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Research Paper

Analysis of socio-economic factors affecting the coffee yields of smallholder farmers in Kirinyaga County, Kenya

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Abstract. This study examined the socio-economic factors influencing coffee yields within the smallholder sector of Kirinyaga County, Kenya. It also assessed the influence of coffee prices on re-investment and yields. A total of 251 farmers were selected from the study area using the stratified random technique. The data was analyzed by use of descriptive statistics, regression and correlation analysis using Stata (version 11). The results indicated that the mean age of the farmers were 52.95 years and the average yields were 2.31 kg of cherry per tree. The multiple regression analysis showed an R^2 of 0.5217 for all variables investigated which means that 52.17% of the variation in yields can be explained by these variables. The explanatory variables which were statistically significant were access to adequate credit, having some source of cash from other enterprises or employment and consulting extension agents. It was also found out that there is a strong positive relationship between price and the level of reinvestment (Pearson's r = 0.814). This indicates that higher prices encourage reinvestment in coffee. However, the correlation analysis between price and yields showed a Pearson's correlation coefficient of 0.154 which was statistically insignificant. This implies that although price influence yields positively, it may not necessarily lead to significantly higher yields. Higher prices need to be supported by the three significant variables in order to increase yields significantly. It is concluded that agricultural policy effort on small holder coffee farming should thus focus on ensuring farmers get access to adequate credit, diversification of farm income base and training.

Keywords: Yields, socio-economic factors, price, coffee, Kenya.

INTRODUCTION

Coffee is one of the key agricultural export commodities in the Kenyan economy. Prior to 1998, it was Kenya's top foreign exchange earner and currently ranks fourth after tea, tourism and horticultural sub-sector (Government of Kenya (G.o.K), 2010). Currently, coffee contributes about 10% to total agricultural export earnings, and up to 30% of the labor force employed in the agriculture sector. The coffee industry contributes significantly to the sustenance of rural livelihoods. It supports about 700,000 smallholder growers and up to 4,000 small and medium estate growers (Coffee Board of Kenya (C.B.K), 2012). In 1963, coffee production stood at 43,778 tons from a total hectarage of 45,538 and this rose to approximately 130,000 tons from 170,000 ha by 1988. In the last two and a half decades, production has declined to about 50,000 metric tons in 2011/12 (C.B.K, 2012).

To revive the industry, the government introduced a phased liberalization since 1992. It introduced the payment of coffee in US Dollars in 1992 and liberalized coffee milling in 1994. In 2001, the Coffee Act no.9 was enacted following the repeal of Coffee Act Cap 333. This de-linked the marketing and regulatory functions undertaken then by the former Coffee Board of Kenya (now renamed Coffee Directorate under the Agriculture

Food and Fisheries Authority). The marketing function was privatized in the year 2002 and the Board's role was redefined as regulatory, overall development and promotion of the industry (C.B.K, 2012). Other measures included inter-alia: Establishment of the Coffee Development Fund in 2006, Debt Waiver to growers amounting Ksh 3.2 billion in 2006 and a further waiver of about Ksh 2 billion in 2012 (CBK, 2012).

However, despite the measures undertaken by the Kenya government and the improvement in coffee prices since 2002, yields have remained low. This is not in tandem with the basic law of supply which states that as the price of a commodity rises, producers expand their supply into the market (Lipsey, 1986). In 2010/11 for instance, the Nairobi Coffee Auction posted an average of 329.12US dollars per 50 kilogram bag (C.B.K, 2012) – a 293% increase in price from 83.73 US dollars posted in 2003/04 but there has not been a corresponding increase in yields**.** Since coffee farming is an important activity in Kirinyaga County with many smallholder farmers depending on its proceeds for their livelihoods, low yields have affected the coffee farmers' economic wellbeing due to the loss of income. There was therefore need to study the socio-economic factors influencing the low yields and assess the influence of the improved coffee prices on the small holder production in the county.

