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Empirical Analysis of the Environmental Benefits of Compliance with GLOBALGAP Standards Among Smallholder Farmers in Eastern and Central Kenya: An Environmental Valuation Approach

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Abstract

Increasing calls for an African green revolution are being made so that Africa can increase its food production; thus enhancing its ability to feed its high population while exploiting emerging opportunities in developed country markets. This will involve an increased use of agro-chemicals. Use of agro-chemicals by sometimes lowly educated farmers in developing countries is associated with health and environmental degradation risks. Health risks to consumers manifest themselves through high levels of pesticide residues in food commodities; this led to development of the mandatory GLOBALGAP standards. Though primarily focused on consumer interests, compliance with GLOBALGAP standards is increasingly being associated with farmer level benefits.

Besides conferring market access; studies show the existence of quantifiable health benefits which accrue to GLOBALGAP compliant farmers. Studies also allude to existence of environmental benefits of compliance. Through data obtained from farmers in Eastern and Central Kenya, this paper uses Contingent Valuation Approach to estimate the economic value of changes in soil quality to empirically analyze the environmental benefits of compliance with GLOBALGAP standards. Further, factors (including compliance) influencing the economic value of changes in soil quality are analyzed.

Compliance is found to have quantifiable environmental benefits to smallholder farmers as seen by the higher economic value of changes in soil quality and the positive and significant influence of compliance on the economic value of changes in soil quality. Agri-regulation is thus a useful tool that can be applied to enhance sustainability in Africa's increasingly intensive agriculture

Introduction

Economic activities utilize the environment as a source of inputs for the production of goods and services or as a waste sink (Pretty et al., 2000). Agriculture is not an exception to this as it involves the basic husbandry of animals and crops to utilize ecosystem services and functions to produce food from which livelihoods are derived. At the same time, agricultural production results in waste production whether in terms of animal waste or crop residue or even agro-chemical residues which are all assimilated by the environment. As the world's food demand continues to increase in the wake of an ever increasing global population against a backdrop of a resource constraint, there has been a concomitant increase in the rate of intensification in agricultural enterprises.

The land resource in Kenya is not an exception to this phenomenon; farm holdings in Kenya are becoming increasingly fragmented into smaller land parcels due to a rapidly increasing human population and a land inheritance culture. The fragmentation of land holdings has had the effect of making Kenya's agriculture a predominantly smallholder sector. With smaller land holdings, farmers are forced and indeed encouraged to adopt strategies that yield high rates of returns through intensification for increased yields despite a smaller land resource and cultivation of high value crops among others (Shirley and Ayiko, 2008).

Technological advances have been a key pillar in facilitating farmers' adoption of intensive agricultural practices; technology has been used to develop higher yielding crop varieties, more responsive and environmentally friendly synthetic inputs such as pesticides and fertilizers, and better communication tools and approaches for extension. Cultivation of high value fresh vegetables for international and local markets is one such intensive agricultural production enterprise which has been adopted in developing countries such as Kenya. With a good tropical climate such as that found in Kenya, cultivation of fresh vegetables allows for two to three harvest per year compared to the conventional annual crops such as maize. This has made it possible for developing countries located in the tropics to feed the food demand of the developed temperate countries whose climates are not as conducive and given consumer demand for year round supply of freshly produced food commodities and especially vegetable products.

As mentioned, intensive agricultural enterprises require increased use of agro-chemicals; this is associated with significant negative health and environmental effects, especially in developing countries, alongside some level of increased agricultural production. The negative health and environmental effects are due to a various factors which lead to poor application practices; these include poverty, high levels of illiteracy among farmers, high pricing of the appropriate and quality agro-chemicals. Consequently, the increasingly intensive agricultural practices practiced in developing and underdeveloped countries have been found to be unsustainable (Pagiola, 1995; Urama, 2005; Raut et al., 2010). Though it is generally accepted that developing country producers and especially in Africa are still under-utilizing the agro-chemical inputs, it has been noted that inefficiencies in the use of agricultural inputs is responsible for the observed low yields in the countries and may actually lead to environmental degradation (Pingali and Rosegrant, 1994; Piot-Lepetit et al., 1997; Ecobichon, 2001; Pearce and Koundouri, 2003). Further, use of agricultural inputs by these farmers is associated with disregard for the producer’s health and safety thus high health expenditures by farm households (Okello and Okello, 2009).

