potato production [1-2]. It has area coverage of 66, 745 ha and production of 784,993 tonnes in the country [3].

Ethiopian farmer's main objective of growing potato is to ensure adequate food supply during food shortage months and as well as an important source of cash income [4], because of its ability to provide a high yield of high-quality product per unit of input with a shorter crop cycle than major cereal crops like maize [5]. Potato has been considered as a strategic crop by the Ethiopian government aiming at enhancing food security and economic benefits to the country [6]. It is among the major vegetable export products [7]. It is traded in local market and export market outlets, which is an essential activity of the farming households where it generates income and have contributed to the development of potato sector [8]. For instance, the country exported about 118,019 tonnes of potatoes per year [3]. On the other hand, potato exported to bordered countries to Somaliland and Djibouti is increasing which is major motive for potato farmers in Eastern Ethiopia [9].

The importance of marketed and marketable surplus has greatly increased owning to the recent changes in agricultural technology as well as social patterns. In order to maintain the balance between demand for and supply of food grains with the rapid increases in demand due to higher growth population, urbanization, industrialization and overall economic development accurate knowledge on marketed and marketable surplus is essential in the process of proper planning for the procurement, distribution, export and import of agricultural product [10]. Marketable surplus shows the quantity left out for sale in the market after meeting the farmer's consumption and utilization requirements for kind payment and other obligations such as gifts, donations,

charity, etc. The marketed surplus shows the quantity actually sold after accounting for losses and retention by the farmers, if any and adding the previous stock left out for sale [11]. Thus, marketed surplus may be equal to marketable surplus, it may be less if the entire marketable surplus is not sold out and the farmers retain some stock and if losses are incurred at the farm or during transit.

Out of the total land area under cultivation in the country, land under fruits and vegetables is insignificant as compared to food crops [6]. In order to benefit potato farmers from production and market supply, potato marketing system must operate well. In doing so, the study attempted to contribute in filling the knowledge gap by identifying factors affecting potato marketed surplus in the study area for the purpose of providing vital information for effective research, planning and policy formulation and for better interventions in the future.

