Journal of Behavioral and Experimental Finance 18 (2018) 18–29

Contents lists available at ScienceDirect

Journal of Behavioral and Experimental Finance

journal homepage: www.elsevier.com/locate/jbef

Full length article

Risk attitude effects on Global-GAP certification decisions by smallholder French bean farmers in Kenya

N. Kibet [a,*], G.A. Obare [b], J.K Lagat [b]

[a] Department of Agricultural Bio-systems and Economics, University of Kabianga, Kenya
[b] Department of Agricultural Economics and Business Management, Egerton University, Kenya

ARTICLE INFO

Article history:
Received 23 August 2017
Received in revised form 19 October 2017
Accepted 29 January 2018
Available online 9 February 2018

Keywords:
Smallholder farmers
French beans
Risk attitudes
Global-GAP certification decisions

ABSTRACT

Knowledge on the link between French beans farmers' attitudes toward risks and Global-GAP compliance decisions is limited in Kenya. A social experiment (Lottery games involving real pay-offs) was implemented on 119 randomly selected farmers to solicit risk attitudes and Binary Logit Model to determine the effect of risk attitudes on compliance decisions. Majority of non-certified farmers (24 percent) were risk averse relative to certified farmers (4.3). Non-certified farmers were more averse towards losses ($p = 0.062|MD = 0.50$). Farmer's probability weighting ($p = 0.046$), aversion to loss ($p = 0.094$), contract farming ($p = 0.000$) and daily household expenditure per adult equivalent significantly and negatively affected compliance decisions while risk aversion ($p = 0.081$), annual asset value ($p = 0.092$) and acreage under French beans ($p = 0.033$) significantly and positively affected compliance decisions. The results suggest that crop insurance and affordable credit is important in mitigation of potential production and marketing risks in French bean farming.

1. Introduction

In Kenya, approximately 2.57 million people are farmers and out of these, 60,000 are producers of French beans (Ebony Consulting International, 2001). There is a tendency by many farmers in Kenya shifting to vegetable farming due to the perception that horticultural crops are more yielding and profitable. In Central region of Kenya for instance, more farmers are shifting towards production of French beans for both local and export markets. The increasing awareness of healthy foods among consumers has seen markets, particularly export markets in Europe, demand Global-GAP certified French beans. The European markets are more lucrative than the local markets. Global-GAP standards incorporate the principles of Hazard Analysis Critical Control Point (HACCP) which ensure decency in production and marketing of horticultural products. The standards also incorporate International Labour Organization (ILO) principles, which ensure decency in workers welfare (GLOBALG.A.P, 2017).

Production of vegetables in the presence of different institutional arrangements like Global-GAP standards exposes farmers to varying degrees of returns and risks (Tschirley et al., 2004). Jaleta et al. (2009) further noted that, the shift from subsistence to commercial farming may expose the households to risks such as volatile market prices, especially in rural areas where the markets are not well-integrated. The production of French beans in the face of Global-GAP standards is characterized by volatile returns due to price fluctuations Asfaw et al. (2010), high incidence of pests and diseases and high cost of compliance and certification (Humphrey, 2008; Muriithi et al., 2011). In addition, incomplete compliance with the Global-GAP standards in the production of French beans poses a risk of commodity rejection in the export market. For instance, in the year 2014, value of vegetables exported dropped by 17.9 per cent due to Minimum Residue Limits (MRLs) challenges (Economic Survey, 2015). Given the risks, the study determined the relationship between French beans farmer's risk preferences and Global-GAP compliance decisions in Kirinyaga County, Kenya.

Studies on agricultural technology adoption in the face of risk preferences of farmers have been extensively conducted using experiments, both real and hypothetical pay-off. Studies that used experiments include (Liu, 2013) who estimated the effect of loss aversion, risk aversion, and nonlinear probability weighting on adoption of Bt cotton adoption in China. The study found that farmers averse to risks and losses adopted the Bt cotton. In addition, farmers who overweighed smaller probabilities adopted the Bt cotton. Cavane (2011) used Likert scale to solicit risk attitudes and binary Logit model to determine the effect of farmers' attitudes toward risks on the adoption of new maize varieties in Mozambique. The study found a positive relationship between risk aversion and adoption of improved maize varieties and chemical fertilizers. In Nigeria, Chinwendu et al. (2012) also used Likert scale to solicit risk

* Correspondence to: P.O Box 7519 – 30100, Eldoret, Kenya.
E-mail address: noahkibet@gmail.com (N. Kibet).

https://doi.org/10.1016/j.jbef.2018.01.003
2214-6350/

attitudes of poultry farmers and found that, farmers who are risk takers and aware of the benefits of agricultural insurance were able to acquire and use the insurance services.

Koundouri et al. (2006) used moment-based approach proposed by Antle (1987) to solicit risk attitudes and Probit model to determine the effect of risk attitudes on the uptake of modern irrigation technologies among farmers in Greece. They found that as production risks increased, farmers' probability of adopting the modern irrigation technologies also increased. By using an experiment (under prospect theory) to solicit risk attitudes and Tobit model to determine the effect of risk attitudes on uptake of new rice varieties among farmers in Lao PDR, Ross et al. (2012) found no significant relationship. Kirumba and Pinard (2010) used hypothetical payoffs to determine Kenyan coffee farmers' willingness to protect environment by embracing Global-GAP standards. The study revealed that, farmers' perception towards potential benefits from compliance is the major factor that drives coffee farmers in Kenya to comply with coffee eco-certification standards. Though risk preferences is an important factor in determining uptake of new agricultural technologies worldwide, studies on the relationship between risk preferences and Global-GAP compliance decisions in Kenya are very scanty. This is because, existing studies on private standards operating in horticulture industry have been done (Asfaw, 2007; Humphrey, 2008; Asfaw et al., 2009; Asfaw et al., 2010; Muriithi et al., 2011; Nyota, 2011; Kangai and Mburu, 2012; Karira et al., 2013). However, none of these studies captured and linked vegetable farmers' risk attitudes to their decisions to comply with the private standards. The studies may have studied each case in different dimension but failed to study the link between them.

2. Theoretical framework

In this paper, "risk chain" concept outlined in Hoddinott and Quisumbing (2008) forms the basis of this theoretical framework. The concept assumes that, links exist between risk attitudes facing households and activities the households decide to engage in. The production of French beans in the face of Global-GAP standards is characterized by several risks which are perceived to influence farmers' decisions on whether to comply and get certified under Global-GAP standards or not. Methods of soliciting risk attitudes of respondents are many and categorized in many ways depending on authors. For instance Moscardi and De Janvry (1977) categorizes as interview and experimental methods. Experimental methods directly and precisely solicit risk attitudes of decision makers. However, they are not only costly, time consuming but also may give inaccurate results since respondents in a given place at a given time differ in the levels of tolerance or intolerance for gambling and that the concepts of probability are by no means intuitively obvious (Moscardi and De Janvry, 1977). Binswanger (1980, 1981) applied both methods, interview and experiment in soliciting risk attitudes and concluded that, interview method is inappropriate since risk aversion results were totally inconsistent with those of experimental approach. The methods are further classified by Dillon and Scandizzo (1978) as; economic anthropology, econometric estimation of models, farm risk programming, sectoral risk programming, expected utility and safety-first theory. According to Ghartey et al. (2014), despite the existence of enormous methods of soliciting risk attitudes, there is no universally accepted method of soliciting risk attitudes. But, since experimental approach has been widely applied by many studies (Binswanger, 1980; Bradford et al., 2014; Holt and Laury, 2002; Wik et al., 2004; Yesuf and Bluffstone, 2009) and found to be reliable, it was adopted in this paper.

Expected Utility theory (EUT) and Prospect Theory (PT) are widely applied theories in modeling farmers' decisions under risky situations. Both theories use social experiments to solicit risk attitudes of decision makers. EUT was first proposed by Bernoulli (1738) and later further developed by Neumann and Morgenstern (1944). Its underlying assumption is that, decisions made under risky situations are like making choices between prospects. If this assumption is valid, then according to Neumann and Morgenstern (1944), a prospect let say A, can be defined as a function of outcomes and their respective probabilities of occurrence. This is given as:

$$A = f\{(M_1, P_1), \ldots, (M_n, P_n)\} \tag{1}$$

In Eq. (1) M_{1-n} is outcomes of the prospect A and P_{1-n} are the respective probabilities of the outcomes. Under EUT, decision makers are assumed to consider final net wealth/assets as the reference point when making decisions under risky situations (Kahneman and Tversky, 1979). Mathematically, this is given as:

$$EV = (1 - P)U(M_1 + W) + PU(M_2 + W) \tag{2}$$

In Eq. (2) EV is the expected value of the prospect, U represents utility and W represents wealth/assets. Under EUT, risk aversion is the only parameter that determines the shape of the utility function. Utility function of a risk averse decision maker is concave, linear for risk neutral and convex for a risk loving (Kahneman and Tversky, 1979). Contrary, Prospect Theory (PT) assume decision makers consider gains and losses from a certain reference point and not their final asset base (as assumed in EUT) while making choices under risky situations. In PT, decision makers are assumed to be risk averse when faced with gains or positive prospects and risk seeking when faced with losses and negative prospects (reflection effect). In addition, the decision makers are assumed to consider more the "value" of a prospect (non-linear probability weighting) rather than the level of probability attached to a prospect as assumed in EUT. That is, decision makers overweigh the outcomes that are considered certain relative to outcomes that are risky (Kahneman and Tversky, 1979).

