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Effects of the use of GAPs on market participation by Irish potato farmers in Kenya

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Abstract

Irish potato production in Kenya is characterized by low supply which does not meet the increasing demand in urban areas. The decline in supply indicates low yield which has been intensified by the use by use of traditional methods of farming, notably planting low-quality potato seed and application of low ratios of inputs. The participation in the potato market is dependent on the amount of potato yield that the farmers get after applying good agricultural practices (GAPs). There is insufficient empirical evidence on the extent of commercialization by Irish potato farmers who use GAPs. This study provides evidence of how the use of GAPs would influence the level of market participation by potato farmers. Primary household survey data of 238 randomly sampled Irish potato farmers were analyzed using descriptive statistics and Tobit Regression model. The results showed 0.4 percent of the farmers were highly commercialized while 13 percent had very little or none to offer for sale. Intuitively, age, asset value, and potato yield had a significant influence on the level of market participation. Therefore increased use of GAPs through extension advice will intensify Irish potato yield and ultimately participation in the ware and seed potato market.

Keywords: Commercialization, Good Agricultural Practices, Irish Potatoes, Kenya, Market Participation, Productivity

Introduction

1.1 Background

Agriculture has been seen to contribute directly to livelihoods through increased output and indirectly through a decline in the prices of food and employment of individuals as reported by DFID, (2005). Many African counties such as Kenya are characterized by high levels of poverty (53 percent) and a population that lives below 1.25 USD per day. It is expected that the growth in the agriculture sector will contribute immensely to poverty reduction (DFID, 2005). According to the Agricultural Sector Development Strategy (ASDS) policy, the primary objective is to transform agriculture into a commercialized sector. Agricultural commercialization is a shift from subsistence production to commercial activities that enhance the production of commodities for sale and in turn increase labor productivity and improves the livelihoods of farmers (Olwande & Mathenge, 2012).

Irish Potato is the most consumed commodity under the non-grain foods globally with an annual production estimated at 376 million tonnes as reported by FAOSTAT, (2014). The crop is the second most utilized commodity after maize (Mutunga, 2014). Despite an increase in consumption of the commodity in the recent past, the price of Irish potato is subject to the influence of local demand and supply as well as the speculation the international market (FAO, 2013). Therefore the sustainability in its production will contribute immensely to improved livelihoods. Irish Potato has the potential to enhance food security as stated in the Malabo declaration 2014 which seeks to end hunger and poverty by 2025 and the realization of Sustainable development goals 1 & 2 which aims to end hunger and promote sustainable agriculture by 2030 (UNDP, 2015). Notably, potato yield has been declining gradually at the rate of 111 percent annually as reported by FAO (2010).

Past studies attribute the massive decline to poor agronomic activities and infestation of insect pests and diseases (Kaguongo et al., 2008). Similarly, low yields are also attributed to smallholder production which accounts for 75 percent of the total yield that is utilized for subsistence. The farmers have small land holdings at an average of 2.5 hectares (Salami et al., 2010). Only a few farmers engage in commercial production of Irish potato due to resource constraints as well as low levels of literacy (Kristen et al., 2013).

Agricultural commercialization has been seen to influence the welfare of smallholder farmers in Kenya as stated by Muricho (2015). The quantity of produce offered for sale in the market is dependent on the volume of production such that the farmer can be able to purchase other foods and access basic needs. He found out that about 75 percent of the surveyed households were commercialized. The average commercialization intensity was 37 percent with the commercialized households selling about 37 percent of the value of all the crops they produced. Explanatory variables such as gender, years of formal education, asset ownership, and farm size were found to be significant in determining Agricultural commercialization. The current study also followed a similar approach in the analysis of the household level of market participation.

Similarly, a study by Sebatta et al., (2014) on the factors that influence smallholder farmers' decision to participate in the potato market and level of participation in Uganda was done using descriptive statistics (OLS) and two-stage Heckman model. The results of the study showed that gender, the price of potato, access to the village market, extension agents, level of education and

distance to the nearest town were significant on the decision to participate in the market. On the other hand, off-farm income had a significant adverse effect on the level of market participation. Gender and group membership had a positive and significant influence on the volume of produce sold in the market by smallholder farmers.

Participation of Irish potato farmers in the market is affected by the amount of produce realized in a planting season (Olwande and Mathenge, 2012). It is expected that the use of Good Agricultural Practices such as crop rotation, certified seed, application of manure and pest scouting will increase yield and enable the farmers to offer their produce for sale (Zhongqi et al., 2012). There is scant literature on the extent of commercialization by farmers who use GAPs. The objective of this study is to examine the effects of the use of good agricultural practices on market participation by Irish potato farmers.

