Impact of GlobalGAP Compliance on the Relative Poverty Status of Smallholder Horticultural Farmers in Eastern and Central Kenya

Owuor Rosebell Achieng'

Department of Agricultural Economics

Faculty of Agriculture

University of Nairobi

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DECLARATION

This thesis is my original work and has not been submitted for the award of a degree in any other university.

_____ Date: _____

Owuor Rosebell Achieng

Registration No: A56/64076/2010

This thesis has been submitted with our permission as University Supervisors:

_____ Date: _____

Dr. John Mburu

Department of Agricultural Economics

University of Nairobi

_____ Date: _____

Prof. Chris Ackello-Ogutu

Department of Agricultural Economics

University of Nairobi

DEDICATION

This work is dedicated to my parents, Professor and Mrs. Owuor, who through their encouragement and sacrifices I have made it this far. May God continue to bless you both abundantly.

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ABSTRACT

Global good agricultural practices (GlobalGAP) have significant, yet contentious impacts on different livelihood aspects of smallholder farmers. The GlobalGAP pose the threat of eliminating smallholder farmers from accessing international markets due to the high costs of implementation, maintenance and certification. But the practices associated with GlobalGAP improve the health of farmers and create employment opportunities. The practices are therefore useful in reducing poverty levels among smallholders and especially in rural areas. GlobalGAP was introduced in Eastern and Central Kenya but its impacts, especially on poverty status in the region, are unknown. The extent to which the modes of GlobalGAP compliance affect the poverty status of the farmers involved in production and marketing of fresh export produce is also unknown. This study was undertaken in order to fill this gap in knowledge. The objectives were to compare the poverty status of smallholder horticultural farmers under different compliance arrangements, and to determine the relative effect of GlobalGAP compliance on the poverty status of smallholder horticultural farmers in Eastern and Central Kenya. The impacts were classified into of four categories based on whether: (a) smallholder farming household compliance status was continuous throughout the study period; (b) compliance was gained during the study period; (c) the household lost compliance during the study period or (d) gained and lost compliance during the study period. The study used a longitudinal research design whereby panel data from three study areas in Eastern and Central Province (i.e. Buuri, Mbooni and Kirinyaga) were collected during baseline and follow-up surveys done in 2009 and 2012. The target population was 1,324 farmers from the baseline survey, out of which a sample size of 573 follow-up respondents was selected using a stratified method that mainly comprised proportionate to population size. Interview schedules and questionnaires were employed in

collecting the data. One-way analysis of variance (ANOVA) and paired t-tests were used to establish poverty status of horticultural smallholders under different compliance arrangements. Group compliant farmers had lower levels of poverty, though statistically insignificant compared to non-compliant farmers. Since there were no significant differences in the mean poverty status between GlobalGAP compliant farmers, it was concluded that the poverty status of smallholder horticultural farmers was equal across all compliance arrangements. Comparison between baseline and follow-up periods showed that only Mbooni recorded significant ((PÒ0.05) poverty reduction among the group contract farmers while Kirinyaga had significant (PÒ0.01) poverty reduction under individually fully compliant farmers. Impacts of GlobalGAP compliance relative to the period of compliance uptake was estimated using the difference-in-differences method (DD). The results showed that GlobalGAP compliance reduced poverty status of farmers who had gained and maintained compliance in Buuri and Kirinyaga. Continuous GlobalGAP compliance reduced poverty status in all study areas though only significant (P Ò0.10) in Buuri and Mbooni. Short-term impacts of gaining compliance during the study period showed reduction on poverty in all the study areas except Mbooni. Although households that gained GlobalGAP compliance showed mixed changes on poverty status, these influences were not significant. The assessment of farmer interaction with GlobalGAP compliance on poverty status showed increased poverty in all the study areas except Mbooni but was not significant in any of the study areas. The study recommended that policies that improve on consistent implementation, certification and maintenance of GlobalGAP compliance should be formulated in order to aid in alleviating poverty among fresh producer in Kenya.

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LIST OF ABBREVIATIONS

CMAAE	Collaborative Masters in Agricultural and Applied Economics
DD	Double differences
EU	European Union
FAO	Food and Agriculture Organization (of the United nations)
FPEAK	Fresh Produce Exporters Association of Kenya
FSS	Food Safety Standards
GLOBALGAP	Global Good Agricultural Practices
GOK	Government of Kenya
HCDA	Horticultural Crops Development Authority
KES	Kenya shillings
MOA	Ministry of Agriculture
PA	Participatory Appraisal
PRA	Participatory Rural Appraisal
RA	Rapid Appraisal
UK	United Kingdom
UoN	University of Nairobi

1. INTRODUCTION

1.1 Background

Agriculture sector in Kenya currently accounts directly for 24% of the Gross Domestic Product (GDP) and 27% indirectly through linkages with manufacturing, distribution and other service related sectors (Kenya Economic Survey, 2014). In terms of revenue, the sector contributes more than 50% of the export earnings. Horticulture as a sub-sector of agriculture ranks third in the national economy in terms of foreign exchange earnings after tea and tourism. It contributes 33% of the agricultural GDP, 38% of export earnings while continuing to grow by between 15-20% per year (Ministry of Agriculture, 2010).

Kenyaôs horticultural industry employs over 6 million Kenyans both directly (in production, processing and marketing) and indirectly (through trade and other activities). Approximately 96% of horticultural production is consumed locally while the remaining 4% is exported (*ibid*.. However, in terms of incomes, the export segment earns the country substantial amounts of foreign exchange (Figure 1). The production and marketing trends show that horticultural production has been increasing over the years. Despite the decline in production observed between 2010 and 2011 which was occasioned by unfavourable weather, horticultural crops still fetched higher prices and continued to grow in 2012 (Horticulture Validated Report, 2012). The sub-sector offers one of the best alternatives for increased food self-sufficiency, improved nutrition and ensuring the generation of increased incomes and employment and reducing rural poverty (Ganry, 2007; 2009).

