



Research Article

# Farmer's Participation in Irish Potato Marketing in Njombe Urban and Wanging'ombe District, in Tanzania: Value Determinants

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Irish potato is one of the most important economic crops in Tanzania contributing to household food requirements and income. In order to ascertain the contributions of Irish potatoes to stakeholders involved, this study aimed at determining the factors influencing Irish potato farmers' decision to participate in the marketing and the extent of participation in Southern Highlands of Tanzania. Multistage sampling technique was used to collect cross section data from 497 Irish potato farmers. Cragg's two step model was used to analyze data. In the first step Probit model was used to determine the factors that influence decision to participate in the market, while in the second step Truncated regression model was used to determine factors that influence the proportion of output sold. The results showed that socio-economic factors significant in the first stage are not necessarily significant in the second stage. Factors such as farming experience, farm size, price, education, extension service, credit and gender significantly influence the decision to participate in the marketing and the extent of participation. Policies need to enhance capacity of farmers through adult literacy programmes and help farmers to adopt the modern farming techniques that will lead to increased Irish potatoes output and market participation.

**Key words:** Irish potatoes, Market participation, Cragg's two step model, Southern Highlands, Tanzania

## INTRODUCTION

Irish potato (*Solanum tuberosum*) is the most popular root and tuber crop and the fourth most important crop in the world after maize, rice and wheat (FAOSTAT, 2009). Worldwide, more than 320 million tons of Irish potatoes are produced annually from 20 million hectares of land. Almost a third of the world's Irish potatoes are produced in China and India (FAO, 2010). Irish potato production in developing countries has been increasing year after year. A study done by Maganga *et al.* (2012) reported that, the production had increased to 47.2% of the world production.

Irish potatoes were introduced in Tanzania by German missionaries in 1920s in the Southern Highlands of Tanzania, where local farmers began its cultivation in small-scale gardens (Macha *et al.*, 1982). Since its introduction, production trends have been increasing

because of increasing demand in both national and regional markets (Anderson, 2008). This growth in demand of Irish potatoes can be traced to many factors, including increasing economic activities, busy urban lifestyles, increased tourism and urbanization, increased number of fast food or takeaway restaurants and introduction of food products that can be 'consumed on the street' such as potato chips, fries and crisps (Anderson, 2008 and FAOSTAT, 2008).

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According to FAOSTAT (2014) data, local demand in Tanzania grew from about 508000 Tons to 887000 Tons in a period of 1995 to 2009. However, supply falls short of the demand, where by 508000 Tons and 861000 Tons were locally produced in 1995 and 2009 respectively in Tanzania. This left a gap of 62 tons and 26000 tones which were filled via imports in the same period of time (FAOSTAT, 2014). This steady growth in demand has been accompanied by growth in prices especially in end markets in major urban centers. Small scale farmers are likely to be the main beneficiaries of this increase in demand and prices of Irish potatoes through positive response by increasing participation in the Irish potato marketing.

Despite this potential on increasing Irish potatoes demand, production of Irish potatoes is characterized by low market participation (Marengo and Kisetu, 2016). A farmer's decision to produce either strictly for sale, or to participate in a marketing by selling off what remains after consumption depend on many other factors than the price of output. It is very important to explore other factors to determine their effect on the Irish potatoes market participation decision. Literature suggests that small-scale farmers often have high production costs, which reduce incentives for participation in marketing. The high production cost partly result from farmer's tendency to purchase inputs in small quantities involving small and repetitive transactions (Barrett, 2008).

Jari (2009) cited that farmer's readiness to participate in the marketing is very vital for sustaining economic growth, food security and poverty alleviation. Increasing market participation and rural incomes will require smallholder farmers to understand the factors that influence smallholder market participation and the level of participation. Few studies have empirically investigated the factors that influence smallholder farmers' market participation in food markets in developing countries (Goetz, 1992 and Omiti *et al.*, 2009). It was therefore the purpose of this research to contribute to the growing body of literature by exploring out on issues that motivate farmers to participate in Irish potatoes marketing.

