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Effect of Certified Organic Production Systems on Poverty among Smallholder Farmers: Empirical Evidence from Kenya

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Summary. — This study evaluates the effect of certified organic production on poverty in smallholder production systems. Data was collected from cross sectional survey of local market-oriented peri-urban vegetable and rural honey producers in Kenya. Poverty was measured using the multidimensional poverty methodology and endogenous switching probit model used to assess the effect of certified organic production on multidimensional poverty. Findings were that certified producers were less likely to be multidimensional poor compared to their counterfactual case of not participating in organic certification schemes. Additionally, noncertified producers would be less likely to be poor if they were to participate in organic certification production.

Key words — certified organic production, multidimensional poverty, endogenous switching probit model, smallholder, Kenya

1. INTRODUCTION

Globally, agri-food systems are experiencing transformation with emergence of food standards and vertical integration of farmers along the supply chains (Asfaw, Mithöfer, & Waibel, 2010; Bolwig, Ponte, du Toit, Riisgaard, & Halberg, 2010; Subervie & Vagneron, 2013). The transformation is attributed to growing consumer concerns on food attributes, environmental sustainability, social benefits of agricultural production systems, urbanization, and the rising standards of living (Aung & Chang, 2014; Denver & Jensen, 2014). One of the fast growing agri-food systems is organic farming, giving rise to organic food production and marketing standards (Hattam, Lacombe, & Halloway, 2012). Producers and marketers of organic products certify their processes to guarantee consumers that the food they consume have met the required food safety, social, and environmental thresholds.

In developing countries, considerable growth of organic-certified production systems in the past two decades has been reported destined to European and North America markets (IFOAM, 2013; Oberholtzer, Dimitri, & Jaenicke, 2012). However, there has been also considerable growth in local oriented organic production systems in sub-Saharan Africa, Kenya included, as a result of urbanization and rising standards of living (IFOAM, 2013; Probst, Houedjofonon, Ayerakwa, & Haas, 2012). This has made organic certification schemes popular, hinged on a multitude of potential environmental, health and social benefits (Barham & Weber, 2012; Bennett & Franzel, 2013). Important potential social benefit from certified organic farming in developing countries among smallholder production is the ability to provide integrated sustainable conduit out of poverty trap by enhancing the development of farmers' livelihood assets (Bennett & Franzel, 2013; Setboonsarng, 2006). This has made organic certification schemes an attractive agribusiness model and governments, nongovernmental organizations, donors, and other developmental partners are being involved in as livelihood improvement and sustainable developmental pathway in smallholder production systems, through access to high-value markets (IFOAM, 2013; Kleemann & Abdulai, 2013). Further, there is ongoing drive to integrate organic agriculture component in most poverty eradication policies and sustainable development agenda in Africa (Willer & Lernoud, 2014).

Pro-poor certified organic farming in Kenya, like in many developing countries, is mainly though farmer based organizations. Certified organic production is being promoted against recent statistics that 47.8% of the population in Kenya is multidimensional poor and 27.4% being vulnerable to poverty, using Demographic and Health Survey (DHS) of the year 2009 (OPHI, 2013). Additionally, adoption of Millennium Development Goals by United Nation member states shifted development focus from economic growth in developing countries to poverty reduction, where majority of the poor depend on agriculture for their livelihood (Christiaensen, Demery, & Kuhl, 2011). However, the question is what is the effect of certified organic schemes on poverty status in smallholder production systems?

Certified organic production could contribute to poverty reduction in various ways. Smallholder farmers, who are mainly resource constrained, could benefit from: (i) savings in form of cash from purchases made on external inputs; (ii) price premium on certified organic produce through access to high-value markets; (iii) value addition on organic produce through processing and packaging; and (iv) surplus production caused by change from conventional production to certified organic production (Asfaw *et al*., 2010; Barham & Weber, 2012; Bennett & Franzel, 2013; Beuchelt & Zeller, 2011; IFOAM, 2013; Kilcher, 2007; Reardon, Barrett, Berdegué, & Swinnen, 2009). Certified organic production systems also provide interactive learning and other knowledge-sharing platforms, which enhances farmer's analytical skills, innovative

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thoughts, and the ability to design on-farm solutions to their farming problems. The knowledge gained positively shapes farmer's human development pathways, eventually leading to poverty reduction (Donovan & Poole, 2014; Kilcher, 2007). Further, financial benefit from organic production system is important in facilitating acquisition of human development assets, leading to poverty reduction (Bennett & Franzel, 2013; Beuchelt & Zeller, 2011; Donovan & Poole, 2014).

On the contrary, Humphrey (2006) argues that stringent organic food safety standards may dissuade participation of smallholder resource-constraint farmers in high-value markets, thus leading to further marginalization. High labor cost and low yield in organic production systems compared to conventional production systems has also been reported to disadvantage organic producers, hence hindering its ability of being pro-poor (de Ponti, Rijk, & van Ittersum, 2012; Goklany, 2002; Oelofse *et al*., 2010). To refute or affirm the hypothesis that organic certification leads to poverty reduction in smallholder production systems justifies the need for systematic empirical analysis. Further, few studies exist in literature to overtly explain the effect of value chain activities on poverty (Bolwig *et al*., 2010). Therefore, effect of certified organic production on poverty status assessment would shed more light on the level of understanding on its true effect. This is in the face of proliferation of pro-poor local market-oriented certified organic production systems as a result of increasing income and urbanization in developing countries, Kenya included. Hence, analysis of the effect of certified organic production schemes on poverty would provide the relevant empirical evidence and policies that could benefit program planners and policy analyst.