Among the problems that are hampering coffee yields are non-affordability of agricultural inputs such as fertilizers and agrochemicals coupled with inaccessible credit. Kamau (1980) reported that adoption of weed control recommendations in coffee production was influenced by cash flow constraints and availability and cost of labour. While looking at the factors affecting the technical efficiency of Arabica coffee producers in Cameroon, Amadou (2007) found out that the educational level of producers and access to credit are the main socio-economic variables that significantly affect the technical inefficiency of farmers. He also found out that age has a negative effect on technical efficiency, implying that older farmers are technically more inefficient than younger ones. Other variables that are positively associated with adoption of technologies and hence higher yields are: increased farming experience, access to extension services and access to credit services (Aneani et al., 2012; Jatoe et al., 2005; Mazuze, 2007; Namwata et al., 2010).

Battese and Coelli (1995) and Ajibefun et al. (1996) found a positive relationship between the degree of inefficiency and the producer's age and a positive relationship between the degree of efficiency and the educational level of the producers. According to Oniah and Kuye (2012), older farmers are less likely to have contact with extension workers and are equally less inclined to adopt new techniques and modern inputs than younger farmers. Seyoum et al. (1998) also found that the farmers' educational level positvely influence yields. Coelli and Battese (1996) analyzed the factors affecting the technical inefficiency of Indian coffee farmers, and found a negative correlation between inefficiency and variables such as farm size, the level of education and age of the farmer. Oluyole and Sanusi (2009) carried out a study in Cross River State, Nigeria and reported that increased farm size improves farm output. Amusa et al. (2011) and Kebede et al. (1990) also found out that farm size was positively related to the output of cocoyam.

The general objective of this study was to analyze the causes of the low coffee yields in Kirinyaga County despite the improved coffee prices. The specific objectives were:

i) To determine the socio-economic factors causing low coffee yields in the small holder sector of Kirinyaga County.
ii) To assess the influence of prices on the level of reinvestment in coffee farming.
iii) To assess the influence of coffee prices on yields in Kirinyaga County.

MATERIALS AND METHODS

Study area, design and sampling technique

The study was carried out in Kirinyaga County located on the slopes of Mount Kenya. The county was chosen because it is has all the agro-ecological zones where coffee can grow and is centrally placed within the major coffee growing region and thus a good representative of other counties. The study used a survey design employing both quantitative and qualitative methods. The sample was selected using the stratified random technique from the target population of 47,610 coffee farmers (G.o.K, 2012). The population was stratified according to the various Agro-ecological zones (AEZs) outlined as suitable for coffee farming by Jaetzold et al. (2007) and further into coffee co-operative societies and factories. At the factory level, random selection of individual farm households was done to avoid bias. The total population was first divided into several sub-populations. These were the coffee – tea zone (upper midland one - UM_1), the main coffee zone (upper midland two -UM_2) and the marginal coffee zone (upper midland three - UM_3). Sixty two farmers were sampled from UM_1, 131 from UM_2 and 58 from UM_3 since according to G.o.K (2006), approximately 25% of the coffee farmers are in UM_1, 50% in UM_2 and about 25% in UM_3 .

To achieve this, three co-operative societies cutting across the three zones were randomly selected and fourteen wet mills representing the various AEZs further selected to represent each stratum. Finally, farm households were randomly selected from each of the selected factories using the Tippets random number tables. Farmers' membership numbers were used as the farmers' exclusive identity. A structured questionnaire

was used to collect data from the respondents. The data was analyzed using descriptive and inferential statistics. The descriptive statistics used to summarize the socio-economic characteristics of the farmers were measures of central tendency (means, frequency distribution and percentages and measures of dispersion (variance, standard deviation and range) while regression model of the log-linear form was used to estimate factors and determinants of coffee productivity in the study area. Correlation analyses were done to determine whether a linear relationship between price and investment and between price and yields existed.