The main objective of this study was to evaluate the factors that influence market participation among the small-scale Irish potatoes farmers in Njombe urban and Wangin'gombe districts, Tanzania. Specifically, the study intended to assess the factors influencing participation and extent of participation in marketing of Irish potatoes in Njombe urban and Wangin'gombe districts.

## MATERIALS AND METHODS

### Study Area

The study was carried out in Njombe region (Njombe urban and Wangin'gombe districts) in the Southern highlands of

Tanzania. The region covers an area of 21347 km<sup>2</sup> approximately (land mass), and lies between longitude 35°00'0.00"E and latitude -9°15'0.00"S. According to 2012 National census the total population of Njombe region is 702097, while Njombe urban district has a total population of 130223 and Wangin'ombe district has the total population of 161816 people (URT, 2013). The region bounded by Mbeya, Iringa, Morogoro, and Ruvuma regions. Most of the population is engaged in agricultural activities with farming as their major occupation. The main crops grown in region are maize, irish potatoes, pyrethrum, beans, green peas, wheat as well as variety of fruits. The location of the study area is presented in Figure 1.

### Sampling Techniques Procedure

The study used the Multistage sampling technique to select respondent. In the first stage 2 districts (Njombe urban and Wangin'ombe) were purposefully selected based on the intensity of Irish potatoes production in the Southern highlands of Tanzania (URT, 2013), since the target was Irish potatoes farmers. The second stage involved random selection of two villages from each district where Irish potatoes are grown in large quantity (Table 1).

**Table 1: Sampled districts, ward and villages**

District	Ward	Village	No of farmers	Sample selected
Wanging'ombe	Ulembwe	Igagala	365	180
		Ulembwe	268	140
		Iwungilo	217	100
Njombe urban	Iwungilo	Ngalanga	213	100

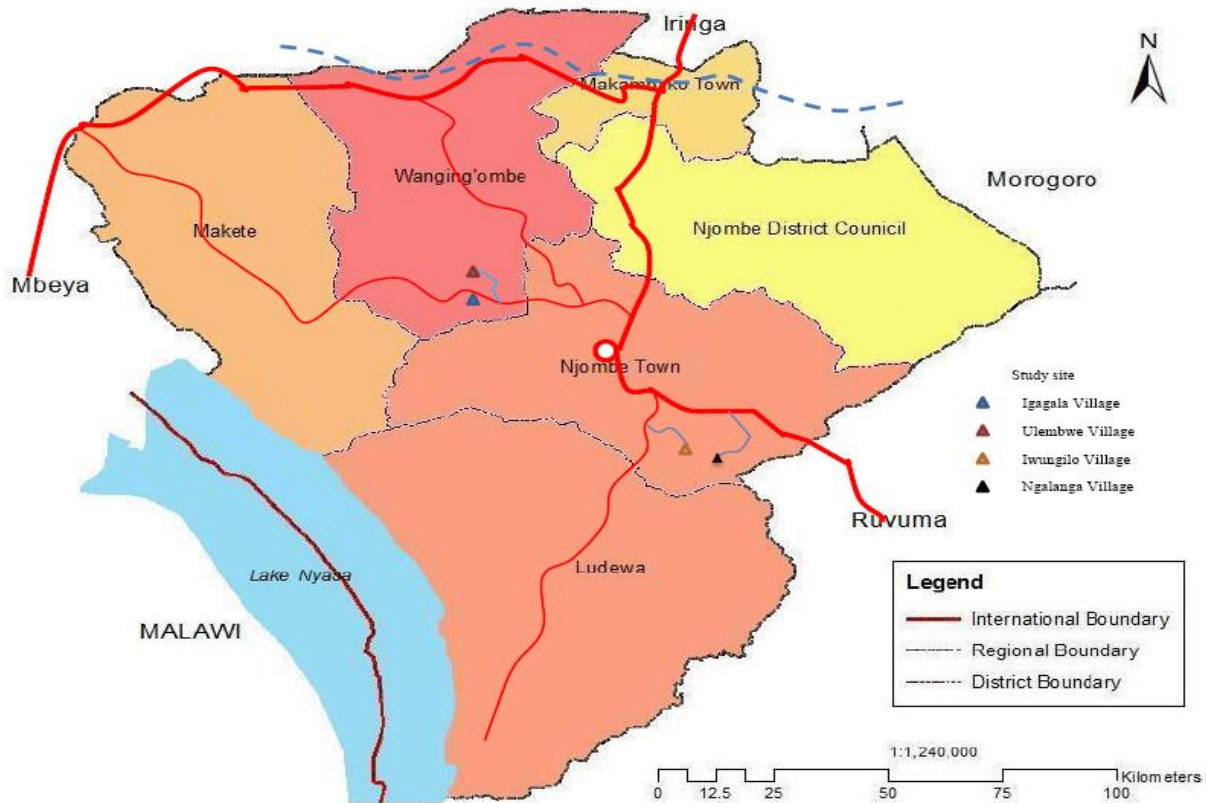
Following Kothari (2004), systematic sampling technique was employed to select the respondents from the list of Irish potato farmers obtained from Village executive officers (VEO). The target population was 490 smallholder Irish potatoes farmers, the study proposed 520 respondents to cater for non-response and incomplete questionnaires.