In light of the foregoing, the objective of the study is to assess the effect of certified organic production on poverty in smallholder farming production systems. The novelty of the study is to make contribution to empirical literature in terms of effect of local market-oriented organic production systems on poverty. This is as opposed to related prior studies (Bolwig, Gibbon, & Jones, 2009; Chiputwa, Qaim, & Spielman, 2013) which have focused on export markets. There exists a dearth in micro level empirical evidence in literature that tests the hypothesis that certified organic agriculture is really pro-poor among smallholder farmers focusing on fast emerging pro-poor local market-oriented production systems in Kenya. The study demonstrates so using data from cross-sectional survey of peri-urban vegetable and rural honey producers to assess the effect of local market-oriented certified production systems on poverty.

2. MATERIALS AND METHODS

(a) *Data*

Data were obtained from cross sectional household survey among peri-urban vegetable producers in Ongata Rongai district and rural honey producers in Mwingi District during the months of June and July, 2013 in Kenya. In vegetable production systems, data were collected from conventional producers (also referred as noncertified vegetable producers in this study) and certified organic producers. [1] In contrast, among honey producers, all honey production in Mwingi is considered organic because of minimal usage of external inputs in agricultural production and existence of forest buffer zones. Hence, in organic honey production system, data were collected from noncertified and certified organic honey producers. Producers sampled in both case study sites had practiced commercial farming in their respective production systems for at least three years. The two studies were purposively sampled because they have relatively developed pro-poor crop and livestock organic production and marketing systems supplying local markets and involving relatively large number of farmers. Plans are in advanced stage in certified organic production systems to diversify the schemes to exploit demand export market. Certified organic produce are meant for the growing local niche market in urban areas that are conscious of the quality of food intake due to the increasing income levels and the negative effects of urbanization. Certified organic producers supply their produce to local supermarkets, restaurants, hotels, several organic shops, other urban markets and in flea market in Nairobi, mainly though farmer groups and as individuals. Further, the two certified organic production systems benefit from group certification and initial certification costs is subsidized by nongovernmental organizations in order to facilitate the participation of the poor in the schemes. Certification of organic farming processes is through local farmer producer groups formed for the purpose of enhancing organic farming in respective production systems.

Ongata Rongai district is along the great rift valley near the Ngong' hills, located southwest of Nairobi, the capital city of Kenya in Kajiado County. The district receives bimodal rainfall pattern; short rains occurring between October and December and long rains between March and May. The certified organic vegetable production project is coordinated by Kenya Organic Agricultural Network (KOAN) (a local nongovernmental organization). Certified organic farming was initiated in 2007 by KOAN and groups of farmers to curb the problem of rapid soil degradation and to enhance alternative livelihood strategies, thus helping in alleviation of poverty. Organic production and marketing systems are certified by Encert through farmer groups to reduce the cost of certification. The groups also help in ensuring larger marketable produce throughout the year through members' coordinated production, reduced contract making costs with consumers and transportation of organic produce to the markets. In 2003, the Ongata Rongai district which was in the former Kajiado district had 11% of the population living below the Kenya's national poverty line. However, some sub locations had poverty incidences of up to 93% (CBS, 2003). Based on Kenya Integrated Household Budget Survey of 2009, the larger County of Kajiado had poverty levels of 11.6% (CRA, 2011). Government extension officers and Community Sustainable Agriculture and Healthy Environmental Program (CSHEP) provide technical assistance to farmer groups ranging from biodiversity and soil conservation, food production and marketing, food and quality standards, and crosscutting issues in general human development.

Mwingi district on the other hand is located in Eastern Kenya and is a semi-arid region receiving rainfall of between 500–700 mm. It is a highly food insecure region where the livelihood of the residents heavily hinges on rain fed agro-pastoralism and honey production. [2] Certified organic production is through a main producer group (Mwingi Honey Place) established in the year 2002 and currently involving over 2,000 households in 38 groups. The farmer groups receive technical assistance and inputs inform of high-yielding Langstroth bee hives from International Centre of Insect Physiology and Ecology (ICIPE) and International Fund for Agricultural Development (IFAD). The member's organic production and marketing systems are certified by KOAN and Institute of Marketecology through farmer groups. The intervention has led to 10–18% increase in productivity, which has increased household income by 15% (ICIPE, 2013). Based on Kenya Integrated Household Budget Survey of 2009, Kitui County which Mwingi falls had poverty levels of 63.5% (CRA, 2011).

In the peri-urban vegetable production system, data were collected from 237 households, of which 65% were conventional producers and 35% were certified organic producers. Data were collected from 232 households comprising 48% noncertified and 52% being certified organic honey producing households. Multi-stage sampling approach was used to select the sampled households. Purposive sampling technique was used to select two case study sites and selection of three divisions in each case study site based on information from the respective district agricultural offices. From each division selected in each case study site, four locations were randomly selected. In the respective production systems, random sampling methodology was used in the locations chosen to select organic-certified households sampled from the list of farmers available in the nearest locational agricultural offices. For comparison purposes, conventional vegetable producers and noncertified honey producers were randomly selected from a list from the nearest locational agricultural offices. Conventional vegetable producers and noncertified honey producers had close similar characteristics in terms of agro-ecological conditions, livelihood strategies, and land holding living to certified organic producers. Face-to-face interviews were conducted to the sampled households using pretested semi-structured questionnaires by trained enumerators to elicit data on production, marketing, and other household socioeconomic characteristics. Focus group discussion was conducted in each case study site to extract related information for further understanding of the schemes.

(b) *Multidimensional poverty measurement*

In measuring poverty status, the present study used the counting multidimensional methodology developed by Alkire and Foster (2011). Following Alkire and Foster (2011) and Terzi (2013), let $n \times d$, be the matrix of reported attainments in dimensions d in the sample of vegetable and honey producers n be denoted by $\mathrm{P} = \left(p_{ij}\right)$. Thus, the ith household poverty attainment in dimension j is $y_{ij} \geqslant 0$, such that $i = 1,\ldots, n$; $j = 1,\ldots, d$. Further, there is a weighting vector w, such that the jth element $w_j(1j =, \ldots, d)$ denoting the applied weights to dimension j and the set $\sum w_j = d$. This implies that the summation of dimensional weights w_j is equal to the total poverty dimensions included in measuring multidimensional poverty d in the study (Terzi, 2013).

