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Determinants of Vulnerability to Expected Poverty among French Bean Farmers in Kenya

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Abstract
Poverty is increasing in rural areas of Kenya. The study examined factors influencing vulnerability of French beans farmers to expected poverty using Vulnerability to Expected Poverty approach on 492 randomly selected respondents. The study found a mean vulnerability to expected poverty of 19.6% which is below vulnerability threshold of 50% indicating that majority of French bean farmers irrespective of Global-GAP certification status were invulnerable to expected poverty. However, majority of those who were expenditure (56.3 percent) and income poor (92.2 percent) are vulnerable to future poverty. Factors influencing vulnerability to expected poverty are asset value (P=0.000), net crop income (P=0.000), off-farm income (P=0.000), household size (P=0.000), age of household head (p = 0.088), gender of household head (P=0.001) and distance to market (P=0.000). French beans farmers should practice farm diversification and expand acreage under Global-GAP certified French beans in order to increase income and expenditure and hence alleviate future poverty.
Key words: French Beans, Vulnerability, Poverty, Global-Gap Standards
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1. Introduction

Since independence, poverty reduction, disease eradication and health has been recognized as the key pillars to consider in policy formulation in order to attain progressive development and increased living standards of Kenyan citizens health (Republic of Kenya, 1965). To date, poverty is still a major challenge to the development and requires constant monitoring in order to understand its causes so as to effectively address it. Statistics indicate that, the probability of falling non-poor, moderately poor and extremely poor in rural areas in Kenya is 42, 13 and 45 percent respectively. Shepherd *et al.* (2014) projected that over 10.57 million Kenyans will remain poor by the year 2030. According to Republic of Kenya (2005), rural poverty in Central region where Kirinyaga County is located range between10-56 percent and the same trend is observed across constituency level. In Kirinyaga County, rural vulnerability to expected poverty stands at 31.9 percent, which is slightly higher than the national rate of 28.3 percent (Oxford Poverty and Human Development Initiative, 2017).

To overcome poverty in rural areas, at least 60,000 small-scale farmers in Kenya are increasing diversifying their farming activities towards production of French beans (Ebony Consulting International, 2001). However, the increasing awareness of healthy foods among consumers has seen the export and local markets increasingly demand French beans that are certified under private standards, mainly Global Good Agricultural Practices (Global-GAP). Global-GAP standards are implemented mainly on French beans produced for export markets in Europe (FPEAK, 2014). Studies indicates that production of vegetables in the presence of different institutional arrangements, expose farmers to varying degrees of losses, returns and risks (Tschirley *et al.,* 2004). For instance, uptake of Global-GAP standards is accompanied by high but volatile returns due to price volatility (Asfaw *et al.,* 2010a) and high costs (Humphrey, 2008; Muriithi *et al.,* 2011). Being a risky business, the question here is that, will continued production of French beans in the face of Global-GAP standards move farmers out of poverty brackets in future?.

In Kenya many studies on the impact of French beans production in the face of Global-GAP standards on household welfare have been based on the concept of observed poverty (,Humphrey, 2008; Asfaw *et al.,* 2009; Asfaw *et al.,* 2010; Muriithi *et al.,* 2011). According to Chaudhuri (2000) and Chaudhuri (2003), observed poverty is seen as static or poverty defined at a single point in time. Static poverty analysis generates information on who is poor today and not and the characteristics of those who are poor but neglects those who are likely to be poor in future. Empirical studies on poverty have shown that, those who are not poor today may be poor tomorrow (Dercon and Krishnan, 2000; Yaqub, 2000; Chaudhuri, 2002; McKay and Lawson, 2002). Static poverty analysis tells very little about the dynamic processes that push households to poverty or move from poverty Deressa (2013). According to Chaudhuri *et al.* (2001), formulation of policies aimed at poverty eradication based on information

generated from static poverty analysis is ineffective. The study further noted that, effective poverty prevention and reduction should therefore take account of clear understanding of vulnerability to poverty. This will help put in place effective policies and strategies to prevent future poverty.

