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The Influence of Global GAP Certification on the Performance of Small-scale French Beans Growers in Central Kenya

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Abstract:
There is need for small-scale farmers to be Global GAP certified in order to gain entry into the French beans export market. The requirement to form producer groups is largely led by exporter's preferences which determine which farmer groups have the capacity to manage food safety. The objective of this study was to determine the factors that influence the choice of certification as well as to evaluate the impact of certification on the performance of certified small-scale farmers in Central Kenya. A survey conducted in November and December of 2013 was designed and implemented to determine the socio-economic and production characteristics for 266 farmers in 19 locations. Factors that influence the choice of certification were examined using a propensity score probit model and a second stage analysis was conducted to evaluate the impact of certification on the performance of those certified. The results of the econometric analysis show that the age, number of contact hours with extension agents, and distance to local market, positively influence the chances of participation in Global GAP. However, certified farmers were not better-off than non-certified farmers with respect to the income received.

Keywords: *Farmers group, adoption, capacity, management, profitability*

1. Introduction

Fresh produce horticultural crops that include fruits and vegetables, contribute about 25% to Kenya's agricultural GDP making this subsector an important foreign exchange earner and an important source of income generation for rural farm households, traders and investors (Government of Kenya, 2012). French beans (*Phaseolus vulgaris* L.), for example, are a major vegetable export crop in Kenya and a potential income earner for small-scale farmers who are the main growers. To gain entry into the international market, smallholders have to meet the criteria by becoming certified under the Global GAP standard or the Kenya GAP standard developed in 2009 (FPEAK, 2009). Kenya GAP is benchmarked to Global GAP, and takes into consideration the small-scale producers who bulk their produce together to achieve volumes that can be traded collectively for economies of scale (Carey, 2008; Global GAP, 2007). Thus, the smallholders are usually organized into producer associations in order to invest jointly in facilities needed to meet the standards, and to reduce the cost of certification. (Okello, 2005; Graffham *et al*, 2007a).

It is not a requirement of the Standards that small-scale producers are organized into groups. This requirement is largely influenced by the difficulty experienced by small-scale farmers to sign individual contracts with exporters (Graffham *et al*, 2007b). Exporters select farmer groups to supply them by determining their capacity to manage food safety. Thus, the choice of producers does not lie in the efficiency of smallholders but can be said to be driven by the sourcing strategies of the export companies (Humphrey, 2008). However, the capacity to manage a Global GAP compliant farming system requires that producers are able to acquire and process all the information contained in the document.

The dilemma facing small-scale producers is in acquiring information on Global GAP due to the large fixed cost in acquiring and processing the information regarding production and marketing (Narrod *et al*, 2009). Thus, in order to acquire information together with other services, the producers have to maintain linkages with the export companies (Blakmore and MacGregor, 2011; Okello and Swinton, 2006). Group membership, therefore, becomes a precondition for smallholders to gain information from export companies. However, the structure and internal organization of the groups influence their functioning and success in the export market (Paalhaar *et al*,2011). Contrary to Paalhaar *et al*'s (*ibid*) expectations, the groups found to be successful by export companies exhibit 'competitive individualism' which is a characteristic not found in successful associations. This may imply that the farmers are individualistic in terms of wanting to achieve their own successes as agri-entrepreneurs.

Global GAP was first introduced in Kenya in the year 2000 as *Eurep* GAP(Mithöfer, 2011*)*, and in the first decade of its introduction, the impact of Global GAP on the production processes of fresh produce from Kenya generated a lot of inquiries. The studies focus on the impact of Global GAP as a new technology being introduced into export bound horticultural production. Some studies analyze Global GAP with respect to its impact on supply chain analysis (Lenné and Ward, 2008); and effects on household income and welfare (Jaffe, 2003; Tovar *et al*, 2005; Okello and Swinton, 2006; Graffham *et al*, 2007a, 2007b; Okello *et al*, 2007). In this second decade after the introduction of Global GAP in Kenya, continued investigation of its impact consider Global GAP to be an accepted practice in the production of fresh produce for the export market. This includes studies focusing on the effects of Global GAP compliance on market access and contract relations between export companies and smallholders (Kariuki, 2014a; 2014b; Obare and Kariuki, 2003), and its impact on the national economic development of developing countries with respect to foreign exchange earnings (Maertens *et al*, 2011). This study aims at adding to the literature on the effects on Global GAP in this second decade as from 2012.