As noted, agro-chemical inputs are used indiscriminately and inefficiently in developing countries with little if any regard for the quality and safety of the agricultural commodities for human or animal consumption leading to negative human and environmental consequences (Okello and Swinton, 2009; Okello and Okello, 2010). It is out of these realizations that agri-regulation standards (e.g. GLOBALGAP) were introduced in developed country markets. The primary aim of the mandatory GLOBALGAP standards was thus to protect consumers from unsafe food either due to chemical residue contamination or due to other reasons such as poor post harvest handling leading to pest and microbial infestations (Okello and Swinton, 2009). Due to increased globalization and a rapidly expanding middle class, there have been tendencies of increased domestication of international trends and practices in the local markets of developing countries such as Kenya (Campbell, 2005; Ngigi et al., 2010). Indeed, there already exists a voluntary agri-regulation mechanism known as the KenyaGAP standards for the Kenyan domestic market. Muendo and Tshirley, (2004) contend that this is a positive thing and that it is likely to lead to increased contribution of the domestic fresh vegetable sector to the country's economic growth and development. Indeed, there are indications that the government of Kenya is gradually recognizing through policy documents the need to regulate the agricultural sector for sustainability and safeness of farm produce (GoK, 2009). This raises the possibility of the use of agricultural regulation in the country across all commodities and agricultural enterprises.

Agricultural and specifically fresh vegetable production in Kenya is undertaken for both the local and the international markets which operate under different institutional arrangements with varying degrees of returns and risks (Muendo and Tshirley, 2004; Tshirley et al., 2004). Consumer benefits of farmer compliance with agri-regulation standards are well documented since consumer interests were the key drivers behind the establishment and development of the GLOBALGAP agri-regulation regime. The same cannot be said of farmer interests though they are key factors affecting the adoption of farmer compliance. Increased farmer compliance can however be enhanced by minimizing both direct and indirect compliance costs while maximizing the direct and indirect benefits of compliance. Swinton and Okello, (2009) illustrate this best when they note that farmer compliance was increased once the costs compliance with agri-food standards were significantly lowered through the innovative group compliance mechanism. The process of determining the producer level benefits of compliance is relatively easy for the direct benefits but not so for the indirect or non-market benefits.

The case of the compliance of Kenyan smallholder farmers with GLOBALGAP standards offers an opportunity to evaluate producer level benefits of compliance despite the orientation of these standards to the interests of consumers in developed countries. This is possible as a significant number of farmers growing fresh produce for export to developed countries comply with GLOBALGAP standards. Indeed, various studies undertaken in the past have sought to thrash out the key challenges, opportunities and benefits of compliance with agri-food standards among smallholder producers of fresh vegetables for export (Asfaw et al., 2008; Okello and Swinton, 2009; Okello and Okello, 2010). Among the studies that have sought to quantify the farmer level benefits of compliance with these standards, the results have generally shown that although compliant farmers enjoy greater market access and possibly higher incomes, they also incur compliance costs which more or less eliminate any extra income benefits associated with compliance (Asfaw et al., 2008; Ragona and Mazochi, 2008).