The poverty deprivation cut-off is denoted by $z_j > 0$ in the j dimension and z represents cut-off deprivation vector. For vegetable and honey producers, a deprivation matrix $G^0 = \left(g_{ij}^0\right)$, with $g_{ij}^0 = w_j$ if $y_{ij} < z_j$ and $g_{ij}^0 = 0$ if $y_{ij} \leqslant z_j$ was defined. Summation of all each row elements in the matrix resulted in a column count of deprivation vector c, such that the ith household weighted deprivation count was given by $c_i = \sum g_{ij}^0 (i = 1, \ldots, n)$. The definition of a poor household was concluded by selection of a poverty cut-off k, such that $0 < k \leqslant d$. Therefore, for a household to be considered multidimensional poor, the deprivation count is $c_i \geqslant k$ had to be met (Alkire & Foster, 2011; Terzi, 2013). The dimensions, indicators, and deprivation cut-offs used to measure multidimensional poverty are presented in Table 1.

The dimensions and indicators included various components of human development, including the Millennium Development Goals, derived from previous studies in developing countries (Batana, 2013; Batana & Duclos, 2010; Chowdhury & Mukhopadhaya, 2012; Terzi, 2013). The dimensions include education, health, standards of living, and health which were weighted equally (Alkire & Foster, 2011; Batana, 2013; OPHI, 2013) with each dimension having a weight of 1. The indicators in each dimension were further equally weighted following Alkire and Foster (2011) methodology, of "nested weights structure". For a household to be defined multidimensional poor, a poverty cut-off of 1/3 on the total weighted indicators was applied based on prior similar studies in Sub-Saharan Africa (Batana, 2013; OPHI, 2013; Terzi, 2013).

(c) *Econometric estimation strategy*

The aim of the study was to provide empirical evidence on the effect of certified organic production on poverty using data from vegetable and honey production systems in Kenya. However, the unobservable characteristics that influence household participation in organic certification scheme decision are likely to correlate with unobservable characteristics that influence the poverty status. Ignoring the endogeneity of participation in organic certification would result in biased estimated parameters. To address the endogeneity problem, the study used the endogenous switching probit model, which accounts for the correlation in the unobserved characteristics in the organic participation decision and the poverty status, which is the outcome variable. Following Lokshin and Sajaia (2011), consider a household with two binary outcome equations (whether multidimensional poor or not) and the criterion function C_i (binary variable of household participation in certified organic scheme) that determines the regime faced by the household. The potential values are represented as;

$$C_i = 1 \quad \text{if} \quad \alpha Z_i + \mu_i > 0 \tag{1a}$$

$$C_i = 0 \quad \text{if} \quad \alpha Z_i + \mu_i \leq 0 \tag{1b}$$

$$p_{1i}^* = \beta_1 X_{1i} + \varepsilon_{1i} \quad p_{1i} = I(p_{1i}^* > 0) \tag{2a}$$

$$p_{0i}^* = \beta_0 X_{0i} + \varepsilon_{0i} \quad p_{0i} = I(p_{0i}^* > 0) \tag{2b}$$

where p_{1i}^* and p_{1i}^* are latent variables (household poverty status) that defines observed poverty status p_1 and p_0 (whether the household is multidimensional poor or not, respectively), Z is a vector of exogenous variables determining participation in organic certification schemes, X_i is a vector of exogenous variables determining poverty status, α and β are the vector of parameters to be estimated while μ_i, ε_{1i} and ε_{0i} are the disturbance terms.

The observed poverty status p_i is defined as $p_i = p_{1i}$ if $C_i = 1$ and $p_i = p_{0i}$ if $C_i = 0$. With the assumption of joint normal distribution of μ_i, ε_{1i} and ε_{0i} with a mean of zero, the correlation matrix is written as;

$$\Omega = \begin{pmatrix} 1 & \rho_0 & \rho_1 \\ & 1 & \rho_{10} \\ & & 1 \end{pmatrix} \tag{3}$$

where ρ_0 is the correlation between ε_0 and μ, ρ_1 is the correlation between ε_1 and μ while ρ_{10} is the correlation between ε_0 and ε_1. Consequently, the log likelihood function for the model is given by;

$$\begin{aligned} Ln(\xi) = & \sum_{C_i \neq 0, p_i \neq 0} \omega_i \mathrm{In}\{\Phi_2(X_{1i}, \beta_1, Z_i\alpha, \rho_1)\} \\ & + \sum_{C_i \neq 0, p_i = 0} \omega_i \mathrm{In}\{\Phi_2(-X_{1i}\beta_1, Z_i\alpha, -\rho_1)\} \\ & + \sum_{C_i = 0, p_i \neq 0} \omega_i \mathrm{In}\{\Phi_2(X_{0i}\beta_0, -Z_i\alpha, -\rho_0)\} \\ & + \sum_{C_i = 0, p_i = 0} \omega_i \mathrm{In}\{\Phi_2(-X_{0i}\beta_0, -Z_i\alpha, \rho_0)\} \end{aligned} \tag{4}$$

Table 1. *Dimensions, indicators, and deprivation cut-offs used in poverty measurement*

Dimension and indicators	Description of deprivation cut-offs
Education	
Schooling achievement	Deprived if the household spouses have completed primary level of education
School attendance	Deprived if the household has school-aged children not going to school
Standard of living	
Electricity	Deprived if the household has no electricity
Drinking water	Deprived if the household does not have access to safe drinking water or they have to walk over 30 min to get safe drinking water
Sanitation	Deprived if the household has no descent pit latrine
Flooring	Deprived if household house is earth
Assets	
Phone	Deprived if the household does not own a mobile phone
Radio and/or television	Deprived if the household does not own at least radio
Vehicle	Deprived if the household does not own at least a bicycle
Health	
Nutrition1	Deprived if the household reports a household dietary diversity score of 6 and below out of the possible 12 food groups
Nutrition2	Deprived if the household relies on relief food or any case of malnutrition in the past 2 years
Access	Deprived if the household has difficulty in meeting basic public hospital bills

where ω_i is an optional weight for the ith household and Φ_2 is the cumulative function of bivariate normal distribution (Lokshin & Sajaia, 2011). Previous studies have used the switching probit regression model in social research (Floro & Swain, 2013; Gregory & Coleman-Jensen, 2013; Lokshin & Glinskaya, 2009).