The concept of dynamic poverty is therefore increasingly gaining popularity in poverty analysis. This is because the changes in vulnerability to future poverty are linked to static poverty levels over time (Bidani and Richter, 2001). Vulnerability to expected poverty is defined as the likelihood or probability of one falling into poverty or reduction in one's well-being in future (Pritchett *et al.,* 2000; World Bank, 2000). According to Chaudhuri (2002) defines it as a forward-looking ex-ante measure of household's well-being that shows that irrespective of whether a household is poor today or not, may be poor tomorrow. The difference between observed poverty and vulnerability to expected poverty situations is explained by the presence and changes in risks and shocks within the environment in which decision makers operate in.

According to Dercon (2004), changes in consumption and welfare of individuals are caused by shocks and the changes in households' consumption levels over time determine households' vulnerability to poverty. Households face two types of shocks and risks namely covariate or idiosyncratic. Idiosyncratic shocks are those that are specific to a household and include illness, death of a household member, household member loosing employment, household size and age of household head among other factors (Chaudhuri *et al.*, 2002; Dercon *et al.*, 2005). According to Christiansen and Subbarao (2004), such shocks create unstable household income. According to Jacoby and Skoufias (1997), such shocks may lead to irreversible losses such as distress sale of productive assets, reduced nutrient intake, or interruption of education that permanently reduces human capital.

The study was guided by the need to generate information on the link between the shocks and French beans farmer's future poverty in order to help in early formulation of effective poverty alleviation strategies as recommended in Chaudhuri (2003). The information will also help farmers identify in advance risks and possible shocks that are likely to occur and the relevant strategies to embrace in order to prevent the occurrence of such risks. Information on household future poverty and its determinants is critical in informing National and County Government policies with respect to poverty eradication at the grass root level. The generated information will also help in future poverty benchmarks, within and between various Counties in the Country as well as informing the public on what they require to do to mitigate the increasing poverty and in guiding resource allocation at national level (KNBS and SID, 2014).

2. Material and Methods

2.1 Study area

The study was conducted in Kirinyaga County, within Kirinyaga Central, Kirinyaga East, Kirinyaga West, Mwea East and Mwea West Sub-counties because of concentration of French bean farmers and implementation of Global-GAP standards in the Sub-counties. Kirinyaga County is located 120 Kilometers North West of Nairobi and has a total population of 153,095 (Economic Survey, 2009). A part from French beans, rice, maize and horticulture (Onions, tomato, snow peas, avocado, mango and pawpaw) are also commonly grown in the County. French beans are mainly produced under irrigation and rain-fed.

2.2 Sample size

Lists of French bean farmers were obtained from Kirinyaga County Agricultural Office, farmer groups and exporters of French beans operating in the County. The lists were used to generate a sampling frame of 1,943 respondents (both certified and non-certified French bean farmers). Systematic random sampling procedure was then used to draw the sample size of 492 respondents consisting of 294 certified and 198 non-certified French bean farmers. The recommended sample size given a population of 1,943 is 322 but due to the availability of resources for data collection and the need to increase accuracy, the sample size was increased to 492 respondents. The sample size of 492 was proportionally distributed within the five Sub-Counties based on Global-GAP certification status and population of each Sub-County in the sampling frame. The sample size was computed as follows using formula developed by Krejcie and Morgan (1970):

$$S = \frac{X^2 NP(1-P)}{d^2(N-1) + X^2 P(1-P)} \quad (1)$$

where S is the required sample size, X^2 = the table value of chi-square for 1 degree of freedom at the desired confidence level (1.96 × 1.96 = 3.84), N = Population size P = Population proportion (assumed to be 0.50), d = degree of accuracy expressed as a proportion (0.05). Using the formula, sample size corresponding to N = 1,943 is 322 but the sample size was increased to 492 during data collection.

2.3 Sampling procedure

The study adopted multistage sampling procedure in the selection of respondents. Within Kirinyaga County: Kirinyaga Central, Kirinyaga East, Kirinyaga West, Mwea East and Mwea West Sub-Counties were purposively selected because this is where French beans are mainly produced. French bean farmers in each Sub-County were then stratified into two groups: Global-GAP certified and non-certified farmers. Sampling frames for the certified and non-certified French bean farmers were then generated for each Sub-County with the help of farmer group leaders and County Agricultural Officers. Systematic random sampling procedure was then applied to select the certified and non-certified French beans farmers from the sampling frames. Both certified (294) and non-certified (198) French bean farmers were selected proportionately depending on the size of sampling frames in each Sub-County and Global-GAP certification status to give a total sample size of 492 respondents.