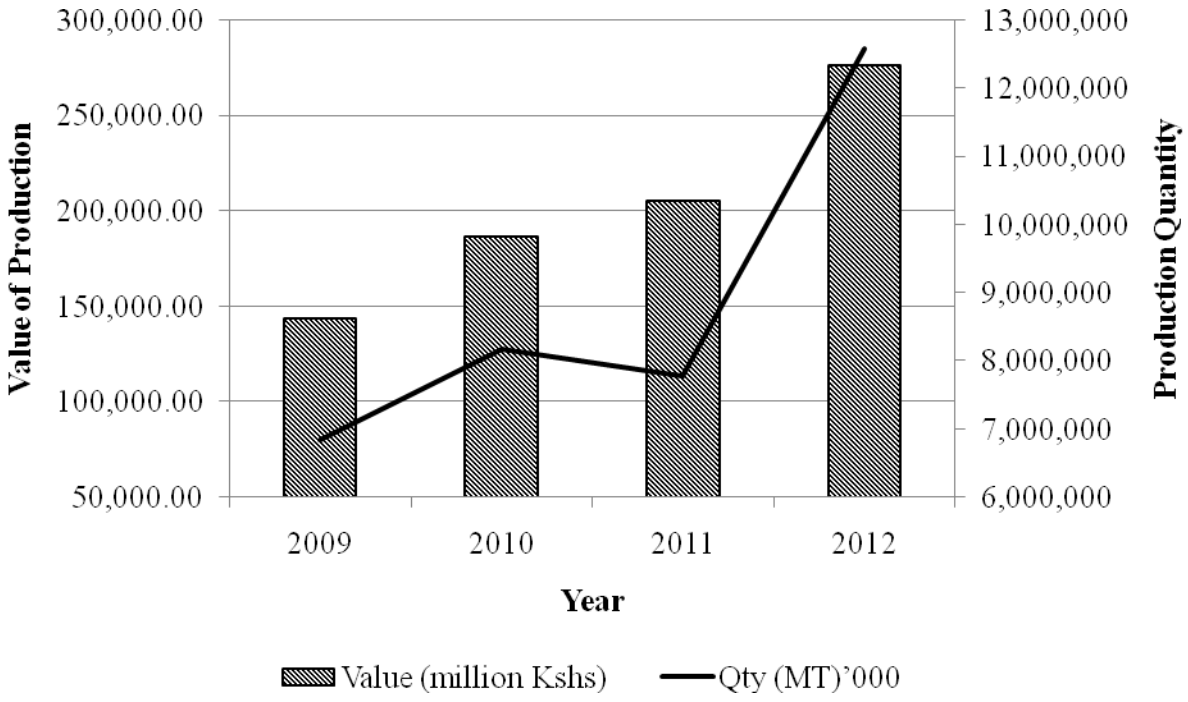


Figure 1: Export value and production of fresh fruits and vegetables from Kenya between 2009 and 2012

Source: Horticulture Validated Report, 2012

Like in other developing countries, the issue of poverty and wellbeing has been of great concern in Kenya. About two thirds of the world poor population is concentrated in rural areas, which are predominantly agriculture-oriented (World Bank, 2004). Similarly, over 80% of the Kenyan population live in the rural areas and derive their livelihoods mainly from agricultural related activities (Future Agricultures, 2006). It is estimated that 46% of Kenyan population live below the poverty line and this percentage is projected to increase to about 66% in 2015 (World Bank, 2013). Agriculture has therefore been given high priority by the Government in respect to poverty eradication strategies and raising welfare standards of the population (Kenya Vision 2030, 2007). Among these strategies are policies geared towards the horticulture sector due to its dominance by smallholder farmers. Up to 80% of horticultural production in Kenya is undertaken by smallholder farmers, who produce 70% of the sectorôs output and 60% of exports

(KDLC, 2010). The remaining 20% of growers are medium to large-scale producers and are mainly concentrated in the floriculture sub-sector. Key horticultural products include vegetables, fruits, and cut flowers. Of these products, French beans account for 60% of all vegetable exports and 21% of horticultural exports (HCDA, 2010; Nderitu *et al.,* 2007). However, smallholder horticultural farmers still face many production challenges, relating notably to marketing. With consumers demanding for safe food coupled with strict food regulations in the European Union, food safety standards such as GlobalGAP (Global Good Agricultural Practices)[1] have been imposed on farmers in order to make them more accountable in ensuring food safety. GlobalGAP is a quality assurance scheme based on the principles of Good Agricultural Practice, Hazard Analysis Critical Control Point (HACCP) principles for food handling and marketing, local regulations and International Labor Organization (ILO) conventions (HCDA, 2012). Compliance with GlobalGAP was meant to provide a level of assurance that the products were in compliance with the defined minimum product and process requirements (Spencer and Jaffee, 2007). The standards have however made access to foreign markets more difficult and resulted in new costs being imposed on horticultural farmers (Wasilwa, 2008).

The views on effects of food safety standards (FSS) on fresh produce trade and livelihoods of farmers vary widely. There are views suggesting that FSS are eroding the competitiveness of developing countries (UNCTAD, 2007a; 2008) and/or excluding smallholders from value chains that present opportunities for livelihood enhancement (Dolan and Humphrey, 2000; Graffham, 2007). There is also increasing evidence that continuously meeting the strict requirements and high costs associated with GlobalGAP is challenging for smallholders (Nyota *et al.,* 2012). In particular donor facilitated GlobalGAP adoption is often not sustainable since farmers abandon

[1]Initially EurepGAP-European retailersô protocol for Good Agricultural Practice

the standard following the withdrawal of donors. The FSS also have detrimental trade effects on poorest parts of the world (CAC, 2008). On the other hand private FSS are considered catalysts for necessary processes of upgrading and the enhancement of competitiveness (World Bank, 2005; Henson 2007). The lack of a consistent body of evidence has not quelled the debate of whether FSS impact positively on the livelihoods of smallholder farmers. A growing body of literature deals with the determinants of GlobalGAP adoption, food security and with the financial, environmental, health and social benefits of compliance by examining complaint versus non-complaint smallholder farmers (Muriithi, 2011, Asfaw *et al.,* 2010; Asfaw *et al.,* 2009a; Asfaw *et al.,* 2009b; Kariuki *et al.,* 2012; Khaldi *et al.,* 2007; Chege *et al.,* 2013). However, it is not known if the FSS influence poverty status of smallholder horticultural producers. The studies also fail to account for the impact of FSS based on time the farmers comply. Studies have also shown that GlobalGAP compliance has two main options, namely, group compliance or individual compliance (Asfaw *et al.,* 2009b; Okello, 2005; Kleinwechter and Grethe, 2006; Chemnitz, 2007).

There are many reasons attributed to the persistence of poverty in rural areas in Sub-Saharan Africa. For smallholder horticultural producers in Kenya, globalization, violent civil conflict, governance failure and institutional gaps have been minimal. Indeed the Government of Kenya has put up favorable policies to aid the smallholder horticultural producers. Despite these efforts, poverty status is still high.

1.2 Problem statement

Poverty in Kenya is still a major issue despite the implementation of various policies geared towards its reduction. The increasing relevance of private standards like GlobalGAP in high-value supply chains offers new challenges as well as opportunities for small-scale farmers in

developing countries. Most of past GlobalGAP adoption studies have focused on its associated costs, factors affecting its adoption, health and environmental impacts and its effect on food security (Muriithi, 2011, Nyota et al, 2012, Asfaw et al., 2010, Asfaw et al., 2009a, Asfaw et al., 2009b, Kariuki et al., 2012, Khaldi et al., 2007, Chege et al, 2013). So while several attempts have been made to measure impact of standards on several aspects of farmer livelihoods, none has focused specifically on relative poverty status[2]. Moreover, existing studies have shown that when farmers comply with GlobalGAP, they do so in groups or on individual basis (e.g., Muriithi, 2011). However, these studies fail to explain the extent to which any of these modes of compliance are likely to affect the poverty status of farmers involved in production and marketing of fresh export produce.

Previous empirical studies on impact of GlobalGAP standards on livelihoods in Kenya have primarily adopted a cross-sectional approach (Asfaw *et al.,* 2010; Asfaw *et al.,* 2009a). Although these studies have documented mixed impacts on poverty, they have largely ignored its multidimensional[3] aspects and dynamisms that are likely to occur during periods of adoption of GlobalGAP standards. Thus this study makes an attempt to fill this knowledge gap.

1.3 Objectives

The general objective of this study was to evaluate the impact of GLOBALGAP compliance on the poverty status of smallholder horticultural farmers in Eastern and Central Kenya.

