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Analysis of profitability of organic vegetable production system in Kiambu and Kajiado counties of Kenya

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Abstract Though there are many documented reasons that make farmers adopt organic farming system, economic benefits present a major motivation. The study was conducted to analyse the profitability of organic production system as an investment alternative to conventional farming in the two Kenyan Counties of Kiambu and Kijiado so as to appraise its contribution to improvement of rural livelihoods. The study collected data on costs and returns from 208 smallholder vegetable farmers who were composed of 78 organic and 130 conventional farmers. The means of variables of the two samples were compared using chi square, while factors associated with adoption of organic production system were analysed using logistic regression. Factors influencing profitability of organic production system were evaluated using ordinary least square regression. Organic production system was found to have higher gross margins for kales and spinach. Age, farming experience, and number of trainings attended; availability of irrigation, target market selected, production per acre, cost of production and price per unit were found to have a bearing on the profitability of an a given vegetable. In addition, age, farming experience, irrigation, land ownership and County of residence were found to be associated with adoption of organic vegetable production system.

Key words: Organic, profitability, smallholder production systems, vegetables

Introduction

In Africa, more than 75% of farming community practices subsistence and/or traditional agriculture. Due to the low skills, knowledge and asset base, agricultural productivity has declined over the years and is 2-3 times lower than the world average (FAO, 2006). There is, therefore, a growing need to provide food to an increasing population through innovative and adapted sustainable farming systems. Organic production system is gaining popularity as one of the options which can enhance production of healthy food in a sustainable way (NEP-UNCTAD-CBTF, 2008). It contributes to the achievement of MDG (Millennium Development Goal) number one and seven on eliminating Poverty and hunger; and enhancing environmental sustainability, respectively.

In Kenya, there are more than 200,000 farmers who have been trained on organic farming principles and practices (Kenya Organic Agriculture Network, 2010). Currently certified land under organic management in Kenya stands at 104,211 ha while the sector employs 12,647 producers/wild harvesters directly (Willer & Lukas, 2010). The vigorous growth of organic agriculture in the country is partially hampered by the perceived high economic risk leading to low adoption (UNEP-UNCTAD, 2007). This is contributed by limited empirical documentation of its economic benefits which also limits support by government and development partners. In order to support appraisal of organic agriculture as a viable alternative production system which contributes to livelihood improvement, there is a need to evaluate its impact on profitability especially for smallholder farmers.

The numbers of studies evaluating the impact of organic production system in terms of profitability are numerous. Of these, only few studies consider long term economic impact and most of them have been undertaken in developed countries (mainly USA) and on certain crops (corn, soy and wheat) (IFOAM, 2013). In Africa and other developing countries, there are only few studies which compare organic and conventional production system (Bolwig *et al*., 2009). The comparison between the two systems, however, faces several challenges (Offermann & Nieberg, 2000; Canavari *et al*., 2004; Cisilino & Madau, 2007; Zanoli *et al*., 2007).

The challenges can be categorised as; a) high differences as far as the productive techniques are concerned; b) different technical- productive paradigm making it difficult to define a peculiar one for each group; c) heterogeneity, mostly because conventional farming is a mix of agronomic techniques, some of which are similar to the organic ones.

However, most of the organic system impact studies done show organic production system as having a positive impact to farm profitability (Cobb *et al*., 1999; Offermann & Nieberg, 2000; Northeast Organic Farming Association, 2001; Zanoli *et al*., 2007; Demiryurek & Ceyhan, 2008; FAO, 2009; Agriculture and Policy Research Centre, 2009). Comparably, few studies show adoption of organic farming system having no impact on profitability (Cobb *et al*., 1999; Offermann & Nieberg, 2000; Northeast Organic

Farming Association, 2001; Zanoli *et al*., 2007; Caliendo & Kopeing, 2008; Demiryurek & Ceyhan, 2008; FAO, 2009; Agriculture and Policy Research Centre, 2009). On the other hand, some studies show organic production system having no impact on farm profitability during conversion but show profitability increasing with achievement of full organic status (Cobb *et al.*, 1999; Pimentel *et al*., 2005). The impact of organic system on profitability is shown to have disparities depending on crops, regions and technologies employed (Pimentel *et al*., 2005). This study focused on analyzing the profitability of vegetable production system among smallholder producers in Kiambu and Kajiado Counties of Kenya so as to appraise its contribution to household livelihoods.