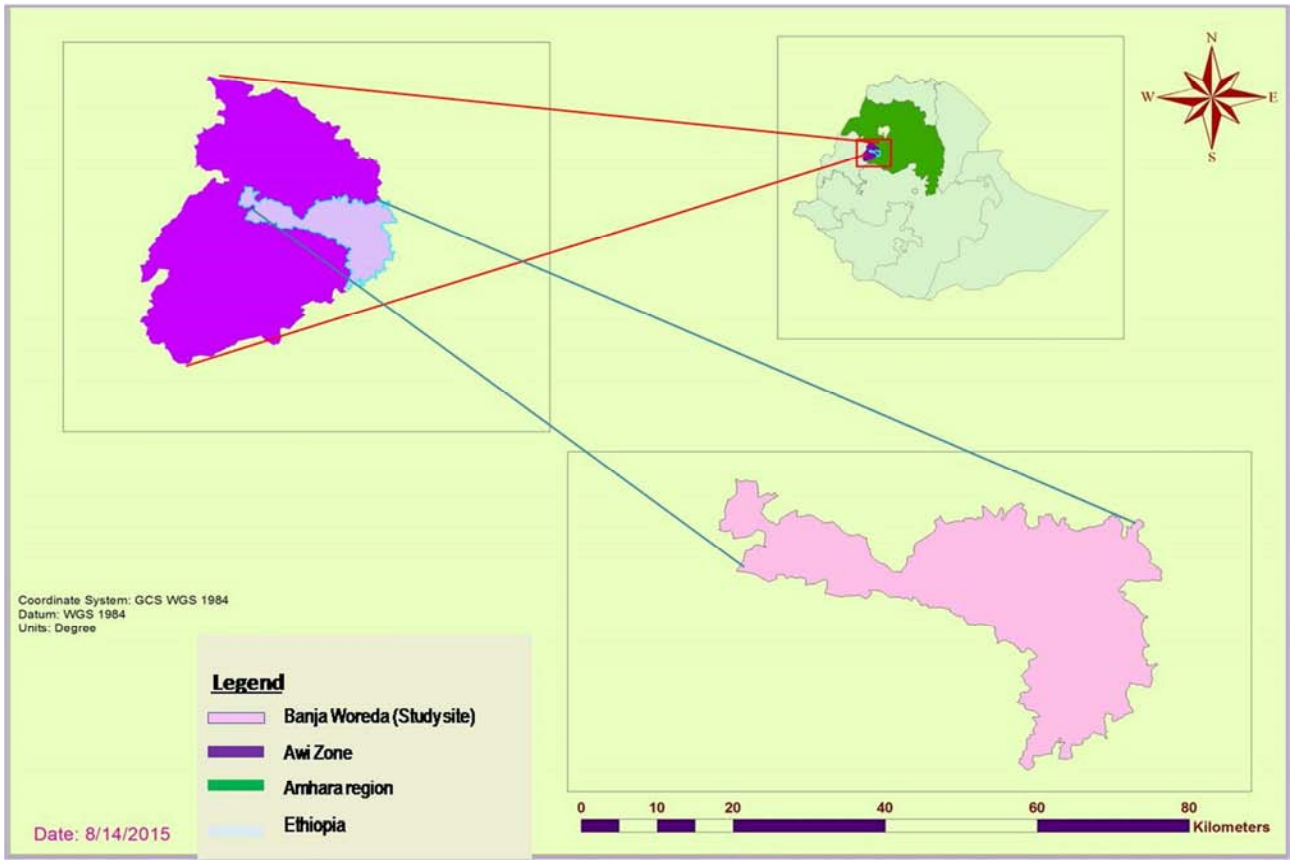
2. Research Methodology

2.1. Description of the Study Area

This study was undertaken in Banja district in Awi zone of Amhara region, Ethiopia. The district is bordered on the south by Ankesha, on the West by Guangua, on the North by Fageta Lekoma and in the East by the West Gojam zone. The district is composed of 26 *kebeles* of which 25 are rural *kebeles* and one urban *kebele*. *Injibara* town is the capital of Banja district. It is located about 447 kms North West to Addis Ababa and 122 kms South of Bahir Dar.

Total population of the district in 2015 was estimated at 121511 out of this 60354 (49.67%) were male and 61157 (50.33%) were female [12]. The number of farm households were 16239 out of this 13684 were male headed households and 2555 were female headed households. The district has the total area coverage of 47,915.82 ha. Land use pattern of the district is 12,277 ha cultivated land, 21,141.57 ha grazing/pasture land, 12,346 ha covered by forest and the rest 2151.24 ha for other uses. The district comprised of 80% Dega and 20% Winadega agro ecologies and the altitude ranges from 1800- 2750 m. The annual temperature is 26°C at the maximum and 16°C at minimum. It has unimodal rainfall distribution pattern. The rainy season for the area starts in May and extends to the end of October. The average annual rainfall reaches 2300 mm.

Crop production, livestock farming and forestry are the main sources of livelihood of farmers in the district. Different types of crops are produced namely, potato, teff, maize, wheat, barley, finger millet and other crops like bean, oats, onion, cabbage and other vegetables. The major crops produced in the district in the order of area coverage include potato, teff, wheat and maize which covers 3200, 2800, 2000 and 1350 hectares, respectively. Some farm households use irrigation, particularly for potato production which is the main crops produced and traded in the district (BWARDO, 2015).



Source: Manipulated from Ethiopian map, 2015

Figure 1. *Location of the study area.*

2.2. Data Types and Methods of Data Collection

Both secondary and primary data were used for this study. The formal survey was undertaken through interviews with selected potato producer farmers using a pre-tested semi-structured questionnaire. Secondary data was collected from published and unpublished documents, and internet sources.