Econometric model

The regression model was as expressed implicitly as:

$LnY_i = \beta_0 + \beta_1 CA + \beta_2 IOS + \beta_3 FS + \beta_4 ESC + \beta_5 EHH + \beta_6 GHH + \beta_7 AHH + \varepsilon$.

Where:

Ln Y_i = Log of the production per unit (Kilograms of cherry per tree), CA = Access to adequate credit (dummy variable), IOS = Income from other sources other than credit - such as employment, tea, dairy, etc (Measured in Kenya shillings), FS = Farm size (Acres), ESC= Extension services consultation– either trainings, demonstrations or other educational contacts (dummy variable), EHH = Education level of House hold Head (number of years in school), GHH = Gender of House hold Head (dummy variable) and AHH = Age of Household Head (years), β_0 is the Y intercept, β_1 to β_7 the slope coefficients and ε the error terms.

In this model, the slope coefficient measures the percentage change in Y for a given absolute change in the value of the regressor (Gujarati, 2007).

RESULTS AND DISCUSSION

Socio-economic characteristics of the farmers

Results in Tables 1 and 2 show that 87.65% of the household heads were male while 12.35 % were female indicating that most households are male headed. The average age of the farmers was 52.95 years with the youngest farmer being 20 years old and the oldest 91. This suggests that the small holder coffee farming cluster is skewed towards the ageing. This concurs with the findings of the Coffee Research Foundation (2010) baseline survey conducted under quality coffee and commercialization project. Since most coffee production operations in the farm are manual, this has the potential to limit productivity. The results also agrees with the findings of Adesoji and Farinde (2006) who found that farmers older than 52 years had a tendency of getting less yields.

The findings revealed that 6.05% of the household heads had no formal education, 51.21% had primary education, 34.68% had secondary education and 8.06% had tertiary education.The mean number of years of education was 8.16 years with a standard deviation of 3.7. The minimum number of years of schooling was 0 while the maximum was 16 years as shown by Table 2. Similar observations were made by Mumba et al. (2011). Generally, the more educated people are, the more efficient producers they become (Battese and Coelli, 1995). Low literacy levels can therefore hamper coffee production.

The study showed that 48.21% of the farmers in the study area had farm sizes of 1 acre or less, 43.83% had farm sizes of between 1.1 and 5 acres and only and only 7.97% had 5.1 acres or more. This showed that the farmers in the area have small farm holdings. The average acreage in the area is 2.23 acres with a standard deviation of 2.37 while the minimum and maximum holdings is 0.25 and a maximum of 25 acres respectively as shown in Table 2. Further, majority of the farmers - over 55%, have 0.5 acres of coffee or less. Only 3% have more than 2 acres as indicated by Table 1. The average area under coffee was 0.63 acres while the minimum and maximum acreage was 0.04 and 8.93 acres, respectively. The average number of coffee trees per farmer was 348 with the minimum number and maximum number being 35 and 4820 respectively as shown in Table 2. The percentage of farmers who consulted extension staff or attended training in the last three years was 72.11 % . Of these, 94.74% attended field training while only 5.26% went to an office to seek advice as shown by Table 1. This means that field based trainings would reach out more farmers than waiting for farmers to seek information themselves.

Table 1 shows that 76.52% of the farmers need need credit to farm their coffee. Of these, 81.04% had access to credit while 18.95% indicated that they had no access. Of those who were able to access credit, 54.98% did not get adequate credit while 45.02% got adequate credit. This inadequacy of credit is primarily because most societies lend depending on the number of kilograms delivered at the factory. Majority of the co-operative societies limit the credit to Ksh 10 per kilograms of cherry delivered. This creates a vicious circle of low yields since only those who have cash from other sources can afford the fertilizers and pesticides needed for coffee production. As Junge et al. (2009); Okoedo-Okojie and Onemolease (2009) observed, credit enables farmers to adopt new technologies more readily since they are able to plan ahead. Most of the credit, 86.6% was sourced from the co-operative societies with only 4.24% being sourced from the banks. None of the farmers indicated to have borrowed from the Coffee development fund despite the fund being in existence for over seven years.