The objective of the study is to quantify the profit opportunities, if any, of adopting Global GAP certification by French beans small-scale producers. This is done by examining the factors that influence the small-scale farmers' decision to produce under a Global GAP certified system of production. This will be achieved by comparing certified and non-certified smallholders in Central Kenya. A second-stage analysis follows in order to evaluate the impact of certification on the performance of certified small-scale farmers in Central Kenya.

2. Methods

The effect of certification on production is best estimated by models that resolve selection bias (Hahn, 1998). Examples of such models are propensity score matching model (PSM), Heckman's sample selection model or endogenous-switching regime model. The choice of any one of the models depends on the objective function. For this study, a propensity score econometric model was used as the objective was to determine the factors that influence the choice of certification as well as to evaluate the impact of certification on the performance of those certified. The propensity score matching (PSM) model evaluates the average effect of a programme on participant's outcome and this is conditional on the pre-participation characteristics of such participants. This is consistent with the literature built up from the work of Rosenbaum and Rubin (1983). Thus, inasmuch as the French beans export companies select those farmers or farmer groups as their suppliers, once selected, it is the individual small-scale farmers who are the final decision makers as to whether to adopt a Global GAP farming system, or not.

Consistent with Singh *et al*, (1986) and Barnum and Squire (1979), the assumption held is the farmer's objective is utility maximization whether they adopt a Global GAP farming system or not, and farmers gain a higher utility from adopting the standard than from non-adoption. Although utility is not observed directly, the utility U_{ij} for a given farmer i adopting Global GAP can be expressed as a function of a vector of explanatory variables X_i such as farm size, any items required in meeting the Global GAP standard, household characteristics such as family size, among others.

Global GAP enters a household's utility function in the time and budget constraints. Global GAP requirements buy out the amount of time a household would otherwise have put into leisure. These requirements include, amongst others, recording and monitoring the entire French beans production process and attending trainings, seminars and regular meetings with extension agents. The budget constraint, according to related literature (Ericksson, 1993; Asfaw et al, 2007), has a great impact on the small-scale French bean producers under the Global GAP scheme. The decision to adopt safety standards is an investment decision, which may involve sizeable fixed costs, such as a grading shed, pesticide store, a charcoal cooler, and a disposal pit, while the benefits will be realized over time (Asfaw, 2011). The household's income is determined by the marketed quantity of surplus food and cash crops. When the household income is not adequate to finance production costs inclusive of Global GAP costs, this study assumes that the household would depend on non-labour, non-farm income such as borrowings, transfers and remittances.

The analysis of the factors which influence the decision or choice to adopt Global GAP became pertinent to this study using the propensity score econometric model. The first consideration was that an individual may have access to Global GAP certification, but for various reasons may not seek to become certified. Literature on programme evaluation shows that the estimated coefficients from the analysis would correctly measure the average impact of the programme on participants' outcome (Hahn, 1998; Hirano *et al*, 2003; Austin, 2011; Dehejia and Wahba, 2002; Heckman *et al*, 1998). The method would summarize the pre-certification characteristics of each farmer, after filtering non-certified participants with similar attributes as those certified, into a single-index variable, the propensity score, which would then make the matching feasible. This would allow the reduction, not the elimination, of the bias generated by the unobservable confounding factors (Becker and Ichino, 2001). The matching would then generate the average effects of certification (AEC) through computation of the differences in outcome between certified participants and controls. The programme would then identify subjects who meet the certification conditions and drop those who do not, based on their characteristics.

Structurally, the propensity score model is presented as:

$$p(x_i) = pr\{D = 1 / x_i\} = E\{D / x_i\} \qquad (1)$$

where $p(x_i)$ is the propensity score or probability of participation; $D = 1$ if individual is a participant and 0 otherwise; and x_i is the vector of pre-participation characteristics. The model indicates that probability of participation is conditional on x_i covariates since we want to know what influences some individuals to adopt the certification and others not to. Therefore, the higher the probability, the higher the likelihood of participation. This, however, does not imply that non-participants have equal propensity scores, but the scores may fall within a given range known as blocks of propensity scores which are generated during the estimation process.