The specific objectives were:

[2] Relative poverty is defined as the extent to which a household is worse off or better off compared to other households (Henry *et. al*, 2003)

[3] Poverty in this study is based on a wide range of indicators that capture common characteristics of poverty.

i) To establish the poverty status of smallholder horticultural producers under individual and group GlobalGAP compliance arrangements
ii) Determine the effect of GlobalGAP compliance on the poverty status of smallholder horticultural farmers

1.4 Hypotheses

The null hypotheses to be tested were:

i) Relative poverty of smallholder horticultural farmers is the same across all GlobalGAP compliance arrangements
ii) GlobalGAP compliance has no effect on poverty status of smallholder horticultural farmers

1.5 Justification of the study

High levels of poverty in Kenya, especially in the rural areas, is a paradox considering that the country is one of the best developed economies in eastern Africa. GlobalGAP compliance was intended to offer a pro-poor strategy of alleviating poverty in rural areas where poor infrastructure and dynamic and unpredictable market conditions exist. The mandatory nature of GlobalGAP compliance, it was hoped, would force smallholder farmers to choose different compliance arrangements based on their ability.

Understanding the impact of GlobalGAP compliance arrangements on poverty would guide policy makers in formulation of policies that advise farmers on choosing compliance options that are sustainable in the long run and easier to facilitate in the planning and initiation stages. An in depth understanding of impact of the compliance options on poverty will assist in making

decisions on resource allocation, investments and actions to mitigate or encourage specific distributional, environmental or risk consequences associated GlobalGAP compliance options.

The government could use the information from this study to create optimal institutional arrangements, make conducive policy decisions, and create an enabling economic environment (with access to input and output markets) to increase agricultural productivity and profitability for sustainable livelihoods and poverty reduction. The study also contributes to knowledge on whether GlobalGAP is in line with the poverty eradication goals in the Millennium Development Goals and Kenyaôs Vision 2030.

2. LITERATURE REVIEW

2.1 Poverty in Kenya

Poverty remains widespread in Kenya, despite anti-poverty programs and spending and an extensive research and policy literature since Kenyaôs independence in 1963. About 46% of the Kenyan population live below the poverty line and this percentage is projected to increase to about 66% in 2015 (World Bank, 2013). Over 80% of the Kenyan population lives in rural areas which harbor most of the poor people.

Kenyaôs Vision 2030, under the second Medium Term Plan (MTP), has agriculture prioritized as one of the key sectors that will contribute towards reduction of poverty. This MTP integrates well with the Millennium Development Goals (MDGs) which include ending extreme poverty (GoK, 2013). Among the strategies focused on agricultural development to alleviate poverty includes prioritization of commercialization of agriculture in order to provide higher rural incomes. In this respect, horticulture is positioned as one of the key subsectors in agriculture that will immensely contribute to the realization of these strategies. This is mainly due to its dominance among smallholder farmers in Kenya.

There are many driving forces that can be attributed to the persistence of poverty in rural areas in Kenya. Among them are natural calamities, minimal wages, unemployment, poor infrastructure, and limited accessibility of basic important services like education, health, water and sanitation. However, since agriculture is the predominant source of livelihood in the rural areas, the prominent factor attributed to the persistence of poverty is mainly related to low agricultural productivity and poor access to markets (World Bank and IFPRI 2006).

2.2 Horticultural production and poverty

Horticulture is the third largest earner of foreign exchange in Kenya and has been presented as one of the best alternatives towards contributing to poverty reduction in the country (Ministry of Agriculture, 2010). Studies that have analyzed the impact of horticultural production on reduction of poverty have mainly focused on fresh produce income or income generated through employment from labor provision in the horticultural chain. Horticultural farmers benefit directly from higher incomes and indirectly through greater access to markets (McCulloh and Ota, 2002). Minot and Ngigi (2004) focused on success in smallholder horticultural farming and on the factors that contribute to that success. Horticulture had positive impact on the incomes of smallholders who produced for the export market, despite the low/small numbers of the producers (Minot and Ngigi, 2004). However, the vegetables were only grown on small plot sizes since vegetable production is labor intensive. The findings did not therefore necessarily imply a significant effect on overall income and hence poverty alleviation. Horticultural farmers earned significantly higher incomes than non-participating farmers (Weinberger and Lumpkin, 2005). However, factors such as land allocated to farming were not controlled, so the study did not explicitly demonstrate whether export-oriented farming yielded more income.

In the cases of domestic and export market alternatives, incomes were significantly higher for households that commercialized their products through export market pathways (Muriithi, 2013). Similarly, export-oriented production increased household incomes of horticultural farmers (Rao and Qaim, 2011; Asfaw, 2009a; Maertens and Swinen, 2009). While the studies analyzed poverty based on participation into horticultural production, the studies did not consider the role of food safety standards.

2.3 Food safety standards and their effect on smallholder farmers' livelihoods

Increasingly stringent food safety and agricultural health standards in industrialized countries pose major challenges to developing countries for successful ventures in international markets especially for high-value food products (Jaffe, 2006). Yet, in many cases, such standards have played positive roles, providing the catalysts and incentives for the modernization of export supply and regulatory systems and adoption of safer and more sustainable production and processing practices (*ibid.*). In Kenya, several attempts have been made to measure impact of standards on several aspects of farmer livelihoods (Okello *et al.,* 2007, Muriithi, 2013, Nyota *et al.,,* 2012, Chege *et al.,* 2013, Okello, 2005, Barret *et al.,* 1999, Asfaw, 2009b and Asfaw *et al.,* 2010). Okello *et al.,* (2007) analyzed impact on small farmersô income and health, Muriithi (2013) focused on fresh produce income, Nyota *et al.,* (2012) studied transaction costs, while Chege *et al.,* (2013) focused on food security. The farmers and laborers showed improved health as a result of adhering to pesticide regulations and having trained individuals handle the agrochemicals (Okello, 2005). FSS also added the benefit of improved hygienic conditions due to the presence of hand-washing facilities, disposal pits for waste from the farm and clean toilets. Barret *et al.,* (1999), Asfaw (2009b) and Asfaw *et al.,* (2010) demonstrated that smallholder farmers benefit from food safety standards through increased agricultural productivity and higher incomes. However no study has focused on poverty status of the farmers. It is not known whether these benefits were sustainable in the long run or whether the increased income resulted to reduced poverty.

Despite the benefits, food safety standards marginalized small scale farmers from the international markets since the farmers were unable to fund the heavy investments required to attain certification (Muriithi, 2011 and Okello *et al.,* 2007). The failure to comply resulted in loss

of markets and incomes from both the international and domestic market. For those countries and suppliers who are financially well prepared, raising standards represent an opportunity; for those who are poor, they pose safety and market access risks.

In some countries, the impact of food safety standards on poverty has been determined. In Tunisia, food safety policies reduced poverty in rural areas (Khaldi *et al.,* 2007). However, the study was based on basic nutrition as the threshold for poverty measurement hence it addressed food security and not poverty *per se*. In Senegal, Maertens *et al.,* (2009) quantified effects of income on FSS and integrated labor markets. The study focused on income effects, not poverty. While these studies explored the impact of food safety standards on some aspects of farmersô livelihoods, the studies focused on exploring the impact in terms of cost of compliance, income and food security and thus came up with mixed observations. These studies also centered on finding ways to increase the participation of developing countries in international standard-setting bodies, or otherwise influencing the level and nature of the standards themselves. Indeed, most studies on poverty impacts of food safety standards have ignored the multidimensionality aspect of poverty by only focusing on the first-order impacts which is income.

