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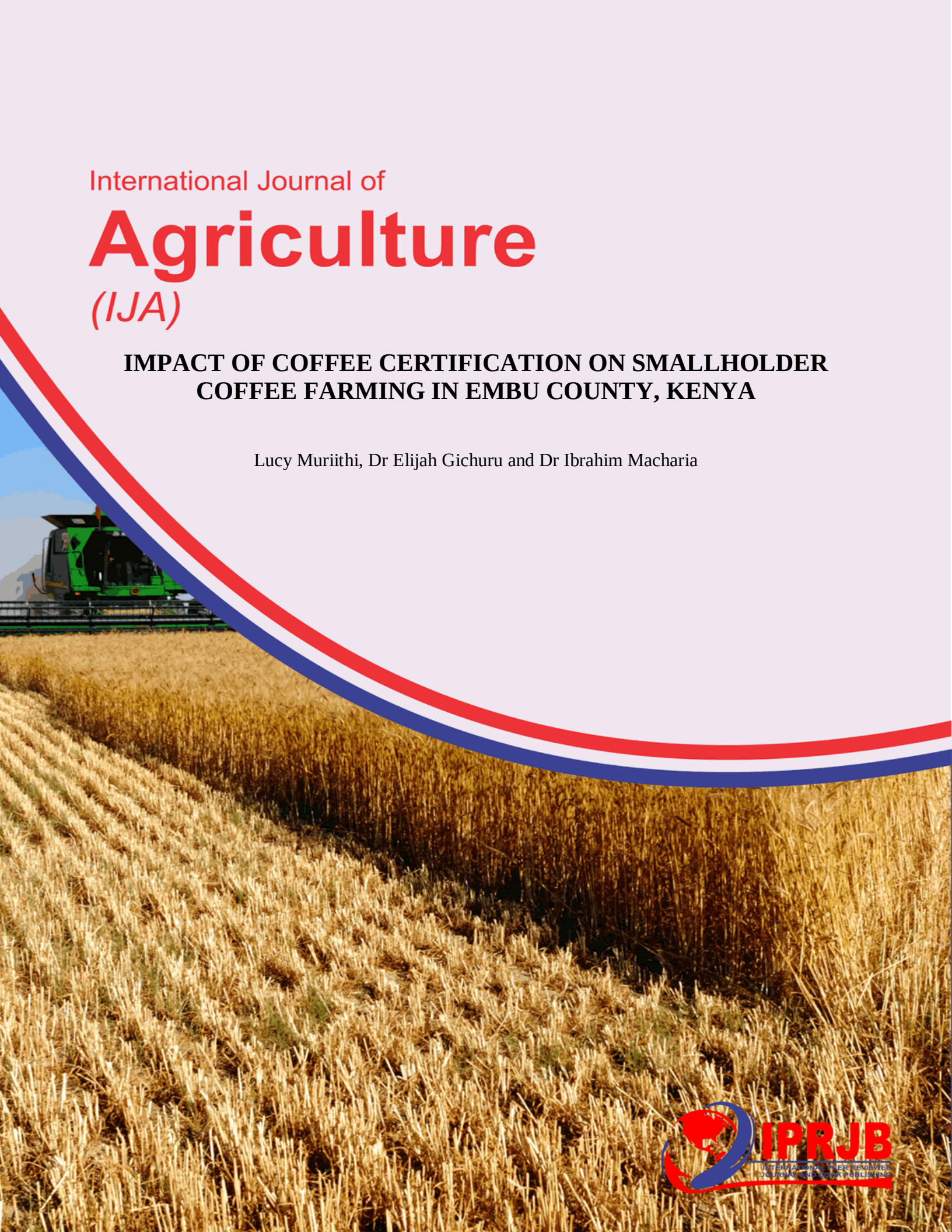

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IMPACT OF COFFEE CERTIFICATION ON SMALLHOLDER COFFEE FARMING IN EMBU COUNTY, KENYA

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Abstract

Purpose: The coffee sub-sector plays a significant role in Kenya's economy. It is a major foreign exchange earner and supports about 800,000 households in terms of incomes, employment and food security. Coffee certification has been a relatively new approach, focusing on both small-holder coffee farmers and estates in Kenya. Data on the impacts of coffee certification exists although it has been piecemeal or anecdotal. Therefore, the results obtained from this study, will add to the knowledge base on the impact of certification programs and provide useful insights to coffee certification bodies and coffee farmers in Kenya.