The advantage of endogenous switching probit model specified in Eqn. (4) is the possibility of deriving probabilities in counterfactual cases for household's poverty status on participation in certified organic vegetable and honey production systems. Following Aakvik, Heckman, and Vytlacil (2000) and Lokshin and Sajaia (2011) two cases are defined as;

$$\begin{aligned}\mathrm{TT}(x) &= \Pr(p_1 = 1|C = 1, X = x) - \Pr(p_0 = 1|C = 1, X = x) \\ &= \frac{\Phi_2(X_1\beta_1, Z\alpha, \rho_1) - \Phi_2(X_0\beta_0, Z\alpha, \rho_0)}{F(Z\alpha)}\end{aligned} \tag{5a}$$

$$\begin{aligned}\mathrm{TU}(x) &= \Pr(p_1 = 1|C = 0, X = x) - \Pr(p_0 = 1|C = 0, X = x) \\ &= \frac{\Phi_2(X_1\beta_1, -Z\alpha, -\rho_1) - \Phi_2(X_0\beta_0, -Z\alpha, -\rho_0)}{F(-Z\alpha)}\end{aligned} \tag{5b}$$

where F is the cumulative function of the univariate normal distribution. Eqn. (5a) computes the effect of treatment on the treated (TT), which is the difference between the predicted probability of being multidimensional poor for organic-certified households and the probability of being poor for household had they not participated in organic-certified production. Computing the average of TT(x) on households engaged in organic-certified production results in the average treatment effect on the treated (ATT). The effect of the treatment on the untreated (TU) was computed by Eqn. (5b), which is the expected effect on poverty status if noncertified households had participated in certified production scheme. Computing the average of TU(x) of households that did not engage in organic-certified production results in average treatment effect on the untreated (ATU) (Aakvik *et al.*, 2000; Lokshin & Sajaia, 2011). The descriptions of the variables used in the switching probit model are presented in Table 2.

Theoretically, endogenous switching probit model is identified by a functional form (Gregory & Coleman-Jensen, 2013; Lokshin & Sajaia, 2011). Hence, the study used exclusion restriction methodology to improve on identification, where z_i in Eqns. 1(a) and (b) contained at least one variable not in X_i, in Eqns. 1(a) and (b) (Lokshin & Sajaia, 2011; Wooldridge, 2010). The study used agricultural information sources as used in previous studies (Asfaw, Shiferaw, Simtowe, & Lipper, 2012; Di Falco, Veronesi, & Yesuf, 2011; Negash & Swinnen, 2013). The type of agricultural information sources included were farmer-to-farmer, government extension officers, non-governmental organization extension officers and print and visual media. Table 7 in the appendix presents the falsification tests that indicated sources of agricultural information as valid instruments. Further diagnostic tests were conducted on validity of the instruments. Sargan's test was used to test the correlation between the instruments excluded and error terms (Sargan, 1958). Sargan test was $\Pr > \chi^2(1) = 0.427$ in vegetable production system and $\Pr > \chi^2(1) = 0.312$ in honey production system affirming that the excluded instruments were uncorrelated with the error terms. Further, Wald test was used to test the joint significance of the instruments excluded helping in testing the hypothesis of weak instruments. Wald test was $\chi^2(2) = 34.11$ in vegetable production system and $\chi^2(2) = 27.99$ in honey production system. Hence, the hypothesis of weak instruments was rejected.

3. RESULTS AND DISCUSSION

(a) *Descriptive statistics*

The mean for the variables used in the econometric analysis is presented in Table 3. In terms of multidimensional poverty status, 45% and 42% of conventional and organic-certified peri-urban vegetable producers respectively were categorized as poor. In the same vein, 53% of organic honey producers and 47% of the certified organic honey producers were classified as multidimensional poor. Poverty status in both production systems is comparable to those of OPHI (2013), where 47.8% of the population in Kenya was multidimensional poor. The results portray spatial differences in poverty status among rural and urban households, where rural producers were relatively poor than peri-urban households. Similar findings in Sub-Saharan Africa were found by Duclos, Sahn, and

Table 2. *Definition of variables used in the endogenous switching probit regression model*

Variables	Description of the variables
Education head[a]	Education level of the household head
Gender head	Dummy = 1 if the household head is male, 0 otherwise
Head age	Age of the household head in years
Household size	Household size (numbers)
Off-farm employment	Dummy = 1 if the household head participated, 0 otherwise
Farm size	Farm size in acres
Agricultural assets ('000)	Value of agricultural assets (KES)
System of keeping livestock	Dummy = 1 closed system of keeping livestock, 0 otherwise
Number of extension	Number of contacts with agricultural extension officers in the past 12 months in the past 12 months
Number of trainings	Number of agricultural trainings received
Credit access	Dummy = 1 Had access to credit, 0 otherwise
Market distance	Distance to the nearest produce market (km)
Information sources	
Farmer-to-farmer extension	Dummy = 1 if the household head got information from fellow farmers, 0 otherwise
Government extension	Dummy = 1 if the household head got information from government extension workers, 0 otherwise
Non-governmental extension	Dummy = 1 if the household head got information from non-governmental organization extension workers, 0 otherwise
Print and visual media	Dummy = 1 if the household head got information from newspapers, televisions, and other related media, 0 otherwise
Household social capital	
Density of membership	Density of membership (numbers)
Group heterogeneity[b]	Group heterogeneity index
Meeting attendance	Meeting attendance index (meetings attended/scheduled meetings)
Decision index	Decision making in the groups, 0–100%
Trust	Level of trust among group members, 0–100%
Multidimensional poor	Multidimensional poverty index

[a] Education measured in terms of 1 = not gone to school; 2 = primary; 3 = secondary; 4 = tertiary; 5 = university.
[b] The heterogeneity index derived from questions of whether members were from the same neighborhood, occupation, kin-group, economic status, religion, gender, education level, and age group.