2.4 Impact studies on poverty

Studies on the effects of agricultural technology on poverty showed how little investments in agricultural technology benefited households without land directly through production of vegetables and fruits and indirectly through generation of employment (Shah *et al.,* 2002). There were strong complementarities between physical infrastructure and human capital (Binswanger *et al.,* 1993 and Canning and Bennathan, 2000). Participation in governance and social networks were strongly associated with low poverty levels of smallholder farmers (Bogale, 2011). Agricultural technology (treadle pump irrigation adoption) increased per capita income which in

turn reduced poverty of farmers in the irrigated areas (Mangisoni, 2006 and Adeoti, 2009). Adoption of the technology was influenced by the literacy level of farmers, availability of labor and high number of extension visits to the farmers. On food security, there was a positive effect of horticultural farming on per capita calorie intake (Chege *et al.,* 2013). In a different study (Amaza *et al.,* 2011*)*, projects promoting sustainable agriculture reduced per adult equivalent household expenditure. While income is an important measure of poverty, it is limited in that it simply illustrates a fraction of human welfare. A more inclusive and expansive measure of human welfare, which includes variables such as education, life expectancy, infant mortality, employment, and more, would be necessary to capture the power income can have once accompanied by other measures.

Studies that have assessed impacts of smallholder horticultural farming and the technologies adopted on poverty status focused on examining the differences in mean outcomes of participants and non-participants. Such studies used simple regression procedures on income (sometimes proxied by expenditure) among the set of explanatory variables (Mangisoni, 2006; Bogale, 2011), or used gross margin analysis (Weinberger and Lumpkin, 2005; Rao & Qaim, 2011). Using mean outcomes between participants and non-participants fails to establish the direction of causality. The procedure used in these studies failed to deal with the problem of self-selection bias in observational data collected through households, thus making these procedures flawed. The mentioned studies lacked an explicit agricultural technology-poverty linkage. This complicated efforts to understand the relationship between agricultural technology and poverty reduction in order to design ways to make agricultural technology more effective in lifting poor people out of poverty. The studies also made evidence on the agricultural technology-poverty linkages that were partial and indirect. Following Langyintuo and Mungoma (2008) and, Zeller

et al., (2006) there is need to approach poverty using a multidimensional approach by constructing a poverty index based on both qualitative and quantitative indicator variables of household. There is need to consider land and other classic wealth indicators as the asset bases together with financial capital, human capital, physical capital, natural capital and social capital to account for the extent to which these non-income aspects contribute to the poverty status of the households after adopting food safety standards. This would capture both the monetary and non-monetary facets of poverty and may be suitable to measure structural and stochastic poverty transitions than income or consumption snapshots.

3. METHODOLOGY

3.1 Study Area

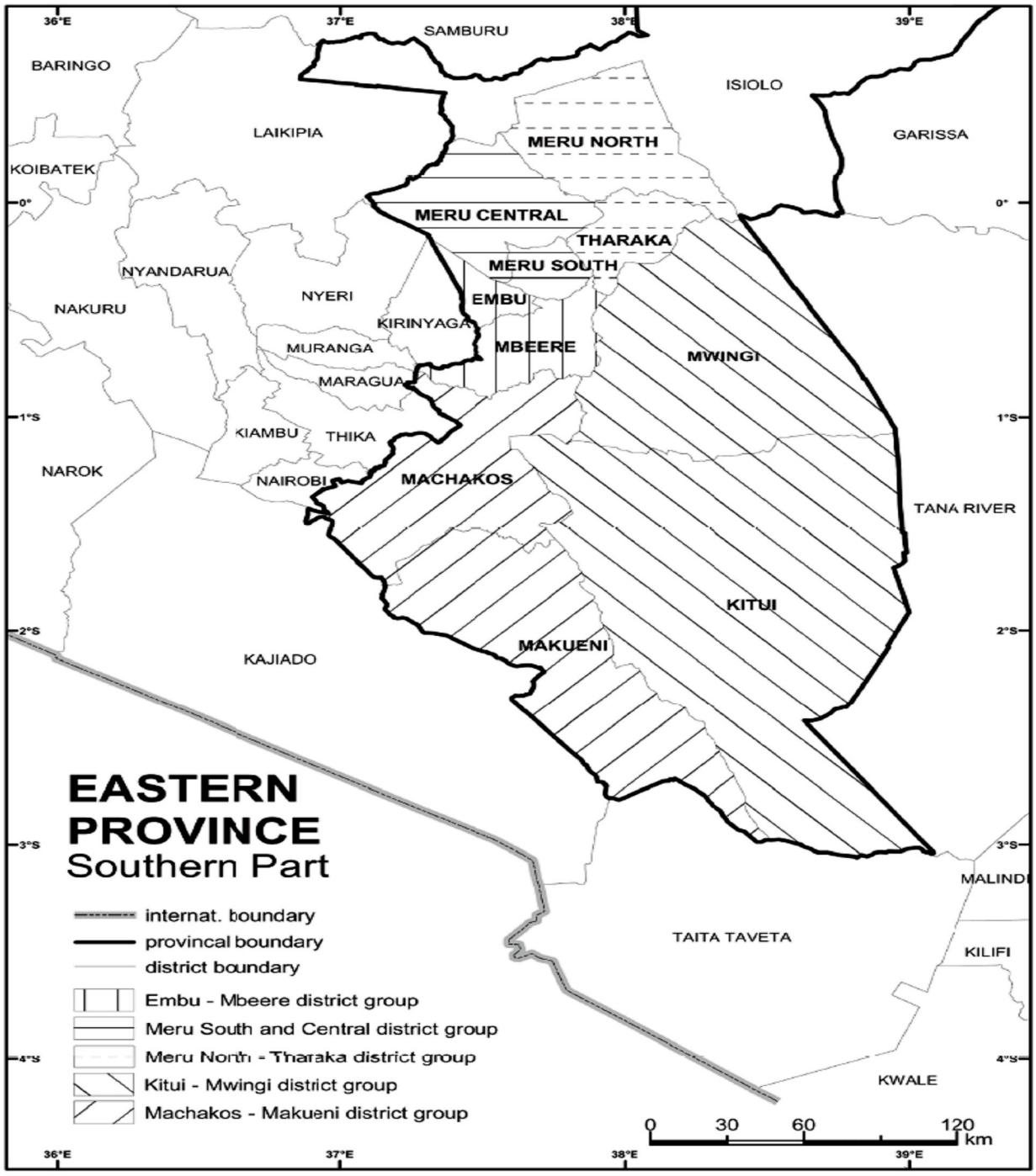
This study targeted smallholder farmers in major horticultural crop producing areas in Central and Eastern provinces. This was a follow-up study from a baseline survey done in 2009 by the University of Nairobi[4]. These provinces were chosen since they were the major horticultural producers in the country for both local and export markets. The selection of the two provinces during the baseline survey was done after a preliminary survey and a thorough literature review on production and export data of each province. Based on this, three distinct areas were purposively sampled:

- Buuri-part of Buuri and Laikipia East Districts
- Mbooni- Mbooni East and Mbooni West Divisions.
- Kirinyaga- Kirinyaga West, Kirinyaga South and Kirinyaga East districts.

The locations of the study areas in these two provinces are shown in Maps 1 and 2. Buuri and Mbooni East and Mbooni West are located in the former Eastern Province of Kenya, with Mbooni East and West being on the climatically drier Ukambani in the former Eastern Province while Buuri is located on the slopes of Mount Kenya which is of higher agricultural potential. Kirinyaga West, Kirinyaga South and Kirinyaga East districts are located in the former Central Province of Kenya. The main vegetables grown for export in the study areas were French beans, garden peas, snow/snap peas and chillies.