Table 1. Socio-economic characteristics of the farmers interviewed during the survey.

Parameters	Relative frequency (%)
Gender	
Male	87.65
Female	12.35
Age (years)	
18 - 35	15.14
36 - 45	16.73
46 - 55	29.48
56 - 65	17.93
Over 65	20.70
Education level of household heads	
No education	6.05
Primary	51.21
Secondary	34.68
Tertiary	8.06
Farm size (acres)	
0.0- 0.5	17.53
0.51-1.0	30.68
1.1- 2.0	18.73
2.1 - 5.0	25.10
5.1-10.0	5.98
Over 10 acres	1.99
Farmers with various acreage under coffee (acres)	
< 0.5	54.98
0.51 - 1.0	33.07
1.1 - 2.0	8.76
> 2.0	3.19
Farmers who consulted extension staff	
Consulted	72.11
Did not consult	27.89
Extension forum	
Field training / demonstration	94.74
A visit to an agricultural office	5.26
Farmers who need credit	
Need credit	76.52
Don't need credit	23.48
Percentage of farmers who have access to some credit	
Have access	81.04
Do not have access	18.96
Percentage of farmers who got adequate credit	
Credit adequate	45.02
Credit not adequate	54.98

Table 1. Contd.

Sources of credit	
Co-operative society	86.06
Commercial banks	4.24
SACCOS	9.7
Coffee deevelpoment fund	0
Yields (kg/tree)	
0.00 – 1.00	34.66
1.01 – 2.00	24.30
2.01 – 3.00	13.94
3.01 – 5.00	19.52
5.01 – 10.00	6.37
Over 10	1.2

Source: Author (2013)

Table 2. Summary of the characteristics of various variables in the model.

Variable	Mean	Std. Dev[1]	Min[2]	Max[3]
Age of head household (years)	52.95	14.73	20	91
Years of education (years)	8.16	3.70	0	16
Farm size (acres)	2.23	2.57	0.25	25
Area under coffee (acres)	0.63	0.80	0.04	8.93
Total no. of trees	348.21	432.82	35	4820
Average yields per tree (kg)	2.31	2.47	0.1	19.9

[1] Standard deviation, [2] Minimum, [3] Maximum. Source: Author (2013)

Majority of the farmers, 72.91% were producing 3 kg of cherry per tree or less. About 19.52% were producing between 3 and 5 kg, 6.37% between 5.01 and 10 kg and only 1.2% were producing over 10 kg as shown in Table 1. The mean yield was 2.31 kg per tree with a standard deviation of 2.47. The lowest yield was 0.1 and the highest was 19.9 kg. This confirmed the secondary data collected before the study as in G.o.K (2006).

Regression analysis results

The analysis of variance (Table 3) for the regression analysis yielded an F-value of 37.87, with a p-value of 0.000, indicating that the model was statistically significant even at the 1% level. The coefficient of determination (R^2) was 0.5217, meaning that approximately 52.17% of variability of the dependent variable (yields) was accounted for by the explanatory variables in the model. Thus the regression model was adequate since in determining model adequacy, features such as the R^2 and the F-value are observed (Gujarati, 2007).The remaining 47.13% could be due to measurement errors or factors not accounted for in the model such as soil and climatic factors.

Access to adequate credit had a positive coefficient of 1.2493 with a p-value of 0.000 which is significant at 1%. This means that all other predictors held constant, having access to adequate credit increases yields by 125%. Similar results were obtained by Binam et al. (2004) and Amadou (2007) while undertaking studies on small scale coffee farmers in Cameroon. They argued that access to adequate credit permits a farmer to enhance efficiency by overcoming liquidity constraints which may affect their ability to apply inputs and implement farm management decisions on time. Use of credit therefore loosens financial constraints, ensures timely acquisition and use of inputs and results in increased economic efficiency. The results also agree with the findings of Adesoji and Farinde (2006) as well those of Nyagaka et al. (2009) who found that farmers with access to credit tend to exhibit higher levels of yields.