### Data Sources

The data for this study were obtained from both primary and secondary sources. The study employed a cross-sectional research design. Both qualitative and quantitative data were obtained using structured questionnaire which was administered to respondents in the form of open and closed ended and Focus Group Discussion. Primary data were collected from Irish potatoes households in the month of June, 2014. Secondary data were obtained from existing published literature, internet and Ministry of Agriculture Food Security and Cooperatives.

### Theoretical Framework

The study is based on the random utility model, which is founded on the assumption that a decision maker, faced



**Figure 1:** Sketched map of Njombe region indicating the location of the study area

**Source:** Modified from URT, 2013.

with a set of alternatives. In economics, utility is a measure of relative satisfaction. The principle underlying the farmer's choice is that he/she chooses the outcome that maximizes the utility (Greene, 2007). Suppose the farmer *i* is faced with two levels of utilities,  $U_1$  or  $U_0$ , from making choices between participation and nonparticipation respectively. However, the observed state only reveals which choice provides a higher utility but not the unobservable utility. That is, the observed (latent) indicator equals 1 if  $U_1 > U_0$  and 0 if  $U_1 < U_0$ .

$$U_1 = w'\beta_1 + z_1'\gamma_1 + \varepsilon_1 \tag{1}$$

$$U_0 = w'\beta_0 + z_0'\gamma_0 + \varepsilon_0 \tag{2}$$

Where, *w* represents the observable characteristics of the individual, such as age, sex, and other demographics. The vector *z* denotes two choices (participating in the market and not participating). The random terms,  $\varepsilon_1$  and  $\varepsilon_0$ , denote individual specific stochastic elements not be known to the researcher. If the individual's choice of alternative 1 is denoted by  $Y=1$ , then  $U_1 > U_0$ , which follows:

$$Prob[Y = 1 | W, Z_1, Z_0] = prob[u_1 > u_0] \tag{3}$$

$$= Prob[x'\beta + \varepsilon > 0 | X] \tag{4}$$

Where  $x'\beta$  are the observable elements of the difference of the two utility functions and  $\varepsilon$  represents the difference between the two random elements.

A farmer's choice as to whether or not to participate in Irish potato markets as a seller depends on the utility derived from participation. Thus, we represent choice by the indicator variable  $Y=1$  if the household participates in the market, and zero otherwise.

**Model Specification**

Market participation refers to any market related activity which promotes the sale of produce (Key *et al.*, 2000). Many studies have been used either two-step cragg's, Heckman two-stage models or Tobit model to examine market participation (Komarek, 2010; Bellemare and Barrett, 2006), but few of them have used both two-step cragg's and Tobit model in one study (Katchova and Miranda 2004 and Shiimi *et al.*, 2010). We follow much of the recent market-participation literature in modeling Irish potatoes market participation as a two-step procedure. Two-step cragg's model which was proposed by Cragg (1971) is the type of corner solution outcome in which all data is observed and non-participation implies that some economic agents have made the optimal choice of a corner solution.