2.3. Sampling Techniques and Sample Size

The study area, Banja district was selected as a study area since the area has high potential for potato production and marketing. For sampling producers, a multi-stage sampling technique was implemented. The district has 25 rural *kebeles*, 20 of them produce potato. In the first stage, all potato producer *kebeles* in the district were selected purposively. In the second stage, from these potato producer *kebeles*, 5 sample *kebeles* were selected randomly. In the third stage, the study considered only potato producer households. Thus, from each sampled *kebele* potato producer farmers were listed out with the help of development agents at *kebele* level. From these population lists, sample farmers were selected randomly based on probability proportional to size sampling technique.

For this study the total sample size was determined based on the sampling formula provided by Yamane (1967). The formula used for sample size determination with 95% confidence level, degree of variability = 0.5 and level of precision 9% (0.09) was:

$$n = \frac{N}{1+N(e^2)} \quad (1)$$

Where: n= Sample size, N= Population size and e= level of precision

Based on the above formula a total of 120 households were interviewed.

Table 1. *Distribution of sample households in the district.*

Sample *kebeles*	Number of potato producer households	Number of sample households
Askuna Abo	979	37
Zufari Absketem	678	25
Akena Jefi	624	23
Wusla Kindikan	593	22
Gashen Akayta	352	13
Total	3226	120

Source: Own computation, 2015

2.4. Methods of Data Analysis

Descriptive statistics and econometric analysis were used to analyze the data collected from potato producers. Descriptive statistics employed graphs and percentages in the process of describing households' characteristics. Econometric analysis uses multiple linear regression model to analyze factors affecting farm level potato marketed surplus in the study area because all potato producers participate in the market. Econometric model specification of marketed surplus function in matrix notation is the following.

$$Y = X'\beta + U \quad (2)$$

Where: Y is Potato marketed surplus, X ' is a vector of explanatory variables, β is a vector of parameters to be estimated and U is disturbance term

Potato marketed surplus is a continuous dependent variable used in the multiple linear regression model. It is measured in quintal (log-normalized) and represents the actual supply of potato by farm households to the market in the year 2014/15. Whereas the summary of independent variables used in this model are presented below in Table 2.

Table 2. *Summary of independent variables used in the multiple linear regression model.*

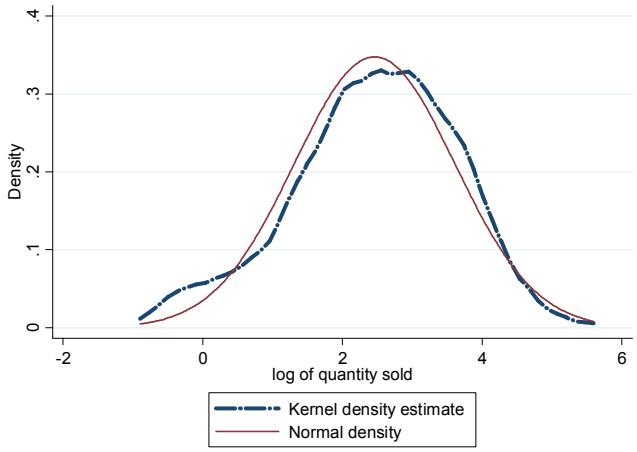
Variable name	Types	Measurement	Hypotheses
Distance to the nearest market	Continuous	Km	-ve
Potato farming experience	Continuous	Years	+ve
Land size allocated for potato production	Continuous	Hectare	+ve
Number of Livestocks owned (TLU)	Continuous	Number of animals	+ve
Access to irrigation	Dummy	1= yes, 0 = no	+ve
Income from non/off farm Activities	Continuous	"000"ETB	-ve
Family size	Continuous	Number of family member	±
Distance to all weathered road	Continuous	Km	-ve
Credit access	Dummy	1= yes, 0= no	+ve
Frequency of extension contact	Continuous	Number	+ve
Education level of the household Head	dummy	1= literate, 0= illiterate	+ve
Income from other on farm activities	Continuous	"000"Birr	+ve
Lagged Price	Continuous	Birr/kg	+ve

Note: ± affecting either positively or negatively

3. Result and Discussion

3.1. Distribution of Potato Marketed Surplus

Kernel density estimation is a useful method of representing the overall structure of the data. Figure 2 shows kernel density estimation of logarithm of potato marketed surplus by households. Kernel density by using bandwidth (smoothing parameter) value of 0.3852 was constructed. The log-marketed surplus data seem to be reasonably symmetric, though they are possibly slightly left-skewed.