Methods: The study was carried out in Embu County. Multi-stage sampling technique was used to sample 480 coffee farmers. Logit model was applied to establish the factors that influenced farmers' to participate in certification. Propensity score-matching method analyzed the impact of certification on coffee productivity and prices.

Results: Results showed there were factors that influenced farmers' to participate in certification. Certified farmers produced more coffee in some years compared to non-certified farmers. However, the study did not find any impact of certification on coffee prices.

Unique contribution to theory, practice and policy: The study recommended that on awareness level, policy makers need to focus on training and empowering coffee farmers and coffee stakeholders on the different certification programs available in Kenya, so that farmers are aware and can make decisions on whether to be certified or otherwise and also on the type of certification to implement

Key words: *Coffee Certification, Propensity Score Matching, Coffee Farmers, Certified Farmers and Non-Certified Farmers*

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INTRODUCTION

Coffee is one of the most important commodities in the world today. It is the second most traded commodity after petroleum and a vital source of export earnings for many of the developing countries that grow it (Rice & Jennifer, 1999). Coffee remains a major cash crop and top foreign exchange earner for the Kenyan economy and is ranked 5th contributor to GDP after horticulture, tourism, tea, and diaspora remittance. The industry contributes about 1% national GDP, about 8% of the total agricultural export earnings and up to 25% of the total labor force employed in agriculture(AFFA, 2013).

Kenya mainly produces highly valued Arabica coffee based on varieties (SL28, SL 34, K7, Ruiru 11 and Batian). It is estimated that area under coffee is approximately 113,500 ha out of which 80% is occupied by small holder farmers in cooperatives. The industry supports about 800,000 households comprising of 535 Coffee Cooperative Societies and 4,000 Coffee Estates. Due to its effective forward and backward linkages, the industry supports about 5 million people subsequently contributing to food security, employment and generally household welfare within the coffee growing areas thus providing a boost to the Kenya's overall economy through multiple effects (AFFA, 2013).

Kenya's coffee cooperative system was formed after the end of World War II and is regulated by the government under the Cooperatives Act. This act requires small holders with less than five acres of coffee to come together and form coffee cooperative societies where they process mill and market their coffee collectively. The societies vary greatly in size, where merging and splitting are common. Some cooperatives have only one wet mill whilst others have more. Factories (How many?) typically provide services to 300 to 800 members of a society (CIDIN, 2014).

Coffee consumers on the other hand are mostly found in the developed countries, with the Nordic countries showing some of the highest per capita consumption. Sweden, for example, is among the world's top coffee consuming nations, with an annual per capita consumption of around nine (9) kg of coffee beans equivalent, or about 3.4 cups of coffee per person per day (ICO, 2015).

Coffee markets link producers and consumers in developed and developing countries and is an important vehicle for sustainable development. Recognizing this, consumers, Non-Governmental Organizations (NGOs), the private sector and donor agencies have taken a growing interest in promoting sustainable production and trading practices along coffee supply chains. These have taken the form of sustainability labels such as Fair trade certification, business-to-business standards, other certification initiatives, Voluntary Sustainability Initiatives that provide assurances to consumers and other supply-chain stakeholders that production is in accordance with sustainable development objectives (Potts & Sanctuary, 2010). Increased awareness among coffee consumers of the impact of their consumption habits on the people and environment in coffee producing countries has resulted in implementation of certification programs in the coffee sector as an assurance of good practices in production and marketing of coffee (Mercy et al.,

2010). However, the complexity of certification mechanisms, their reliance on cooperative formation to make them economically viable, and the tangible livelihood benefits and disadvantages remain poorly understood by the small scale coffee farmers in Kenya and therefore few coffee societies have adopted certification standards (Mercy *et al.*, 2010).