In this study, we adopt a two-step procedure proposed by Katchova and Miranda (2004). In the first step a probit model was used to determine household characteristics that influence the decision of whether or not to participate in the market and in the second stage a truncated

regression model was used to capture the factors that influence the quantity sold. This is based on the assumption that households make two separate decisions; one involves the decision to participate in the market or not and secondly the level of participation. Tobit model was also used in the study for comparison with the two step Cragg's model as follows;

### Tobit Model

Originally, market participations were estimated using the Tobit model that accounts for the clustering of zeros due to non-participation (Wooldridge, 2002). In Tobit model market participation decision and the extent of participation are determined by the same parameters.

Given that  $E(y | x)$ ; If the farmer does not participate in the market ( $y=0$ ), whereas if a farmer participates in the market ( $y=1$ ). Tobit model is described as:

$$y_i = \begin{cases} 0 & \text{if } y_i \leq 0 \\ y_i & \text{if } 0 < y_i < 1 \\ 1 & \text{if } y_i \geq 1 \end{cases} \quad (5)$$

According to Katchova and Miranda (2004), the Tobit model assumes that a latent variable is generated by:

$$y^* = x\beta + \varepsilon \quad (6)$$

whereby  $y^*$  is the latent variable that takes the value of 1 if a household participates and 0 otherwise,  $x$  is a vector of household characteristics and  $\beta$  is the change in the mean of the latent dependent variable that is  $\beta = \partial E(y_i^*) / \partial x_i$  and  $\varepsilon$  is the error term which is assumed to be independently and normally distributed with mean zero and variance  $\delta^2$

### Two Step Procedure

The study used the Cragg's model which in the first stage probit model was used to determine household probability whether or not to participate in the market and truncated regression model in the second stage;

$$P(y > 0) = \Phi(x'\beta) \quad (7)$$

Given that  $\Phi$  represent the standard normal distribution. In this case it is assumed that non-participation is a purely economic decision by households not to participate in the market.

The truncated regression model for the decision to participate in the market is expressed in equation 8 below;

$$E(y | y > 0) = x'\beta + \delta \lambda \left( \frac{x'\beta}{\delta} \right) \quad (8)$$

The respondents who did not participate in the market (with zero values) have been dropped in the second stage of the model therefore the term  $\frac{x'\beta}{\delta}$  is an adjustment factor.

The two-step cragg's model implies that farmers make two decisions with regard to their decision to participate in the market. The first decisions is whether they will participate in Irish Potatoes marketing and the second one is the proportional of Irish potatoes sold, this approach relaxes the Tobit assumption and makes the better model to use than the one step Tobit model. Tobit was also tested against the Cragg's model as found in Katchova and Miranda (2004):

$$\lambda = 2(\ln L_{probit} + \ln L_{truncated\ regression} - \ln L_{Tobit}) \quad (9)$$

Where  $\lambda$  is distributed as chi-square with R degrees of freedom. The Tobit model would be rejected in favor of Cragg's 2-step model if  $\lambda$  is greater than chi-square critical value.

## RESULTS AND DISCUSSION

### Characteristics of Farmers' Households

Descriptive statistics of Irish potatoes farmers show that the average distance from home to the nearest market was 3 km (Table 2). Distance to market proxy the travel time and costs that influence market participation, we thus expect a negative relationship between distance to the market and likelihood to participate in marketing. This implies that the higher the distance to the nearest selling points, the lower the likelihood of a household to participate in the markets. The study done by Olwande and Mathenge (2010) has found that distance to the nearest market had a negative effect on market participation. However, Fafchamps and Hill (2005) observed that wealthy farmers can sell their produce to distant markets as they can afford the high transport costs compared to the poor farmers.