Subsequently, once the propensity score $p(x_i)$ was known, the average effect of treatment on the treated (ATT), that is, the average effect of Global GAP on the certified participants, AEC was estimated, as below:

$AEC = E\{Y_{1i} - Y_{10}/D_i = 1\}$

$= E\{E\{Y_{1i} - Y_{0i}/D_i = 1, p(x_i)\}\}$

$= E\{E\{Y_{1i}/D_i = 1, p(x_i)\} - E\{Y_{oi}/D_i = 0, p(x_i)\}/D_i = 1\}$ .....(2)

Y_{1i} and Y_{0i} being the potential outcomes for the two counterfactual situations of certified and control groups respectively, $p(x_i)$ is the propensity score (AEC score), 'D' is the participation variable as stated earlier.

This model works under two lemmas: The Balancing Property (Lemma 1) and the Conditional Independence Assumption (Lemma 2).The balancing lemma dictates that the propensity score $p(D = 1x_i) = p(x_i)$, must be a pre-condition for the evaluation of the effect of the programme on the observations (Katchova, 2013). The Conditional Independence Assumption (CIA) is based on the balancing lemma, and results in a common support for the matching approaches (Caliendo and Kopeinig, 2005; Grilli and Rampichini, 2011; Sianesi, 2001).Common support is reached after propensity score estimation, and a second variable 'comsup' is added to the data which defines the region of common support.

Thus, AEC, as a second stage analysis, can be expressed as being a function of the output influencing factors used in the household model, such as, household specific characteristics represented by vector Ω_{hh}, farm specific characteristics represented by vector Ω_{ff}, market characteristics represented by vector Ω_{mk},*and* Global GAP constraints represented by vector Ω_{gg} as:

$AEC = f(\Omega_{hh}, \Omega_{ff}, \Omega_{mk}, \Omega_{gg},)$ .....(3)

The AEC results were used to further analyze the pre-participation characteristics of the participants and their influence on the certified farmers' participation in the programme. This was followed by the matching estimation of the average effect of participation. The approaches used in matching participants and controls are Nearest Neighbour, Radius, Stratified and Kernel matching methods (Caliendo and Kopeinig, 2005). The matching approaches assume similarity between participants and non-participants in respect of their pre-participation characteristics captured in the propensity score with the only exception being that participants participated in Global GAP while non-participants did not.

2.1. Data and the Empirical Propensity Score Matching Model

The data used in the PSM analysis reported in this paper was from a sample of smallholders located in Nyeri and Kirinyaga Counties of the Central region of Kenya. The counties were selected because the region supplied most of the export bound horticultural crops due to its close proximity to the capital city of Nairobi, the export companies, and the readily available local markets. In Kirinyaga County, the study was conducted in Mwea East and Mwea West sub-counties which lie to the south-south east area of the county. The sub-counties are traversed by an extensive government-sponsored rice irrigation scheme. Kirinyaga County has a favourable climate for agriculture. It ranges in altitude from 1,000 – 2,000 meters above sea level (a.s.l.), experiences a bimodal rainfall pattern with long rains in March – May and short rains in October to December. A large range of crops were grown either under rain-fed agriculture or through irrigation. There were a large number of producer groups in the irrigation scheme, and a larger number of survey participants were identified in these two sub-counties.

Nyeri County is 153 km north of Nairobi at the base of the Aberdare ranges that form part of the eastern end of the Rift Valley. It occupies 3 356 km^2,and has a wide climatic range. The temperate conditions are suitable for vegetables and fruit growing at the high altitude areas while tropical agriculture is practiced in the lower regions of the mountain ranges with warmer temperatures. The study was carried out in Mathira East and West sub-counties which are located 137 km from Nairobi. Altitude ranges between 1580 to 2 070 m a.s.l., with a bimodal rainfall distribution of between 800-1400mm. The annual temperature ranges from 18-24^oC. This makes the sub-county ideal for temperate crop production such as French beans and other vegetables, and a vast array of fruits. The population was 166 700 persons from over 55 000 farm families. The area had four irrigation schemes which drew waters directly from Mount Kenya facilitating the production of vegetables all year round. The irrigation schemes were Kangocho, Kanjuri, Kimbiria and Sagana. Sagana was the main study area in this sub-county as at the time of data collection Mathira West farmers had turned away from producing French beans for export and towards the domestic canning industry. Sagana is a large irrigation scheme with a well-organized farmers' cooperative which owned the entire supply chain of French beans; from farm to overseas retailers, thus by-passing the local export companies. The other sub-county included in the study was Kieni East which is located in the northern part of Nyeri County and 174km from Nairobi. Kieni East lied lee-wards of Mount Kenya and was more favourable for livestock ranching. However, closer to the mountain, with cooler temperature ranges and water supply from permanent streams from the mountain, horticultural crops were predominant.