2.4 Ethical considerations

Formal consent to carry out the study was sought from Graduate school, Egerton University, National Research Fund, County Agricultural Office and French bean farmer organizations and participation of respondents was purely voluntary.

2.5 Data and data analysis

Single cross-sectional data was used in the study. Data was obtained from the 492 randomly selected respondents using semi-structured questionnaire and covered 2014 cropping season. Both structured and unstructured questionnaires were used to solicit data. Data on household socio-economic, psychological and institutional characteristics were collected. Non-normal data were log transformed to approach normality. T-test and Chi-square tests were performed in the analysis. Data analysis was done using SPSS and STATA computer software. Results were then presented in form of tables.

2.6 Estimation strategy

Theoretical framework of this study was based on “risk chain” concept which assumes that, link exist between shocks and risks facing households, activities households choose, households’ incomes, households’ consumption levels and their vulnerability to future poverty (Chaudhuri 2003; Chaudhuri *et al.,* 2002; Hoddinott and Quisumbing, 2008). Given the risk chain concept, an individual is assumed vulnerable to poverty if he/she is consumption poor. The link between consumption and vulnerability to poverty concept is widely applied in studies on poverty analysis across the globe. Most of these studies share the same definition of vulnerability to expected poverty with respect to household consumption. For instance, Skoufias (2002) defined vulnerability to risk as the degree to which the growth rate of household consumption co- varies with the growth rate of household income. Pritchett *et al.* (2000), Quisumbing (2002) and Chaudhuri *et al.* (2002) define vulnerability to future poverty as the likelihood that a household will find itself consumption-poor in the near future. World Bank defines vulnerability as "the likelihood of being adversely affected by a shock that usually causes consumption levels, or other factors that affect well being to drop (World Bank, 2001).

There are three methods of estimating household vulnerability to poverty: Vulnerability as Expected Poverty (VEP) approach, Vulnerability as low Expected Utility (VEU) approach and Vulnerability as uninsured Exposure to Risk (VER) approach (Chaudhuri *et al.,* 2002). VEP and VEU approaches determine probability of a household falling below a predetermined poverty line while VER approach does not construct probabilities. In addition, VEP and VEU approaches measure vulnerability to future poverty at an individual/household level and it is possible to aggregate the individual measures of vulnerability to a single measure. VEP approach predicts the future impact of shocks while VER approach evaluates current impact of shocks. Cross sectional data can be used in VEP and VEU approaches while VER approach requires time series or panel data (Hoddinott and Quisumbing 2008). Since cross-sectional data was used in this study, VEP approach was adopted.

2.6.1 *Vulnerability to expected poverty approach*

Vulnerability as Expected Poverty (VEP) approach as originally proposed by Chaudhuri *et al.* (2002) was adopted. This is because of availability of single cross-sectional data. VEP approach assumes that a household let say *h* in time *t* becoming vulnerable to future poverty, is the probability that the household is consumption poor in time *t* + 1 as illustrated in equation 2.

$$V_{ht} = Pr\,(C_{h,\,t+1} \leq z) \tag{2}$$

where $C_{h,\,t+1}$ is the per-capita consumption of household *h* in time *t+1* and *z* is the consumption poverty line that is predetermined for benchmark purposes (Chaudhuri *et al.,* 2002). There are two recommended consumption poverty lines namely standard threshold of 0.5 (50 percent) and mean poverty rate of a given population (Hoddinott and Quisumbing 2008). This study used a consumption expenditure based national poverty line of KES 2900 per month per adult equivalent. According to Deaton (1993), consumption expenditure of household *h* at any period depend on factors such as: current income, expected income, uncertainty of future income, wealth and household's ability to smoothen consumption in the face of various shocks as shown in equation 3.