In terms of age the results show that the average age of the market participant was 42 years old, while the youngest was 18 years old and the oldest was 76 years old (Table 2). On the other hand, the average age of non-market participant was 46 years old, an indication that most of them are still economically active with strength and ability to carry out agricultural activities. Studies show that older farmers may take their decision more easily than the young farmers, because the older farmers might have accumulated capital and land, sometimes they view farming as a way of life and have a strong emotional with farming (Randela *et al.*, 2008).

The average number of years spent in school by Irish potatoes market participant was 5.6 while that for non-market participant was about 4.2, thus the majority had gone through primary school (7 years). Education is expected to influence a household's decision to participate in the market, but higher education is important as it will reduce search, screening information costs and

transaction cost (Matungul *et al.*, 2001) and it will add skills on how to market your product.

In terms of farming experience households that participated in the Irish potatoes marketing on average had 19 years of farming experience with a minimum of 1 year and a maximum of 43 years compared to their

counterparts with average of 2.62 years of farming experience with a minimum of 1 year and a maximum of 23 years. Farming experience is an important factor determining both production level and the decision to participate in the market as it may lead to a better managerial skill being acquired over time and marketing network.

**Table 2: General Characteristics of Agricultural Households**

Variables	YES				NO			
	Mean	Std. Dv	Min	Max	Mean	Std. Dv	Min	Max
Distance to the nearest market (km)	2.99	2.79	0.02	15	2.87	2.84	0.04	15
Irish potato farm size (acre)	1.59	1.01	0.25	6.5	2.65	1.64	0.25	6.5
Farming experience	19.03	8.82	1	43	2.62	2.62	1	23
Price sold (Tsh)	185.17	53.66	0	376	2.36	26.62	0	300
Household size	5.34	1.82	1	10	5.62	1.96	1	10
Education (number of years spent in school)	5.66	3.14	0	11	4.28	3.65	0	11
Age of the household head (years)	42.31	12.48	18	76	46.17	15.26	20	76
Group membership	0.30	0.46	0	1	0.19	0.39	0	1
Gender	0.70	0.45	0	1	0.31	0.47	0	1
Extension service	0.59	0.49	0	1	0.22	0.42	0	1
Credit	0.18	0.39	0	1	0.06	0.24	0	1
Percent of households in farmers group			30.27				18.90	
Percent of male farmers			60.81				41.50	
Percent of farmers with access to extension service			22.05				59.73	
Percent of farmers with access to credit			18.65				6.30	

**Source:** Computation from authors' household survey data (2014)

The results showed that amongst the market participating households, male headed households were dominant making 60.81% while 58.50% of the non-market participating households were female headed. Patriarchy and male dominance in decision making in many African societies have resulted into most households being led by men (Duze and Mohammed 2006). In terms of access to extension services, the result shows that only 22% of market participants had an access to extension service while the majority (78%) did not have an access to extension service. This implies that the majority of the market participants had not an access to extension service. Access of extension service through extension officers plays an imperative role of empowering the farmers with marketing information and ability. According to Alene *et al.* (2008), access to agricultural extension services enhances market participation and marketable surplus as agents provide technical assistance and information on improved varieties and technologies.

Among market participant and non-market participant the result indicated that the mean of the household size was 5, the smallest household size was 1 member while the highest was found to be 10 members. The Household size accounts for supply of family labour for production activities and household consumption level (Alene *et al.*,

2008 and Mathenge *et al.*, 2010). Household size is expected to have either positive or negative impact on market participation. It is expected to have positive impact if the household provide labour efficiently and negative impact on consumption level. Larger household are likely to have a lower level of commercialization as confirmed by Lapar *et al.* (2003) that market participate declines with number of household members.

### Empirical Results

The Probit results on the decision to participate in Irish potatoes marketing and truncated regression analysis results on the extent of market participation are presented in Table 3 and 5. The three models are estimated with same variables and the log-likelihood of the Tobit model is compared to the sum of those in the probit and the truncated regression model. The log-likelihood test rejects the Tobit model specification in favor of the more general Cragg model specification. This implies that the same parameters do not influence both the decision of whether or not to sell to the markets and the decision-making of the proportion of Irish potato sold. The marginal effects indicate that the amount of the sales resulting from a unit change in the explanatory variables.