The production statistics of the main crops grown in the study area is presented in Table 1.

Crop	Mwea East	Mwea West	Mathira East
Rice	19 517	29 625	-
Tomatoes	46 125	2 160	n/a
Maize	15 4550	20 280	31,380
French beans	4 820	520	n/a
Beans	2 794	768	999
Bananas	10 640	875	15 400
Tea	-	-	17 783
Coffee	-	-	10 104
Irish/sweet potatoes	675	n/a	1 096

Table 1: Main crops grown in the study area and yield (tonnes) in 2012/13
Source: Mwea East, Mwea West, and Mathira East sub-county crop statistics, 2013.

Other vegetables grown under irrigation all year round and in varying quantities were kales, spinach, bulb onions, butternuts, pumpkins, capsicum (sweet pepper), and fruits, such as, water melons, mangoes, avocadoes and paw-paws.

The study focused on small-scale farmers owing a maximum of 2.5 acres, and implementing a Global GAP compliant production system at the time of data collection in November, 2013. To be certified, an individual small-scale farmer would be a member of a group with linkages to an export company. Thus, as a group, the farmers' were contracted as suppliers of French beans by an export company in a given production period. The control group for the study was made up of farmers who were not Global GAP certified and were, therefore, excluded from group membership. This latter group consisted of those who had never been certified. However, this group included those farmers identified as having once been certified but had allowed their certification to lapse, and those who had chosen to discontinue in the process of gaining Global GAP certification. A sample size of thirty (30) farm households growing French beans were randomly selected from each location, making a total of 480 farm households for the study. After discarding 214 incomplete records, records which captured farms with more than 2.5 acres and other anomalies, a sample of 266 farms was used for the study.

Data was collected using a structured questionnaire which was designed for a single visit given the time and financial constraints. The questionnaire was designed in a way that farmers would provide household characteristics to enable the assessment of socio-economic factors which influence the adoption of Global GAP certification of smallholder French beans farmers.

The propensity score for this study was expressed in general form as:

$$Y = f\beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \ldots\ldots\ldots + \beta_{15}X_{15} + \varepsilon_i \qquad (4)$$

and Y was the French beans output under Global GAP farming system or not, and x_i were the variables representing the socio-economic characteristics of the observed individual. Empirical estimation of the propensity score was accomplished using a Probit model following (Katchova, (2013) and Owuor (2009), as shown:

$$\Pr ob[y_i = j] = \frac{\exp(\beta_j x_i)}{s(j = 0 - j)\exp(\beta_j x_i)}, j = 0,1\ldots\ldots, J \qquad (5)$$

where the left hand side represented the probability of participation in Global GAP certification production system of French beans for the j^{th} household and 'x_i' variables were the characteristics of the observed household, which were the same across all outcomes. The strength of the propensity score modeling approach was that the selection bias was reduced when comparisons of outcomes was performed using participants and non-participants who were as similar as possible. This allowed for the estimation of average effect of certification, while controlling for the unforeseen factors in selection process. In linear form, equation 5was reduced to:

$D(0,1) = \beta_{o+}\beta_{1i}x_{1i} + \boldsymbol{\varepsilon}$, *pscore*(*mypscore*)*blockid*(*myblock*)*comsup*…………………………………………… (6)

where D was the indicator for participation, whereby D=1 if a household was certified, and 0 otherwise. x_i represented a vector of participation covariates of the household such as household head's age, gender of the household head, education level, value of livestock assets, value of household assets, income from off-farm employment, value of remittances and transfers received, exposure to information on the certification process through extension contact, farm size, value of intermediate assets (machinery and equipment), expenditure on material inputs (i.e. farm stock), family labour, hired labour, and distance to the nearest market.