Some researchers, most notably Okello and Swinton (2009) and Okello and Okello (2010) have taken the issue further and evaluated the existence of non-market benefits which accrue to GLOBALGAP compliant farmers. Their studies found that clearly identify quantifiable health benefits accrue to compliant farmers owing to the use of protective clothing, proper storage and application of agro-chemicals as well as the use of what are considered to be safe human agro-chemicals (Okello and Swinton, 2009; Okello and Okello, 2010). They also point out that compliant farmers are much more likely to practice more sustainable agricultural practices such as integrated pest management (IPM) as opposed to non-compliant farmers and thus there might be some environmental benefits of compliance with the agri-food standards (Cuyno et al., 2001; Pretty, 2006; Asfaw et al., 2008; Ragona and Mazochi, 2008; Okello and Swinton, 2009; Okello and Okello, 2010). However, no study has gone further than this and attempted to empirically quantify or analyze the environmental benefits of compliance with the GLOBALGAP standards in Kenya. This paper thus addresses this gap by empirically analyzing the environmental benefits of compliance with GLOBALGAP standards among Kenyan small scale producers of fresh vegetables for export. The study further analyzes the influence of compliance with agri-food standards on the economic value of changes in an environmental resource – soil.

As this happens, the wide scale producer compliance or non-compliance with the GLOBALGAP standards and associated findings, based on empirical studies on the benefits, both direct and indirect, which accrue to farmers, can be used to inform the consideration and development of agri-regulation in developing countries. These can also be used to inform farmer's decisions on compliance or its lack thereof with agri-regulations since identification and quantification of benefits, both market and non-market will encourage farmers to comply with such standards as they also benefit.

Further, even as calls are being made for an African green revolution, the need to exercise caution is being pointed out. In particular, agricultural development practitioners are advising African policy makers to consider the negative environmental outcomes of the Asian green revolution and possibly formulate policies that will forestall such negative outcomes in the African case (Pingali and Rosegrant, 1994).

Methods of Analysis

A Model of the Economic Value of Change in Environmental Quality

A revenue function approach to a producer of fresh vegetables for exports is adopted to inform this paper's approach to model the economic value of changes in an environmental resource (Pattanaya and Kramer, 2001). The basic assumption is that a change in the quality of an environmental resource will result in a decline in the farmer's production output and thus a decline revenues / profits (Rasul and Thapa, 2003). For instance, assume a farmer earns a revenue, $Y(X.S)$ with X representing a vector of production inputs while S represents the environmental resource and thus his revenue function is $Y=f(X.S)$. Holding the other production factors constant, suppose you have two levels of the environmental quality S i.e. S^1 and S^2 where $S^1>S^2$. It follows that up to a certain level, the revenue Y^1 associated with environmental resource quality S^1 and similarly for Y^2, consequently, $Y^1>Y^2$.

Since a farmer derives utility from using the revenue generated to purchase consumer goods for his own utility, an indirect utility function associated with a given environmental resource quality level can be mapped through its associated revenue level such that the utility level V^1 i.e. $V(P,M^1)= V(P,Y^1)$ since the revenue level Y^1 is the income level M^1 which the farmer has at his disposal for purchasing consumables. Thus, since from above $Y^1>Y^2$, it then follows that with a higher quality of environmental resource i.e. S^1, a farmer derives a greater utility than when the quality of the environmental resource is low (degraded) i.e. S^2, consequently,

$V^1(P,Y^1)>V^2(P,Y^2)$. From this, a Hicksian equivalent surplus measure (E.S) can be defined for the change in the quality of the environmental resource as follows; $E.S = V(P,Y^1) - V(P,Y^2)$ or as $E.S = V\big(P,Y(X.S^1)\big) - V\big(P,Y(X.S^2)\big)$Since deterioration in the quality of an environmental resource is being considered in this case, a willingness to pay question (to avoid the loss in utility) will be asked in this case (Carson and Haneman, 2005).

Data Collection

This paper is an outcome of a DRIVLIC - Kenya study project undertaken in Eastern and Central Kenya among producers of fresh produce for export. The data used to conduct this paper's analysis was obtained from through two socio-economic surveys undertaken in Kirinyaga in Central Kenya, and Buuri and Mbooni in Eastern Kenya. The areas sampled in this study was collected through a randomized data collection process while the study areas were purposively selected given their role on their production volumes of high value fresh vegetables in the country. In the first socio-economic survey – undertaken in 2010, general information on the household's socio-economic and agricultural production characteristics was collected. This information was collected from a project wide data set with the selected households having been identified through random sample selection given the sampling frame drawn for all farmers in the study areas. In the second socio-economic survey – undertaken in late 2011, information relating to the WTP for change in environmental quality was collected from the households. Randomized sampling within a sample (project wide sampling frame) was done for the second stage.