MATERIALS AND METHODS

Study Area, Design and Sampling Technique

The study was carried out in Manyatta and Runyenjes sub counties of Embu County. The target population of the study comprised of small holder coffee farmers of Embu County. Multi stage sampling procedure was used. Embu County was purposively sampled out of the 47 counties since it had the highest number of certified societies. Six co-operative societies were purposively sampled, three certified and three non-certified to act as control but with similar characteristics such as membership and the number of wet mills. The six sampled cooperatives included Muramuki, Rianjagi and Kamurai which were certified while Ivinge, Kithungururu and Kirindiri were the control (non-certified) group. Simple random sampling was applied to each of the six sampled cooperatives to sample a total of 480 households and this was determined using the sampling methodology of Mugenda and Mugenda (2003).The research design sought to establish the factors that influenced farmer's participation in the coffee certification program in Embu County. The logistic regression model was utilized with response to variable being certification and was coded as a binary variable with one representing household's participation in the program and zero otherwise.

Logit Model

The Logit model was used to estimate the propensity scores using household characteristics. These characteristics included covariate variables that seemed to influence the participation decisions and the outcome of interest. The coefficients were used to calculate propensity scores and certified small holder coffee farmers matched with non-certified small holder coffee farmers based on having similar propensity scores. In estimating the Logit model Gujarati (2004), the dependent variable was certification, which took the value of one if a household was certified and zero otherwise. The mathematical formulation of Logit model was as follows:

$$p_i = \frac{e^{zi}}{1 + e^{zi}} \qquad (1)$$

Where, p_i was the probability of participation for the i^{th} household and it ranges from 0 -1

Z was a function of N-explanatory variables which was also expressed as:

$$Z_i = \beta_0 + \sum \beta_i x_i + u_i \qquad (2)$$

Where,

ị= 1, 2, 3… ….n

β_0= intercept

β_i=regression coefficients to be estimated or Logit parameter

u_i= a disturbance term, and

x_i= certification characteristics

The probability that a household was not certified was

$$1 - p_i = \frac{1}{1 + e^{zi}} \quad (3)$$

The odd ratio can be written as:

$$\frac{p_i}{1-p_i} = \frac{1 + e^{i}}{1 + e^{-z_i}} = e^{z_i} \quad (4)$$

$\frac{p_i}{1-p_i}$ Was the odds ratio in favor of farmers participating in the certification program. This was defined as the ratio of the probability that a household/family will participate in certification to the probability that a household will not participate in certification. Lastly, by taking the natural log of equation above the log of odds ratio was written as:

$$l_i = ln\left(\frac{p_i}{1-p_i}\right) = Z_i$$

$$Z_i = \beta_0 + \sum \beta_i \, x_i + u_i \quad (5)$$

RESULTS

Factors that influence farmers' decision to participate in the coffee certification

The results in table 1 showed that at 95% level of significance, there was statistically significant evidence that participation in the coffee certification programs was positively influenced by the following explanatory variables: gender of household head, price of coffee and farmers awareness level. The log of odds of households headed by men participating in coffee certification was 2.06 (p=0.07) when all variables were held constant. This means that families headed by women had higher odds of participating in coffee certification. The odds of farmers' awareness level were 0.01 which means that farmers who were aware of certification were more likely to participate in it. In addition farmers who earned higher coffee prices were also likely to participate in certification programs, the odds of price and income from coffee was found to be 1.25 (p=0.00) .The odds ratio associated with a one-year increase in the age of a household head was 0.73 (p = 0.01), younger farmers had higher odds of participating in the coffee certification as compared to their older counterparts therefore age of the household head negatively influenced participation in certification.