This was followed by options which commanded for the generation of the propensity score index, '*mypscore'*, generation of variable '*myblock'* for the identification of blocks of propensity scores, and '*comsup'* option for common support which generated a dummy variable which identified the households which met the matching condition. The common support variable attached numeral '1' corresponding to the subjects that met the matching condition and '0' to those that did not meet the condition. Estimation of average effect of certification in the programme followed commands in STATA, namely '*attnd'* for nearest neighbor matching, '*attr*' for radius matching, '*attk*' for kernel matching and '*atts'* for stratified matching methods. The general formulation of the empirical model was as follows:

Command: $y = \beta_0 + \beta D + \beta_i x_i + \varepsilon$, *pscore*(*myscore*), *com*sup, *probit* ……………………………………… (7)

where command stood for either one of the matching estimations above (*attns, attr, atts, attk*), 'y' was the outcome of output, x_i was a vector of participation covariates, followed by the propensity score option, then the common support option. The two options were important in the sense that the average effect of participation (AEP) was computed from the propensity score index (i.e. the difference in outcomes for participants /certified farmers and controls/non-certified farmers who were similar in personal characteristics as possible). Common support was also a mandatory option to ensure matching was done only on controls that were similar to participants. Estimation of propensity score was accomplished using a Probit model using STATA version 12.0., and matching commenced immediately thereafter.

The *a priori* effect of the variables used followed the proposition by Austin (2011) that the variables to be included were those measured at baseline and that guidance for identifying variables was to be provided from related literature. In line with this proposition, the choice of variables for this study's model was guided by related socio-economic studies such as Jara-Rojas *et al* (2012) and Owuor (2009). A more detailed definition of these variables and the hypothesized influence of each variable on the adoption of Global GAP certification in the model are presented in Table 2.

Variable	Definition and Units	Effects
X_1 *Participation Dummy* (D)	If farmer is certified (Yes = 1, No = 0)	(+, -)
Household characteristics (x_i)		
$X_{2\ Age}$	Years	(+, -)
$X_{3\ Gender}$	Dummy (male=1, female=0)	(+, -)
X_4 Education level of decision maker	No. of years of formal schooling	(+)
$X_{5\ Family}$ labour	Family labour non-remunerated (man-days)	(+)
$X_{6\ Livestock}$ assets	Total value of livestock	(+)
$X_{7\ Household}$ assets	Value of furniture, electronics, cell phones, etc.	(+,-)
$X_{8\ Off}$-farm income	Income from businesses	(+)
X_9 Remittances and transfers	Average value of transfers and gifts received	(+)
X_{10} Exposure to information	No. of contact hours in the year with extension, NGOs and/or export companies in the year.	(+)
Farm/Firm characteristics (x_j)		
X_{11} Farm size	Farm size in acres	(+)
X_{12} Intermediate assets	Value of machinery and equipment	(+)
X_{13} Material inputs	Expenditure on stock (fertilizer, seeds, feeds, veterinary & crop chemicals)	(+)
X_{14} Hired labour	Hired labour on the farm (man-days)	(+)
X_{15} Market access	Distance to the market in kilometers	(-)

Table 2: Definition of the variables used in the econometric model and their hypothesized effects

The output variable for French beans, Y, was the value of the quantity of French beans produced during the year 2013 by a farm household, measured in Kenya Shillings (Ksh.). In irrigated areas, three crops, on average, were produced during the year while in rain-fed areas, two crops were produced. However, on average, four pickings (harvests) were done in each crop cycle. The effect of Age on adoption was ambiguous. On the one hand, the effect was expected to be positive since years of farming experience could be directly correlated with adoption. On the other hand, given that adoption of Global GAP was an investment decision which involved sizeable fixed costs while the benefits were expected to be realized over time (Asfaw, 2011), the effect remained ambiguous for Global GAP's adoption.

With respect to gender, since men sought employment in urban centers, their participation in agriculture was expected to decline leaving women as the active decision-makers on the farms. Women were expected to have better access to rural based information such as Global GAP certification, and had a higher likelihood of adoption. The effect of education was expected to be positive since skills imparted enabled individuals to better conceptualize issues and combine resources in a more efficient manner, and consequently improve the probability of adopting Global GAP. Wealth and exposure to information through seminars and extension were associated with better access to input and product markets.