Contrary to expectations, Irish potato farm size negatively influenced the probability of participating in the market (sell), although it was not significant for quantity of potatoes sold. The reason for this might be most of farmers who own large farms were intercropping Irish potatoes with other crop such as maize and timber. The Probit model results show that farming experience is significantly associated with the higher probability of market participation. This shows that experienced farmers were more likely to participate in the market relative to un-experienced ones, because they might have a long term relationship with their clients and marketing network. A study done by Adenegan *et al.* (2012) also found that farming experience was linked with higher probability of market participation.

Gender of the household head negatively and significantly influenced the extent of market participation; being a female headed household increased the quantity of Irish potatoes sold. This implies that women were more inclined to selling more Irish potato than men. These results were in contrast with the expected outcomes. Possibly because the data were collected immediately after the harvest season and female farmers participated in the market immediately after harvest to cover their basic needs due to poor resource endowment. This is unlike men farmers, who would prefer and are able to store Irish potatoes until the price is high. The results agree with the findings of Muthini *et al.* (2017) which found that female farmers engaged more in marketing activities than male famers.

**Table 3: Probit Model for Factors Influencing Probability of Market Participation**

Variables	Coefficient/ Standard error
Distance to the nearest market (km)	0.039(0.082)
Farm size (acre)	-0.578**(0.281)
Farming experience	0.190***(0.059)
Price sold (Tsh)	0.022***(0.004)
Family size	-0.041(-0.126)
Education (number of years spent in school)	0.188**(0.965)
Group membership	-0.375(-0.562)
Gender	0.433(0.602)
Extension service	0.605(0.544)
Credit	0.896(0.787)
Cons	-3.341***(1.112)
No of observation	497
Log likelihood	-16.27
LR chi <sup>2</sup>	532.38
Prob>chi <sup>2</sup>	0.000

**Source:** Computation from authors' household survey data (2014).

errors are reported in parentheses. Asterisks denote statistical significance at 10% level of confidence (\*), 5 % level (\*\*), and 1% level (\*\*\*).

The output price of the Irish potatoes is positively and significantly related to the higher probability of selling Irish potato. This implies that as the price of product increase the probability of famers to sell will increase. This is as expected because economic theory suggests that higher prices are an incentive to product selling as they determine profitability of the business. Studies done by Mailu *et al.* (2012) and Komarek (2010), argues that the output price is an important driver of market entry. The results agree with Onoja *et al.* (2012) in their study on determinants of market participation in Nigerian small-scale fishery sector.

**Table 4: Tobit and Truncated Regression Models for the Proportion of output sold**

Variables	Tobit	Truncated Regression
Distance to the nearest market (km)	-0.007 (0.008)	-0.003 (0.006)
Farm size (acre)	-0.117***(0.021)	-0.012 (0.018)
Farming experience	0.022***(0.003)	0.002 (0.002)
Price sold (Tsh)	0.005***(0.000)	0.000 (0.000)
Family size	0.005 (0.013)	0.015 (0.009)
Education (number of years spent in school)	0.026***(0.008)	0.017***(0.006)
Group membership	0.068 (0.052)	0.053 (0.039)
Gender	-0.195***(0.054)	-0.275***(0.041)
Extension service	-0.001 (0.048)	-0.101***(0.036)
Credit	-0.099 (0.064)	-0.078 *(0.046)
Cons	-0.088(0.102)	1.309 *** (0.094)
No of observation	497	370
Log likelihood	-315.485	-116.997
LR chi <sup>2</sup> /Wald chi <sup>2</sup>	542.13	64.48
Prob>chi <sup>2</sup>	0.000	0.000
Log likelihood test for tobit vs truncated regression test	364.431	

**Source:** Computation from authors' household survey data (2014).

Standard errors are reported in parentheses. Asterisks denote statistical significance at 10% level of confidence (\*), 5 % level (\*\*), and 1% level (\*\*\*).