Therefore, under PT, risk aversion, loss aversion and non-linear probability weighting determine the shape of utility function of an individual decision maker. As a result, value function for decision makers who consider an outcome of a prospect as a loss is convex and relatively steep and concave, but not so steep, for those who consider an outcome of a prospect as a gain (Plous, 1993). A prospect in PT is further assumed to have two components namely "common" and "unique". The components yield different preferences (isolation effect) and thus possible to decompose a given prospect into risk and riskless components (Kahneman and Tversky, 1979). Both EUT and PT are suitable for soliciting risk attitudes of farmers. However, some studies acknowledge that PT predicts better than EUT due to some unrealistic assumptions in EUT (Camerer, 2001; List, 2005; Plous, 1993; Quiggin, 1993). In particular, Quiggin (1993) found EUT not suitable for soliciting risk attitudes when individuals are faced with losses and gains.

In PT, three parameters V, $\Pi(p)$ and v are introduced to capture psychological impacts of the decision makers. V represents the overall value of an edited prospect, $\Pi(p)$ is a decision weight, which reflects the impact of p (probability) on the over-all value of the prospect and v is the value function that measures the value of deviations from the reference point (gains and losses). The prospect is strictly positive if its outcomes are all positive, strictly negative if its outcomes are all negative and regular if it is neither strictly positive nor strictly negative (Kahneman and Tversky, 1979). Assuming $(x, p; y, q)$ is a regular prospect, then,

$$V(x, p; y, q) = \Pi(p)v(x) + \Pi(q)v(y) \tag{3}$$

A prospect is segregated into riskless and risky components at evaluation phase as follows:

$$V(x, p; y, q) = v(y) + \Pi(p)[v(x) - v(y)] \tag{4}$$

In Eq. (4), $q = 1 - p$, $v(y)$ represents the riskless component and $[v(x) - v(y)]$ represents the risky component. $\Pi(p)$ is the ratio of the weight associated with the probability p to the weight associated with the sure event (Kahneman and Tversky, 1979). French beans farmers' decisions to embrace Global-GAP standards are like the prospects in EUT and PT. This is because uptake of the standards comes with varying levels of returns and risks (Tschirley et al., 2004). Compliance with the private standards is a costly activity, which squeezes out farmers' profits (Muriithi et al., 2011). Since compliance with the standards is a risky venture, aversion to risk and time are expected to influence French beans farmers' decisions to comply with the standards. In addition, the French beans farmers are assumed to be after profit maximization and cost minimization. In this regard, it is expected that they will consider losses and gains (as assumed in PT) rather than their current assets (as assumed in EUT) as a reference point in making decisions to comply with the standards. That is, French beans farmers who will view compliance with the Global-GAP standards as a profitable decision will end up complying and those who will view it as a loss due to high cost of compliance and certification will fail to comply (non-probability weighting).

Since there is likelihood that risk aversion, loss aversion and non-probability weighting will explain French beans farmers' decisions to comply with the standards, PT will be applied. EUT does not capture loss aversion and non-probability weighting behavior of decision makers and therefore will not be appropriate for application. Both EUT and PT can be used to explain risk aversion behavior of the French beans farmers but the problem is that, it is not known whether EUT or PT will explain better. To clear the doubt, approach by Tanaka et al. (2010) will be applied because it combines both EUT and PT. The approach enables researchers to determine if EUT or PT predicts well risk attitudes. It also allows estimation of both the coefficient of risk aversion, loss aversion and non-linear probability weighting. Mathematically, Tanaka et al. (2010) utility function is given as:

$$U(x, p; y, q) = \begin{cases} v(y) + w(p)(v(x) - v(y)) & x > y > 0 \ or \ x < y < 0 \\ w(p)v(x) + w(q)v(y) & x < 0 < y \end{cases} \quad (5)$$

In Eq. (5) $U(x, p; y, q)$ is the expected value of a prospect while x and y are the outcomes of the prospect while p and q are the respective probabilities for the outcomes.

$$v(x) = \begin{cases} x^{1-\sigma} & for \quad x > 0 \\ -\lambda(-x)^{1-\sigma} & for \quad x < 0 \end{cases} \quad (6)$$

In Eq. (6) $v(x) = x^{1-\sigma}$ is value function for gains $x > 0$ and $v(x) = -\lambda(-x)^{1-\sigma}$ represent value function for losses $x < 0$. σ Indicate the shape of the value function (concavity) which is because of increasing/decreasing marginal value of money. If $\sigma < 0$ French bean farmer is risk loving, risk neutral if $\sigma = 0$ and risk averse if $\sigma > 0$. λ denotes the midpoint of the lower and upper bounds of the switching point in the questions of series. It also indicates the degree of loss aversion such that, a higher value of λ will mean decision maker is more loss averse. Probability weighting function is given as:

$$w(p) = \exp[-(-\ln p)^{\alpha}] \quad (7)$$

In Eq. (7) α is the non-linear probability weighting measure such that probability weighting function is linear if $\alpha = 1$, S-shaped if $\alpha > 1$ (the individual under-weights small probabilities and over-weighs large probabilities), inverted S-shaped if $\alpha < 1$ (the individual over-weighs small probabilities and under-weights large probabilities). According to Tanaka et al. (2010), weighting function by Prelec (1998) is appropriate for use since it fits well cases where individual decision makers have either inverted-S or S-shaped weighting functions. When $\alpha = 1$ and $\lambda = 1$, Tanaka et al. (2010) model reduces to model under EUT. The study hypothesized that, household socio-economic characteristics (X_1), household preferences (X_2), institutional factors (X_3), technology characteristics (X_4) and farm characteristics (X_5) influence French beans farmers' decisions to comply with the private standards (ST_i) as indicated in Fig. 1. Functionally, this is given as:

$$ST_i = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + e_i \quad (8)$$

In Eq. (8) ST_i denotes French beans farmers' decisions to comply with the private standards. ST_i takes value 0 for non-certified French beans farmers and value 1 for Global-GAP certified French beans farmers. α is a constant, β_i is a vector of coefficients for the socio-economic, household preferences, institutional and policy factors, technology and farm characteristics while e_i is an error term. Factors influencing binary decisions can be estimated using binary Logit or Probit models. Both models are based on the random utility model and yield similar results (Gujarati, 2004). Nonetheless, binary Logit assumes that error terms are logistically distributed while binary Probity assumes a normally distributed error terms (Greene, 2003; Gujarati, 2004; Nyota, 2011). Ordinary Least Squares (OLS) regression is unsuitable because the endogenous variable is discrete and the fact that non-linear relationship is expected exists between the endogenous and exogenous variables. Using OLS therefore might result to inefficient estimates and heteroscedasticity (Gujarati, 2004). Multinomial Logit (MNL) model is also unsuitable since its endogenous variable takes more than two categories (Greene, 2003; Gujarati, 2004).

3. Experimental design

Lottery experiments oriented to Expected Utility (EUT) and Cumulative Prospect Theory (CPT) were used in this study. EUT and CPT have been applied by many studies on agriculture. Some of these include: Binswanger (1980) and Holt and Laury (2002) which used experiments oriented to EUT and Liu (2008) and Tanaka et al. (2010) which used experiments oriented to EUT and CPT. Experiments under EUT and CPT are framed such that the outcome probabilities are held constant while lottery stakes are varied. In addition, CPT Experiments include both gains and losses and their respective probabilities. Summary of the studies are shown in Table 1.

This study adopted lottery experiments similar to those in Tanaka et al. (2010) and Love et al. (2014). Two (2) and one (1) experiment series for PT and loss aversion were implemented respectively. Samples of PT and loss aversion series used are shown in Tables 2 and 3 respectively. In PT series (Table 2), each respondent was asked to make choices between two options: option A and B in each series of experiment. Option A involved a 70 percent probability of receiving KES 100 and a 30 percent probability of receiving KES 200. Option B involved a 90 percent probability of recipients receiving KES 50 and a 10 percent probability of their receiving KES 200 KSH which increases by KES 50 in each task until it surpasses the expected value of Option A. Each lottery series had 9 tasks and the percentages in each option remained unchanged. The lotteries were structured in such a manner that ensures that more/less risk-averse decision maker is identified based on the point at which he or she decided it was worth the risk to switch from Option A to Option B (Love et al., 2014).