Wealth was measured in the form of livestock ownership, farm machinery (intermediate assets), small tools and equipment, and household assets. Contact with extension agents was also expected to positively influence adoption of Global GAP practices through better understanding of requirements for production of export produce. Off farm employment was expected to have a negative influence on adoption as this took away the time required to implement a farming regimen under Global GAP. Income in the form of gifts and remittances enabled households to acquire consumptive goods as well as productive inputs, thus improving the chances of gaining certification. Market access, measured in distance to the market, was theoretically expected to negatively influence adoption because distance related to transaction costs both in input acquisition as well as output marketing. This would consequently lead to a lower probability of participation in Global GAP certified farming practices.

3. Results and discussion

Age, increased contact with extension agents through attending extension meetings, trainings and seminars, and distance to local market positively influence the chances of participation in Global GAP as hypothesized. Other variables such as land size, having a large assets base, engaging in off-farm employment, or the size of family and hired labour, had no significant influence on the chances to adopt Global GAP. The descriptive statistics of both certified and non-certified farmers are presented in Table 3.

Variable	Certified (N=205)		Non-Certified (N=61)	
	Mean	*SD*	Mean	*SD*
French beans Output (kilograms)	69 431	47 737	76 827	54 091
Household Characteristics				
Age (Years)	48.4*	9.38	46.1*	10.8
Gender	-	-	-	-
Education (No. Years in school)	13.6	4.8	14.1	9.8
Family Labour (Hours on-farm)	1 566	567	1 452	649
Value of Livestock Assets (Ksh.)	65 984	84 241	55 445	87 412
Value of Household assets (Ksh.)	45 979	74 462	40 051	60 633

Off-farm Employment income (Ksh.)	86 989	171 098.6	107 903	152 023
Transfers, gifts and remittances (Ksh.)	15 027	38 606	29 328	80 392
Contact hours with extension (Hours)	289.7*	352.3	179.6*	121.8
Farm Characteristics				
Farm size (Acre)	1.57	0.58	1.53	0.64
Intermediate assets (Ksh.)	6 323	6 878	10 772	51 124
Inputs held in stock (Ksh.)	226 570	313 473	158 597	133 399
Hired Labour (Hours on-farm)	1 746	627	1 926	647
Distance to nearest market center (kilometers)	2.58*	3.85	4.16*	6.67

Table 3: Household and Farm Statistics of the study sample
Source: Computed from survey data of 2013

3.1. Description of French Beans Smallholders in the Study Sample

The proportion of the household heads who had adopted Global GAP in French beans farming was relatively high for the age group 25 – 50. There were 179 farmers in this age bracket of whom 137 were certified and 42 were not certified. The respondents would have been relatively young, and were in their teenage years when Global GAP was first introduced in Kenya in 2000. This was considered as having a positive influence on their adoption of certification in that they were exposed to the Global GAP standard earlier on in their lives. Age was found to be statistically significant at the 5% level.

The education level in the study area was relatively high with 110 Global GAP certified farmers having attained secondary school education compared to 33 non-certified, and 12 certified farmers had acquired university education to 4 non-certified. The number of years in school was, however, not statistically significant.

French beans smallholders are owners of small parcels of land which measure less than 2.5 acres. The farmers were advised by the export companies to use, at the most, a quarter of their land holding for French beans production. This translated to the largest permitted land size for French beans production of half (1/2) an acre and this also ensured that the remaining land was used for food crops, and livestock keeping. However, with an average of three French beans crop cycles per year and multiple harvests of the beans in one cycle, land size was taken as not being a determining factor for adopting Global GAP. A few farmers leased additional pieces of land for additional French beans production and one farmer was farming up to 3 acres per crop cycle. This practice was found to be dependent on the ability of a farmer to meet the high labour requirements of French beans production.

Certified farmers put in less labour as compared to non-certified farmers during the year. The difference was attributed to intensive labour use during the 2 to 3 French beans production cycles within the year, and labour use being dispersed throughout the year depending on the number of enterprises on the non-certified farms. However, both family and hired labour were not statistically significant.