Source: Own survey result, 2015

Figure 2. *Kernel density estimates for log potato marketed surplus using the Epanechnikov kernel.*

3.2. Factors Affecting Potato Marketed Surplus

In the study area potato is an important crop used as source of cash income and for household food consumption. On average about 62.71% of potato produced by sample farmers was supplied to the market, 26.59% was consumed and 10.70% was retained as seed.

For this study 13 explanatory variables were hypothesized as factors affecting household level marketed surplus of potato. The hypothesized variables were family size, education level of household head, farm experience of the household head, frequency of extension contact, credit access, irrigation access, land size allocated for potato production, distance to all-weather road, distance to the nearest market, TLU, lagged price, non/off farm income and cash income from other farm activities. From these, six variables are found to be significantly affecting marketed surplus of potato. Distance to all weathered road, irrigation access, land size allocated for potato production, TLU, lagged price and income from other farm activities other than potato influenced the marketed surplus of potato. The F-test calculated value F (13, 106) = 7.97 was significant; and the adjusted R^2 was computed to be 43.22% implying that 43.22% of the variation in the dependent variable was explained by the explanatory variables under consideration.

Table 3. *Determinants of marketed surplus of potato.*

Variables	Coefficients	Standard error
Family size	0.035	0.047
Education level of household head	0.032	0.170
Distance to all-weather road	-0.161**	0.076
Distance to nearest market	0.032	0.063
Frequency of extension contact	-0.031	0.019
Irrigation access	1.182***	0.218
Credit Access	0.005	0.212
Potato farm experience	-0.058	0.073
Land size allocated for potato production	1.575***	0.561
TLU	0.073**	0.034
Non/ off farm income	-0.014	0.013
Other farm income	0.032**	0.013
Lagged price	0.295*	0.173
_cons	0.280	0.580
R^2	0.4942	
Adj R^2	0.4322	
F(13, 106)	7.97***	
N	120	
Root MSE	0.8648	
Muticollinearity (mean VIF)	1.37	
Hetroscedasticity (prob >chi2)	0.5486	
Model specification (ovtest: prob>F)	0.4079	

Note: Dependent variable is potato marketed surplus in Qt (transformed to logarithm), ***, ** and * show the values statistically significant at 1%, 5% and 10% significance level, respectively.
Source: Own survey result, 2015

Before the interpretation of model coefficients, better to test some the assumption of CLR model should hold true. Hence, multicollinearity, hetroscedasticity and model specification error test (test for omitted variables) were performed using appropriate statistical tests. VIF was employed to test the existence of muliticollineratity among explanatory variables and the result showed that the mean VIF was 1.37 which indicates no problem of multicollinarity among explanatory variables in the model. Breusch-Pagan/Cook-Weisberg test for heteroscedasticity was used and the result indicated that heteroscedasticity was not a problem. Furthermore, regression specification error test, test of omitted variables result showed that no omitted variables in the model.

Distance to all-weather road: As expected, this variable is negatively related to marketed surplus of potato. The result shows that distance to all-weather road significantly affected marketed surplus negatively at 5% significance level. The coefficient for this variable implied that an increase in the distance of household's residence from the nearest all weather road by one kilometer results in quantity of potato supplied to the market to decrease by 16.1%, keeping all other explanatory variables constant. The study finding backed by results of [13], road infrastructure had influence on quantity of sweet potato sold in Kenya because existing road infrastructure that link major production areas with the major consumption sites is important factor of sales volume

like as proximity to terminal market. When a potato farmer near to the all-weather road, he/she is able to supply easily without incurring substantial cost and also buyers come to his farm to buy more quantity of potato.