While a larger number of households were covered in the first socio-economic survey, the second socio-economic survey sampled within the originally sampled households on a probability to size, based on the compliance arrangements that a given household had chosen for the production of fresh vegetables in the study area. A total of 550 respondents were interviewed with 502 questionnaires retained upon data cleaning while the elimination of the protest bids reduced the effective number of analyzed questionnaires to around 454. In the second socio-economic survey, the open ended iterative bidding approach was adopted for eliciting the household’s WTP for changes in the quality of an environmental resource. This approach was adopted owing to its mimicking of a real market situation and due to the fact that it results in a significantly lower number of zero WTP responses.

Empirical Methods

Using the data obtained from the iterative bidding, it is possible to estimate the Mean Maximum WTP of the sampled households by averaging the stated maximum WTP for all the households. Thus; $Mean\ Max\ WTP_{j,k} = \frac{1}{n_{j,k}} \sum_{i=0}^{n} Stated\ Max\ WTP_{i,j,k}$ Where n is the total number of sampled farmers, i is the i^{th} household, j is the compliance category of the farmer, while k is the farmers location i.e. Kirinyaga, Mbooni or Buuri.

Regression analysis was used to determine the factors influencing the economic value of changes in soil quality as it is one of the most commonly used and reliable tools of determining causality between household factors (Gujarati, 2007). In undertaking a regression analysis, the choice of the regression approach is determined by the type of data collected and in particular the nature of the dependent variable. In choosing the open ended iterative bidding approach to contingent valuation, the nature of the dependent variable was more or less restricted to a continuous one though with occurrence of zero values as some people are not willing to pay for changes in environmental quality.

With a high occurrence of zero values of the dependent variable, use of the ordinary least squares results in biased and inconsistent parameter estimates and thus the Tobit and other higher level regression approaches are recommended (Tobin, 1958; Salazar and Koster, 2007; Gujarati, 2007; Liebe et al., 2011). The deciding factor in the choice of regression model to adopt between OLS and Tobit given occurrence of zero values of the dependent variable is the proportion of observed zero values of the dependent variable. Past studies have found that with low occurrence (below 25%) of zero values in the dependent variable, the results of the Tobit and the OLS models tend to converge (Tobin, 1958; Cynthia et al., 1986 and Clevo et al., 2002). In this study, the elimination of protest bids resulted in the decrease of zero

WTP observations from 13.1% to 7.8% which is well below the recommended 25% cut-off point for which the Tobit model has to be used in order to ensure that the regression estimates are not biased and inconsistent. As such, the OLS regression model was adopted for this study with the following specification:

$$\text{Final\_WTPBid}_i = \beta\text{Tot} - \text{land}_i + \beta\text{Manure} - \text{Use}_i + \beta\text{Aware Soil} - \text{lab}_i + \beta\text{HH\_size}_i + \beta\text{HHeadOccup}_i + \beta\text{Comstatus}_i + \beta\text{Membr} - \text{Grp}_i + \beta\text{Resp\_sex}_i + \beta\text{HH} - \text{Income}_i + \beta\text{Hhead} - \text{Exp}_i + \beta\text{Livestock}_i + \beta\text{Totl} - \text{laborers}_i + \beta\text{DistInptshp}_i + \beta\text{Transpt} - \text{costs}_i + \beta\text{RoadType}_i + \beta\text{Extensncntact}_i + \beta\text{TakeCrdt}_i + \beta\text{Importance}_i + \beta\text{Buuri}_i + \beta\text{Mbooni}_i + \varepsilon_i$$

The Table 1 summarizes a description of the variables code used in the above specified regression model.