Table 3. *Mean of the variable used in the endogenous switching probit regression model*

Variables	Vegetable producers		*t* value	Organic honey producers		*t* value
	Conventional	Certified		Noncertified	Certified	
Multidimensional poor	0.45(0.23)	0.42(0.25)	1.544	0.53(0.18)	0.47(0.21)	1.681*
Education head	3.46(0.65)	3.59(0.95)	1.632*	2.21(0.27)	2.56(0.54)	1.625*
Gender head	0.87(0.31)	0.60(0.52)	1.153	0.82(0.38)	0.60(0.41)	1.336
Head age	49.98(10.15)	45.92(12.26)	1.981**	55.89(13.25)	49.71(14.25)	3.773***
Household size	4.39(1.21)	4.80(1.35)	−1.438	5.07(1.85)	7.06(1.98)	−6.622***
Off-farm income employment	0.56(0.24)	70.8(0.31)	2.206**	0.44(0.40)	0.70(0.35)	2.747***
Farm size	0.89(0.11)	0.71(0.52)	1.364	3.54(1.25)	3.37(1.54)	0.493
Agricultural assets ('000)	268.92(248.18)	268.58(193.36)	1.452	156.40(25.11)	186.87(38.98)	0.683
System of keeping livestock	0.23(0.11)	0.67(0.30)	2.073**	2.20(0.32)	0.3(0.02)	0.221
Number of trainings	6.44(2.11)	7.21(3.28)	−2.271**	10.47(3.41)	12.95(3.64)	−1.672*
Market distance	3.47(2.27)	3.26(1.56)	0.510	9.77(1.24)	10.04(1.21)	0.760
Farmer-to-farmer extension	0.25(0.25)	0.65(0.17)	2.444***	0.43(0.42)	0.74(0.35)	2.812***
Government extension	0.26(0.12)	0.27(0.25)	0.442	0.14(0.22)	0.49(0.46)	2.271**
Non-governmental extension	0.12(0.13)	0.95(0.56)	8.562***	0.45(0.28)	0.81(0.53)	3.244***
Print and visual media	0.64(36)	0.45(0.22)	−1.623**	0.52(0.40)	0.16(0.13)	−2.647***
Density of membership	1.49(1.25)	1.71(1.03)	−1.415	1.79(1.24)	1.61(1.39)	1.066
Group heterogeneity	0.25(0.22)	0.19(0.25)	2.804***	0.10(0.06)	0.15(0.24)	−2.817***
Meeting attendance	0.83(0.28)	0.94(0.27)	−1.422	0.57(0.12)	0.71(0.19)	−2.621***
Decision index	0.61(0.44)	0.69(0.38)	−1.711*	0.51(0.17)	0.62(0.30)	−2.827***
Trust	0.56(0.40)	0.61(0.32)	−1.325	0.63(0.31)	0.66(0.40)	−1.411

Note: *, ** and *** = significant at 10%, 5%, and 1% level, respectively.

Younger (2006) in Ghana, Madagascar, and Uganda as well as Batana (2013) in Kenya, Ghana, Malawi, Cameroon, Tanzania, and Uganda, where rural households were relatively poor than urban households. Certified organic household heads had relatively high education and more female-headed household heads than noncertified producers in both production systems. In general, farmers who participated in organic-certified farming had younger household heads participating in off-farm activities and relatively large household size. They also had a higher number of agricultural trainings.

Enhancing soil fertility in organic vegetable production systems heavily relies on manure from livestock reared in the

farm. About 67% of certified organic vegetable producers had closed systems of livestock keeping livestock compared to 23% in conventional vegetable producing households. Social capital was measured as detailed in Grootaert (1999), which included group heterogeneity index, meeting attendance index, decision-making index, trust among members in the group and density of membership. Certified vegetable and honey producers had relatively high group heterogeneity index, meeting attendance index and level of decision making. The comparative farm-level economic benefits are presented in Tables 8 and 9 in the appendix for honey and vegetable producers, respectively.

(b) *Determinants of farmers participation in organic-certified production schemes*

The determinants of participation in certified vegetable and honey production systems are presented in Table 4. The explanatory variables were derived from review of past studies on adoption (Odendo, Obare, & Salasya, 2009) and farmer participation in high-value markets (Hattam *et al*., 2012; Kersting & Wollni, 2012; Subervie & Vagneron, 2013; Wollni & Andersson, 2014). Older farmers were less likely to participate in certified organic farming among vegetable and honey producers. Older farmers tend to be risk averse, thus not willing to undertake new production techniques compared to younger farmers, who tend to be flexible and risk takers. Similar findings were reported by Kersting and Wollni (2012) among Thailand farmers adoption of GlobalGap standards. Higher levels of education increased the likelihood of participating in certified organic production systems in both production systems. Education is important in developing knowledge, which influences attitudes and perceptions critical in determining the socioeconomic condition of the farmer as well as choice of livelihood strategies. Education is also important in instilling ethics, understanding application, and transmission of knowledge and information among farmers, which is important in ensuring better implementation of food quality standards.