1.2 Role of GAPs in Increasing Market Participation by Irish Potato Farmers

Good agricultural practices are farmer practices that are applied during production and post-harvest activities to enhance the realization of high yield while ensuring cost minimization as well as environmental conservation (FAO, 2008; Rockstrom et al., 2009; Wollni et al., 2010). The two leading GAP principles are Soil and water conservation practices which mitigate and assist farmers to adapt to vagaries of weather (Delgado et al., 2011). This is achieved through minimum tillage, hand-weeding, and leaving crop residue in the field to promote the conservation of natural resources (FAO, 2008). Selected GAPs considered in this study include the use of fungicides to control bacterial blight (Champoseau et al., 2009), use of Certified Seed Potato (Okello et al., 2017), Integrated Pest Management [IPM] (Champoseau et al., 2011), crop rotation (Larkin et al., 2011b) and fertilizer application (Zebarth et al., 2009). The above studies found out that the GAPs applied appropriately led to effective pest and disease control and increase in soil fertility as well as a tremendous increase in potato yield (Senanayake and Rathnayaka, 2015; Okello et al., 2016).

To enhance sustainability in potato production, through maintaining viable farming practices and contributing to livelihoods, adoption of GAPs could result in higher potato production. GAPs can be applied to a vast category of farming systems of different scales through improved agricultural sustainable practices such as integrated pest, weed, and disease management, soil, and water conservation as well as fertilizer management (Nyongesa et al., 2012; Kassie et al., 2013).

Against this background, it is essential that GAPs are introduced and promoted to the Irish potato farmers to ensure that they record an increase in yield and consequently offer their produce for sale. Market participation as defined by Jaleta and Gebremedhen, (2010) is the amount of produce offered for sale and use of purchased inputs by smallholder Irish potato farmers. Market participation is limited by institutional and standard constraints production (capital, land, labor, technology). This defines the choices made by farmers considering transaction costs and hence the effectiveness and practicability of market participation (Jagwe et al., 2010). Commercialization gives opportunities for households to generate revenue that increases the disposable income used for purchasing food and improving their livelihoods. Households that participate in the Irish potato markets enjoy gains due to trade and can now specialize their production to suit the demands in the market (Ramoroka, 2012). The use of GAPs will enable the farmers to shift from subsistence production to commercial production which will positively improve their livelihoods as witnessed by an increase in the household level of food security by approximately by 0.27 percent as stated

by Seth (2009). The more substantial revenues derived from participation in potato markets can be reinvested into the production of potato through the purchase of inputs. Therefore to enhance adoption of GAPs, adequate knowledge should be given to the farmers through farm visits and farmer to farmer transfer of this technology.

2.0 Materials and methods

2.1 Study Area

The study was conducted in two areas of Kenya namely Mt. Elgon and Nyandarua County. Mt. Elgon region is a marginal area with high altitude; it is characterized by a majority of smallholder farmers and inadequate infrastructure. Conversely, Nyandarua County is ranked the highest in potato production with good infrastructure that links farmers to the output market. More so, the farmers in the area are well endowed with resources and hence have a higher adoption rate of GAPs.

2.2 Empirical framework

This research was based on Expected Utility Theory (EUT) where the farmer adopts a new technology if the utility derived from it is higher than the traditional technology (Batz et al., 1999). EUT views farmers as rational with the aim of maximizing efficiency which is achieved through profit maximization (Edwards-Jones, 2006). EUT was used in this study in conjunction with the production theory of the firm as it expounded on the maximum utility a farmer can obtain by using the i^{th} number of Good Agricultural practices considering the following explanatory variables: farm and household characteristics, socio-demographic characteristics, distance to market, social network and extension.

2.3 Sample Selection

The sample population was selected through a multistage sampling technique. This method was cost-effective and could allow data to be collected from geographically dispersed groups where face to face interviews were required (Sudman, 1976). The sampling started with purposive sampling where all potato farmers in Mt. Elgon region were selected then followed by random sampling to avoid selectivity bias and random errors. A random sampling of 260 respondents which include potato farmers who had grown, harvested and utilized the produce was done in all the selected villages in each of the two locations. This gave us 13 respondents per village in addition to 120 respondents for the market survey. Enumerators were assigned different zones in the market survey where they interviewed every 3rd buyer of potato. To avoid selectivity bias and random errors; however, Heckman test was used to correct selectivity bias and the formula for determining sample population gave room for additional of 10%-30% which took care of unreached respondents.

2.4 Data Collection and Analysis

The data was collected through personal interviews using a pre-tested questionnaire. The data collected included farmer characteristics, household asset endowments, farm, institutional and regional characteristics and intensity of use of GAPs. This study used primary data that was received from smallholder farmers located in Mt Elgon and Nyandarua counties. Primary and secondary data were used in the study. Secondary data were obtained from government websites,

previous studies, and internet sources. Primary data was collected using a semi-structured questionnaire where the household heads were interviewed. The effect of the use of GAPs on market participation was analyzed using econometric software SPSS version 20 for data entry and analysis. Tobit model was used in STATA to investigate the significant levels of the hypothesized variables influencing the commercialization index of the Irish potato farmers.