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Table 1: Logistic regression results for coffee farmers in Embu County

Covariates	Coefficients	Std. Error	P>|z|
Gender of household head	0.72	0.39	0.07*
Age of the household head	-0.31	0.12	0.01**
Education level of household head	-0.23	0.20	0.26
Distance to the coffee factory (km)	0.22	0.11	0.06*
Farmers' perception	0.10	0.29	0.74
Price of coffee (Ksh/kg)	0.22	0.04	0.00***
Income from coffee (Ksh)	0.01	0.01	0.18
Farmers' awareness level	4.23	0.42	0.00***
Cons	-3.85	1.91	0.04
N	472.00		
LR χ^2 (8)	323.96		
Prob >χ^2	0.00 ***		
Pseudo R^2	0.50		
Log Likelihood	-165.15		

*= Significant at 10% ** ==Significant at 5% *** =Significant at 1%

Propensity Scores and Covariates

The propensity score matching methodology was used to adjust for the selection bias and estimate the counterfactual effects (Rosenbaum *et al.,* 1983) by identifying households that had similar pre-treatments as that of the target group. Different algorithms were employed in matching the certification and control groups; from which the final matching procedure was selected using the equal mean tests criterion (Dehajia & Wahba, 2002) and the pseudo-R^2.

Table 2: Performance of different matching estimators

	Performance criteria		
	Balancing test	Pseudo-R^2	Sample size
Nearest Neighbour			
NN(1)	13	0.15	334
NN(2)	18	0.08	343
NN(3)	13	0.40	320
Kernel matching			
Band width 0.01	08	0.13	244
Band width 0.25	14	0.24	289
Band width 0.50	18	0.09	256
Radius caliper			
Radius 0.01	12	0.21	278
Radius 0.25	10	0.25	242
Radius 0.50	14	0.07	263

In analyzing performance criteria, it is suggested that a matching estimator be used if it results in insignificant mean differences between the non-certified and certified, gives a large sample size

and a lower pseudo-R^2 after performing the matching. Table 2 showed the results of the different matching algorithms, nearest neighbour, Kernel and Radius caliper matching. Following the above criteria, the nearest neighbour algorithm was found to be the best estimator and thus was used to check the balance of propensity scores and covariates, the t-test was used to test the equality of means while the chi-square test in 3 of the same analysis was used to test the joint significance of the variables that were used in the analysis.

Table 3: Chi-square test for significance

Sample	Pseudo R^2	LR χ^2	P >χ^2	Mean Bias	Med Bias
Raw	0.499	326.80	0.000	47.2	17.3
Matched	0.217	1270000.00	0.000	39.4	11.8

The propensity scores were estimated on certified and non-certified farmers and the Pseudo R^2 before and after matching compared using the method of Sianesi, (2010). The presented values of Pseudo R^2 for the unmatched (raw) and matched results in Table 3. Indicated that both the certified farmers and the non-certified farmers had the same distribution after the matching procedure. Thus the matching algorithm balanced the characteristics in both the comparison groups. The results presented in the next sections, estimation of average treatment effect on certified farmers for the households' certification program were based on the above algorithm.

Sensitivity Analysis

Sensitivity analysis was performed using the Rosenbaum bounding approach (Rosenbaum and Rubin, 2002) as a validity check for unobserved selection bias. All the variables that influence the participation in the coffee certification and the outcome variables were observed simultaneously.

The results of the sensitivity analysis are presented in Table 4. In the calculation of the results, the certified and non-certified farmers were allowed to differ in their odds of being certified up to 100%. All the p-values at different levels of e^y (log of odds of differential due to unobserved factors) were found to be statistically significant implying that significant covariates influencing both certified and non-certified farmers and the outcome variables were considered.