Materials and methods

The study was conducted in Kiambu and Kajiado Counties of Kenya. The two Counties were selected due to their proximity to Nairobi County which is the main organic produce market. A farm survey was conducted among a sample of 78 organic certified and 130 non organic smallholder farmers through scheduled interviews. The conventional farmers were sampled using stratified sampling method where K-means clustering approach was used based on the organic sample as postulated by Cisilino & Madau (2007) and Zanoli *et al*. (2007).

Data was collected on production costs, yield, prices, target market, social economic and farm characteristics of smallholder organic and non organic vegetable farms growing kales, spinach and cabbages. Secondary data was collected between January and February 2012 while primary data was collected between March and June 2012. Primary data collection was done using structured questionnaire which was administered through scheduled interviews for both smallholder organic and non organic farmers. Data was collected on acreage, yield, prices, costs and target market for the previous 2 seasons for the year 2010/2011. To enhance reliability and validity of the tools used in data collection, pretesting was done with a group of smallholder vegetable farmers from Githunguri division with the same characteristics as the trial and control groups.

Data was entered in an excel sheet and cleaned. Total costs and revenue and gross margins were calculated. Data was entered in Stata version 11.0 for analysis. Means were compared using chi square. To evaluate the motivation for adoption of organic vegetable production system, the effect of social economic, farm and market characteristics on adoption of smallholder organic vegetable production was evaluated using a logistic regression model. According to Genius *et al*. (2006), adoption can be evaluated as a probability that in this case a farmer will practice organic vegetable farming denoted by Pr (Yi=1); where the farmers probability to practice conventional production system as a counterfactual can be expressed as Pr (Yi=0). The model below, therefore, will suffice the analysis required thus:

$$\Pr(Yi = 1) = \frac{e^{\beta x + \varepsilon}}{1+e^{\beta x + \varepsilon}} \quad \text{................................ (1)}$$

Where *Pr (Yi=1)* is the probability that a farmer is practicing organic and â is the coefficient while x represents adoption factors (social economic, farm and market characteristics) and is the error term. By taking the natural logarithm of equation 1 above we get a simplified form of adoption logistic probability model as follows:

$$\ln[\Pr(Y = 1] = \frac{e^{\beta x + \varepsilon}}{1+e^{\beta x + \varepsilon}} \quad \text{............................... (2)}$$

The equation 1 above can be expanded to a full logistic regression equation with explanatory variables included as follows:

$$\ln[\Pr(Yi = 1)] = \ln\left[\frac{e^{\beta 0 + \beta 1\, Sex + \beta 2\, Age + \beta 3\, OCC + \beta 4\, EXP + \beta 5SIZ + OWN\, \beta 6 + IRR\, \beta 7 + \beta 8PAR + \beta 9MKT + \varepsilon}}{1 + e^{\beta 0 + \beta 1\, Sex + \beta 2\, Age + \beta 3\, OCC + \beta 4\, EXP + \beta 5SIZ + \beta 6OWN + \beta 7IRR + \beta 8PAR + \beta 9MKT + \varepsilon}}\right] \quad \text{.......... (3)}$$

By taking the log odds, the equation can be simplified, thus;

$$Ln(Yi) = \beta 0 + \beta 1\, Sex + \beta 2\, Age + \beta 3\, OCCUPATION + \beta 4\, EXPERIENCE + \beta 5SIZE + OWN\, \beta 6 + IRRIGATION\, \beta 7 + \beta 8PAR + \beta 9MKT + \varepsilon \quad \text{.......... (4)}$$

Where the default value β_0 is the constant and $\beta_{1,}$ $\beta_{2,}$ $\beta_{3,}$ $\beta_{4,}$ $\beta_{5,}$ $\beta_{6,}$ $\beta_{7,}$ $\beta_{8, and}$ $\beta_{9,}$ are parameters for explanatory variables; sex, age, occupation of the household head, experience in farming, farm size, ownership, irrigation facility on the farm, number of parcels and target market, respectively. e_i represents the error term. The preference of using logit model in analysing adoption is due to its consistency in parameter estimation associated with the assumption that the error term has a logistic distribution (Zhoa, 2008).