Results

Estimated Total Economic Value of Changes in Soil Quality

As can be seen in Table 2 below, non-compliant farmers are found to have the lowest mean willingness to pay for changes in soil quality followed by the GLOBALGAP compliant farmers in all the three study clusters. This confirms the apriori expectation that compliant farmers may be practicing different agronomic practices and may perhaps be receiving a different extension package compared to the non-compliant farmers. Further, the requirement for them to use more environmental friendly agro-chemicals as part of the compliance requirements may have resulted in them appreciating the economic value of their environment.

When evaluated across locations, the farmers (both compliant and non-compliant) show some variation in their stated maximum WTP with the farmers in Mbooni having the highest Mean Maximum WTP responses followed by those in Buuri and those in Kirinyaga. Considering that Mbooni's agro-climatic conditions are harsher compared to those of Kirinyaga, it is probable that agro-climatic conditions also have an influence on the stated maximum WTP.

Factors Influencing the Economic Value of Changes in Soil Quality

Similar to the results obtained in estimating the economic value of changes in soil quality i.e. notable differences in the economic values based on compliance status of the household and the household's location, compliance status and the household's location are found to influence the economic value of changes in soil condition. Indeed, result of the regression analysis show that the compliance status of the household with the GLOBALGAP standards has a positive and significant influence on the economic value of changes in an environmental resource such as soil. At the same time and in line with the known agro-climatic differences, the households located in Mbooni have relatively higher economic values due to the positive and significant effect of the Mbooni location dummy variable.

Consistent with past contingent valuation studies and with the apriori expectations, the household's income is found to positively and significantly influence the household's stated economic value of changes in soil condition. The respondent's gender in relation to their ability to make decisions on the household's expenditure is found to have a significant though negative influence on the household's economic value of changes in soil quality. This finding re-enforces previous findings and held beliefs that women's views are generally considered inferior when it comes to the household's decision making process.

The awareness of the existence of nearby soil testing facilities by the respondents is found to have a positive and significant influence on the household's economic value of changes in soil quality. This may be related to the household's perception of the hypothesized economic valuation scenario which among other things involved a soil testing and analysis mechanisms for generating information to be used in undertaking soil quality conservation and restoration. Closely related to this is the importance attached by respondents to the hypothetical scenario posed. It is observed that this variable has a positive and significant effect on the household's economic valuation of changes in the quality of their soil resource. This result captures the importance of the acceptability of the hypothetical construct in a contingent valuation exercise.

Conclusions

This paper adds to the dearth of knowledge on the non-market benefits of compliance with GLOBALGAP standards. Using the iterative bidding approach to the contingent valuation method, the paper empirically demonstrates the existence of quantifiable environmental benefits of compliance with GLOBALGAP standards. The findings of this paper indicate that across the three study clusters, compliant farmers have relatively higher economic values of changes in soil quality compared to the non-compliant farmers; Kshs 2,621.69 vs Kshs 1,993.15 for Kirinyaga, Kshs 2,611.69 vs Kshs 2,066.64 for Buuri and Kshs 2,743.29 vs Kshs 2,216.00 for Mbooni. This validates and indeed quantifies the postulations of previsous studies vis a vis the possible existence of environmental benefits that accrue to farmers as a result of compliance with GLOBALGAP standards. The paper thus links with previous study by showing that in addition to compliant farmers practicing the environmental friendlier integrated pest management; they have a higher value preference for non-degraded environments among the compliant farmers. Furthermore, through regression analysis, this paper quantifies the positive and significant influence of compliance of with GLOBALGAP standards on the economic value of changes in soil quality.

Recommendations

Given the clearly identifiable and quantifiable benefits of compliance with agri-regulations such as GLOBALGAP, we recommend that developing countries should adopt agri-regulation as a possible tool for enhancing sustainable agricultural development. This will minimize the occurrence of negative environmental effects associated with intensive agricultural production which is being advocated for in African countries. In particular, as African countries such as Kenya look into ways of spurring a green revolution among their farmers, the use of agri-regulations such as the recently established KenyaGAP standards can result in benefits to both consumers and farmers and by extension result in sustainable agricultural production. Given such benefits at both the consumer and farmer levels, agri-regulation will result in greater societal welfare manifested in form of lower agro-chemical related sicknesses and fatalities as well as environmentally friendly agricultural practices.