$$C_{ht} = c(X_h, \beta_t, \alpha_h, e_{ht}) \tag{3}$$

where, X_h represent observable characteristics of household *h*, β_t represent a vector of parameters explaining the macro-economic environment at time *t*, α_h represent an unobserved time-invariant household-level effect and e_{ht} represent idiosyncratic shocks that contribute to differences among households in terms of well-being (Chaudhuri *et al.,* 2002). Equation 3 is substituted into equation 2 so that, vulnerability level of household *h* can be obtained as follows:

$$V_{ht} = \Pr(C_{h,t+1} = C(X_h, \beta_t + 1, \alpha_h, e_h, t+1) \leq z \mid X_h, \beta_t, \alpha_h, e_{ht}) \tag{4}$$

Equation 4 shows that, vulnerability level of household *h* depend on the changes that occur in consumption levels of the household *h* over time. The consumption levels of household *h* over time are determined by household characteristics and changes in the setting in which the household operate in (environment). Equation 4 further shows that, multicollinearity and poverty trap are likely to occur. This is because; household's *h* vulnerability level is determined by the future consumption prospects, which in turn influenced by current observed and unobserved household characteristics. Furthermore, aggregate shocks and changes in macro-economic environment, denoted by *βt*, influences vulnerability level of household *h* (Chaudhuri *et al.,* 2002). Since vulnerability of household *h* to expected poverty depend on its expected mean consumption and changes on its consumption stream over time, both the expected mean and variance of the household consumption level are estimated in order to determine vulnerability to poverty. This estimation requires time series or panel data to allow direct estimation of inter-temporal variance of consumption at the household-level without any assumption.

However, because of unavailability and unreliability of time series data in developing countries, Chaudhuri *et al.* (2002) developed a model that predicts household's vulnerability to expected poverty using single cross-sectional data. Nevertheless, for one to use such a model, strong assumptions need to be made on the stochastic process that generates consumption. The stochastic process generating the consumption of household *h* is specified as:

$$\ln C_h = X_h \beta + e_h \tag{5}$$

In equation 5 ln C_h is log per capita consumption expenditure of household *h*, X_h represents observable characteristics of household *h*, β is a vector of parameters and e_h is an error term (with mean-zero) that captures idiosyncratic shocks that explain the differences among households in terms of per capita consumption levels. According to Chaudhuri *et al.* (2002), the idiosyncratic shocks are assumed to be identical and independently distributed over time for each of the households. Without time series data, it is not possible to identify parameters that determine an individual consumption levels and the stochastic process generating β. In such cases, the variance of e_h and ln C_h is allowed to depend on observable household characteristics in some parametric way (Equation 6).

$$\sigma_{e,h}^{\,2} = X_h \theta \tag{6}$$

A three-step Feasible Generalized Least Squares (FGLS) is then used to estimate β and θ, a procedure outlined in Amemiya (1977). According to Chaudhuri *et al.* (2002), equation 5 is estimated first by use of ordinary least squares (OLS) procedure. The resulting estimates are then used to estimate the following equation:

$$\hat{e}^{2}_{OLS,h} = X_h\theta + \eta_h \quad (7)$$

Using OLS procedure and estimates from equation 6, equation 7 is further transformed as follows:

$$\frac{\hat{e}^{2}_{OLS,h}}{X_h\hat{\theta}_{OLS}} = \left(\frac{X_h}{X_h\hat{\theta}_{OLS}}\right)\theta + \frac{\eta_h}{X_h\hat{\theta}_{OLS}} \quad (8)$$

OLS procedure is then used to estimate equation 8 in order to obtain an asymptotically efficient FGLS estimate denoted as $\hat{\theta}_{FGLS}$. $X_h\hat{\theta}_{FGLS}$ is a consistent estimate of the variance of idiosyncratic component of household consumption $\sigma^{2}_{e,h}$. The variance is estimated as follows:

$$\hat{\sigma}_{e,h} = \sqrt{X_h\hat{\theta}_{FGLS}} \quad (9)$$

The estimated variance is then used to transform equation 5 as follows:

$$\frac{\ln C_h}{\hat{\sigma}_{e,h}} = \left(\frac{X_h}{\hat{\sigma}_{e,h}}\right)\beta + \frac{e_h}{\hat{\sigma}_{e,h}} \quad (10)$$