The effect of Social economic factors, farm and market characteristics on profitability were estimated using an OLS multiple linear regression model stated as follows:

$$Y = \beta_0 + \beta_1 Age + \beta_2 EXPERIENCE + \beta_3 SIZE + OWN\, \beta_4 + \beta_5 PAR + \beta_6 MKT + e_i \quad \text{.......... (5)}$$

Where the default value β_0 is the constant and $\beta_{1,}$ $\beta_{2,}$ $\beta_{3,}$ $\beta_{4,}$ $\beta_{5,}$ $\beta_{6.}$ are parameters for explanatory variables; age, experience in farming, farm size, ownership, number of parcels and target market, respectively, and e_i represents the error term.

When ordinary least square regression method is used in statistical analysis, endogeneity and self selection bias may occur due to possible omitted variables, measurement error or simultaneity leading to error term and explanatory variables being correlated. To detect presence of endogeneity and self selection bias in the model, instrumental IV variable regression was applied where position in the household of the farmer and the number of trainings attended were used as instrumental variables and transaction costs used as endogenous. The selection of the two variables was based on the consideration that they were not included in the main equation since they were considered to have no effect on profitability for smallholder organic vegetable production. First, test for over-identifying restrictions was done to check if the instruments satisfied the requirement for exogeneity. Self selection bias was later done to establish the robustness of the estimators. Whereas the presence of heteroscedasticity should not bring alarm over the unbiasness and consistency of predictor variables, it may reduce the efficiency of the estimators (Gujarat, 2003). To correct this, Whites heteroscedasticity corrected standard errors (robust standard errors) were used (Bolwiq *et al.*, 2009).

Results and discussions

Descriptive statistics. Age, level of education, farming experience, number of training, land size, number of parcels of land owned by the farmer, and source of labour were significantly different for the two cohorts (Table 1). However, position in the household, marital status, topography, occupation, source of financing and type of irrigation for the two cohorts was the same.

As observed by Demiryurek & Ceyhan (2008) and Jans & Cornejo (2001), the organic vegetable farming group was older compared to conventional farmers group and had bigger land sizes and more parcels of land compared to non organic farmers. The adoption of organic vegetable production system by aged population is expected as most farming activities in Kenya are done by an aging population while most of the youth go to towns to seek employment (Republic of Kenya, 2010). The preference of organic production by older generation can be said to relate to their preference for health benefits associated with consuming organic foods as observed by International Federation of Agriculture Movement (IFOAM. 2013).

Organic farming as a new technology is expected to attract more educated farmers and requires farmers to attend trainings to acquire skills. In addition, the organic cohort had more educated farmers who were less experienced but had attended more training compared to the conventional cohort. This was in line with findings of other authors (Demiryurek & Ceyhan, 2008; Republic of Kenya, 2010) who found organic farmers to be new entrants in farming with less experience but with higher education level of post secondary level compared to conventional farmers who have more experience but with lower education level. Organic farmers were also having bigger land sizes which were in form of many parcels contrary to expectation that organic farmers have small farms as observed by Cisilino & Madau (2007).

The existence of significant difference between the two groups for selected variables suggests that these variables have an influence on farmers decision whether to adopt organic vegetable production system. It is, therefore, important to use econometric analysis to understand motivation for adoption.

Factors associated with adoption of organic production system. To determine factors associated with adoption of organic productions system, logit regression estimators of social economic, farm and market characteristics on adoption of organic vegetable production system were derived as shown in Table 2. The explanatory variables considered were; age, gender, farming experience, occupation, and land size, number of parcels, irrigation, land ownership, and County location.