To estimate loss aversion, one series of two options (A and B) was used (Table 3). In each option, respondents were making choices between gains and losses. Also as done in the risk aversion series, more or less loss-averse decision-makers were identified based on the point at which they decided to switch from Option A to Option B. Participants were paid KES 100 with certainty, and won more money based on their responses given the series (Love et al., 2014).

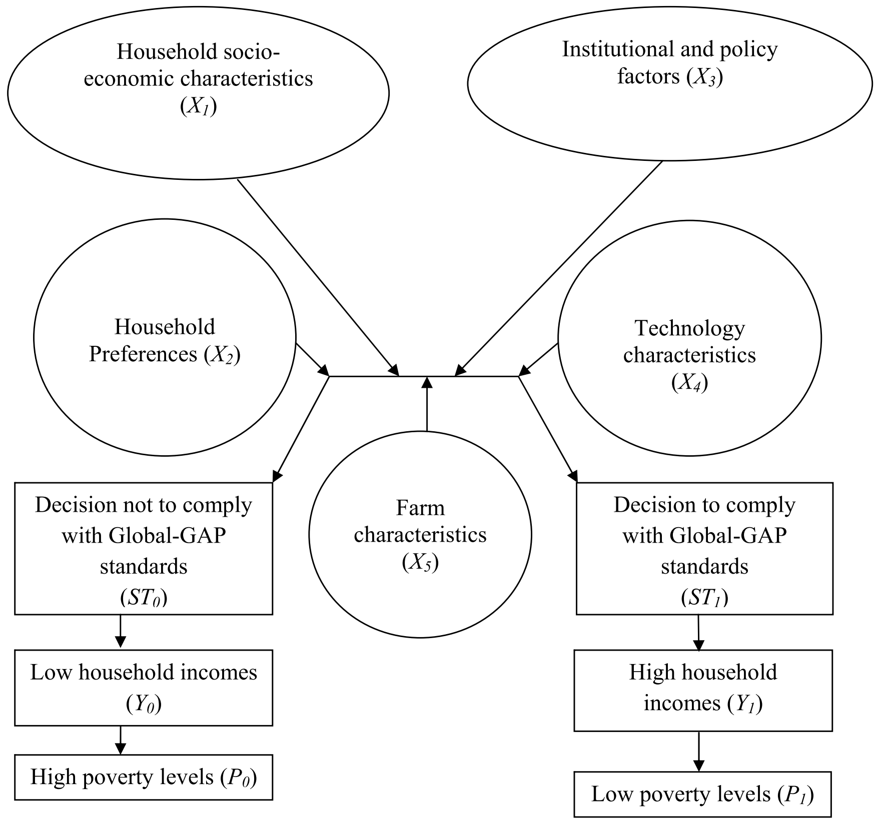

Fig. 1. Conceptual framework of risk chain concept.
Source: Own conceptualization.

Table 1
Summary of studies that used EUT and CPT perception frameworks.

Study	Country	Lottery type	Perception framework	Utility function
Binswanger (1981)	India	Hypothetical and real	EUT	CRRA
Holt and Laury (2002)	USA	Hypothetical and real	EUT	CRRA and POWER
Liu (2008)	China	Real	EUT and CPT	CRRA
Tanaka et al. (2010)	Vietnam	Real	EUT and CPT	CRRA
Love et al. (2014)	Kenya	Real	EUT and CPT	CRRA

EUT—Expected Utility Theory, CPT—Cumulative Prospect Theory, CRRA—Constant Relative Risk Aversion, RDUT—Rank Dependent Utility Theory.

Table 2
PT series 1.

Task No.	Starting point	Option A	Option B	How to identify a switching point
1		100 if 1 2 3 4 5 6 7 200 if 8 9 10	50 if 1 2 3 4 5 6 7 8 9 200 if 10	If option A is chosen, move DOWN the table If option B is chosen, move UP the table
2		100 if 1 2 3 4 5 6 7 200 if 8 9 10	50 if 1 2 3 4 5 6 7 8 9 250 if 10	

4. Logistic regression model

In this study, a Binary Logit regression was used. The model applies maximum likelihood estimation after transforming the dependent into a logit variable. Logit coefficients correspond to beta (β) coefficients in the logistic regression equation and a pseudo R^2 statistic summarizes the strength of the relationship between the exogenous and endogenous variables. Normally, a rational decision maker is expected to choose an alternative that maximizes his/her utility or profit when faced with many alternatives. The alternative chosen depend on both the non-error term component of the utilities and the values of the error terms associated with the utilities of the decision maker (Nyota, 2011). In this study, it is assumed that French beans farmer i makes decision j from a bundle of decisions available to him/her in order to maximize his/her utility level U_{ij} subject to his/her socio-economic, institutional, household preferences, farm and technology constraints (X_i). The random utility model for the French bean farmer i is given as:

$$U_{ij} = X_{ij}\beta_j + e_{ij} \tag{9}$$

In Eq. (9) i denotes individual French bean farmer, j denotes alternative decisions facing farmer i. An underlying unobserved or latent variable ($Y_i{}^*$) can be defined to denote the level of indirect utility associated with the j^{th} decision. The unobservable variable is related to the actual decision to either comply with the Global-GAP standards or not. The observed variables are defined as: $Y_i = 1$ if

Table 3
Loss aversion series.

Task No.	Starting point	Option A	Option B	How to identify a switching point
1		185 if 1 2 3 4 5 -30 if 6 7 8 9 10	200 if 1 2 3 4 5 -150 if 6 7 8 9 10	If option A is chosen, move DOWN the table.
2		30 if 1 2 3 4 5 -30 if 6 7 8 9 10	200 if 1 2 3 4 5 -150 if 6 7 8 9 10	If option B is chosen, move UP the table

$Y_i* = \max(Y_1*, Y_2*, \ldots, Y_m*)$ and $Y_i = 0$ otherwise (Nyota, 2011). Assuming there is no ties, then

$$Y_i^* = X_i\beta_i + \varepsilon_i \tag{10}$$

where X_i represents the socio-economic and institutional factors, household preferences, technology and farm characteristics influencing compliance decisions of French beans farmer *i*. β_i are parameters to be estimated while ε_i is the error term that captures unobserved variations in French beans farmers' perceptions and choices, and attributes of the alternative choices. Functionally, the binary logistic regression model is given as follows:

$$E(y|x) = F(\beta' x) = \frac{e^{\beta' x}}{1 + e^{\beta' x}} \tag{11}$$

If the residuals are independently and identically distributed with a cumulative distribution function given as $F(\varepsilon_i < E) = \exp(-e - E)$ and whose probability density function is $F(\varepsilon_j) = \exp(-\exp(-\varepsilon_{i,j}))$, an analytical solution exists and the probability of a given choice alternative for the *i*th French bean is given as:

$$P(yi = j) = \frac{\exp(X'_{ij}\beta_j)}{1 + \sum_k \exp(X'_{ik}\beta_j)}, k = i, \ldots, j \tag{12}$$

In Eq. (12), $P\,(y_i = j)$ denotes probability of French beans farmer *i* making decision *j*, X_i' *is* a vector of the exogenous variables while β_j are the parameters of the exogenous variables to be estimated using maximum likelihood (ML) method. Binary logistic regression can yield either odds ratio or marginal coefficients. Odds ratios mean a unit change in an exogenous variable leads to changes in the probability of complying with Global-GAP standards changes by a factor of exp β. On the other hand, marginal coefficients indicate the effect of each exogenous variable on the probability to comply with Global-GAP standards, *ceteris paribus* and are interpreted as typical beta coefficients in a linear regression model (Nyota, 2011). Empirical model estimated is given as follows:

$$ST_i = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + e_i \tag{13}$$

5. Methods and materials

5.1. Study area

The study was conducted in Kirinyaga County because of the importance of French beans in the farming systems and the implementation of Global-GAP standards among the French beans farmers in the County (Fig. 2).

The County is located 120 Kms North West of Nairobi and has a total population of 153, 095 (Economic Survey, 2009). The County has five Sub-Counties where French beans are produced. They are namely: Kirinyaga Central, Kirinyaga East, Kirinyaga West, Mwea East and Mwea West. 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.