Estimation of equation 4 using OLS procedure yields a consistent and asymptotically efficient estimate of β. The standard error of the estimated coefficient $\hat{\beta}_{FGLS}$ was then be obtained by dividing the reported standard error by the standard error of the regression. Expected log consumption and variance of log consumption of each household are then directly estimated using β and θ estimates Chaudhuri *et al.* (2002) as shown in equation 11 and 12 respectively.

$$\hat{E}[\ln C_h \mid X_h] = X_h\hat{\beta} \quad (11)$$

$$\hat{V}[\ln C_h \mid X_h] = \hat{\sigma}_{e,h}{}^{2} = X_h\hat{\theta} \quad (12)$$

It was assumed that ln C_h is normally distributed so that, the estimates in equation 11 and 12 were used to form an estimate of the probability that household h with characteristics X_h will be poor (Chaudhuri *et al.,* 2002). This is given as.

$$\hat{v}_h = \hat{\Pr}(\ln C_h < \ln z \mid X_h) = \phi\left(\frac{\ln z - X_h\hat{\beta}}{\sqrt{X_h\hat{\theta}}}\right) \quad (13)$$

In equation (13), Φ represents cumulative density of the standard normal. The estimated variance was assumed equal for all households so that equation 5 is estimated using Ordinary Least Squares (OLS) to obtain an estimate of β and the standard deviation of e_h and ln C_h. The estimates were then used to determine the probability that household h with characteristics X_h (See description of these characteristics in Table 1) will be poor in future. Vulnerability to expected poverty for each household was then compared with the predetermined poverty line (z) such that, any household with VEP value equal to or above 0.5 was considered vulnerable to future poverty (Chaudhuri *et al.,* 2002).

Table 1: Description of factors influencing vulnerability to expected poverty

Variable	Description	Expected sign
Vulnerability to future Poverty	1=Non-vulnerable, 0=Vulnerable	None
Global-GAP Certification status	Certified=1, Non-certified=0	+
Location	Sub-Counties	+/-
Asset value per adult equivalent	KES	+
Household size	Number of members per household	+/-
Household head age	Years	+/-
Gender of household head	1=Male, 0=Female	+/-
Marital status	Categorical	+/-
Total land size owned	Acres	+
Risk preferences	Categorical	+/-
Group membership	1=Yes, 0=No	+
Number of times household head sick	Numbers	-
Net livestock income	KES	+
Off-farm income	KES	+
Net crop income	KES	+

3. Results and Discussions

3.1 Mean monthly consumption expenditure per adult equivalent

On average, households of French bean farmers, irrespective of whether certified or not certified spend KES 7,292 per month per adult equivalent (Table 2).

Table 2: Mean consumption expenditure

Variable	Mean (N = 492)	Std. Dev.	Min	Max
Mean consumption expenditure per month per adult equivalent	7,292	25,682	160	477,381

This figure is above the national consumption based poverty line of KES 2,900 expenditure per month per adult equivalent. Given the poverty line and the consumption expenditure, the results suggest that on average French bean farmers in Kirinyaga County are not poor.

3.2 French beans farmers' mean vulnerability to expected poverty

On average, French bean farmers, irrespective of whether certified or not, were not vulnerable to expected poverty as indicated by vulnerability level of 0.196 (19.6 percent), which is below the vulnerability threshold of 50 percent (Table 3).

Table 3: Mean vulnerability to expected poverty

Variable	Mean	Standard Error	[95% Confidence interval]	
Mean vulnerability to expected poverty	0.196	0.0187	0.1597	0.2332

3.3 Vulnerability to expected poverty by French beans farmers' characteristics

Results in Table 4 shows that, statistically, vulnerability to expected poverty did not vary according to Global-GAP certification status (Pr = 0.347), risk preferences (Pr = 0.866), gender of the household head (Pr = 0.169), group membership (Pr = 0.309) and credit access (Pr = 0.281) among French beans farmers. The reason why Global-GAP certification is not significantly related to the future poverty is because, income to be earned from producing the French beans will not be sufficient enough to drive French bean farmers out of poverty. The findings are in line with those of Masanjala (2006) who found that engagement in cash crop increases farmer's income but sometimes not sufficient enough to move households out of poverty.