Table 4: Sensitivity analysis

Variable	$e^y = 1.00$	$e^y = 1.25$	$e^y = 1.50$	$e^y = 1.75$	$e^y = 2.00$
Household head	3.80E-05	5.90E-10	3.30E-03	7.50E-03	3.40E-07
Marital status	8.00E-04	6.80E-04	6.70E-02	3.20E-07	8.70E-04
Age of household head	1.20E-07	1.80E-05	2.60E-08	8.00E-08	3.00E-04
Education level	8.30E-10	3.20E-06	7.70E-05	4.90E-10	3.90E-11
Years of coffee farming	3.20E-03	1.80E-05	9.00E-04	4.80E-05	3.10E-12
Distance to the factory	6.80E-04	2.40E-08	3.60E-11	5.00E-07	1.20E-05
Farm size	3.40E-07	2.60E-07	5.20E-06	8.90E-07	6.20E-03
Mature coffee trees in 2007	4.60E-09	4.70E-05	6.40E-12	7.00E-12	2.40E-08
Mature coffee trees in 2012	3.70E-11	4.60E-04	7.70E-05	2.10E-06	1.30E-07
Coffee area in 2007	7.70E-04	3.60E-08	5.80E-08	2.10E-04	5.30E-12
Coffee area in 2012	6.00E-02	3.40E-05	4.20E-05	6.00E-08	4.00E-08
Average income from coffee	1.00E-08	5.00E-04	3.60E-07	1.70E-08	7.60E-05
Quantity of coffee produced	1.70E-04	4.50E-10	8.00E-05	4.90E-11	6.10E-03
Rate paid per kg of coffee	2.80E-03	7.10E-07	3.00E-06	7.90E-07	5.50E-07

Assessing the impact of certification on farm level coffee productivity

This was done by computing the average treatment effect on treatment or certified farmers (ATT) for coffee production. Results of ATT for coffee production in table 5 showed that at the 10% level of significance, the certified farmers produced significantly more coffee than the non-certified farmers in the year 2008/2009. However, in the year 2010/2011, non-certified farmers produced significantly more coffee than the certified farmers.

Table 5: ATT for coffee production in kilograms for farmers in Embu County between 2006 and 2007

Year	Quantity of coffee cherry produced in kilograms				
	Certified	Non-certified	Difference	SE	t-stat
2006/2007	419.53	352.86	66.67	86.57	0.77
2007/2008	363.27	264.71	98.55	161.75	0.61
2008/2009	534.96	417.98	116.98	114.99	1.02*
2009/2010	439.69	463.27	-23.57	114.19	-0.21
2010/2011	195.16	263.51	-68.35	72.44	-0.94*

* Significant at 10%

Impact of certification on coffee prices

Table 6: ATT for the prices of coffee in Kenya shillings for farmers in Embu County between 2006 and 2007

Year	Price per kg (Kenya shillings)				
	Certified	Non-certified	Difference	SE	t-stat
2006/2007	18.00	19.47	-1.47	0.25	-5.94**
2007/2008	33.00	29.87	3.14	0.95	3.30**
2008/2009	33.00	33.34	-0.34	0.49	-0.70
2009/2010	50.00	54.56	-4.56	1.52	-3.00**
2010/2011	90.55	62.94	27.61	1.86	14.85**

** Significant at 5%

The results in table 6 showed that there was statistically significant evidence that certified farmers received a higher price of coffee in the years 2007/2008, and 2010/2011 but in the years 2006/2007 and 2009/10 the non-certified farmers received higher coffee prices than the certified farmers. However, in year 2008/2009 the price between the certified and the non-certified farmers was not statistically significant.

Discussions

Logistic regression analysis was done to estimate the relationship between participation in certification program and the independent variables under study namely: gender of the household head, age of the household head, education of the household head, price and income from coffee and awareness level. Gender of the household head, was found to positively influence participation in certification, household that were headed by women were more likely to participate in certification than those that were headed by men, women do most of the work in the coffee farms, face unequal treatment in leadership and discrimination, yet men receive all the coffee payments. Certification programs such as Fair Trade strive to help women realize their full potential through empowerment trainings which promotes female cooperative membership (Fair trade, 2010).