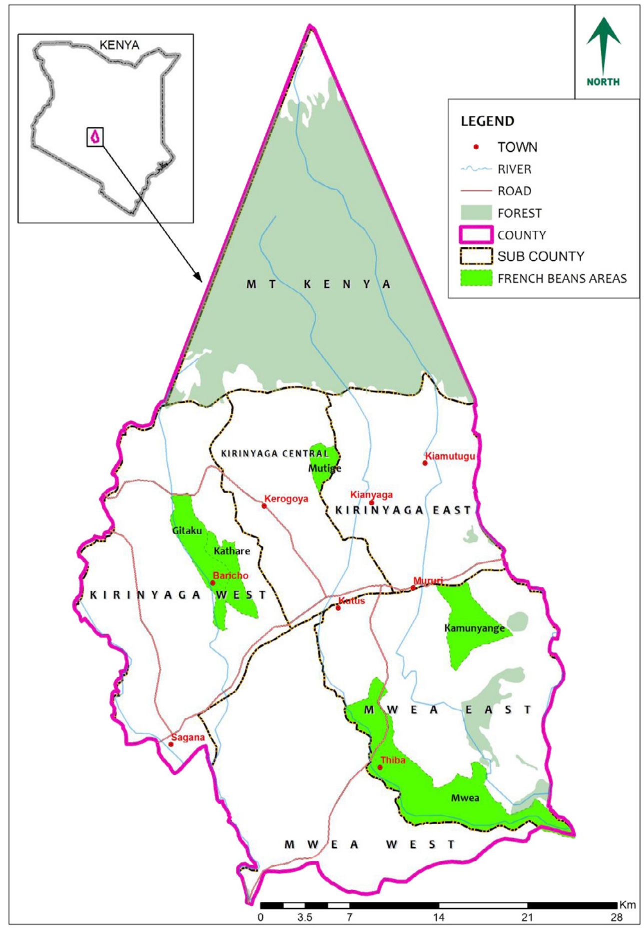

Fig. 2. Map showing French beans growing areas in Kirinyaga County.
Source: WRI, DIVA-GIS and ILRI.

5.2. Sample size and Sampling procedure

Lists containing French beans farmer's certification details were obtained from Kirinyaga County Agricultural Office, farmer groups and exporters of French beans contracting farmers. The lists were then used to generate a sampling frame of 1943 certified and non-certified farmers. Formula by Krejcie and Morgan (1970) was then used to determine the sample size. Mathematically, the formula is given as:

$$S = \frac{X^2 NP(1 - P)}{d^2(N - 1) + X^2 P(1 - P)} \tag{14}$$

In Eq. (14), S is the required sample size, X^2 = the table value of chi-square for 1 degree of freedom at the desired confidence level ($1.96 \times 1.96 = 3.84$), 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 $N = 1943$ is 322. But due to availability of funds, the need to increase accuracy and the anticipation of some questionnaires being rejected, the sample size was increased to 492. Systematic random sampling procedure was used to draw the sample size of 492 respondents (certified and non-certified) from the sampling frame. The sample size was drawn in such a way that all the Sub-Counties (Kirinyaga Central and East, and Mwea East and West) were represented proportionately. A sub-sample of 119 respondents (comprising of 69 and 50 certified and non-certified French beans farmers respectively) were drawn from the overall sample size of 492 respondents using systematic random sampling procedure and subjected to social experiment (lottery games) to solicit the risk attitudes. All the four Sub-counties: Kirinyaga Central and East, and Mwea East and West) were represented in the selection of both the certified and non-certified farmers.

5.3. Data

Data collected include household socio-economic, psychological and institutional characteristics. Attitudes toward risks were solicited by implementing a social experiment involving real payoffs. Both structured and unstructured questionnaires were used to capture the data.

6. Results and discussions

6.1. Descriptive statistics

Table 4a summarizes characteristics of 119 certified ($N = 69$) and non-certified ($N = 50$) French beans farmers. To facilitate comparisons and discussions, t-test was done to determine if the two categories of farmers were statistically and significantly similar based on their socio-economic, psychological and institutional characteristics. The results indicates that, both categories of farmers are similar based on aversion to risks (alpha), probability weighting (sigma), total land size owned, acreage under French beans, number of times attended agricultural trainings, total adult equivalent, household size, distance to the nearest French beans market, household head age, total expenditure on non-food items, expenditure on food items per adult equivalent per day, total annual expenditure, total expenditure per adult equivalent per day, net annual income and income per adult equivalent per day. This is because none of the characteristics was statistically significant.

Years of experience in farming is statistically significant ($p = 0.066$) with a mean difference of 1.32 years. This indicates that, on average, non-certified French beans farmers had 1.32 years of experience above the average age of certified farmers. The results indicates that majority of non-certified farmers have been in farming of French beans for a relatively longer time vis-a-vis certified ones. Total cost of producing French beans is highly significant ($p = 0.003$) with a mean difference of KES −5060.25 as indicated in Table 4a. That is, on average, certified French beans farmer incurred KES 5060.25 per acre above what non-certified farmer incurred. The reason is that, Global-GAP compliance and certification processes are costly which inflates the cost of producing French beans. Net income from French beans per acre is also statistically significant at ($p = 0.089$) with a mean difference of KES −8930.47 per acre. This indicates that each certified French beans farmer earned a net income of KES 8930.47 per acre above what non-certified farmer earned from the same unit of land. The results suggest that, decision to comply and get certified under Global-GAP standards in French beans production is a profitable venture.

Expenditure on food is statistically significant ($p = 0.028$) with a mean difference of KES −17,369.44 per household per annum. The results indicates that, certified French beans farmers spent on average KES 17,369.44 above what non-certified farmers spent per annum per household on food items. The results suggest that French beans farmer's decisions to comply and get certified under Global-GAP standards positively influence their household income and thus expenditure on food items. Table 4a further shows that, on average, certified French beans farmers had more total asset value per annum than non-certified farmers as indicated by $p = 0.076$ and mean difference of KES −112, 403.22. That is, certified farmers had assets valued at KES 112, 403.22 per household per year above what non-certified households had. Considering total asset value per adult equivalent per annum, certified farmers still had the highest value as indicated by $p = 0.002$ with a mean difference of KES −199,880.50 per annum (Table 4a). The results indicate that on average, certified farmer had value of assets amounting to KES 199, 880.50 per adult equivalent per annum above what non-certified farmer had. The results suggest that at *ceteris paribus*, Global-GAP compliance and certification in production of French beans increases household asset accumulation.

Table 4b shows that both certified and non-certified French beans farmers did not significantly and statistically differs in terms of gender of the household head, education level of the household head, marital status, group membership and access to credit as indicated by p-values greater than 10 percent level of significance. On the other hand, the results shows that majority of the Global-GAP certified French farmers (83 percent) were contracted farmers as indicated by $p = 0.000$ and majority of non-certified ones (75 percent) were not in any form of contract. Furthermore, Table 4b shows that majority of Global-GAP certified French beans farmers (65.6 percent) accessed formal farmer trainings when compared to 50 percent of non-certified ones who did not accessed. The results suggest that farmer trainings and availability of contract agreements in marketing may have played a role in influencing Global-GAP compliance and certification decisions of French beans farmers.

6.2. Risk preferences of certified and non-certified French beans farmers

6.2.1. Experiment results

Summary of risk preference parameters: sigma (σ), alpha (α) and lambda (λ) generated from the social experiment are summarized in Table 5. The results shows that, both certified and non-certified French beans farmers did not statistically and significantly differ in terms of aversion to risks ($p = 0.334$) and probability weighting ($p = 0.862$). However, non-certified farmers were averse towards losses as indicated by significant lambda value ($p = 0.062$) with a mean difference of 0.50. Upper ($p = 0.041$) and lower ($p = 0.097$) lambda values are also statistically significant with a mean difference of 0.56 and 0.44 respectively. This indicates that non-certified farmers were more averse towards losses than certified farmers. The results suggest that the decisions by French beans farmers not to comply and get certified under Global-GAP standards may have been informed by farmer's aversion towards the high probability of expected losses in French beans farming.

The findings of this study show that the mean values of σ, α and λ stand at 0.61, 0.48 and 2.04 respectively as indicated in Table 5. The values are close to the values found by Love et al. (2014), Tanaka et al. (2010) and Liu (2013) as indicated in Table 6. Love et al. (2014) found values of σ, α and λ to be 0.50, 0.86 and 3.18 respectively, Tanaka et al. (2010) found to be 0.59, 0.74 and 2.63 respectively while Liu (2013) found to be 0.48, 0.69 and 3.47 respectively.

6.2.2. Likert scale results

5-point Likert scale results are presented in Table 7 shows that Global-GAP certification may have been driven by both risk taking and aversion towards the risks. This is because, using a sample of 119 respondents, it indicates that, majority of those never like taking risks (55.6 percent) were certified French beans farmers

Table 4a
Descriptive statistics.