The hypothesized financial injections from off-farm activities were found to be unavailable to both certified and non-certified farmers. Having a large assets base, wages or salaries, and cash transfers from gifts and remittances were not statistically significant at the 5% level, and did not influence the adoption of Global GAP. This implied that all Global GAP costs and all household and farm financial obligations such as medical care, school fees, purchasing large equipments, etc. were met from the income earned from the sale of farm produce. Price instability for a cash crop like French beans would, therefore, have serious impacts on the small-scale farmers' livelihoods.

Contact with extension agents was expected to influence adoption of Global GAP practices through better understanding of the requirements for production of export quality produce. Female household heads, whether certified or not, had difficulties in attending agricultural seminars which took longer than a few hours. Females had between 9 – 52 contact hours per month during the year and supported the hypothesis that women had access to rural based information, in addition to that provided by extension agents. Male household heads had between 9-208 hours per month, showing that male household heads attended agricultural seminars and trainings which were day long, or longer. The number of hours given for extension trainings was found to be statistically significant at the 5% level, and was deemed to be a major finding with policy implications.

Certified farms were located at or closer to the nearest local markets at distances of between 0 kilometers (kms) to 20kms. On the other hand, non-certified farms were widely dispersed from the nearest local market center up to a distance of 40 kms. Thus, as hypothesized, market access measured in distance to the market negatively influenced participation in Global GAP with those households closer to markets having a higher probability of participation as compared to those located further away. The t-test confirmed that the difference in means according to the certification status was statistically significant at the 5% level.

3.2. Factors Influencing Global GAP Adoption

The econometric results for the propensity score model are exhibited in Table 4 below. The value of the likelihood ratio indicated that the model, as a whole, was highly significant ($P<0.05\%$). The likelihood ratio test result was 0.0049 which indicated the significance in the explanatory powers of the variables included in the probit model. 3 out of the 12 co-efficient were statistically significant at the 5% level. Age, attending extension meetings and seminars, and distance to local market, significantly influenced the marginal probability of a household participating in Global GAP certification. The estimation of marginal probabilities enabled ease in the interpretation of the covariates, and reflected the marginal changes of the dependent variable, due to a unit, or smaller, change in the covariates. Specifically, the table presents the predicted probability of success for an individual who was had adopted Global GAP certification.

Variables	Global GAP certification		Semi-Elasticities	
Age	0.0191546*	0.010186	0.005642	0.002795
Gender	0.4096687	0.440734	0.0944	0.1234
Education	0.0297957	0.038197	0.0107	0.0101
Family Labour	-0.0000519	0.000208	0.0000	0.0001
Livestock assets	-2.09e-07	1.16e-06	0.0000	0.0000
Household Assets	2.23e-06	1.91e-06	0.0000	0.0000
Off-farm employment	-8.68e-07	5.81e-07	0.0000	0.0000
Transfer gifts and Remittances	-2.53e-06	1.77e-06	0.0000	0.0000
Extension Contact	0.0013303*	0.00051	0.0004	0.0002
Farm Size	-0.0251886	0.161831	-0.0016	0.0444
Small equipments and tools	-6.88e-06	4.78e-06	0.0000	0.0000
Farm inputs held in stock	1.90e-06	8.46e-07	0.0000	0.0000
Hired Labour	-0.0003539	0.000198	-0.0001	0.0001
Distance to local market	-0.0393298*	0.019782	-0.0121	0.0053
Constant	-0.5034892	0.970715		
% of correct predictions				
Log-likelihood	-125.79964		-127.5539	
N	266		266	

Table 4: Estimates of the Propensity Score Model (PSM) and semi-elasticities (Probit model)
** P<0.05.*

Age was significant and positive with marginal influence on probability of participating in Global GAP of 0.0056. Age was hypothesized to be an important factor in the adopting Global GAP which is an information-laden production process. It was, therefore, assumed that Global GAP would not be adopted by older farmers. The average age was 47 years, and this showed that French beans farmers were in their productive years. The decision to adopt safety standards being an investment decision with benefits realized in the long term would favour younger farmers who would be more inclined to bear this investment cost, in time and money, than older farmers.