The Pseudo R^2 indicated goodness of fit for regression estimators meaning that they were able to explain the participation probability. The values of R^2 and Adjusted

Table 1. Difference in means of characteristics of adopters and non adopters.

Variables	Conventional N= 120	Organic N=71	Mean DifferenceT-test
Position in the household	1.74	1.75	-0.05(0.12)
Marital status	1.88	1.83	0.05(0.05)
Age	37.73	46.68	-8.95***(1.68)
Level of education	2.87	3.39	-0.53***(0.13)
Experience	9.35	6.37	2.99***(1.02)
Number of trainings	1.75	2.94	-1.19**(0.56)
Topography	1.66	1.55	0.12(0.10)
Occupation	1.55	1.46	0.09(0.09)
Total farm size	0.57	3.04	-2.47***(0.59)
Number of parcels	1.17	1.43	-0.27**(0.11)
Source of finance	1.00	1.01	-0.01(0.01)
Type of irrigation	2.40	2.05	0.35(0.65)
Source of labour	1.21	1.56	-0.36***(0.08)

Note: Significance level of mean difference is at *10 %, **5 % and ***1 %, Standard errors in parenthesis.

R^2 as shown in Table 2 was within the accepted range, and therefore, showed that the model fitted well the predictor variables. This was also confirmed by pearson goodness of fit test that yielded large P- value. The model was also shown to have well and correctly specified predictor values with high percentages. In addition, correlation matrix for the coefficients reported weak relationships which can be interpreted to mean low or absence of multicollinearity.

Adoption of organic farming technology refers to a farmer's decision to implement principles and practices of organic production system. As shown in Table 2, age, irrigation, land ownership, farming experience and County of residence significantly influence a farmer's decision to convert to organic farming. Age, accessibility to irrigation and land ownership positively influence adoption of organic production system while farming experience and County of residence has an inverse relationship to adoption of organic vegetable production system. Though men are seen to favour adoption of organic farming (Demiryurek and Ceyhan, 2008) , there was observed gender influence on adoption in the study.

The findings presented demonstrate that social economic factors, farm and market characteristics can significantly explain the adoption of smallholder organic vegetable production system. The study established that aged farmers were more responsive to adoption of organic agriculture compared to the youth. This finding can be explained by the labour intensity associated with organic production system as observed by Cisilino & Madau (2007). Young people are also generally less interested in agriculture production enterprises due to lag in earning (Republic of Kenya, 2010). Other studies by Bolwig *et al.* (2009) on organic coffee in Uganda and Oxouzi & Papanagiotou (2010) on organic grapes in Greece indicated that organic farming population was more aged compared to conventional production system.

The study also found that farmers with more experience in farming are not likely to convert their farms to organic production system. This means that organic production system is more preferred by farmers who have less prior expereince in farming and are experimenting the system as an innovate departure from the dominant conventional production system. As expected, farmers who have access to irrigation and own land are more likely to adopt organic production system. Access to irrigation is a key component to planning and ensuring consistency in production. Its presence will, therefore, contribute to farmers notivation to convert. Since organic production system requires investment in establishing cropping systems, canopies and requires planning as observed by Elzakker & Eyhon (2010), farmers on hired or leased land will not be motivated to convert as observed in this study.

Table 2. Factors associated with adoption of organic vegetable production system.

Variable definition	Coefficient	Standard error
Age	0.088***	0.023
Gender of HH	-0.485	0.411
Farming experience	-0.111***	0.039
Occupation	0.056	0.608
Land size	-0.152	0.146
Number of land parcels	0.345	0.263
Irrigation	1.621***	0.592
Land ownership	1.123***	0.436
County	-1.917***	0.731
Constant	-4.337***	0.95

Wald Chi^2=42.51, Prob> Chi^2=0.001, Pseudo R^2=0.33, Log likelihood=-79.01 F(9,191) =4.7; Significance level of regression estimators: *0.1, **0.05, ***0.01.