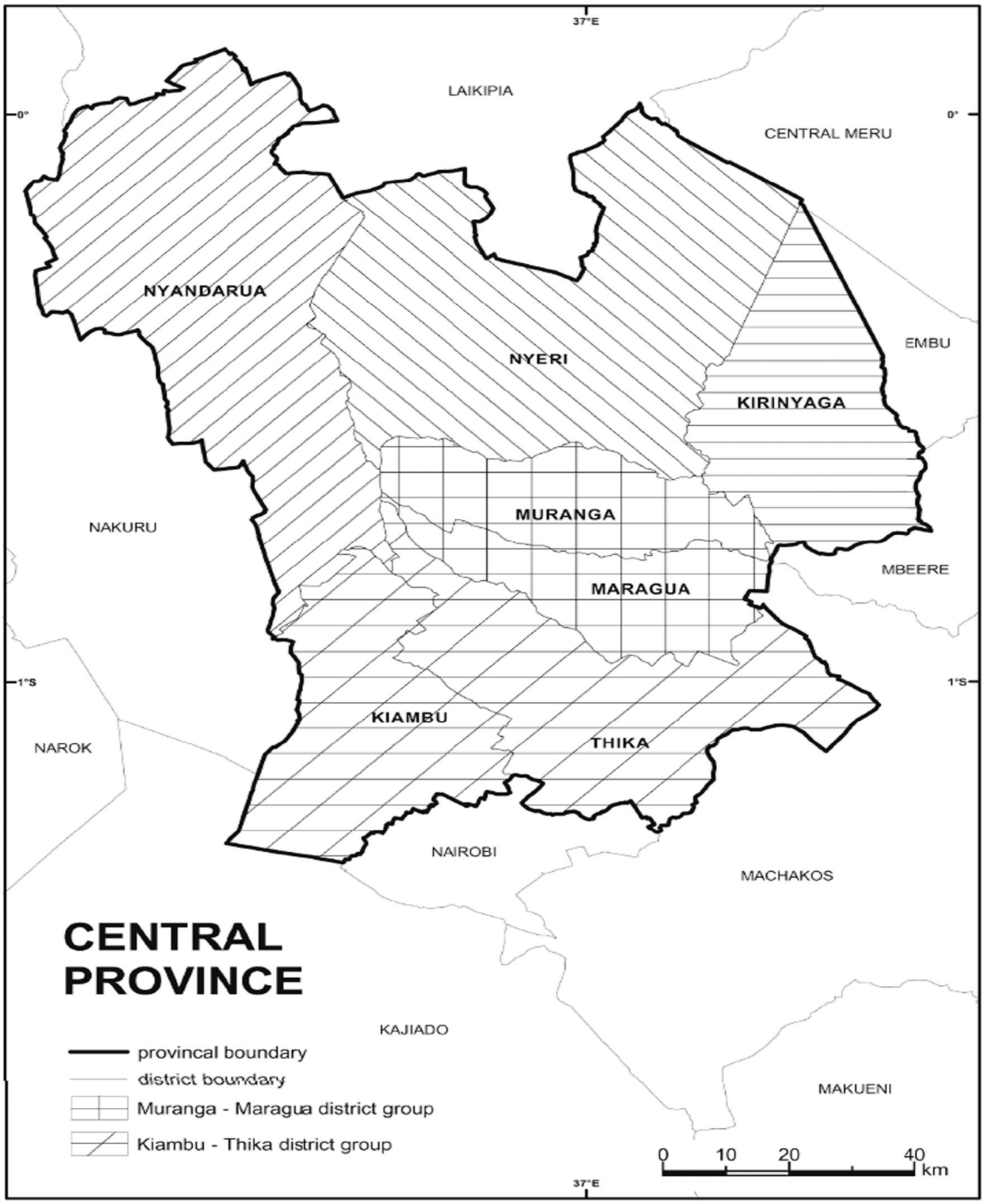
[4] The study was undertaken under the project on Drivers, Viability and Livelihood Impact of Compliance with Private Food Safety Standards among Smallholder Horticultural Producers in Kenyaô (DriVLIC-Kenya)

Map1: Eastern province



Source: Jaetzold and Schmidt, 1983

Map 2: Central Province



Source: Jaetzold and Schmidt, 1983

3.2 Conceptual framework

The starting point for the conceptual framework of this study is the consideration that every household had its poverty status (Figure 2). This status is determined by the asset portfolio that the household can use or draw upon for the livelihoods of its members. Rather than only considering land and other classical wealth indicators as the asset base, the framework included financial capital (cash as well as liquid assets, formal and informal credit), human capital (education, labor power, health and nutrition), physical capital (general infrastructure and technology), natural capital (in terms of access to natural resources like land) and lastly social capital (networks that enable the farmers to work coherently, informal safety nets and membership to groups) (Zeller *et al.,* 2006). The framework considered the potential interaction of the different types of assets, and the way in which they complemented each other to reduce poverty in a household. For example, membership in a social group (social capital) could be necessary for access to land (natural capital), which is necessary for access to credit (financial capital), which, in turn, is needed to purchase inputs to take advantage of compliance with food safety standards (Figure 2).

The policy and governance environment comprised policies and organizations in which the farmers operated. These policies affected how people used their assets in pursuit of changing/reducing their poverty status. They included among others, ethical standards, property rights, extension rules, credit regulations, land tenure and cultural beliefs/practices. This environment had a direct influence on poverty status of farmers as well as availability and accessibility of different assets (Figure 2). Analysis of the influence of this component of the framework on poverty was however outside the scope of this study.