Higher household membership measured by household size was associated with participation in certified organic farming in honey production system only. This could be due to relatively large family size in rural honey-producing households than in peri-urban vegetable-producing households. Families with larger household size have higher food and nonfood expenditure, forcing such households to try out any new low-cost initiative with potential guarantee of additional economic benefits to meet their basic requirements.

Off-farm activity participation by the household head increased the probability of participation in certified organic vegetable production only, possibly attributed to the relatively high financial capital requirements compared to the honey production system. Odendo *et al*. (2009) found similar results where off-farm incomes positively influenced adoption of manure and compost use in Kenya. Access to information sources positively increased the probability of households to participate in certified vegetable and honey production systems. Whereas government extension agents influenced certified honey production only, farmer to farmer and non-governmental extension sources influenced both production systems. Perhaps this is because farmer-to-farmer extension has high convincing power as farmers can easily observe practically what their colleagues are practicing on their farms and get an explanation of the technology in a language they can easily understand. Moreover, non-governmental extension officers could be using other motivational factors to influence farmers to participate in certified production systems since they have an interest of achieving such goals in the various projects they

Table 4. *Determinants of participation in certified organic production (first stage)*

Variable	Vegetable producers		Honey producers	
	Coeff.	Std. Err.	Coeff.	Std. Err.
Head age	−0.032**	0.027	−0.087***	0.018
Gender head	−1.801	0.663	−0.674	0.314
Education head	0.390*	0.197	0.377***	0.198
Household size	0.180	0.150	0.383*	0.101
Off-farm employment	0.714**	0.400	0.102	0.339
Log of agricultural assets	0.980	0.321	0.174	0.250
Farm size	−0.241	0.185	0.052	0.211
Information sources				
Farmer-to-farmer extension	0.019*	0.590	0.087***	0.483
Government extension	−0.018	0.196	0.120**	0.103
Non-governmental extension	0.057***	0.248	0.526**	0.145
Print and visual media	0.039	0.090	−0.044	0.090
Number of trainings	0.216***	0.412	−0.268	0.362
Market distance	−0.077	0.021	−0.091**	0.035
Credit access	0.532	0.414	0.595	0.584
Social capital variables				
Density of membership	0.058***	0.187	−0.050	0.185
Meeting attendance	0.338	0.413	1.487**	0.546
Group heterogeneity	0.111*	1.820	0.874**	0.174
Decision index	0.186**	0.149	0.306**	0.072
Trust	−0.093	0.028	0.321	0.104
System of livestock keeping	1.438**	0.418	–	–
Constant	−4.321**	3.471	−5.247*	3.100

Note: *, ** and *** = significant at 10%, 5%, and 1% level, respectively.

are carrying out in the country. Access to agricultural information enables a farmer to get informed about the various inputs and farming technologies available for different farm enterprises. This enables farmers to make an informed choice from different alternatives available in an effort to maximize farm returns.

Higher household agricultural asset value also increased the probability of participation in certified organic vegetable production only. Agricultural assets are important in safeguarding the farmer against any risks and providing liquidity during the production and marketing of the organic produce, bearing in mind that the certified organic production is still in its infancy stage.

Higher number of trainings was also important in increasing the likelihood of participating in certified organic vegetable production only. This could be explained by the large variety of vegetable production in relatively small pieces of land compared to the honey producers to meet the tight organic food safety requirements. Shorter distance to the market as a locational variable increased the likelihood of participating in certified organic honey production systems. This finding demonstrates the critical role of market access in increasing the likelihood of participation in high-value markets in rural areas.

Higher social capital was also found to increase significantly the likelihood of participation in certified production systems. Important social capital variables in both production systems were group heterogeneity and decision-making indexes. Additionally, in vegetable producing households, density of membership was important among vegetable producers while meeting attendance index enhanced the participation in certified organic honey production. The social capital variable depicts the various dimensions of social capital as described by Grootaert (1999), which are deemed vital in influencing attitude and thinking among the members, transmission and acquisition of knowledge and information. This is geared toward shaping the farmers' livelihood strategies for collective livelihood improvement. Similar findings were reported by Wollni and Andersson (2014), where social conformity and increasing the information network among farmers increased the probability of adopting organic farming in Honduras. Finally, farmers using closed system increased the likelihood of participation in organic-certified vegetable production system because of easy manure management for maintaining and improving soil quality.

(c) *Determinants of multidimensional poverty status*

The determinants of household multidimensional poverty status results are reported in Table 5. The independent variables were selected from past studies on determinants of poverty (Batana, 2013; Carter & Barrett, 2006; Krishna & Shariff, 2011). At the lower panel of Table 5, ρ_0 and ρ_1 are negative for nonparticipants and participants in vegetable and honey certified organic production system. This was an indication that households which were less likely to participate in organic-certified production systems were more likely to be multidimensional poor, due to unobservable household characteristics. The likelihood-ratio tests for the joint independence of the equations were not significant in both production systems, validating the use of the switching probit model as opposed to the bivariate probit model.