Variable	Overall sample (N = 119)		Non-certified (N = 50)		Certified (N = 69)				
	Mean	S.D	Mean	S. D	Mean	S.D	M.D	t-value	P-value
Acreage under French beans	0.53	0.50	0.52 (0.06)	0.43	0.55 (0.07)	0.54	0.74	−0.34	0.554
Times of training attended	1.31	1.60	1.06 (0.24)	1.67	1.49 (0.18)	1.53	−0.43	−1.47	0.623
Total Land size owned (acres)	2.54	6.84	1.85 (0.22)	1.58	3.05 (1.07)	8.88	−1.20	−0.94	0.245
Household adult equivalent (WHO)	3.26	1.37	3.01 (0.18)	1.26	3.44 (0.17)	1.43	−0.43	−1.71	0.731
Household size	3.73	1.28	3.62 (0.20)	1.40	3.81 (0.14)	1.19	−0.19	−0.81	0.202
Total distance to French beans market	5.25	3.97	5.33 (0.67)	4.75	5.20 (0.40)	3.34	0.14	0.19	0.225
Years of experience in farming	14.09	11.10	14.86 (1.77)	12.49	13.54 (1.21)	10.04	1.32*	0.64	0.066
Age (Household head)	43.95	12.72	43.38 (1.95)	13.76	44.36 (1.44)	12.00	−0.98	−0.41	0.135
French beans total costs per acre	12421.09	12832.31	9487 (1043.36)	7377.69	14547.25 (1847.87)	15349.50	−5060.25***	−2.16	0.003
French beans net income per acre	35028.57	58507.05	29850.40 (4749.76)	33585.90	38780.87 (8591.54)	71366.70	−8930.47*	−0.82	0.089
Annual expenditure on non-food items	84367.50	86265.83	86263.22 (10941.34)	77367.00	82993.79 (11161.50)	92714.40	3269.43	0.20	0.855
Annual expenditure on food items	86578.04	96988.19	76506.68 (7913.26)	55955.20	93876.13 (14212.99)	118062.00	−17369.44**	−0.96	0.028
Total annual expenditure	170945.54	130714.32	162769.90 (13442.75)	95054.60	176869.91 (18278.87)	151836.00	−14100.01	−0.58	0.206
Net annual income	199473.61	319167.05	197107.60 (48835.38)	345318.00	201188.12 (36283.27)	301391.00	−4080.52	−0.07	0.757
Total annual asset value	2082670.03	2529007.17	2147845 (426039.83)	3012557.00	2035441.78 (256894.65)	2133927.00	−112403.22*	0.24	0.076
Income per adult per day (WHO)	201.98	423.59	230.36 (80.44)	568.81.00	181.42 (33.45)	277.85	48.94	0.62	0.411
Annual asset value per adult (WHO)	712046.47	941349.56	827943.57 (177221.99)	1253149.00	628063.07 (75092.18)	623763.00	−199880.50***	1.15	0.002
Daily food expenditure per adult (WHO)	87.41	98.29	88.71 (11.73)	82.9589.00	86.47 (13.079)	108.64	2.24825.00	0.12	0.406
Daily total expenditure per adult (WHO)	165.26	142.58	175.69 (21.34)	150.90	157.70 (16.48)	136.86	18.00	0.68	0.818

*, ** and *** means significant at 10, 5 and 1 percent level of significance. S.D—Standard Deviation. M.D—Mean Difference. WHO—Means adult equivalent determination approach recommended by World Health Organization (Muyanga et al., 2007). Figures in parentheses are standard errors of means.

Table 4b
Descriptive statistics.

Variables	Indicators	Certification status		
		Non-certified ($N = 50$)	Certified ($N = 69$)	Total ($N = 100$)
Gender of HH	Female	5 (45.50)	6 (54.50)	11 (100.00)
	Male	45 (41.70)	63 (58.30)	108 (100.00)
Education level	None	1 (50.00)	1 (50.00)	2 (100.00)
	Primary	23 (41.10)	33 (58.90)	56 (100.00)
	Secondary	16 (34.80)	30 (65.20)	46 (100.00)
	Diploma	69.20 (9)	4 (30.80)	13 (100.00)
	Degree	1 (50.00)	1 (50.00)	2 (100.00)
Marital status	Single	3 (37.50)	5 (62.50)	8 (100.00)
	Married	43 (40.60)	63 (59.40)	106 (100.00)
	Divorced	1 (100.00)	0 (0.00)	1 (100.00)
	Widow	3 (75.00)	1 (25.00)	4 (100.00)
HH sick	No	36 (39.60)	55 (60.40)	91 (100.00)
	Yes	14 (51.90)	13 (48.10)	27 (100.00)
Contract farming	No	39 (75.00)	13 (25.00)***	52 (100.00)
	Yes	11 (16.40)	56 (83.60)***	67 (100.00)
Farmer training	No	28 (50.90)	27 (49.10)*	55 (100.00)
	Yes	22 (34.40)	42 (65.60)*	64 (100.00)
Group membership	No	19 (50.00)	19 (50.00)	38 (100.00)
	Yes	31 (38.30)	50 (61.70)	81 (100.00)
Credit access	No	39 (43.80)	50 (56.20)	89 (100.00)
	Yes	11 (36.70)	19 (63.30)	30 (100.00)

*, ** and *** means significant at 10, 5 and 1 percent. Number in figure is percentage. HH-Household head.

Table 5
Lottery games results by Global-GAP certification decisions.

Variable	Overall sample ($N = 119$)		Non-certified ($N = 50$)		Certified ($N = 69$)				
	Mean	S.D	Mean	S. D	Mean	S.D	M.D	t	Sig.
Alpha (α)	0.48	0.36	0.53 (0.05)	0.36	0.45 (0.04)	0.36	0.08	1.21	0.862
Sigma (σ)	0.61	0.40	0.65 (0.06)	0.39	0.58 (0.05)	0.41	0.08	1.038	0.334
Mean lambda (λ)	2.04	3.15	2.33 (0.49)	3.45	1.83 (0.35)	2.93	0.50*	0.86	0.062
Upper—lambda	2.28	3.22	2.60 (0.50)	3.55	2.04 (0.36)	2.96	0.56**	0.94	0.041
Lower—lambda	1.81	3.12	2.06 (0.48)	3.38	1.62 (0.35)	2.93	0.44*	0.76	0.097

*, ** and *** means significant at 10, 5 and 1 percent level of significance. S.D—Standard Deviation. M.D—Mean Difference. Figures in parentheses are standard errors of means.

when compared to 44.4 percent of non-certified. Majority of those who sometimes like taking risks (66.7 percent), in most cases like taking risks (65.9 percent) and who always like taking risks (59.3 percent) were certified farmers while 80percent of those who in most cases do not like taking risks were non-certified farmers as indicated in Table 7. Nevertheless, when cumulative percentage is considered, majority of risk takers were certified farmers. The results therefore suggest that risk taking positively influence Global-GAP certification decisions in French beans farming.

The same trend is witnessed when a sample of 492 respondents is used as indicated in Table 8. Majority of those who never like taking risks (6.1 percent) and in most cases do not like taking

Table 6
Comparison of Sigma, Alpha and Lambda values of previous studies.

Study	Country	Lottery type	Perception framework	Utility function	Sigma (σ)	Alpha (α)	Lambda (λ)
Love et al. (2014)	Kenya	Real	EUT and CPT	CRRA	0.50	0.86	3.18
Liu (2013)	China	Real	EUT and CPT	CRRA	0.48	0.69	3.47
Tanaka et al. (2010)	Vietnam	Real	EUT and CPT	CRRA	0.59	0.74	2.63

EUT—Expected Utility Theory. CPT—Cumulative Prospect Theory.

Table 7
Risk preferences by certification status category.

Risk preferences	[a]Certification status		
	Non-certified ($N = 50$)	Certified ($N = 69$)	Total ($N = 119$)
Never like take risks	4 (44.40)	5 (55.60) **	9 (100.00)
In most cases I do not like take risks	12 (80.00)	3 (20.00) **	15 (100.00)
I sometimes like take risks	9 (33.30)	18 (66.70) **	27 (100.00)
In most cases I like take risks	14 (34.10)	27 (65.90) **	41 (100.00)
I always like take risks	11 (40.70)	16 (59.30) **	27 (100.00)

*, ** and *** means significant at 10, 5 and 1 percent respectively. Number in figure is percentage.
[a] Certification status: Certified=1 and Not certified=0.

Table 8
Risk preferences by certification decisions.

Risk preference indicators	[a]Certification status		
	Non-certified ($N = 198$)	Certified ($N = 294$)	Overall sample ($N = 492$)
"I never like take risks"	6.06 (12)	3.74*** (11)	4.67 (23)
"In most cases I do not like take risks"	20.20 (40)	9.18*** (27)	13.62 (67)
"I sometimes like take risks"	29.29 (58)	23.47*** (69)	25.81 (127)
"In most cases I like take risks"	30.30 (60)	41.16*** (121)	36.79 (181)
"I always like take risks"	13.64 (27)	21.77*** (64)	18.50 (91)
No response	0.51 (1)	0.68*** (2)	0.61 (3)

Figures in parentheses are number of observations. *, ** and *** means significant at 10, 5, and 1 percent level of significance respectively.
[a] Certification status: Certified=1 and Not certified=0.

risks (20.2 percent) were non-certified French bean farmers while majority of those who sometimes like taking risks (29.3 percent) were also non-certified. On the other hand, majority of those who in most cases (41.2 percent) and always like taking risks (21.8 percent) were certified farmers. Cumulatively, majority of those who never like and in most cases do not like taking risks (26.3 percent) were non-certified when compared to 12.9 percent, cumulative percentage of certified farmers. On the other hand, majority of those sometimes, in most cases and always like taking risks (86.4 percent) were certified farmers when compared to 73.2 percent, cumulative percentage of non-certified farmers.