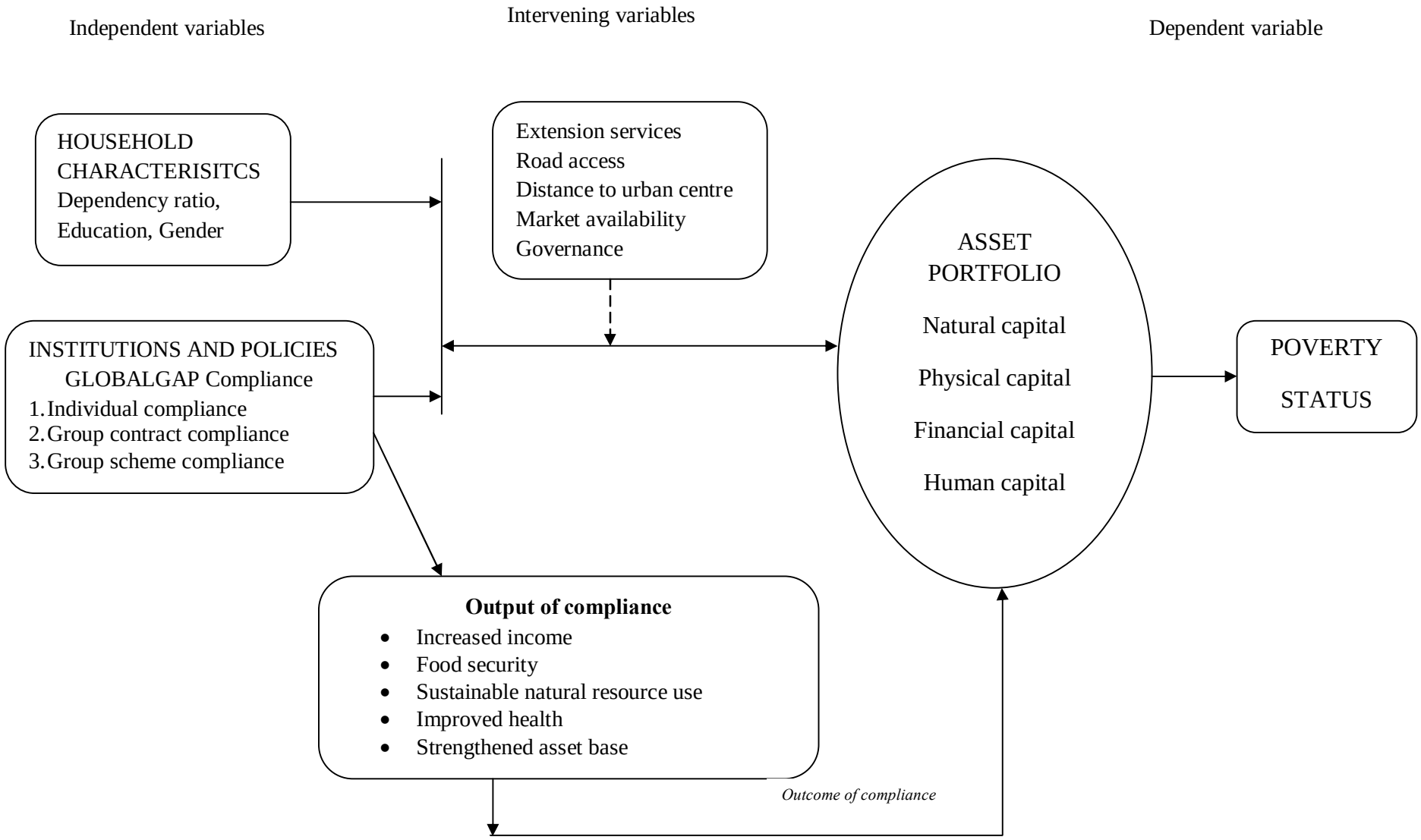


Figure 2: A conceptual model of the impact of food safety standards on poverty status of smallholder farmers

Source: Author's Conceptualization

The assets interacted with institutions or institutional arrangements to determine the choice of compliance with standards and eventually influenced how best to change (reduce) the poverty status of the households by improving household income, security, well-being and other productive and reproductive goals. The institutions[5] considered were the compliance arrangements: group contract, group scheme and individual compliance. The assets also contributed directly to the choice on whether or not to comply since different types of assets were required to adopt the standards. For example, human knowledge and skills were required to properly make use of the new technology. Collective action (social capital) was also needed to coordinate the action of individuals for common investment or adherence to rules (Kerstin *et al*., 2009).

Compliance however is not necessarily the only output as it feeds back into the future asset base by either reducing or increasing the status of poverty since the household adjusted or adapted to the situation presented. Potential outputs included indicators such as income, food security, and sustainable use of natural resources and improved health. The study focused on an increased/strengthened asset base which would have a feedback effect on the poverty status of the household through the asset portfolio. By changing the relative returns to different factors or assets, compliance with food safety standards could effectively change the distribution of the value of assets within and between households.

3.3 Empirical framework

3.3.1 Measurement of poverty

The main poverty assessment methods used in practice include; (i) construction of a poverty line and computation of various poverty measures that take into account the way in which actual

[5] Institutions here are defined according to the theory of New Institutional Economics (Kerstin et al., 2009)

household expenditures fall short of the poverty line, (ii) rapid appraisal and participatory appraisal methods in which households are ranked with respect to their wealth by community members themselves, and (iii) construction of a weighted poverty index using a range of qualitative and quantitative indicators (Zeller *et al.,* 2006).

Construction of a poverty line, also known as per adult equivalent or per capita method, involves computing, at minimum cost, a basket of goods and services at minimum cost for one person with the corresponding local consumption patterns that satisfies a pre-set level of basic needs. Although this method is widely accepted, it has very huge data requirements and presents a major concern, given the long recall periods involved in collecting the data. Furthermore, the analysis of expenditure data necessitates advanced skills in statistical analysis which translate into high costs for data processing and the presentation of the results as well (Zeller *et al.,* 2006).

Rapid Assessment (RA) and Participatory Appraisal (PA) methods are accepted methods of identifying vulnerable groups though the results are difficult to verify because the implicit criteria for wealth ranking are not systematically disclosed and measured as they stem from the subjective ratings of reference groups about the relative wealth of their community members. As a result, the results are difficult to compare across larger geographic locations or programs in a country as the subjective scaling system and the undisclosed criteria are likely to differ across different communities. Similar to using household expenditure, when applying RA and PA, it is hard to verify the results since the strategic responses may be given as the respondents may expect to receive certain services after the completion of the poverty assessment (Zeller *et al.,* 2006).

Constructing a poverty index involves identifying a range of poverty indicators at the individual, household or higher levels for which credible information can be quickly and inexpensively

obtained that describe one or different dimensions of poverty. The index is constructed through the application of principal component analysis (PCA). The PCA method is applied to determine how information from various indicators can be most effectively combined to measure a householdôs relative poverty status. The particular combination that proves most instrumental in measuring relative poverty within a given survey area will differ, and often in ways that are somewhat predictable. For example living in a house with a roof made of natural fibers is a sign of wealth in some areas (e.g. Germany), while in other areas (like Bangladesh) it is a sign of poverty, and in some countries an insignificant characteristic not related with poverty. PCA, unlike the previous methods, statistically (not subjectively) identifies and weighs the most important indicators in order to calculate an aggregate index of relative poverty for a specific sample household. The end result of PCA is the creation of a single index of relative poverty that assigns to each sample household a specific value, called a score, representing that householdôs poverty index in relation to all other households in the sample. The lower the score, the poorer the household relative to all others with higher scores (Zeller *et al.,* 2006).

This study applied the PCA method to construct a poverty index based on assets of a household. It focused on how net worth affects the householdsô economic well-being and accounted for the extent to which wealth (asset holdings aspects) contribute to the poverty status of the households.

Construction of Poverty Index using Principal Component Analysis

A poverty index for each household was computed using PCA of variables relevant to farmer livelihoods in the study areas. The index was related to the asset-based characteristics of the households, derived from attributes such as human capital, social capital, financial capital, natural capita and physical capital. The Bartlett-Test of Sphericity was used to test for the null

hypothesis that the variables were uncorrelated[6] i.e. that the correlation matrix of the variables is an identity matrix. The Kaiser-Meyer-Olkin Measure (KMO) was used as the ñMeasure of Sampling Adequacyò (MSA)[7] to check whether the samples were all suited for PCA (Field, 2009). The objective of using PCA was to identify a small number of indicators to explain most of the variance observed in a larger number of variables. Each of the 394 households in both the baseline and follow-up periods was given a score along the new variables generated that consisted of the sum of the products of the weightings and their scores along the original variables. Only the components with eigen values greater than 1 were selected. The eigen values represented the amount of variance in the original variables accounted for by each component.

Figure 3 summarizes the steps involved in the construction of the index. PCA was used to identify and weigh the most important poverty indicators in order to calculate an aggregate index of relative poverty for each specific household. The first step involved selecting a range of variables that were thought to be good indicators of householdôs welfare. These were then filtered systematically to ensure they were meaningful enough to be introduced as potential elements of the poverty index by calculating the correlation between each variable and a benchmark poverty indicator[8]. Once the variables that were correlated with the benchmark indicator had been identified, the PCA was undertaken.

Specifically, PCA isolated and measured the poverty component embedded in the various indicators and as a result created a household specific poverty score or index. PCA sliced information contained in a set of poverty indicators into several components. Each component

[6] If the significance level was lower than 0.05, the null hypothesis was be rejected with a 5% probability of error.