The location of a smallholder vegetable farmer will have an influence on conversion to organic production system. Farmers from Kiambu County are less motivated to convert their farms to organic production system compared to smallholder farmers residing in Kajiado County. Though both Counties are at proximity to Nairobi, the farming population in Kajiado is less compared to Kiambu according to KNBS (2010), leading to bigger local market for the producers. Conventional farming is dominant in Kiambu County where also farming has traditionally been practiced. As indicated above, the presence of less experienced farmers in Kajiado seeking innovations in farming could have led to a wider adoption. Location of a farm is observed to have an influence on adoption of organic farming as was the case for vegetable farmers in Califonia, USA (Jans & Cornejo, 2001.).

From Table 3, smallholder organic vegetable production system have a higher production cost for all the three vegetables though not significant. Smallholder organic producers, however, incur significant transaction costs compared to conventional producers. For kales and spinach, the smallholder organic vegetable production system has a significantly higher gross margin compared to conventional system, while gross margin for cabbage was indifferent. The findings compare with other studies which also show organic production system being costly compared to conventional production system (Jans & Cornejo, 2001; Cisilino & Madau, 2007; Demiryurek & Ceyhan, 2008; Bolwiq *et al.*, 2009; FAO, 2009; Oxouzi & Papanagiotou, 2010). The higher costs can be attributed to more labour requirements which makes labour cost high for organic compared to conventional production system. Most of the studies which have observed the difference between organic production and conventional markets show difference in prices due to organic premium. The study showed that price difference for the different vegetables as observed by Bolwig *et al.* (2009) on pineapples, coffee and cocoa; and Oxouzi & Papanagiotou (2010) on grapes make organic farming to be more profitable.

Factors influencing profitability of organic production system. Profitability of smallholder organic vegetable production system is influenced by several factors. In the study, social economic variables (age, gender, level of education and occupation), farming characteristics (farming experience, number of trainings attended, land size, number of parcels, irrigation, production per acre, average price cost of production and land ownership) and target market were evaluated to determine their relationship with gross margin of the organic production system. Table 4 shows the coefficients for the variables.

The statistics summary above indicates the suitability of the model used. The model fitted in the regression estimators as indicated by the low significant values of F and reasonable values of R^2. To determine the robustness of the model, several tests were conducted. The tests for normality of explanatory variables using Shapiro and swilk tests and kernel density graph for normality of residuals variance was within acceptable levels. Inflation factor test and correlation matrix test for multicollinearity returned positive results as shown by Appendix 4 where mean VIF was 1.77 within the acceptable level of Mean VIF less than 10 (Gujarat, 2003).

In addition, linktest for model specification suggested that the model was well specified. Breuch pagan test for heteroscedasticity returned significant values showing a presence of heteroscedasticity and hence the use of robust standard errors. The Sargan's statistics returned non significant value signifying that the IV instruments selected were valid. In general, the instrumental IV residuals and OLS residuals had the same direction of orientation and were comparable. The strong correlation between the instruments and the selected endogenous variable as shown by Wu-hausman test which returned non significant score under null hypotheses confirmed the robustness of OLS estimators and their suitability for making inference.

As observed by FAO (2009), Cisilino & Madau (2007) and Demiryurek & Ceyhan (2008), farming experience and irrigation are associated with higher profitability in organic production systems. Organic agriculture production system requires long-term investments including soil fertility management, human skills and farm layout as observed by Elzakker & Eyhon (2010). Individual ownership of land will, therefore, motivate farmers to put more invetsment, and thus; earn higher profits from their production systems. As observed by FAO (2009) and Pimetel *et al*. (2005), irrigation influences production by enabling better production and market planning. The positive significant influence of age on profitability can be explained by more effort put by older farmers who are expected to control household resources. These resources are required in organic farming technology which requires more labour for production (Dalate *et al.*, 2002; Elzakker & Eyhon, 2010).