The result also showed that access to credit is negatively associated with the quantity of produce sold. The negative effect means that increasingly smaller quantities are sold as farmer receives the credit, the reason for this might be the data were collected immediately after harvest season and farmers who did not receive credit were selling their produce immediately after harvest to meet immediate cash needs. Farmers who had access to credit were able to delay selling as they had alternative sources of income and hence did not need to sell Irish potatoes to acquire income to meet basic household needs.

Contrary to expectations, access to extension services negatively affected the quantity of Irish potatoes sold.

However, although not significant, extension increased the likelihood of participating in the market. This therefore implies that among the farmers who participated in the market, those who had benefited from extension sold less produce. Similarly, this result may have been occasioned by the timing of data collection. Farmers who have regular access to extension services are expected to engage in improved farm practices such as improved post-harvest handling and better marketing practices, such as storage during glut to anticipate better prices. Thus, although access to extension would increase likelihood of participating in the market as expected, those with access to extension would sell less, possibly store to sell at a later date. There is however need for more studies on these aspects to determine how credit and extension services influence market participation decisions during different seasons and market supply dynamics such as glut and reduced supply and price movement.

**Table 5: Marginal Effects for the Truncated Regression Model**

Variables	Coefficient/ Standard error
Distance to the nearest market (km)	-0.003 (0.006)
Farm size (acre)	-0.012 (0.018)
Farming experience	0.002 (0.002)
Price sold (Tsh)	0.000 (0.000)
Family size	0.015 (0.009)
Education (number of years spent in school)	0.017*** (0.006)
Group membership	0.053 (0.039)
Gender	-0.275*** (0.041)
Extension service	-0.101*** (0.036)
Credit	-0.077* (0.046)

**Source:** Computation from authors' household survey data (2014).

Standard errors are reported in parentheses. Asterisks denote statistical significance at 10% level of confidence (\*), 5 % level (\*\*), and 1% level (\*\*\*).

The number of years spent in school is positive and significantly associated with the higher probability to sell Irish potatoes and the proportion of produce sold. This can be explained by the fact that as individual access more education he/she is empowered with the marketing skill and knowledge that will spur individual to participate in the market and increase the amount of Irish potato sold. Formal education enhances managerial competence and successful implementation of improved production and marketing practices; hence it affects farmer's market participation level (Marenya and Barret, 2009). The results appear to agree with Adenegan *et al.* (2012) in their study

of Determinants of Market Participation of Maize Farmers in Rural Osun State of Nigeria, this suggests that higher level of education provides a greater opportunity for the farmers to participate in the Irish potatoes marketing. However, it is not clear in this study why more educated farmers were likely to sell their produce immediately after harvesting. There is need to for further research to determine how formal education influences market participation decisions during different seasons.

## CONCLUSIONS

This paper analyzed the determinants of market participation among Irish potatoes farmers in Njombe region, Tanzania. The study used both Tobit model and two steps cragg's model but from the test of Tobit verses cragg's model the log-likelihood test rejects the Tobit model in favor of the two stage Cragg model. This implies that the same parameters do not influence market participation decision and the extent of participation. In the first stage probit model was used while truncated regression model was applied in the second stage. Factors such as faming experience, output price and education were found to be positively and significantly influence the probability of market participation, while access to extension services, gender of household head, education level of household head and credit access significantly influenced the quantity sold in the market.

The study concludes that the effect of various factors on market participation decisions may well depend on the season. For instance, contrary to common assumption that access to extension services and credit facilities increases market participation, this study finds that the assumption is not true during harvesting season. Farmers with increased access to extension may delay selling their produce until market conditions are favorable, while those with limited access to credit will most likely sell immediately after harvest to meet cash flow requirements. However, farmers will sell if prices are favorable, as denoted by the positive and significant effect of price on market participation. There is need for more research to determine the effect of these factors on market participation during different seasons, such as harvesting relative to periods of reduced supply.

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Accepted 18 December 2017

**Citation:** Daniel B, Mishili F, Lazaro E (2018). Farmer's Participation in Irish Potato Marketing in Njombe Urban and Wanging'ombe District, in Tanzania: Value Determinants. *Journal of Agricultural Economics and Rural Development*, 4(1): 335-343.



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