2.5 Household Commercialization Index

The effect of the use of GAPs was determined by evaluating its influence on market participation. This was hypothesized to be determined by the realization of high potato yield. Therefore, the level of market participation by households in this study was calculated as a ratio (Household Commercialization Index (HCI) of the volume of total potato sold to the total amount of potato produced (Sebatta et al., 2014).

$$HCI = \frac{\text{Total volume of potato sold}}{\text{Total volume of potato produced}} \dots\dots\dots (1)$$

Since some of the households did not sell any portion of their produce, it resulted in zero commercialization indexes (Sigei et al., 2014). Therefore, the Tobit model (Tobin, 1958) was used instead of OLS. Tobit model was appropriate because the response variable (level of market participation) was censored at lower bounds (Sebatta et al., 2014). In this study, the level of market participation was within 0 to 1 and could not fall outside of this range.

The Tobit model explaining the effect of the use of GAPs in the household level of market participation was to be estimated as (Tobin, 1958):

$$Y_i = \beta_0 + \beta_i X_i + \beta_m D_m + u_i \quad i, m = 1, 2, \dots, n \dots\dots\dots (2)$$

Where; Y_i is the household commercialization index, β_0 is the constant term, β_i is the parameters to be estimated, X_i is a matrix of the explanatory variables that included household's socio-economic and demographic characteristics (e.g., age, level of education, farm size, gender, wealth status, group membership). Farm characteristics (for example, distance to the output market and distance to the nearest all-weather road) were also included during the analysis. D_m is a continuous variable indicating the use of GAPs and u_i is the error term.

$$\text{use of gaps} = \frac{\text{number of recommended GAPs followed by farmers}}{\text{total number of recommended GAPs(9)}} \dots\dots\dots (3)$$

This gave us the level of use of GAPs which was represented as a ration between 0 and 1 (Senanayake and Rathnayaka, 2015).

3.0 Results and Discussion

3.1 Household characteristics

Table 1: Summary Statistics and Characteristics of Respondents (N=260)

Variable	Description	Mean	Std. Dev.	Min	Max
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Education_s	Education in years(count)	9.176	3.216	0	18
Age	Age in years	44.66	11.769	24	89
HCI	Household commercialization index (ratio)	0.386	.327	0	0.962
Hhsize	Total number of people in the household	6	2.570	2	21
Dist_all_wd	Distance to all weather road (in walking minutes)	20.949	37.987	0	300
Lnoff_farmy	Natural log of off farm income	6.750	5.375	0	14.508
Chemicals	Use of chemicals 1=yes & 0 = N0	0.139	.346	0	1
Need_credit	Need for credit 1= Yes& 0= N0	.178	.383	0	1
Numbergaps	Number of Good agricultural practices (count)	3	1.266	0	6
Lnplotsize	Natural Log of plot size	0.276	0.370	0	5.117
INtotalvolyieldpotato	The volume of yield (Kgs)	2.660	0.841	0	5.569
INAsset_Value	Natural log of value of assets	5.014	0.401	3.694	5.927
INDist_Produce	Natural log of distance to produce market	1.588	0.365	0.778	2.382
INDist_Input	Natural Log of distance to input market	0.974	0.537	0	2.478
INExperience	Natural log of experience in potato farming	0.987	0.329	0	1.707
Dist_Agric	Distance to agricultural office (count)	74.914	49.823	5	300
Hired Labour	Used hired labour; 1= yes & 0= No	0.845	.362	0	1

Source: Survey data (2016)

Table 1 above shows the summary statistics include in the estimation of the Tobit Regression Model. The results revealed that the mean age of the Irish potato farmers was 44 years old indicating that most of the farmers were relatively youthful. The farmers owned land at least 2.7 acres in size which is lower than the national average figure of 3 acres according to Kenya National Bureau of Statistics (KNBS) (2017). Similarly, the average household size was at six individuals who are higher as compared to an average of 4 in the national statistics (KNB, 2017). Household size had a significant influence on market participation which is similar to the results documented by Eleni (2008) who said that the increase in the size of the farm would provide sufficient labor needed for implementation of GAPs and also engage them in the transport of produce to the market. Imperatively, Abele et al., (2007) stated that larger households have a higher rate of consumption that would trigger them to adopt more GAPs and offer the produce for sale when faced with a need. The farmers used an average of three GAPs (crop rotation, pest scouting, and roguing) with a smaller number (1 percent) utilizing certified seeds. This ultimately led to a decline in potato yield since certified seeds are of high quality and disease free.