[7] The MSA ranges from 0.5 (unacceptable) to 0.9 (marvelous) describing the degree of interrelationship between the variables

[8] The study used household expenditure as the benchmark indicator

was constructed as a unique index based on the values of all the indicators. The main idea was to formulate a new variable, Q_1, which was the linear combination of the original poverty indicators so that it accounted for the maximum of the total variance in the original poverty indicators.

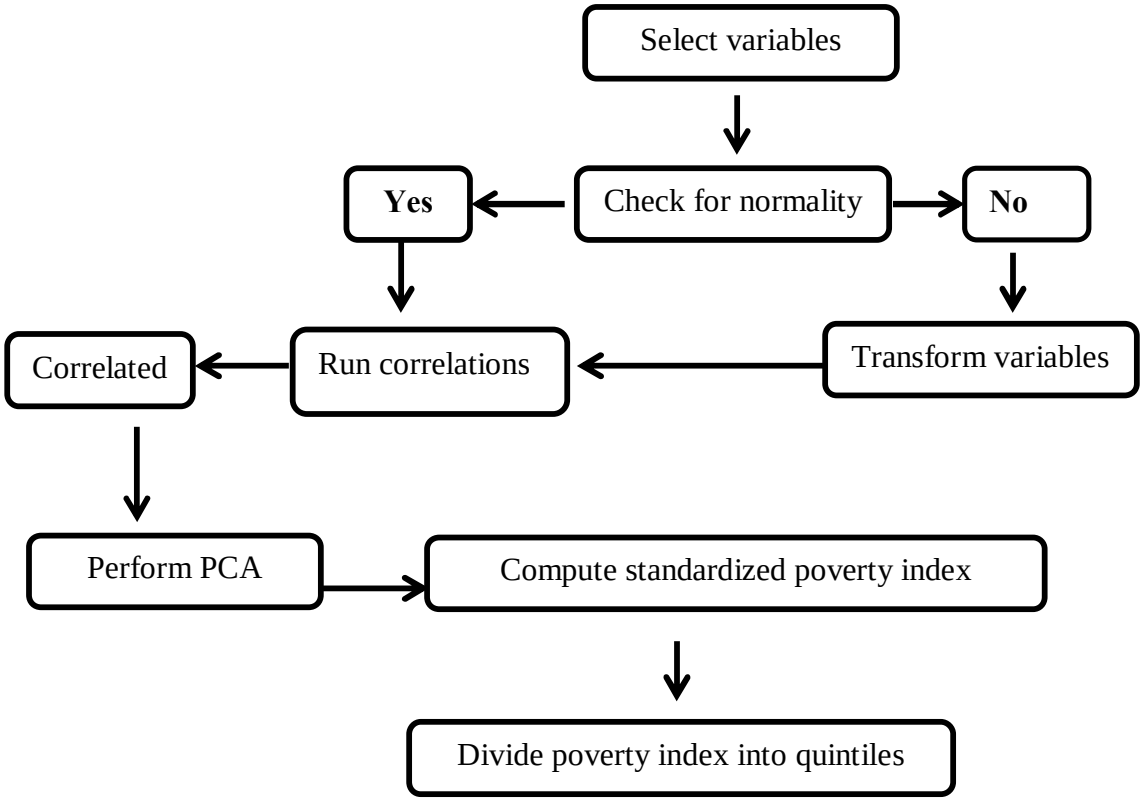


Figure 3: Steps involved in constructing a poverty index using PCA

The first principal component accounted for the largest proportion of the total variance in the set of indicators used. The second component accounted for the next largest amount of variance not accounted for by the first component, and so on for the higher order components. Each component was assumed to capture a unique attribute shared by households. One of the reasons why households answered differently to indicator questions is because of their relative poverty status. Indicators that were related in more than one way had more than one underlying component were created. However, only one component was used to measure a householdôs relative poverty.

Once data on *k* indicators were arranged in *k* columns to form an *n* ×*k* matrix X**,** the method of principle component was used to extract a small number of variables that accounted for most or all variations in X. This was done by obtaining a linear combination of the columns of X that provided the best fit of all columns of X as in

$$Q_1 = XW_1 \qquad (1)$$

In Equation (1), the vector W_1 contained the weights for each of the indicators X that were in the first principle component. This equation can also be represented in a general formula to compute scores on the first component created in a principal component as follows:

$$Q_1 = w_{11}(X_1) + w_{12}(X_2) + \ldots w_{1p}(X_p) \qquad (2)$$

Where:

Q_1= the subjectôs score on principal component 1 (the first component extracted)

w_{1p}= the regression coefficient (or weight) for observed variable p, as used in creating principal component 1

X_p= the subjectôs score on observed variable p.

The index Q_1 aggregated the information contained in the poverty indicators. The resulting index was a normally distributed variable with a mean of zero and a standard deviation of 1 because PCA converted all the indicators into standardized variables (Sharma, 1996).

Having identified the first principal component as the ópovertyôô component, the poverty index for each household was then computed as:

$$Q_j = f_1 * ((X_{j1}-X_1)/S_1) + ...+ f_N * ((X_{jN}-X_N)/S_N) \quad (3)$$

Where;

f_1 is the weight for the first of the *N* poverty indicator variables identified as significant in the PCA model,

X_{j1} is the *j*th household's value for the first variable,

X_1 and S_1 are the mean and standard deviations of the first variable over all households.

In this study, data on asset portfolio of each of the households was collected made up the ''indicators'' and the underlying component that was isolated and measured by principal component analysis was identified as the "poverty index". The computation of the index was based on availability of the variables and correlation or evidence of a pattern of relationships between the variables and their underlying constructs.

3.3.2 Impact assessment methods

Impact evaluation methods vary based on the assumptions on how to best deal with the problem of selection bias when estimating the program treatment effect. Among the methods used to solve this problem include randomized evaluations and matching methods (specifically propensity score matching (PSM), difference-in-differences methods and instrumental variable (IV) methods) as specified by Khander *et al. (*2010). Randomized evaluations fall under experimental designs while the rest are quasi-experimental designs also known as nonrandomized designs (Baker, 2000).

Randomization as a method of impact evaluation is the most robust. It involves randomly allocating a treatment across a sample of units. The progress of the treated and untreated units

that are assumed to have the same pre-treatment characteristics are then observed over time. Randomized experiments have the advantage of avoiding selection bias at the level of randomization and as such yield powerful outcomes. Furthermore, results from randomization are simple to interpret since impact on the outcome can be measured based on average treatment effects (ATE) between the participant and control units (Khandker *et al.,* 2010). However, the evaluator had no control on treatment assignment and hence this method was not applicable.

In the absence of randomization, propensity score matching (PSM) can be used to compare treatment effects across participant and matched nonparticipant units, with the matching conducted on a range of observed characteristics (Khandker *et al.,* 2010). PSM bases selection bias only on observed characteristics and as such has the shortcoming of being unable to account for unobserved factors affecting participation.

Instrumental variable (IV) models allow for selection bias on unobserved characteristics to vary with time. In the IV approach, selection bias on unobserved characteristics is corrected by finding a variable that is correlated with participation but not correlated with unobserved characteristics affecting the outcome. This is the shortcoming of IV approach since the procedure of finding the instrumental variable remains an arduous task in empirical analyses. Moreover, IV procedures tend to impose a linear functional form assumption, implying that the coefficients on the control variables are similar for adopters and no adopters. This assumption may not hold, since the coefficients could differ (Ali and Abdulai, 2009).