As observed by Canavari *et al*. (2008), target market is associated with profitability of organic production system. The positive coefficient can be interpreted to mean increasing profits when farmers prefer to market their products through retail markets. This can be interpreted to mean that retail markets will provide higher prices as

Table 3. Gross margin analysis for organic and conventional kales production systems.

Variable/Unit acre	Organic	Conventional	Standard Error of Mean	P values
Total cost of production (Kales)	1467.28	1364.33	0.987	0.784
Gross margin (Kales)	820.59	708.64	0.012	0.001***
Total cost of production (Spinach)	1121.96	840.27	0.023	0.449
Gross margin (Spinach)	323.37	104.87	0.112	0.016**
Total cost of production (Cabbage)	430.38	269.56	0.012	0.547
Gross margin (Cabbage)	1439.34	1321.48	0.190	0.911

Note: Significance level of regression estimators: *0.1, **0.05, ***0.01.

Table 4. Factors influencing profitability of organic vegetable production system.

Variable	Coefficient	Robust Standard Error
County	-0.53	0.13
Gender	-0.47	0.71
Age	0.85*	0.49
Occupation of household head	-3.4	0.81
Year of experience	-2.09***	0.73
Number of trainings attended	0.43***	1.43
Land ownership	3.26***	0.86
Level of education	1.40	1.01
Total farm size	-2.27	1.13
Number of parcels	0.36	0.35
Irrigation	3.97***	1.13
Source of labour	-0.32	0.98
Target market channel	1.27*	1.71
Constant	4.86	2.74

Number of observations=66; F (7,59)=2.44; Prob> F=0.029; R^2=0.87 and Root MSE=0.851 Significance level of regression estimators: *0.1, **0.05, ***0.01; t-statistics observed by Oxouzi & Papanagiotou (2010). More experienced farmers who have attended more training are expected to have better organic production skills which are associated with higher productivity which meets market and product specifications (Jans & Cornejo, 2001; Demiryurek & Ceyhan, 2008; Oxouzi & Papanagiotou, 2010). Also, presence of irrigation is also expected to increase farm profitability since a farmer can be able to better plan for the market without relying on rainfall.

Conclusions

Determination of factors that influence the adoption of organic production system provides a framework for developing strategies for its promotion. From the study, social economic, farm and market characteristics have been shown to influence smallholder farmers' decision to convert to organic system. While organic production system has many documented benefits including economic and environmental, motivation of any commercial oriented farmer is the profit made from farming activities. Additionally, age of the farmer, years of experience, number of trainings attended, type of land ownership, presence of irrigation, and the target market channel influence the gross margins of smallholder organic vegetable producers.

Recommendations

The study also showed that social economic farm and market characteristics influence the profitability of organic production system. Strategies geared towards improving income generated by smallholder organic vegetable enterprises should, therefore, integrate more aged farmers and establish capacity building programme where farmers can be regularly trained. They should also support irrigation for farmers and encourage farmers to work towards selling to retail markets to improve profitability.

Age, accessibility to irrigation and land ownership positively influence adoption of organic production system while farming experience and County of residence have an inverse relationship to adoption of organic vegetable production system. This, therefore, demonstrates the need for integrating necessary strategies to enhance positive or counter negative influence of these factors when designing an organic farming promotion plan.

References

Agriculture and Policy Research Centre. 2009. Economic and market potential for organic vegetable production in Vientiane capital Lao PDR. , Lao PDR.

Bolwig, S., Gibbon, P. & Jones, S. 2009. The economics of smallholder of organic contract farming in tropical Africa. World Development **37(6),** 1094-1104.

Caliendo, M. & Kopeing, S. 2008. Some practical guidance for the implementation of propensity score matching. Journal of Economic Surveys **22,** 31-72.

Canavari, M., Ghelfi, R., Olson, K. & Rivaroli, S. 2004. A comparative profitability analysis of organic and conventional farms in Emilia-Romagana and Minnesota, in: The 9th Joint Conference on Food, Agriculture and Environment, Conegliano Veneto, Italy.