Attendance to agricultural trainings and workshops/seminars increased the marginal probability of participating in Global GAP by 0.0004. Agricultural trainings were commonly organized at the local level, which were in the form of on-farm demonstrations, or group meetings at a local center such as a school or any open space. The training would normally take a few hours to half-a-day, at most. However, workshops and seminars would take place at the county level, and this would require some travel to the venue or location. Workshops typically involve discussions on various topical issues and therefore are held for more than one day. This, therefore, requires an overnight stay at the venue, or longer. This could be what influenced women against attending agricultural workshops. To ensure women's attendance in extension trainings could be promoted by locating trainings and workshops closer to the farm level. Extension agents are necessary for filling the gap occasioned by the inability of small-scale farmers in acquiring and processing technical information on Global GAP requirements. Improved infrastructure, such as the provision of electricity, would enable the faster and easier flow of such information to the farmers.

Market access measured in distance to the local market indicated the relative effects of transaction costs and remote location on participation in Global GAP certification. Market distance was significant at 5% and negative, with marginal influence on probability of participating in Global GAP of -0.01207. The negative influence was as hypothesized; that high transaction costs infringe on farm incomes, and therefore, lower the chances of participation in Global GAP certified farming practices for French beans. Improved rural roads and other communication channels would reduce transaction costs and enable farmers located further from the local market centers establish linkages with buyers. This would enhance the participation of these farmers in export production.

3.3. Impact of Smallholders Adopting Global GAP Certification in French Beans Production

The results of the average effect of participation in Global GAP farming on household income from all the factors discussed above are presented in Table 5. The incomes used were those generated in 2013 from multiple cropping cycles, and multiple harvests within one cycle. The interpretation and discussion of the results refers to the different matching methods, namely: nearest neighbor, radius, kernel and stratified matching.

Matching Method	**Participants**	**Non-Participants**	**Average Effect of Certification (AEC) (Ksh.)**	**Std. Error**	**t-value**
Nearest Neighbour	205	45	-2 670.976	9 205.755	-0.290
Radius	205	55	-2 221.404	8 237.557	-0.270
Kernal	205	55	-2 176.801	6 868.812	-0.317
Stratified	205	55	-2 646.269	9 417.962	-0.281

Table 5: Average effects of participation in Global GAP certified production
Source: Computed from survey data of 2013

The impact of adopting Global GAP certification in French beans production was found to be statistically insignificant in all the four (4) matching methods. The matching was aimed at generating the average effects of certification from the differences in incomes between Global GAP participants and non-participants. Forty-five (45) non-participants were matched to 205 participants in the Nearest Neighbour Matching method, while in the other three methods 55 non-participants were matched to 205 participants. However, all the test statistics, the t-values, are insignificant at the 5% significance level with t-values of between -0.270 and -0.317. This result implied Global GAP certified households received an annual income of Ksh.2 670.97 less than that received by non-certified households.

The difference in annual incomes is relatively small compared to the difference in the production output in Table 1. The certified farmers produced 7 396 kilograms, approximately 7.4 tonnes, less than the non-certified farmers, therefore, the resultant difference in annual income indicates a price difference of which certified farmers received a higher price. However, from the income received, certified farmers faced payments of recurrent Global GAP costs, such as the annual group auditing costs, and payments for inputs received, in-advance, from the export companies. These additional payments were not faced by the non-certified farmers. This implied that participating in Global GAP continued to be costly for individual smallholders involved in French beans production for the export market.

However, if we consider the additional production practices required of certified farmers in meeting the Global GAP standard, the income and production output differences implied that the certified small-scale farmers had developed the capability to manage a Global GAP compliant system. This was an important finding of this study as this could further imply that, in this second decade of farming under Global GAP , small-scale farmers were beginning to realize the benefits from the initial investments in large fixed costs which were necessary in setting up a Global GAP compliant system.

4. Conclusions

The study involved certified farmers who were members of producer groups which maintained links to export companies for additional services. The group dimension could, therefore, not be disregarded as an influence on the incomes received. However, the study brought out the constraints which continue to hinder the performance of the smallholders. These constraints would be reduced if the development of rural infrastructure; roads, electricity supply, and communication channels to gain information on market demand and prices. These developments would boost the incomes of smallholders producing for the export market and promote the inclusion of farms located further from local markets. Youthful and educated farmers of both genders showed that the small-scale farmers have the capacity to manage a Global GAP farming system.

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