6.2.3. *Effect of risk preferences on Global-GAP certification decisions*

Risk preferences (alpha, sigma and lambda) and other factors perceived to determine French bean farmer's decisions to comply with Global-GAP standards was estimated using binary Logit model. Table 9 presents the results of the binary Logit model. The chi-square test of model Coefficients is statistically significant ($p = 0.000$) indicating that the model fitted the data well. Nagelkerke R^2 is 0.641, which indicates that the estimated explanatory variables explained 64.1 percent of the variation in the explained variable (Global-GAP certification decisions). Hosmer and Lemeshow Test of goodness of fit is statistically insignificant ($p = 0.100$), indicating that the model predicted well the relationship between the dependent and independent variables.

Alpha (α), which is a measure of probability weighting, is statistically significant at 5 percent level of significance ($p = 0.046$) and negatively influences Global-GAP certification decisions of French bean farmers ($B = -4.079$). When $\alpha > 1$ it means an individual under-weights small probabilities and over-weighs large probabilities and vice versa. French beans production is characterized by more risks and high cost of production as well as unstable returns. Based on this, the odds ratio for alpha indicates that at *ceteris paribus*, French bean farmer who under weigh expected returns and overweight costs involved in compliance and certification processes was 0.017 times more likely not to comply and get certified under Global-GAP standards and vice versa. It can also be argued that the French bean farmer's compliance decisions were guided by high expected losses resulting from lack of compliance with the Global-GAP standards. The results are consistent with those of the 5-point Likert scale. Similar findings are reported in Love et al. (2014) who found that, females headed households in Kenya

Table 9
Effects of risk attitudes and other factors on Global-GAP certification decisions.

Dependent variable: Certification status (Certified=1 and Non-certified=0)							95 percent C.I. for EXP(B)	
Variables	B	S.E	Wald	df	Sig.	Exp(B)	Lower	Upper
Gender (Male=1)	1.490	1.325	1.264	1	0.261	4.437	0.331	59.552
Alpha	−4.079**	2.040	3.998	1	0.046	0.017	0.000	0.923
Sigma	3.263*	1.867	3.053	1	0.081	26.130	0.672	1015.545
Lambda (Mean)	−0.192*	0.115	2.803	1	0.094	0.825	0.659	1.033
No education (0)			3.956	4	0.412			
Primary (1)	−3.621	2.820	1.650	1	0.199	0.027	0.000	6.719
Secondary (2)	−2.327	2.700	0.743	1	0.389	0.098	0.000	19.396
Certificate and Diploma (3)	−3.664	2.858	1.644	1	0.200	0.026	0.000	6.936
Degree (4)	−0.542	4.504	0.014	1	0.904	0.582	0.000	3963.682
Single (0)			3.433	3	0.330			
Married (1)	1.981	1.554	1.626	1	0.202	7.250	0.345	152.344
Divorced (2)	−22.444	40192.970	0.000	1	1.000	0.000	0.000	.
Widow (3)	−0.898	2.331	0.148	1	0.700	0.407	0.004	39.294
Irrigation farming (Yes=1)	1.912	1.717	1.239	1	0.266	6.765	0.234	195.932
Contract farming (Yes=1)	−4.481***	0.949	22.282	1	0.000	0.011	0.002	0.073
Cost of producing French beans (Log)	0.885**	0.450	3.866	1	0.049	2.424	1.003	5.858
Net income from French beans (Log)	0.337	0.291	1.343	1	0.246	1.401	0.792	2.478
Daily income per adult equivalent (WH0)	−0.001	0.001	0.665	1	0.415	0.999	0.996	1.002
Total household asset value (Log)	0.387*	0.230	2.832	1	0.092	1.473	0.938	2.313
Distance to the nearest French beans market	0.059	0.085	0.490	1	0.484	1.061	0.898	1.254
Group Membership(Yes=1)	−0.725	0.747	0.942	1	0.332	0.484	0.112	2.094
Household size	−0.241	0.309	0.610	1	0.435	0.786	0.429	1.439
Daily expenditure per adult equivalent (WHO)	−0.003*	0.002	2.958	1	0.085	0.997	0.993	1.000
Number of times attended farmer trainings	0.148	0.226	0.431	1	0.512	1.160	0.745	1.807
Years of farming experience	0.012	0.034	0.121	1	0.728	1.012	0.946	1.082
Acreage under French beans	1.631**	0.763	4.567	1	0.033	5.108	1.145	22.793
Constant	−12.384**	5.897	4.410	1	0.036	0.000		

Chi-square test of model coefficients: $p = 0.000$
Nagelkerke $R^2 = 0.641$
Hosmer and Lemeshow test of goodness of fit: $p = 0.100$

*, ** and *** means significance at 10, 5 and 1 percent. C.I—Confidence Interval. *B*-Coefficient. WHO—World Health Organization approach used in determination of household adult equivalent values (Muyanga et al., 2007). S.E—Standard Errors.

overweigh the probability of drought thus compelling them to adopt drought-tolerant maize hybrid varieties as insurance.

Lambda which is a measure of aversion to loss is statistically significant at 10 percent level of significance ($p = 0.094$) and negatively ($B = -0.192$) affecting French beans farmers' Global-GAP compliance and certification decisions. λ denotes the midpoint of the lower and upper bounds of switching point. It indicates the degree of loss aversion such that, a higher value of λ will mean decision maker is more loss averse and vice versa. The odds ratio for Lambda indicates that at *ceteris paribus*, French bean farmer who is loss averse is 0.825 times less likely to comply and get certified under Global-GAP standards and vice versa (Table 9). The reason is that, French beans farming under Global-GAP standards is characterized by high costs, highly expected losses and unpredictable returns, which act as disincentive for farmers to comply and get certified under Global-GAP standards. Lambda results are also consistent with those of the 5-point Likert scale. The findings concur with the findings of Edmeades and Smale (2006) who found that, perceived yield losses in production of transgenic banana in Uganda reduced farmer's demand for the variety significantly.

Sigma, which indicates aversion to risks is statistically significant ($p = 0.081$) and positively ($B = 3.263$) influencing French beans farmer's Global-GAP compliance and certification decisions. French bean farmer is risk loving if $\sigma < 0$, risk neutral if $\sigma = 0$ and risk averse if $\sigma > 0$. The odds ratio for sigma indicates that, at *ceteris paribus*, French bean farmer who is risk averse is 26.130 times more likely to comply and get certified under Global-GAP standards than the risk loving or neutral counterparts (Table 9). The reason is that, the risk averse farmers overweighed the probability of expected losses resulting from lack of Global-GAP compliance and other risks such as pests and diseases thus an incentive to comply with the Global-GAP standards in order to avoid the losses. The findings concur with those of Love et al. (2014) who found that, maize farmers in Kenya overweigh the probability of drought thus compelling them to adopt drought-tolerant maize hybrid varieties as insurance. The findings however contradict those of Koundouri et al. (2006), Chinwendu et al. (2012) and Bradford et al. (2014) who found a negative relationship between risk aversion and uptake of improved agricultural technologies.

Variable denoting access to contract agreements is statistically significant ($p = 0.000$) and negatively ($B = -4.481$) influencing French beans farmers' decisions to comply and get certified under Global-GAP standards. The odds ratio for variable denoting access to contract agreements indicates that at *ceteris paribus*, French bean farmers who participated in contract farming were 0.011 times less likely to comply and get certified under Global-GAP standards and vice versa (Table 9). Contract agreements are characterized by strict rules and regulations and coupled with high costs and expected risks as well as unpredicted returns experienced in Global-GAP compliance and certification processes may have deterred French beans farmers from Global-GAP compliance and certification.

Variable denoting cost of producing French beans is statistically significant ($p = 0.049$) and positively ($B = 0.885$) relates with French beans farmers' Global-GAP compliance and certification decisions. The odds ratio for variable denoting cost of producing French beans indicates that at *ceteris paribus*, French bean farmer who is willing and able to incur more costs in production of French beans is 2.424 times more likely to comply and get certified under Global-GAP standards and vice versa (Table 9). Despite the Global-GAP certification process being a costly process in the production of French beans, it is still a more profitable venture and this may have been an incentive for the farmers to invest more in the enterprise to gain more income. The study findings concur with those of Nthambi et al. (2013) who found that, as visible transaction costs increases, the probability of French bean farmers complying with Global-GAP standards through group contract and group scheme increases by 0.2 and 0.3 respectively in Kirinyaga County. However on the other hand, individual compliance with Global-GAP standards reduces by 0.4, 3.1 and 5.4 for Kirinyaga, Mbooni and Laikipia Districts respectively as visible transaction costs increased by one unit.