The results further show that, majority of those who are expenditure poor (56.3 percent) and income poor (92.2 percent) are vulnerable to future poverty. The vulnerability rates are higher than the national vulnerability rate of 28.3 percent, rural rate of 31.9 percent and Central Region of Kenya rate of 30.1 percent (Oxford Poverty and Human Development Initiative, 2017). The study confirms that, there is high likelihood that poverty among French beans farmers in Kirinyaga County will remain high in future unless proper interventions to mitigate the poverty are put in place. Given education, majority of those without education (4.7), primary education (64.1) and secondary education (28.9) are vulnerable to future poverty when compared to those with Certificate and Diploma (1.6) and Degree (0.8). Higher education levels are associated with high income from formal employment. High income increases household's expenditure on basic needs and wants thus reducing poverty. Similar findings are reported in Wasonga (2009).

Table 4: Respondent's characteristics by vulnerability to expected poverty

Variable	N	Not Vulnerability	N	Vulnerable
Certification status				
non-certified	142	39.1	56	43.8
Certified	222	60.9	72	56.2
Risk preferences				
I never like take risks	17	4.67	6	4.7
In most cases I don't like take risks	50	13.7	17	13.3
I sometimes like take risks	99	27.2	28	21.9
In most cases I like take risks	132	36.3	49	38.3
I always like take risks	64	17.6	27	21.1
No response	2	0.6	1	0.8
[1]Expenditure poverty				
Poor	123	33.8	72	56.3***
not poor	241	66.2	56	43.7***
[2]Income poverty				
Poor	239	65.7	118	92.2***
not poor	125	34.3	10	7.8***
Gender of HH				
Female	48	13.2	11	8.6
Male	316	86.8	117	91.4
Education level of HH				
No education	3	0.8	6	4.7***
Primary education	170	46.7	82	64.1***
Secondary education	157	43.1	37	28.9***
Certificate and diploma	31	8.5	2	1.6***
Degree	3	0.8	1	0.8***
Group membership				
Not a member of a group	94	25.8	39	30.5
Member of a group	270	74.2	89	69.5
Credit access				
No credit access	279	76.7	104	81.3
Credit access	85	23.3	24	18.7

*, ** and *** means significant at 10, 5 and 1 percent level of significance respectively .[1]Expenditure poverty was determined based on poverty line of KES 2,900 per month while [2]income poverty was determined based on $1.90 income per adult equivalent poverty line. HH-Household head

3.4 Determinants of vulnerability to poverty

Determinants of vulnerability to poverty were estimated using Vulnerability to Expected Poverty Approach and results presented in Table 5.

Table 5: Determinants of vulnerability to poverty

Variable	B	S.E	z	P>z	[95% Conf. Interval]	
Dependent variable: [1]Vulnerability to Expected Poverty						
Never like take risks	0.0652	0.4372	0.150	0.881	-0.7917	0.9220
In most cases don't like take risks	0.1015	0.4108	0.250	0.805	-0.7037	0.9066
Sometimes like take risks	0.3575	0.3974	0.900	0.368	-0.4214	1.1364
In most cases like take risks	0.8198	0.4194	1.950	0.051*	-0.0022	1.6417
Always like take risks	0.6978	1.0261	0.680	0.496	-01.313	2.7089
Certification status	-0.1303	0.1762	-0.740	0.459	-0.4756	0.2150
Assets value PAE	-0.4309	0.0605	-7.120	0.000***	-0.5495	-0.3124
No education	-5.5593	225.4922	-0.020	0.980	-447.5160	436.3974
Primary education	-6.9053	225.4916	-0.030	0.976	-448.8607	435.0500
Secondary education	-7.2872	225.4916	-0.030	0.974	-449.2426	434.6681
Tertiary education	-8.0017	225.4919	-0.040	0.972	-449.9578	433.9544
Household size	1.2671	0.2377	5.330	0.000***	0.8011	1.7331
Age of HH	-0.5472	0.3211	-1.700	0.088*	-1.1765	0.0822
Gender of HH	0.9689	0.2943	3.290	0.001**	0.3922	1.5457
Group membership	-0.2437	0.1963	-1.240	0.215	-0.6285	0.1411
Net livestock income	-0.0245	0.0191	-1.280	0.199	-0.0620	0.0129
Off-farm income	-0.0749	0.0160	-4.680	0.000***	-0.1062	-0.0435
Net crop income	-0.2023	0.0230	-8.810	0.000***	-0.2474	-0.1573
Distance to the market	-0.4360	0.1081	-4.030	0.000***	-0.6479	-0.2242
Constant	13.9598	225.4969	0.060	0.951	-428.0061	455.9256
Number of observation	492					
LR chi2(19)	275.26					
Prob > chi2	0.0000					
Pseudo R2	0.4880					