Age and education of household head had a negative impact in the participation of certification program. These findings were consistent with Mercy *et al.,* (2010) that although not significant, education level and age of household head had an inverse relationship to participation in the certification programs. Awareness of certification programs positively influenced participation in coffee certification programs which means farmers who were aware of the programs were more likely to participate than farmers who had no information. This is because though through certification rigorous capacity building and trainings are done on good agricultural practices, certification programs tend to select potential partners in areas where farmers' cooperatives are effective. Where cooperatives are not effective many farmers are scarcely informed about certification and its different aspects (CIDIN, 2014).

Impact of Certification on Coffee Productivity

The results from the study showed that the certified farmers produced more coffee in early years compared to their non-certified counterparts; these effects then disappeared as the non-certified farmers started learning from the certified farmers and their coffee production increased even though they were not certified. The findings from CIDIN (2014) are inconsistent. Involvement in certification does not influence production volumes in one case (Kiambaa FCS versus Mecari FCS) and in the other case (Rugi FCS versus Kiama FCS) certification negatively influences coffee production volumes, compared to non-certified farmers. Certified farmers showed higher production at baseline (2009) compared to non-certified farmers, but at end line (2013) these effects disappear. The findings were not consistent with Mercy *et al.*, (2010) that participation in the certification programs increased prices (and incomes) and productivity, households belonging to the certified cooperative sold/ produced more coffee than their non-certified counterparts (Mercy *et al.*, 2010).The findings were also not consistent with Fort and Ruben (2008) that yield levels of Fair trade certified farmers are slightly higher than their non-certified counterparts.

Impact of Certification on Coffee Prices

The results of this study found out that certified farmers received higher coffee prices In 2007/2008, but gains disappeared until the end line year 2010/2011 where they were significantly high. The findings agreed with CIDIN (2014) where initial gains from certification are usually high, but these tend to disappear once other non-certified farmers catch up in the process. Most initial gains from trade, therefore, gradually disappear due to spatial externalities. It points to important certification effects in the beginning of the coffee life cycle that tends to even out over time.

Farmers tend to be better off financially when participating in certification standards. The direct impact of participating in certification standards in terms of price and incomes received by producers tended to be positive. However, this is not a uniform conclusion. Jaffee (2008) found mixed evidence on the net income for producers, where the increased earnings did not compensate for the additional costs and increased labour involved in complying with standards requisites. The findings did not agree with Arnould *et al.*, (2009) that Fair trade farmers obtain higher prices than non-Fair trade farmers. Certified farmers garner an increased share of coffee prices relative to non-certified farmers. The findings coincided with Fort and Ruben (2008) that there was also lack of a real price difference between fair-trade and non-fair-trade producers, but were not consistent with Bacon (2005) that Fair Trade certified farmers received higher prices than the non-certified farmers.

CONCLUSION

The study concluded that there were factors that influenced farmers' to participate in certification programs. In particular three explanatory variables were found to significantly influence participation in the program. These variables were gender of household head, price of coffee and awareness level. Households that were headed by females were more likely to participate in the program than those headed by males. Younger farmers were also more likely to participate in

certification as compared to their older counterparts. The prices of coffee and households' awareness level both had a high statistically significant impact on the participation in the program. In the latter, high coffee prices were found to be associated with an increase in the participation of households in the program, while lower coffee prices were associated with lower participation in the program. On the other hand, households that had more knowledge of certification programs were more likely to participate in certification programs. The results were consistent with the hypothesized relationship.

There were inconsistencies in the results of impact of certification on coffee productivity. Whereas results from the study showed that the certified farmers produced more coffee in some years, other years the non-certified farmers produced more coffee than the certified farmers.

Certified farmers received higher coffee prices in 2007/2008, but gains disappeared until the end line year 2010/2011 where the gains were significantly high. There are remarkable prices received by certified farmers in some years compared to the non-certified farmers, and there are also remarkable prices received by the non-certified farmers compared to certified farmers in some years.

RECOMMENDATIONS

The study recommended that on awareness level, policy makers need to focus on training and empowering coffee farmers and coffee stakeholders on the different certification programs available in Kenya, so that farmers are aware and can make decisions on whether to be certified or otherwise and also on the type of certification to implement.

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