The distance to all-weather roads was at an average of twenty walking minutes. Respondents in Koimugul, Bungoma County, reported an average walking distance of 5 hours to the market in Cheptais indicating the existence of poor road infrastructure and challenging terrain. The results

correspond to the findings of Olwande and Mathenge, (2010) who said that long distances to the agricultural market negatively affect potato production and marketing because of the travel time and associated costs. Household commercialization indices were used to estimate the level of market participation by potato farmers. The analysis of household commercialization indices indicates a mean ratio of 0.4 with a maximum of 0.9. However, the majority of farmers (80 percent) had low levels of commercialization while only 0.4 percent were highly commercialized.

Table 2: Tobit Regression Results

HCI	Coefficient	Std. Err.	P>t	dy/dx	Std.Error	p-value
Age	-0.006	0.002	0.015***	-.006	.002	0.010
Education_Years	-0.002	0.008	0.813	-.001	.008	0.850
INplotsize	0.051	0.071	0.478	.059	.072	0.413
INAsset_Value	0.220	0.062	0.001***	.198	.062	0.001
INDist_Produce_Market	-0.041	0.064	0.524	-.024	.064	0.713
INDist_All_WeatherRoad	0.048	0.044	0.271	.051	.044	0.250
INtotalvolyieldpotato	-0.096	0.037	0.009***	-.103	.037	0.005
HHSIZE	0.019	0.009	0.03**	.0174	.009	0.052
Dist_Agric_Office	-0.001	0.000	0.115	-.001	.000	0.070
INExperience_Potato_Farming	-0.038	0.079	0.632	-.045	.08	0.570
Need_Credit	0.042	0.059	0.48	.0389	.059	0.515
Number of Gaps	-0.338	0.165	0.041**	-.035	.017	0.040
_cons	-0.119	0.316	0.706			
/sigma	0.330	0.017			0.297	0.363

*Notes: ***, **, * significance levels at 1, 5 and 10 percent respectively.*

Source: Survey Data (2016)

Discussion

Market participation is critical in improving the livelihoods of potato farmers. It is essential that farmers move from subsistence production to commercial farming to tap on the ready market. Similarly, the use of modern agricultural practices cannot be overemphasized in its influence on yield. Yield depends on not only weather patterns but also the cultural practices that favor vegetative and productive growth. The marginal effects show that an increase in the age of household head by one year decreases market participation by 1 percent other factors constant. This implies that older farmers tend to be risk-averse, and therefore the use of GAPs decline with age (Doss and Morris, 2001). The results were different from Kassie et al., (2013) who argued that older farmers have more resources, use GAPs and hence produce more yields which can be offered to the market for sale as compared to younger farmers.

More so, an increase in household size by an individual led to an increase in commercialization of the household by 17 percent. This illustrated that farmers with larger households provided family labor that could be used in the integration of GAPs during potato production and further supported the family in offering the produce for sale in the market. The results are similar to Mathenge et al., (2010) and Alene et al., (2008) who argued that a large household size positively influenced

participation in the market if they supplied family labor efficiently that translated into output that is greater than household consumption and hence the surplus would be offered for sale.

Similarly, an increase in the natural log of the value of assets by one unit increased commercialization by 19 percent holding other factors constant. This relationship is depicted by the ability of the farmer to not only use GAPs but also acquire the means to transport the produce to the market (Jaleta et al., 2009). Further, the availability of capital is known to lower the transaction costs involved during marketing (Jagwe et al., 2010).

Intuitively an increase in the natural log of potato yield by one unit led to a decline in the level of commercialization by 10 percent. It is expected that yield positively affects market participation which is not the case. This results differed from those of Okello et al., (2017) who found out that farmers with higher yields offered more of their produce to the market compared to those who had low yields.

Further, an increase in the number of GAPs used by one unit negatively influenced participation in the output market by 3 percent. The results differed from those of Ghebreslassie et al., (2014) who found out that 98 percent of the farmers who used GAPs (crop rotation, organic manure, and pest scouting) realized higher yields and participated in the market more than those who did not use them.

Conclusion

The study aimed at assessing the effect of the use of GAPs on the market participation by potato farmers in Kenya. Household commercialization indices were used to estimate the level of market participation by potato farmers. The analysis showed that the majority of farmers had low levels of commercialization while only 0.4 percent were highly commercialized. Further, the study showed that age, natural log of asset value, the natural log of potato yield, household size and number of gaps had a significant influence on the level of market participation. Intuitively, there were low levels of access to essential institutional services such as extension and credit which show the need for promoting agricultural policies and strategies that increase equity in access to resources. The low levels of commercialization witnessed in potato farmers indicate the need for investment in training and capacity building on the importance of market participation.

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