The coefficient for income from other sources was 0.0149 with a p-value of 0.003 which was statistically significant at 1%. This means that for every unit increase in cash amount from other sources other than coffee (one unit = Ksh10,000 as defined in chapter 3), yields increase by 1.5%. This is because farmers usually swivel finances from one enterprise to the other in their operations. The results agree with those of Namwata et al. (2010) as well those of Franzel (1999) who argued that higher income farmers may be less risk averse, have more access to

Table 3. Multiple regression results showing the influence of various regressants on yields.

Variable	Coefficient	Std error	t-statistic	p >|t|
Access to adequate credit	1.24939	.0907784	13.76	0.000***
Income from other sources	0.0148505	0.0049541	3.00	0.003***
Farm size	-0.036068	0.0185508	-1.94	0.053*
Years of education	0.0141456	0.0139061	1.02	0.310
Extension services consultation	0.2120942	0.0991875	2.14	0.033**
Gender of house hold head	-0.0759403	0.139685	-0.54	0.587
Age of household head	- 0.0027915	0.0035457	-.79	0.432
Constant	-.2225871	0.2653446	-.084	0.402

Number of Observations = 251 F (7, 243) = 37.87 Prob > F = 0.0000***
R^2 = 0.5217 Adjusted R^2 = 0.5080
****, **, * Signify significant at 1%, 5% and 10% levels respectively
Source: Author (2013)

Table 4. Results showing the correlation between price and re-investment and between price and yields.

Price (Ksh)	Re-investment (ksh)			Average yields (kg/tree)		
	Pearson correlation (r)	Sig. (2-tailed)	Covariance	Pearson correlation (r)	Sig. (2-tailed)	Covariance
	0.814*	0.048*	77559.809	0.154	0.693	3.309

*Correlation is significant at the 0.05 level (2-tailed). Source: Author (2013)

information, have longer-term planning horizon, and have greater capacity to mobilize resources and hence increased likelihood of adopting new technologies.

Farm size had a coefficient of -0.0361 with a p-value of 0.053. Although this was not statistically significant, the results indicate that farmers with smaller farms are more efficient in resource use. The results agree with the findings of Adesoji and Farinde (2006) who found out that increase in farm size decreases the yields of arable crops. Years of education had a coefficient of 0.0141 with a p value of 0.310. Although not significant statistically, the results shows a positive relationship between education and yields. More educated farmers are able to perceive, interpret and respond to new information and adopt improved technologies such as fertilizers and pesticides much faster than their counterparts. This agrees with the findings of Nyagaka et al. (2010) who used the Tobit model and found out that farmers with more years of formal schooling were more efficient than their counterparts. Aneani et al. (2012) also obtained similar results.

Extension services consultation had a coefficient of 0.2121 with a p value of 0.033 which was statistically significant at 5 %. This means that consulting extension agents on what needs to be done increases yields by 21%. Nyagaka et al. (2010) argued that frequent visits to the farmers by extension agents provides the farmer with necessary information about the availability of needed resources, market prices as well as the profitability status. Nchare (2007), further argued that extension workers play a central role in informing, motivating and educating farmers about available technologies. The results also concurs with Seyoum et al. (1998) who found a 14% difference in technical efficiency between farmers who had access to extension services and those who did not. The gender of house hold head had a coefficient of -0.076 with a p-value of 0.587and thus not significant. This means that being male or female does not significantly affect yields. The results contradict the findings of Aworemi et al., (2010) who found that the male gender had higher yields. The age of household head had a coefficient of -0.0028 with a p-value of 0.432 which was not significant. However, it means that older people are more likely to have less yield than the younger ones perhaps due to the manual nature of coffee operations. The results concur with those of Ayoola et al. (2011) who found out that age negatively affects rice yields.