The variable denoting total asset value is statistically significant ($p = 0.092$) and positively ($B = 0.387$) relating with Global-GAP compliance and certification decisions in French beans production. The odds ratio for variable denoting total asset value indicates that at *ceteris paribus*, French bean farmer who had more assets were 1.473 times more likely to comply and get certified under Global-GAP standards and vice versa (Table 9). More assets generate more income for the farmers hence increasing their ability to meet the high cost of compliance and certification. The findings concur with those of Okello (2005) who found that, farmers' endowments such as physical, human and social capital increases degree of Global-GAP compliance among smallholder farmers in Kenya.

Total daily household expenditure per adult equivalent is statistically significant ($p = 0.085$) and negatively ($B = -0.003$) influencing Global-GAP compliance and certification decisions of French beans farmers. The odds ratio for variable denoting total daily expenditure per adult equivalent indicates that at *ceteris paribus*, French bean farmer who had more household expenditures were 0.997 times less likely to comply and get certified under Global-GAP standards and vice versa (Table 9). This shows that, the more the household expenditure, the less the likelihood French bean farmer will comply and get certified under Global-GAP standards. This is so because, households have many commitments that include expenditure on food and non-food items, and given low income levels and high cost of compliance and certification, poor households will be less likely to comply and get certified under the standards due to less income available to spend.

Acreage under French beans is statistically significant at 5 percent level of significance ($p = 0.033$) and positively ($B = 1.631$) affecting French beans farmer's Global-GAP compliance and certification decisions. The odds ratio for variable denoting acreage under French beans indicates that at *ceteris paribus*, French bean farmer who had more land under French beans were 5.108 times more likely to comply and get certified under Global-GAP standards and vice versa (Table 9). The reason is that, French beans farming is a profitable venture and cultivation of more acres imply more income and consequently increases farmers' ability to meet the cost of Global-GAP compliance and certification processes. Similar findings have been reported in Nthambi et al. (2013) where they found that an increase in farm size by one unit increases group scheme compliance by 3.1 and 2.1 percent in Kirinyaga and Laikipia County respectively. They argued that, larger farm sizes enable farmers to enjoy economies of large scale which in turn increases their probability to comply with Global-GAP standards. Finally, constant term is also statistically significant ($p = 0.036$), but negatively affecting certification decisions of farmers (Table 9). This means that, there are other factors not included in the model that negatively affected Global-GAP compliance and certification decisions of French beans farmers in the face of Global-GAP standards.

7. Conclusions and policy implications

The study aimed at determining the effect of risk attitudes on Global-GAP certification decisions. The 5-point Likert scale results indicate mixed effects of risk preference indicators on Global-GAP certification decisions. When a sample size of the 492 respondents is used it shows that majority of those who never like taking risks (6.1 percent) and in most cases do not like taking risks (20.2 percent) were non-certified while majority of those who sometimes like taking risks (29.3 percent) were also non-certified. On the other hand, majority of those who in most cases (41.2 percent) and always like taking risks (21.8 percent) were certified farmers. When a sample size of 119 respondents is used, the same trend is witnessed. Majority of those never like taking risks (55.6 percent) were certified farmers and at the same time majority of those who: sometimes (66.7 percent), in most cases (65.9 percent) and always like taking risks (59.3 percent) were the certified farmers. On the other hand, majority (80 percent) of those who in most cases do not like taking risks were non-certified farmers. Cumulatively however, majority of risk takers were certified farmers irrespective of the size of sample size.

Social experiment results show that, both certified and non-certified French beans farmers did not statistically and significantly differ in terms of aversion to risks ($p = 0.334$) and probability weighting ($p = 0.862$). However, majority of non-certified farmers were averse towards losses as indicated by significant lambda value ($p = 0.062$) with a mean difference of 0.50. Risk preference parameters (alpha, sigma and lambda) and other factors perceived to influence Global-GAP certification decisions was estimated using binary Logit model. Alpha (α), which is a measure of probability weighting, is statistically significant ($p = 0.046$) and negatively ($B = -4.079$) influences Global-GAP certification decisions of French bean farmers. This means that French bean farmer's certification decisions were guided by high cost of compliance and certification and expected losses resulting from lack of compliance with the private standards. French bean farmer who were loss averse were 0.825 times less likely to comply and get certified under Global-GAP standards and vice versa. This is indicated by significant value of lambda ($p = 0.094$) with a negative effect ($B = -0.192$). French bean farmer who were risk averse were 26.130 times more likely to comply and get certified under Global-GAP standards than the risk loving or neutral counterparts. This is indicated by significant ($p = 0.081$) sigma value with a positive effect ($B = 3.263$) on Global-GAP certification decisions.

Since risk and loss averse French beans farmers failed to comply and get certified under Global-GAP standards, government and the private sector should offer crop insurance and affordable credit to help mitigate the potential production and marketing risks in French bean farming. Since compliance and certification is a costly process, French bean farmers should expand acreage under French beans to achieve economies of scale. They should also enter into contract farming or futures market agreements to mitigate the risks and losses expected in production and marketing processes. The government should ensure that the contract farming agreements are honored by both parties concerned to the latter. Finally farmers should accumulate assets as much as they can in order to meet future expected and unanticipated shocks or losses.

Acknowledgments

We appreciate financial support from DAAD and International Center for Development and Decent Work throughout the entire research study. We also thank the enumerators for data collection, French beans farmer for volunteering information and County of Kirinyaga Agricultural Extension Officers for guiding in identification of farmers.

References

Antle, J.M., 1987. Econometric estimation of producers' risk attitudes. Am. J. Agricult. Econ. 69 (3), 509–522.

Asfaw S., 2007. Does EurepGAP standard marginalize poor farmers? evidence from Kenya. Retrieved July 6, 2017, from https://www.researchgate.net/publication/284687478_Does_EurepGAP_standard_marginalize_poor_farmers_evidence_from_Kenya.

Asfaw, S., Mithöfer, D., Waibel, H., 2009. Investment in compliance with Global-GAP standards: does it pay off for small-scale producers in Kenya? Q. J. Int. Agric. 48 (4), 337–362.

Asfaw, S., Mithöfer, D., Waibel, H., 2010. What impact are eu supermarket standards having on developing countries' export of high-value horticultural products? Evidence from Kenya. J. Int. Agribus. Market. 22 (3–4), 252–276.

Bernoulli, Daniele, 1738. Specimen Theoriae Novae de Mensura Sortis. (1700–1782). Retrieved from http://archive.org/details/SpecimenTheoriaeNovaeDeMensuraSortis.

Binswanger, H.P., 1980. Attitudes toward risk: Experimental measurement in rural India. Am. J. Agricult. Econ. 62 (3), 395–407.

Binswanger, H.P., 1981. Attitudes toward risk: Theoretical implications of an experiment in rural India. Econ. J. 91 (364), 867–890.

Bradford, L.B., Jean-Paul, C., Dylan, F., Vanessa, R.S., Laura, S., 2014. The roles of risk and ambiguity in technology adoption. J. Econ. Behav. Organ. 97, 204–218.

Camerer, C.F., 2001. Prospect theory in the wild: Evidence from the field. In: Kahneman, D., Tversky, A., Baron, J. (Eds.), Choices, Values, and Frames. American Psychological Association, Washington, DC, pp. 288–300. Retrieved from http://resolver.caltech.edu/CaltechAUTHORS:20110216-150212287.

Cavane, E., 2011. Farmers' attitude and adoption of improved maize varieties and chemical fertilizers in mozambique - Google search. Indian Res. J. Ext. Educ. 1 (11), 1–6.

Chinwendu, A., Okezie, C.A., Mejeha, R., Amaefula, C., Okezie, C.A., Mejeha, R., 2012. Risk attitude and insurance: A causal analysis. Am. J. Econ. 2 (3), 26–32.

Dillon, J.L., Scandizzo, P.L., 1978. Risk attitudes of subsistence farmers in Northeast Brazil: A sampling approach. Am. J. Agricult. Econ. 60 (3), 425–435.

Ebony Consulting International, 2001. The Kenyan green bean sub-sector. Department for International Development - Google search. Retrieved July 4, 2017, from https://www.google.com/?gws_rd=ssl#q=The+Kenyan+Green+Bean+Sub-sector.+Department+for+International+Development.

Economic Survey, 2009. Kenya National Bureau of Statistics. Retrieved July 5, 2017, from https://www.knbs.or.ke/download/economic-survey-2009-3/.

Economic Survey, 2015. (2017, February 13). Kenya National Bureau of Statistics. Retrieved July 4, 2017, from https://www.knbs.or.ke/economic-survey-2015-2/.