HH- Household Head. PAE-Per Adult Equivalent. *, ** and *** means significant at 10, 5, and 1 percent level of significance respectively. [1]Vulnerability to expected poverty was captured as: Vulnerable = 1 and Not vulnerable = 0. SE – Standard Error.

Variable indicating Global-GAP certification status is statistically insignificant (P = 0.459) indicating that income farmers receive from producing Global-GAP certified French beans (given several needs facing the households), will not guarantee poverty alleviation in future. Variable indicating asset value per adult equivalent is statistically significant (P = 0.000) and negatively (B = -0.4309) influencing vulnerability to poverty of French bean farmers. *Ceteris paribus*, an increase in asset values by one Kenyan Shilling, vulnerability of French bean farmers to expected poverty will reduce by 43.1 percent and vice versa. The reason is that some asset accumulation coupled with an increase in value will cushion farmers from future poverty. Similar findings are reported in Gbetibouo (2009) who found that wealth accumulation enhances the ability of households to bear anticipated risks. Ajijola *et al.* (2011) also noted that, an increase in the household disposable assets such as stored grains and livestock by one unit reduces poverty by 0.0000127 units. Similar findings are also reported in Muyanga *et al.* (2006) and Mbakahya and Ndiema (2015). Achieng' (2014) however reported contrary findings that, *ceteris paribus*, an additional high valued asset positively influences severity of poverty by 0.280 times among French bean farmers in Kirinyaga County.

Household size is statistically significant (P = 0.000) and positively (B = 1.2671) influencing vulnerability to expected poverty. *Ceteris paribus*, increase in household size by one member increases vulnerability to expected poverty by 126.7 percent and vice versa. The explanation for this is that, increasing the number of household members while holding income constant leads to a decrease in the welfare of the all members due to high competition for the existing scarce resources. Similar findings are reported in Muyanga *et al.* (2006), Muriithi (2008), Meenakshi and Ray (2000), Swanepoel (2005), Dirway (2010), Damisa *et al.* (2011), Mok *et al.* (2011) and Achieng' (2014) who concur that an additional household member increases household poverty. For instance Achieng' (2014) found that an additional household member increases severity of poverty by 0.827 times among French beans farmers in Kirinyaga County. Contrary findings are reported in Megersa (2015) who found that, large family size is a good source of labour for the household in the future that will undermine vulnerability to poverty.

Age of household head is statistically significant (P = 0.088) and positively (B = -0.5472) influencing French beans farmers vulnerability to expected poverty. That is, *Ceteris paribus*, increase in the age of the household head by one year decreases vulnerability to expected poverty by 54.7 percent and vice versa. The explanation for this is that, household heads are household providers and as age increases, their strength and productivity decreases coupled with health problems. As a result, household expenditure increases with dwindling income opportunities thus increasing household probability of falling into future poverty (Igbalajobi *et al.,* 2013). Similar findings are reported in Bogale *et al.* (2005) who found that as the age of household head increases, they tend to own more assets and experience changes in the structure of the family as children grow and leave the household or contribute in lab our force to various farm activities.