We can therefore reject the null hypothesis and conclude that socio-economic factors influences the level of yields in the smallholder coffee sub-sector. The study therefore disagrees with the findings of Rondinelli (1983) that socio-economic factors have no significant influence on performance but supports the findings of Aworemi et al., (2010).

Correlation analyses between price, level of re-investment and yields

There was a strong relationship (Pearson's r = 0.814) between price and the level of reinvestment which was statistically significant at 5% as shown by Table 4. This

means that changes in price were strongly correlated with changes in reinvestment. The higher the price (payment per kilogram of cherry) the more the farmers were motivated to invest in coffee. This agrees with the basic law of supply which states that as the price of a commodity rises, so producers expand their supply onto the market (Lipsey, 1986).

Table 4 also shows that there was a weak relationship (Pearson's r = 0.154) between price and yields. This relationship was also statistically insignificant at 5%. This means that although there is a positive relationship between price and yields, as per the basic law of supply, a good price alone may not necessarily guarantee siginificantly higher yields. It therefore implies that there are constraints that are making farmers not to invest adequately in order to cause signifinant increase in yields thus conflicting the basic law of supply. These constraints are highlighted by the regression analysis results.

CONCLUSIONS

The explanatory variables found to have significantly contributed to the dependent variable (yield) were access to adequate credit, having some source of cash from other enterprises or employment and consulting extension agents. It was also found out that although price has a positive influence on yields, the impact of price on yields is dampened by the socio-economic factors that farmers finds themselves in. This implies that although good prices encourage farmers to invest in coffee, there is need for an enabling environment in terms of adequate credit, extension services provision and diversification of farmers' incomes in order to increase coffee yields significantly. Further, it was found that only 35.4% of farmers were aware of the Coffee Development Fund despite the institution having been formed in 2005 to offer credit to coffee farmers suggesting that there is need to create awareness about the institution and the services it offers.

RECOMMENDATIONS

To enlarge the income base and the sources of cash, farmers should be encouraged to diversify by having other enterprises such as dairy, bananas and macadamia as income generating enterprises. The government should also endeavor to have at least one coffee extension officer per sub-county to enhance provision of coffee extension services.

The government needs to streamline provision of credit to make it accessible. It should be provided in amounts that are adequate to meet the cost of inputs and labour. There is therefore need to create awareness on the existence of the Coffee Development Fund and carry out further research on the challenges in loan application, processing and repayments. Given the level of average yields in the sub-sector, initial capital can be given out to the farmers to jumpstart production followed by provision of adequate credit. There is also need to undertake a similar study to look at factors affecting some other counties that were formerly large coffee producers.

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REFERENCES

Adesoji SA, Farinde AJ (2006). Socio-economic factors influencing yield of arable crops in Osun state, Nigeria. Asian J. plant sci. 5(4):630-636.

Ajibefun A, Battese GE, Daramola AG (2002). Determinants of Technical Efficiency in Smallholder food crop farming: Application of Stochastic frontier production function. Int. Agric. Quart. J. 41:225-240.

Amadou N (2007). Analysis of factors affecting the technical efficiency of Arabica coffee producers in Cameroon. Volume 163 of AERC research paper, African Economic Research Consortium. ISBN 9966778063.

Amusa NA (2010). Man and microbes in a continuous battle. An inaugural lecture delivered in the Faculty of Science, January 12, 2010, Olabisi Onabanjo University, Ago-Iwoye, Nigeria.

Aneani F, Anchirinah VM, Owusu, Asamoah M (2012). Adoption of some cocoa production Technologies by cocoa farmers in Ghana. Retrieved from http://dx.doi.org/10.5539/sar.v1n1.

Aworemi JR, Adegoke AI, Opoola N A (2010). Impact of socio-economic factors on the performance of small -scale enterprises in Osun state, Nigeria. Int. Bus. Res.3:2.www. cceenet.org/ibr.