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Table 1: Variable Codes and their Description

Variable code	Variable Description
Tot-land	Total household Land - the control of the household both owned and rented in excluding what is rented out in acres
Manure-use	Use of Manure by the household in their farming activities (0 do not use, 1 use manure in farming)
Aware Soil-lab	Awareness of nearby soil testing labs (0 not aware, 1 aware)
HH_Size	The size of the household in terms of the number of members that make up the household
HHeadOccup	Occupation of household Head (0 farming, 1 not farming)
Comstatus	Global gap compliance status (0 non-compliant. 1 compliant)
Membr-Grp	Household membership to a farming group (0 no, 1 yes)
Resp_sex	Respondents gender (0 male, 1 female)
HH-Income	Annual Household income (in Kenya shillings
HHead-Exp	Farming experience of the household head in years
Livestock	Household ownership of livestock (0 does not own, 1 owns)
Totl-Laborers	No of farm labourers
DistInptshp	Distance to the nearest input shop in kilometers
Transpt-costs	Transport costs to nearest major urban center in Kenya shillings
RoadType	Type of road to nearest market center (0 seasonal, 1 all weather road)
Extensncntact	Hh contact with extension service providers (0 no, 1 yes)
TakeCrdt	Use of credit in farming (0 no, 1 yes)
Importance	Importance of the SQCIMP (0 not important (important)
Buuri	Respondent from Buuri (0 no, 1 yes)
Mbooni	Respondent from Mbooni (0 no, 1 yes)

Source: Author 2013

Table 2: Estimated Mean Maximum WTP by Study Cluster and Compliance with GLOBALGAP

Study Area	Compliance Status	Estimated Mean Max WTP (/acre/year)	Std. Deviation	Max Stated WTP (/acre/year)
Kirinyaga	Compliant	2,621.69	1,819.04	11,760.00
	Non-compliant	1,993.15	1,700.31	11,408.00
Buuri	Compliant	2,611.69	2,432.32	10,000.00
	Non-compliant	2,066.64	1,588.49	6,000.00
Mbooni	Compliant	2,743.29	1,813.84	6,000.00
	Non-compliant	2,216.00	1,689.85	6,000.00

Source: Authors, 2012

Table 3: Analysis of Factors Influencing the Economic Value of Changes in Soil Quality

	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
Tot-land	(43.416)	29.018	(1.500)	0.135	(100.443)	13.611
Manure-use	(6.149)	171.222	(0.040)	0.971	(342.635)	330.337
Aware Soil-lab	672.467	250.974	2.680	0.008	179.252	1,165.681
HH_Size	2.736	41.133	0.070	0.947	(78.099)	83.570
HHeadOccup	99.806	203.130	0.490	0.623	(299.385)	498.997
Comstatus	325.387	176.808	1.840	0.066	(22.077)	672.851
OrgMbr	185.582	280.091	0.660	0.508	(364.854)	736.019
Resp_sex	(367.644)	158.435	(2.320)	0.021	(679.001)	(56.286)
HH-Income	170.730	54.493	3.130	0.002	63.640	277.820
HHead-Exp	(5.334)	6.326	(0.840)	0.400	(17.767)	7.099
Livestock	345.326	270.770	1.280	0.203	(186.792)	877.443
DistInptshp	(1.493)	18.972	(0.080)	0.937	(38.777)	35.790
Transpt-costs	(2.065)	0.960	(2.150)	0.032	(3.952)	(0.179)
RoadType	(259.703)	209.864	(1.240)	0.217	(672.128)	152.722
Extensncntact	(198.174)	172.244	(1.150)	0.251	(536.667)	140.320
Importance	1,672.577	197.609	8.460	0.000	1,284.236	2,060.918
Buuri	320.896	211.693	1.520	0.130	(95.123)	736.914
Mbooni	688.829	218.389	3.150	0.002	259.650	1,118.009
F statistic		***55.830***				
P value		***0.000***				
R-squeared		***0.689***				

Source: Authors, 2013