Irrigation access: As it was expected having irrigation access had a positive effect on potato marketed surplus and significant at 1% significant level. The result indicates that as compared with non-irrigation users farmers who had irrigation access increase potato marketed surplus by 118.2%, keeping all other explanatory variables constant. This is because farmers who have irrigation access can produce potato more than two times a year and in other ways according to information obtained from farmers and agricultural experts in the district potato cultivated in irrigation was less affected by disease and insects as compared with rain fed produced potato. The survey result also revealed that the productivity of potato produced by irrigation was higher than that produced through rain fed, it was more than two times larger. The study was in line with [14] who found that irrigation enabled the farmer to produce potato more than two times in a year then which leads farmers to supply more.

Land size allocated for potato production: It is a continuous variable measured in hectare and it was expected to affect marketed surplus of potato positively. It significantly affected potato marketed surplus at 1% significance level. A hectare increase in potato land size increases potato marketed surplus by 157.5% keeping all other explanatory variables constant. The study agree with the findings of [15] and [16] that land allocated under cotton and sesame, respectively affected market supply positively. Similarly [17] confirmed that area under cabbage increased marketed surplus of cabbage in Nagaland.

Number of livestocks (TLU): Number of livestock measured in Tropical Livestock Unit (TLU), the households owned. As it was expected, it has positive relationship with marketed surplus of potato and was statistically significant at 5% significance level. The positive and significant relation between the variable indicates that a unit increase in TLU increases the marketed surplus of potato by 7.3%. This study related with the findings of [18] where the number of livestock had a positive effect on pepper market participation. This is because in the district farmers have more number of livestock, have better income by selling the livestock products which in turn motivates farmers to produce more potato. In other cases, farmers with more livestock assets have better animal manure for input of production which helps to increase productivity and production and finally farmers increased quantity supplied to the market.

Cash income from other farm activities: As expected, it affected marketed surplus of potato positively. It was statistically significant at 5% significance level. The coefficient indicate that one unit (in thousand birr) additional increase of other farm income rather than potato increased potato marketed surplus by 3.2%. This may be farmers used other farm income obtained from other farm activities for production of potato and can supply more to the market.

Lagged Price: As it was expected it affected quantity of potato supplied to the market positively and significantly at 10% significance level. This relationship indicates that when one year lagged price increased in one birr per kilogram, the marketed surplus of potato will increase by 29.5%. The finding agree with the case lagged price affected positively market participation of tomato [19]. This is because prices stimulate production, and thus market supply.

4. Conclusion and Recommendation

This study was aimed to identify the determinants of potato marketed surplus among small holder farmers. The data were collected from both primary and secondary sources. The primary data were collected from individual interview using semi-structured questionnaire from 120 randomly selected potato producer households. Secondary data were obtained from different sources like unpublished and published sources, CSA and websites. Data analysis was made using descriptive statistics and econometric analysis. The descriptive statistics measures like percentages and graphs were used in characterizing farm households. Multiple linear regression model was used to identify factors affecting marketed surplus of potato by potato producer households.

The kernel density estimation of log-quantity sold data seem to be reasonably symmetric, though they are possibly slightly left-skewed. The result of the multiple linear regression model indicates marketed surplus of potato was significantly affected by distance to all weather road, number of livestock, land size allocated for potato production, irrigation access, cash income from other farm activities and lagged price. All of these variables affect marketed surplus positively except distance to all-weather road.

Accordingly, the study recommends that establishing modern irrigation systems across main rivers is a key intervention area that service providers engaged to further enhance the production of potato and the quantity marketed. Conditions should be facilitated for farmers to own livestock or other mechanism that can substitute the functions of livestock like tractor and organic fertilizers, development of infrastructure and better transportation improve farmers' access to market and net return from potato marketing and to progress physical access improving road network is one option to further encourage potato growers and reduces marketing cost. Thus strengthening expansion of rural road is also key area of intervention.

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