Age of the household head negatively influenced the likelihood of household being poor in all the four categories, except among noncertified organic honey producers. Older household decision makers had lower likelihood of being poor possibly because of the amassed wealth over time enabling them to make more human development investments. Further, the pseudo characteristic of age being an indicator of farming experience, older household heads could use their experience as household agricultural executives in the uncertain world of farming to get better yields and hence more income, which

Table 5. *Determinants of multidimensional poverty status (second stage)*

Variable	Vegetable producers				Organic honey producers			
	Conventional		Certified organic		Noncertified		Certified	
	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.
Head age	−0.014**	0.013	−0.024***	0.087	−0.045	0.052	−0.022**	0.121
Gender head	−0.640	0.418	0.861	0.382	0.512	0.448	−0.251	0.853
Off-farm employment	−0.065*	0.173	−0.176**	0.241	−0.162***	0.427	−0.385**	0.247
Household size	0.261	0.110	−0.442	0.141	0.073***	0.111	0.181***	0.632
Farm size	−0.057***	0.824	−0.023**	0.054	0.352	0.321	0.258	0.182
Credit access	0.044	0.164	−0.053**	0.179	0.505	0.216	−0.177	0.283
Log of agricultural assets	0.156	1.450	−0.164***	0.532	−0.088	0.285	−0.128***	0.894
Number of trainings	0.057	0.039	−0.044	0.043	0.045	0.035	−0.033	0.023
Market distance	−0.265	0.415	−0.288	0.639	−0.040**	0.017	−0.001*	0.074
Social capital variables								
Density of membership	−0.298	0.384	−0.173	0.217	−0.437**	0.832	0.001*	0.211
Meeting attendance index	−0.849	0.251	−1.325**	0.615	−1.471***	1.949	0.369***	0.524
Group heterogeneity index	−0.216***	0.510	−0.732**	0.761	−0.214	0.361	−0.428	0.392
Decision making index	0.011**	0.425	0.023	0.491	−0.287	0.936	−0.285	0.299
Trust among group members	−0.255	0.782	−2.221	0.462	−2.358	1.280	−0.657	0.710
System of livestock keeping	−0.024*	0.151	0.050	0.010				
Constant	−4.333**	0.825	−3.254**	2.252	7.987*	0.090	−5.472	3.628
ρ_0	−0.814	0.973			−0.449	0.622		
ρ_1			−0.239	0.994			−0.153	0.191
Lr. test for indep. Eqns. (rho1 = rho0)	Chi2(2) = 1.16 prob > chi2 = 0.442				Chi2(2) = 1.81 prob > chi2 = 0.371			

Note: *, ** and *** = significant at 10%, 5%, and 1% level, respectively.

is reinvested for purposes of human development. Krishna and Shariff (2011) also found that older household heads (above 40 years) in India had higher probability of escaping poverty and less likely of falling into poverty.

Participation of the household head in off-farm income-generating activities reduced the likelihood of household being multidimensional poor in all the four categories. The finding demonstrates the vital role of off-farm activities in enhancing household income diversification due to the uncertainty and risks facing agriculture in most developing countries. Additionally, participation in off-farm activities could expose the decision maker and get more information on how to build their household human development indicators. Similar findings were reported by Krishna and Shariff (2011), where participation in off-farm increased the probability of escaping poverty in India. Families with larger household size had higher probability of being poor in honey production systems. Households with larger family size may face difficulty in financing and building their human development indicators, as most of the household income is spent on food expenditure. Households with higher larger family sizes are associated with higher probability of poverty in previous studies (Arif & Farooq, 2012; Shete, 2010), as it places additional burden on their assets and other resources.

Larger agricultural land size decreased the likelihood of being poor in vegetable-producing households only. In vegetable-producing households, land is relatively scarce due to their location in peri-urban compared to rural honey producers. Therefore, farmers with larger land size are more likely to produce more leading to higher income, which facilitates them in building their human development indicators. This is opposed to the semi-arid honey producers, who have relatively big land size, purely rain fed and the production system is faced by relatively high production and investment uncertainty. Having access to credit reduced the probability of household being poor in certified organic vegetable producing households only, possibly because of the high capital requirement and cushioning against possible delays in payments for organic produce by supermarkets and hotels.

Finally, social capital variables were also important in determining household poverty status in all the four categories. Social capital development is important as it acts as a change agent, influencing the attitude, perceptions, as well as providing the necessary information and knowledge platforms increasing household probability of not being poor. However, a caveat that the effect of social capital on poverty is not always positive is needed, as its effects depend on the characteristics of the groups. Olson (1982) observed that some social groups may not lead to poverty reduction due to their engagement in unproductive activities stifling members' economic growth.

(d) *Mean treatment effects*

The effect of participation in organic-certified production systems on multidimensional poverty is presented in Table 6 which was estimated by Eqns. 5(a) and (b) as detailed by Lokshin and Sajaia (2011) from the switching probit regression model. The average treatment effect on the treated (ATT) was −0.071 and −0.184 in vegetable and honey-producing households, respectively. This implied that among certified producers, their participation in certified organic production led to about 7 and 18 percentage point less likelihood of being multidimensional poor compared to the counterfactual case (not participating in organic certification) among vegetable and honey producers, respectively. The findings demonstrate the role of organic-certified production on poverty reduction among smallholder producers among participants in certified organic production system.

To policy makers and program planners, their interest is to understand what would be effects of organic certification on poverty in conventional vegetable and noncertified organic honey-producing households if they were to adopt certified organic production. The finding was interesting and is given by average treatment effect on the untreated (ATU). If farmers in conventional vegetable production system were to undergo organic certification, this would lead to about 7% less likelihood of being multidimensional poor. Hence, they would be better off if they were to participate in organic certification scheme (as opposed to being conventional producers). In the same vein, organic certification would result in about 21% less likelihood of being multidimensional poor among noncertified organic honey producers if they were to be certified. However, comparing the results of ATT and ATU, noncertified honey producers would benefit from poverty reduction more than certified producers by about 2 percentage points. In contrast, conventional vegetable producers would benefit the same as organic-certified vegetable producer upon certification. Thus, in-cooperation of conventional vegetable and noncertified organic honey producing households in organic-certified production would lead to better livelihood outcomes, in form of poverty reduction, but first they must overcome the impediments that bar them from adopting the initiative.