Cisilino, F. & Madau, F.A. 2007. Organic and conventional farming: A comparison analysis through the Italian FADN, in: Mediterranean Conference of Agro-Food Social Scientists, Barcelona, INEA, Spain.

Cobb, D., Feber, R., Hopkins, A., Stockdale, L., O'Rordan, T. & Clements, B. 1999. Integrating the environmental and economic consequences of converting to organic agriculture: Evidence from a case study. Land Use Policy **16,** 207-221.

Delate, K., Duffy, M., Chase, C., Holste, A., Friedrich, H. & Wantate, N. 2002. An economic comparison of organic and conventional grain crops in a Long-term Agro ecological Research (LTAR) Site in Iowa. American Journal of Alternative Agriculture **18(2),** 59-69.

Demiryurek, U. & Ceyhan, V. 2008. Economics of organic and conventional hazelnut production in the Teme District of Sumsan Turkey, Renewable Agriculture and Food Systems **23(3),** 217-227.

Elzakker, B. V. & Eyhon, F. 2010. The organic business guide: Developing value chains with smallholders. Bonn: IFOAM.

FAO. 2006. World Agriculture. Towards 2030/2050. FAO, Rome

FAO. 2009. Comparative analysis of organic and non organic farming systems: A critical analysis of farm profitability, FAO, Rome.

Genius, M., Pantzios, C. J. & Tzouvelekas, V. 2006. Information acquisition and adoption of organic farming practices. Journal of Agriculture and Resource Economics **31(1),** 93-113.

Gujarat, S.D. N. 2003. Basic Econometrics. New York: MacGrow-Hill/Irwin.

IFOAM. 2013. Consumer survey on atitudes and preferences towards organic foods and verification systems in East Africa, , http://www.ifoam.org/en/osea-ii-project.

IFOAM. 2013. Consumer survey on atitudes and preferences towards organic foods and verification systems in East Africa, Bonn, 2013. http://www.ifoam.org/en/osea-ii-project

Jans, S. & Cornejo, J.F. 2001. The Economics of organic farming in the US: The case of tomato production. Washington D.C: Economic Research Service, USDA.

Kenya Organic Agriculture Network. 2010. Annual report for 2010, KOAN, Nairobi, Kenya.

KNBS. 2010. Kenya Census 2009. Nairobi: Kenya National Bureau of Statistics.

Northeast Organic Farming Association. 2001. An economic comparison of organic and conventional dairy production and estimations of the cost of transitioning to organic production. Vermont, USDA, USA, 2001.

Offermann, F. & Nieberg, H. 2000. Economic performance of organic farms in Europe, Hohenheim: University of Hohenheim/Department of Farm Economics.

Oxouzi, E. & Papanagiotou, E. 2010. Comparative Analysis of Organic and ConventionalFarmers and Their Farming

Systems, Where Does the System Lie? Bulgarian Journal ofAgricultural Science **16 (2),** 135-142.

Pimentel, D., Hepperly, P., Hanson, J., Douds, D. & Seidel, R. 2005. Environmental, Energetic and Economic Comparisons of Organic and Conventional Farming Systems. BioScience **55 (7),** 573-583.

Republic of Kenya. 2010. Agriculture sector Development Strategy 2010-2020. Nairobi, Kenya.

UNEP-UNCTAD. 2007. Organic agriculture in Kenya: An integrated assessment for policy Advocacy. United Nations, Geneva, Switzerland.

UNEP-UNCTAD-CBTF. 2008. Organic Agriculture and food security in Africa. United Nations, New York and Geneva.

Willer, H. and Lukas, K. 2010. The World of Organic Agriculture, Statistics and Emerging Trends. Bonn and Frick, FIBL and IFOAM.

Zanoli, R., Gambelli, D. & Vitulano, S. 2007. Conceptual framework on the assessment of the impact of organic agriculture on the economies of developing Countries, FAO, Rome, Italy.

Zhao, Z. 2008. Sensitivity of propensity score methods to the specifications. Economic Letters 309-319.