Edmeades, S., Smale, M., 2006. A trait-based model of the potential demand for a genetically engineered food crop in a developing economy. Agricult. Econ. 35 (3), 351–361.

Ghartey, W., Dadzie, S.K.N., Weittey, M., 2014. Poverty and risk attitudes: The case of cassava farmers in awutu-senya district of the central region of Ghana. Asian J. Agricult. Ext. Econ. Sociol. 3 (2), 164–178.

GLOBALG.A.P, 2017. Cultivating the future of the planet. Retrieved July 7, 2017, from http://www.globalgap.org/uk_en/for-producers-new/globalg.a.p./.

Greene, W., 2003. Econometric Analysis, fifth ed. Pearson Education International, New Jersey, USA.

Gujarati, D.N., 2004. Basic Econometrics Amazoncom.Com: Books, fourth ed. McGraw-Hill, New York, U.K, Retrieved from https://www.amazon.com/Basic-Econometrics-4th-Damodar-Gujarati/dp/0070597936.

Hoddinott, J., Quisumbing, A.R., 2008. Methods for Microeconometric Risk and Vulnerability Assessments (SSRN Scholarly Paper No. ID 1281055). Social Science Research Network, Rochester, New York.

Holt, C.A., Laury, S.K., 2002. Risk aversion and incentive effects. Am. Econ. Rev. 92 (5), 1644–1655.

Humphrey, J., 2008. Private standards, small farmers and donor policy: EUREP-GAP in Kenya. Retrieved from http://temp.ids.ac.uk/idspublication/private-standards-small-farmers-and-donor-policy-eurepgap-in-kenya.

Jaleta, M., Gebremedhin, B., Hoekstra, D., 2009. Smallholder Commercialization: Processes, Determinants and Impact. International Livestock Research Institute, Retrieved from https://www.google.com/search?biw=1024&bih=331&noj=1&q=Smallholder+Commercialization%3A+Processes%2C+Determinants+and+Impact.+Discussion+Paper+No.+18.+Improving+Productivity+and+Market+Success+%28IPMS%29+of+Ethiopian+Farmers+Project&oq=Smallholder+Commercialization%3A+Processes%2C+Determinants+and+Impact.+Discussion+Paper+No.+18.+Improving+Productivity+and+Market+Success+%28IPMS%29+of+Ethiopian+Farmers+Project&gs_l=serp.12.20734.20734.0.23067.1.1.0.0.0.0.0.0.0.0.0.1.2.64.serp.1.0.0.

Karira, W. J., Mburu, J. I., and Guthiga, P. M., 2013. Empirical Analysis of the Environmental Benefits of Compliance with GLOBALGAP Standards Among Smallholder Farmers in Eastern and Central Kenya: An Environmental Valuation Approach. African Association of Agricultural Economists (AAAE). Retrieved from https://ideas.repec.org/p/ags/aaae13/161484.html.

Kahneman, D., Tversky, A., 1979. Prospect theory: An analysis of decision under risk. Econometrica 47 (2), 263–291.

Kangai, E., Mburu, J., 2012. Opportunities and challenges for youth's participation in horticultural production in the face of Kenya-GAP standards in Kenya. In: Paper Presented at the International Conference on 'Young People, Farming and Food' held in Accra, Ghana, 19–21 March, 2012.

Kirumba, E.G., Pinard, F., 2010. Determinants of farmers' compliance with coffee eco-certification standards in Mt. Kenya region. In: Contributed Paper presented at the Joint 3rd African Association of Agricultural Economists (AAAE) and 48th Agricultural Economists Association of South Africa (AEASA) Conference held in Cape Town, South Africa, 19–23 September, 2010.

Koundouri, P., Nauges, C., Tzouvelekas, V., 2006. Technology adoption under production uncertainty: Theory and application to irrigation technology. Am. J. Agricult. Econ. 88 (3), 657–670.

Krejcie, R.V., Morgan, D.W., 1970. Determining sample size for research activities. Educ. Psychol. Meas. 30 (3), 607–610.

List, J., 2005. A simple test of expected utility theory using professional traders. Proc. Natl. Acad. Sci. USA 102 (3), 945–948.

Liu, E., 2008. Time to Change What to Sow: Risk Preferences and Technology Adoption Decisions of Cotton Farmers in China (Working Paper No. 1064). Princeton University, Department of Economics, Industrial Relations Section, Retrieved from http://econpapers.repec.org/paper/priindrel/526htm.

Liu, E.M., 2013. Time to change what to sow: Risk preferences and technology adoption decisions of cotton farmers in China. Rev. Econ. Stat. 95 (4), 1386–1403.

Love, A., Magnan, N., Colson, G.J., 2014. Male and female risk preferences and maize technology adoption in Kenya. In: Selected Paper Prepared for Presentation at the Minneapolis, MN, 2014. Retrieved from http://ageconsearch.umn.edu/record/170241.

Moscardi, E., De Janvry, A., 1977. Attitudes toward risk among peasants: An econometric approach. Am. J. Agricut. Econ. 59 (4), 710–716.

Muriithi, B.W., Mburu, J., Ngigi, M., 2011. Constraints and determinants of compliance with eurepgap standards: A case of smallholder french bean exporters in Kirinyaga district, Kenya. Agribusiness 27 (2), 193–204.

Muyanga, M., Ayieko, M., Bundi, M., 2007. World Health Organization adult equivalent conversion factors. Retrieved July 6, 2017, from https://www.google.com/?gws_rd=ssl#q=Muyanga+et+al.+(2006)+World+Health+Organization+adult+equivalent+conversion+factors..

Neumann, J.V., Morgenstern, O., 1944. Theory of Games and Economic Behavior. Princeton University Press, Retrieved from http://www.goodreads.com/book/show/483055.Theory_of_Games_and_Economic_Behavior.

Nthambi, M., Mburu, J.I., Nyikal, R., 2013. Smallholder choice of compliance arrangements: The case global-GAP adoption by French bean farmers in Kirinyaga, Mbooni and Buuri/Laikipia districts. In: Invited paper presented at the African Association of Agricultural Economists (AAAE), Hammamet, Tunisia.

Nyota, H.N., 2011. Transaction Costs and Other Determinants of Choice of Compliance Arrangements with Global-GAP StandArds Among Smallholder French Bean Farmers: The Case of Kirinyaga South District, Kenya (Master of Science Thesis), Retrieved from http://erepository.uonbi.ac.ke:8080/xmlui/handle/11295/13952.

Okello, J.J., 2005. Compliance with International Food-Safety Standards: the Case of Green Bean Production in Kenyan Family Farms (Doctor of Philosophy Dissertation), Michigan State University, Michigan, Retrieved from https://www.google.com/search?biw=1024&bih=331&noj=1&q=Compliance+with+International+Food-safety+Standards%3A+The+Case+of+Green+Bean+Production+in+Kenyan+Family+Farms.+Ph.D.+dissertation%2C+Michigan+State+University%2C+Michigan..&oq=Compliance+with+International+Food-safety+Standards%3A+The+Case+of+Green+Bean+Production+in+Kenyan+Family+Far ms.+Ph.D.+dissertation%2C+Michigan+State+University%2C+Michigan..&gs_l=serp.12...165911.165911.0.169119.1.1.0.0.0.0.0.0..0.0....0...1.2.64.serp..1.0.0.vBzBOOA_ooU.

Plous, S., 1993. The Psychology of Judgment and Decision Making. McGraw-Hill Education.

Prelec, D., 1998. The probability weighting function. Econometrica 66 (3), 497–527. http://dx.doi.org/10.2307/2998573.

Quiggin, John, 1993. Generalized Expected Utility Theory - The Rank-Dependent Model. Kluwer Academic Publishers, Boston.

Ross, N., Santos, P., Capon, T., 2012. Risk, ambiguity and the adoption of new technologies: Experimental Evidence from a developing economy. In: Paper Presented during International Association of Agricultural Economists Conference, Foz do Iguacu, Brazil, August 18–24, 2012.

Tanaka, T., Camerer, C.F., Nguyen, Q., 2010. Risk and time preferences: Linking experimental and household survey data from Vietnam. Am. Econ. Rev. 100 (1), 557–571.

Tschirley, D., Muendo, M., Weber, M., 2004. Improving Kenya'S Domestic Horticultural Production and Marketing System: Current Competitiveness, Forces of Change, and Challenges for the Future. Tegemeo Institute of Agricultural Policy and Development, Retrieved from http://www.book.y-lib.info/17-political/592013-1-tegemeo-institute-agricultural-policy-and-development-working-paper.php.

Wik, M., Kebede, T.A., Bergland, O., Holden, S.T., 2004. On the measurement of risk aversion from experimental data. Appl. Econ. 36 (21), 2443–2451.

Yesuf, M., Bluffstone, R.A., 2009. Poverty, risk aversion, and path dependence in low-income countries: Experimental evidence from Ethiopia. Am. J. Agricult. Econ. 91 (4), 1022–1037.