Gender of household head is statistically significant (P = 0.001) and positively (B = 0.9689) influencing French beans farmers' vulnerability to expected poverty. That is, *Ceteris paribus*, households headed by males are 0.9689 times more vulnerable to expected poverty and vice versa. Similar findings are reported in Hichaambwa *et al.* (2015) and Machio (2015). According to Hichaambwa *et al.* (2015), female headed households are less likely to be poor because they are more willing to participate in horticultural farming than male headed households. Machio (2015) found that male headed households in Kenya are 2 percent more likely to be poor compared to households that are headed by a female. The explanation for this is that, male headed households control household incomes and expenses, and since they are the sole decision makers, they might decide to spend the money on personal effects rather than on the household income generating activities thus leading his household being poor. On the other hand contrary findings are reported in Oyugi *et al.* (2000), Geda *et al.* (2005) and Githinji (2011).

Variable indicating French beans farmers who in most cases like taking risks is statistically significant (P = 0.051 and B = 0.8198) and positively relating to vulnerable to future poverty. This means that if farmers in Kirinyaga County continue producing French beans in the face of Global-GAP standards, while holding current acreage constant, their vulnerability to expected poverty will increases by 82 percent and vice versa. The reason is that, Global-GAP certification positively increases household's income, but the increase in French beans income is not sufficient enough to move the households out of poverty brackets. The findings are contrary to those of Mosley and Verschoor (2003) and Ghartey *et al.* (2014) who found that risk aversion increases poverty among farmers.

Net annual crop income (P = 0.000 and B = -0.2023) significantly and negatively influenced vulnerability to future poverty of French bean farmers. That is, *ceteris paribus*, an increase in net crop income by one Kenyan shilling, vulnerability to expected poverty decreases by 20.2 percent and vice versa. The findings concur with those of Muyanga *et al.* (2006) who found that income from crop diversification reduces household's probability of falling into poverty among Kenyan farmers. Hulme and McKay (2005) argue that crop failure is associated with household vulnerability to poverty.

Off-farm income (P = 0.000 and B = -0.0749) significantly and negatively influence vulnerability to future poverty of French bean farmers. That is, *ceteris paribus*, an increase in net crop income and off-income of French bean farmers by one Kenyan shilling, vulnerability to expected poverty decrease by 7.5 percent and vice versa. The reason is that, in most cases, agricultural income is seasonal and unpredictable, thus off-farm income or formal employment becomes one of the coping mechanisms that cushion farmers against observed and future poverty. The findings concur with those of Oyugi *et al.* (2000), Burke *et al.* (2007), Githinji (2011), Onyeiwu and Liu (2013) and Megersa (2015) who found that an increase in off-farm income cushion farmers from falling into poverty.

Distance to the nearest market is statistically significant (P = 0.000) and negatively (B = -0.4360) influencing vulnerability of French beans farmers to future poverty. That is, c*eteris paribus*, increase in the distance to the nearest market by one kilometer, French beans farmers vulnerability to future poverty decreases by 43.6 percent and vice versa. The reason is that, local or farm gate markets do offer lower prices which translate to lower income. Lower income increases current and future poverty. Therefore far markets like those in Nairobi and in overseas (for instance European markets) offer higher prices which translate to more income and thus reduction in poverty. Contrary findings however are reported in Elhadi *et al.* (2012).

4. Conclusions and Recommendations

Results further indicate that majority of French beans farmers who were expenditure (56.3 percent) and income poor (92.2 percent) were vulnerable to future poverty. French beans farmers who in most cases like taking risks (P = 0.051 and B = 0.8198) were more likely to be vulnerable to future poverty. That is, if farmers continue producing French beans in the face of Global-GAP standards, while holding current acreage constant, their

vulnerability to expected poverty will increase by 82 percent and vice versa. The reason is that, although Global-GAP certification significantly and positively increases household's income, the increase in income was not sufficient enough to move the households out of current and future poverty brackets. Other important factors influencing French beans farmers vulnerability to expected poverty include: asset value per adult equivalent (P = 0.000|B = -0.4309), household size (P = 0.000|B = 1.2671), age of household head (P = 0.088|B = -0.5472), gender of household head (P = 0.001|B = 0.9689), net crop income (P = 0.000|B = -0.2023), off-farm income (P = 0.000|B = -0.0749) and distance to the nearest market (P = 0.000|B = -0.4360). The findings suggest that, French beans farmers should take more risks by continuing producing and expanding acreage under Global-GAP certified French beans in order to increase household income and expenditure and hence alleviating future poverty.

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