4. CONCLUSION AND POLICY IMPLICATIONS

The objective of the study was to determine the effect of organic certification on poverty among smallholder farmers in Kenya. In achieving the objective, poverty was measured using the innovative multidimensional methodology proposed and endogenous switching probit regression model was used to assess the effect of organic certification on poverty. Findings were that households with younger and highly educated chief decision makers as well as higher household social capital were more likely to participate in organic-certified systems in both production systems. However, unique drivers in each production system were observed. Participation in off-farm income activities by the household head, higher number of trainings because of the diverse crop production information requirement and having closed system of keeping livestock for ease manure management were important drivers in vegetable production systems. In honey production systems, limited market access measured by distance to the nearest market honey

Table 6. *Mean treatment effect from organic certification*

Treatment effect	Vegetable producers		Honey producers	
	Estimate	Std. Err.	Estimate	Std. Err.
Average treatment effect on the treated (ATT)	−0.071	0.088	−0.184	0.110
Average treatment effect on the untreated (ATU)	−0.068	0.056	−0.209	0.122

market was a critical impediment to participation in organic certification program. However, the community self-help group is trying to counter this problem using mobile collection centers during harvest seasons in specific days to collect honey from very distant farmers. On multidimensional poverty, the study concludes that the rural poor were relatively poor (53% of organic honey producers and 47% certified organic) compared to peri-urban producer (45% for conventional and 42% for organic-certified producers).

In the same vein, participating in off-farm income activities increased the probability of not being poor in both production systems. This raises a policy concern on the importance of diversifying farm income through creation of sustainable off-farm activities. Of concern also is the effect of larger household size in rural areas, which significantly increased the probability of being poor. This calls for the need to reevaluate the effectiveness of existing family planning policies in rural areas. Further, higher physical (in terms of agricultural assets) and social capital were found to reduce the probability of being poor. These findings underpin the importance of encouraging reinvestment in agricultural productive assets and need for strengthening societal ties. Stronger societal social capital could provide avenues for attitude and perception change while engineering information and knowledge transfer important for human development through sharing critical life changing decisions. For public policy, there is a need to strengthen and form new local institutions as agents of change and development. However, question on the sustainability of the certification programs and social ties as a result of the farmers' dependency on support from donor and nongovernmental organizations in case they withdraw from the program in both production systems requires further research.

Finally, the effect of certified organic production reduced the probability of being poor in the two production systems. Certified organic producers were 7 and 18 percentage points less likely to be poor compared to their counterfactual case (not participating in organic certification) among vegetable and honey producers. Of interest to policy makers and program planners was the average treatment effect on the untreated results in understanding the possible effect on poverty if noncertified producers were to be certified. From the findings, noncertified producers would benefit from certified organic production; at it reduces the probability of being multidimensional poor by about 7 and 20 percentage points among vegetable and honey producers, respectively. Therefore, noncertified farmers would be better off being certified in both production systems. This could be achieved by enhancing their socioeconomic and institutional drivers of participation in the fast emerging and growing certified organic market for smallholder farmer livelihood improvement through poverty reduction. Though the study attempts to evaluate the effect of certified organic production on poverty, there is a need for further interrogation of the same over time to understand the long-term effects.

NOTES

1. The type of vegetable grown in the area include cabbages, kales, a variety of indigenous vegetables (cowpea leaves, jute, pumpkin leaves, *amaranthus*, spider plant, black night shade, *Crotolaria*), capsicum, courgettes, leeks, eggplant, dhania, beetroot, cucumber, tomatoes, carrots, lettuce, Broccoli, pumpkins , cauliflower, spinach, and onions.

2. For brevity purposes, more details on the project visit ICIPE website at http://www.icipe.org/index.php/component/content/article/62-commercial-insectsprogramme/402-wild-silk-and-honey-bee-farming-for-income-generation-and-biodiversity-conservation-through-value-chain-approach.html. (Accessed on 09 October 2013).

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APPENDIX

Table 7. *Tests on the validity of selected instruments*

Variable	First stage				Second stage			
	Vegetable producers		Honey producers		Conventional vegetable producers		Noncertified honey producers	
	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.
Farmer-to-farmer extension	0.019*	0.590	0.087***	0.483	0.033	0.045	−0.052	0.107
Government extension	0.018	0.196	0.120**	0.103	0.064	0.038	−0.110	0.066
Non-governmental extension	0.057***	0.248	0.526**	0.145	−0.044	0.043	0.045	0.035
Print and visual media	0.039	0.090	0.044	0.090	0.005**	0.059	−0.014**	0.038
Constant	−4.321**	3.471	−5.247*	3.100	−4.181**	0.797	8.071*	0.102
Wald test	27.99***		34.11***					

Note: *, ** and *** = significant at 10%, 5%, and 1% level, respectively.

Table 8. *Comparative farm-level economic benefit from honey production (in Kenya shillings)*

Variables	Non-certified	Certified	*t*-value
Average production (in kilograms)	173.36	186.36	0.352
Price per kg of unprocessed honey	158.31	200.00	−12.774***
Total value of sales	27444.62	37272.00	−1.972**
Labor cost	2882.17	3025.93	−0.641
Other variable costs	376.62	830.53	0.365
Total costs	3258.79	3856.46	0.852
Gross margin per farm	24185.83	33415.54	−1.922**

Note: **, *** = significant at 5% and 1% level, respectively.

Table 9. *Comparative farm-level economic benefit from vegetable production (in Kenya shillings)*

Variables	Conventional	Certified organic	*t*-value
Total value of output	121,030.39	144,998.58	1.676*
Costs			
Labor costs	15,252.21	22,654.00	−2.931***
Pesticides/herbicides	3,622.32	947.91	−2.174**
Fertilizer costs	4,467.12	1,724.87	−1.982**
Seed costs	2,021.39	2,638.36	1.421
Other costs	1,987.23	2,432.38	1.239
Total costs	27,350.27	30,397.52	0.253
Gross margin	93,680.12	114,601.06	−1.971*

Note: *, ** and *** = significant at 10%, 5%, and 1% level, respectively.