Ayoola JB, Dangbegnon C, Daudu CK, Kudi TM, Amapu JO, Adeosun JO, Ezui KS (2011). Socio-economic factors influencing rice production among male and female farmers in Northern Guinea savanna, Nigeria. Lessons for promoting gender equity in action research. Agric. biol. J. North Am. 2(6):1010-1014.

Battese GE, Coelli TJ (1995). A Model of technical inefficiency effects in a stochastic function for panel data. Empir. Econ. 20:325-332.

Binam JN, Tonye J, Wandji N, Nyambi G, Akoa M (2004). Factors affecting the technical efficiency among smallholder farmers in the slash and burn agriculture zone of Cameroon. Food Pol. 29:531-545

Coelli T, Battese G (1996). Identification of factors which influence the technical inefficiency of Indian farmers. Austr. J. Agric. Econ. 40(2):103-128.

Coffee Board of Kenya (2010, 2012). Annual reports, Nairobi, Government printers.

Franzel S (1999). Socio-economic factors affecting the adoption potential of improved tree fallows in Africa. Agrofor. Syst. 47:305-321.

Gujarati DN (2007). Essentials of Econometrics, 4th edition. New Delhi, Mc-Graw-Hill.

International Coffee Organization, (2010). Exporters guide. London: International Coffee Organization.

International Coffee Organization (2000). Coffee Statistics. London : International Coffee Organization.

International Coffee Organization (1997). Coffee price determination and volatility. London: International Coffee Organisation.

Jatoe JB, Al-Hassan R, Abatania LN (2005). Factors affecting the adoption of imroved sorghum among farm households in the northwest Ghana: a probit analysis. Ghana J. Dev. Stud. 2(1):37-50

Jaetzold R, Schmidt H, Hornetz B, Shisanya C (2007). Farm management handbook of Kenya Vol. II, 434. Nairobi: Government printers.

Kamau PC (1980). Economics of herbicide use in coffee.Kenya-Coffee, 45(529), 111-119.

Lipsey RG (1986). An introduction to positive Economics, 6th edition. London: Buttler and tanner Ltd. ISBN 0 297 182 66 5.

Mazuze FM (2007). Analysis of adoption of orange-fleshed sweet potatoes: The case study of Gaza Province in Mozambique. Research Report Series No. 4E. Institute of Agricultural Research of Mozambique, Windhoek, Mozambique.

Namwata BM, Lwelamira J, Mzirai OB (2010). Adoption of improved agricultural technologies for Irish potatoes (Solanumtuberosum) among farmers in Mbeya Rural district, Tanzania: A case of Ilunguward. J. Anim. Plant Sci. 8(1):927-935.

Nchare A (2007). Analysis of the factors affecting the technical efficiency of Arabica coffee farming. Afr. Econ. Res. Consort. p.163.

Nyagaka DO, Obare GA, Omiti JM, Nguyo W (2010). Technical efficiency in resource use: Evidence from smallholder irish potato farmers in Nyandarua North District, Kenya. Afr. J. Agric. Res. 5(1):1179-1186.

Okoedo-Okojie DU, Onomolease EA (2009). Factors affecting the adoption of yam storage technologies in the Northern ecological zone of Edo State, Nigeria. J. Hum. Ecol. 27(2):155-160.

Oniah MO, Kuye OO (2012). Econometric analysis of factors affecting yields of small scale yam farmers on inland valleys of obubra local government area of cross river state, nigeria.International J. Res. Manage. Econ. Comm. 2:5. www.indusedu.org

Oluyole KA, Sanusi RA (2009). Socioeconomic variables and cocoa production in Cross River State, Nigeria. J. Hum. Ecol. 25(1):5-8.

Rondinelli DD (1983). Implementing decentralization programmes in Asia: A Comparative analysis, Public Admin. Dev. 3(3):181-208.

Seyoum ET, Battese GE & Fleming EM (1998). Technical efficiency and productivity of maize producers in Eastern Ethiopia: a study of farmers within and outside the Sasakawa - Global 2000 project. Agric. Econ. 19:341-348.