Impact evaluation can also be computed by difference-in- differences[9] (DD) method, in which one makes comparisons across units[10] (participants and control units); then comparison over

[9] This method is also known as the double differences method.

time[11] (before and after a program). The DD approach assumes that unobserved selection is present and that it is time invariant, allowing for impact estimates over time and across units. As such, DD eliminates selection bias related to time-invariant individual characteristics.

The current study applied a difference-in-differences (DD) method to measure impact evaluation. Unlike the other methods described in this section, DD relaxes the assumption of conditional exogeneity or selection only on observed characteristics. It also provides a tractable, intuitive way to account for selection on unobserved characteristics.

Application of double differences model

A comparison of outcomes is made both before and after treatment and with a control group of similar people not receiving the treatment. In this study, the treatment group consisted of the horticultural farmers who are GlobalGAP compliant during the study period while the control group was composed of the non-compliant farmers. The changes in the poverty index for each farming household was the main outcome variable. This method utilizes the inter-temporal variation within a community so that the time-invariant component of omitted variable bias is eliminated and the model is given in Equation 4:

$$\Delta Y_i = \alpha + \Delta D_i + \Delta Xi + \Delta \varepsilon_i \qquad (4)$$

Where:

ΔY_i is the difference in the outcome variable between the follow up and the baseline period; $Y_{i1} - Y_{i0}$

D_i is a dummy variable equal to 1 if farmer had any interaction with GlobalGAP compliance

[10] Also known as the first difference
[11] Also known as second difference

ΔXi is the vector of differences in the household and farmer characteristics between the two time periods; Xi_1-Xi_0

$\Delta \varepsilon_i$ is the error term differences between follow up and baseline periods

The study recognized that there might have been differential impacts for horticultural farmers who gained or lost GlobalGAP compliance relative to other farmers who had always or never had compliance. .

Applying dummies for different compliance status of the farmers, Equation 4 can be modified to Equation 5:

$$\Delta Y_i = \alpha + \beta_D D_i + \beta_C C_i + \beta_G G_i + \beta_L L_i + \beta \Delta Xi + \Delta \varepsilon_i \quad (5)$$

Where:

Ci = 1 if the farmer had GlobalGAP compliance continuously during the period, or equal to zero otherwise

Gi = 1 if the farmer gained GlobalGAP compliance during the period, or equal to zero otherwise

Li = 1 if the farmer lost GlobalGAP compliance during the period, or equal to zero otherwise

This specification allows GlobalGAP compliance to have different impacts according to the status of the farmer during the study period. In each case, the reference group comprises the farmers who have never complied with GlobalGAP standards. β_G, β_L and β_C measure the relative effect on poverty of gaining, losing and continuously having GlobalGAP compliance. β_D measures the effect of having any interaction with compliance during the study period.

Most statistical packages do not have an in-built procedure for applying the DD methodology. As a result DD model is mostly applied using an Ordinary Least Squares (OLS) regression. However, in the current study, the outcome variable was zero or negative for a substantial part of the population. In different applications where the dependent variable is zero or negative for a substantial part of the population, the alternative to OLS is the Tobit model (Clevo *et al.,* 2002). The use of OLS in the case of censored data makes the estimates biased and inefficient, thus violating the basic tenets of Best Linear Unbiased Estimator. This is based on comparison of the number of zeros and negative values in relation to the number of observations. Statistical analyses by Clevo, *et al.,* (2002) show that when zeros were more than 25% of the total number of observations, then Tobit estimates were more consistent and unbiased. The number of zeros and negatives for the current study were more than 25% in all the study areas; 59.2%, 48.8% and 47.9% in Buuri, Mbooni and Kirinyaga respectively. Hence Tobit regression was used.

3.4 Methods and Procedures

3.4.1 Research design

The study used a longitudinal research design whereby data was collected over a two-wave period through household surveys in the years 2009 and 2012. Data that had been collected earlier in 2009 through the DrivLIC-Kenya Project provided the baseline data. A follow up survey was then conducted in 2012. Longitudinal research design had the advantage of producing better estimates for changes in poverty status of the farmers since it helped control for observed (for example land size) and unobserved (decision making) time invariant characteristics of a household.

3.4.2 Sampling procedure and data collection

The list of 1324 farmers from the 2009 baseline survey of the DriVLIC-Kenya Project formed the sampling population for the follow-up study, with a household as the sampling unit. The population consisted of farmers who were individually fully compliant farmers and were growers in the export market, group contract farmers (who owned facilities, production process and kept their own records), group scheme farmers (exporters owned facilities, kept records and controlled production), non-compliant farmers who abandoned the standards after adoption, non-compliant farmers who had never used the standards and farmers who did not grow any export vegetables. A stratified method that involved proportionate to population size (PPS) method was used to select the follow-up respondents. The aim was to have at least 30 households from each category of farmers. All households were taken for categories with less than 30 households in the sample. For categories that had more than 30 households only 33% were taken. Except for the individually fully compliant households, sub-samples that were too small (less than 10 households) to be analyzed separately were dropped from the sample of the follow-up survey. In total, 573 households were sampled in the three study areas. The follow-up respondents from each of the categories, based on the baseline survey, are shown in Table 1.

Table 1: Study areas and number of respondents sampled for the follow-up interviews

	No. of cases selected from each category (total population of cases parenthesis) in each area.		
Category	**Buuri**	**Mbooni**	**Kirinyaga**
Individually fully compliant farmers who are growers and exporters	16 (16)	20 (20)	27 (27)
Group contract farmers (who own facilities, production process and keep their own records)	30 (46)	0 (4)	31(95)
Group scheme farmers (exporters own facilities, keeps records and controls production)	11 (11)	30 (30)	30 (34)
Non-compliant farmers who abandoned standards after adopting	0 (7)	0(3)	10 (10)
Non-compliant farmers who have never adopted standards	46 (138)	30 (90)	91 (234)
Farmers who do not grow French beans and Complaint farmers who sell to brokers	30 (82)	69 (209)	81 (261)
Total	**133 (293)**	**149 (349)**	**270 (651)**

The questionnaire was pretested in Kirinyaga area on 19th November 2012 using the intended protocol and setting as the survey i.e. through personal interviews. During the pretest, a total of 15 horticultural farmers were interviewed. This exercise increased familiarity of the questionnaires among the enumerators and also allowed for identification of questions that needed modification. The completed pretest questionnaires were then reviewed and it was found that both enumerators and respondents understood the questions. None of the questions needed to be modified either. This confirmed that the pretested instrument was adequate for the study. Data collection was then conducted between 20th November 2012 and 15th December 2012.

During the follow-up survey, personal interview sessions and personal observations were employed in collecting the required cross-sectional primary data from selected households who had previously been interviewed during the 2009 baseline survey. The interview method of data collection was preferred due to its high response rate. Through the interviews, clarification of issues was easily achievable which led to accuracy of data. This was done with the help of properly trained enumerators and two supervisors. The study collected data among smallholder farmers in a survey using semi-structured questionnaire. The questionnaire contained both open ended and closed questions. The survey questionnaire was also geared towards a variety of indicators to capture the multidimensionality of poverty in order to provide a better approximation of its levels. These included household demographics and interactions with others, type of dwelling (housing characteristics which included material of dwelling floor, roof and toilet facilities), ownership of equipment, types and value of various assets (which include; television, radio , bicycle, solar power and vehicle,) and access to basic services like electricity supply and source of drinking water. The questionnaire is attached in Appendix 2. The data collection exercise yielded 71.3% response rate i.e. 98 from Buuri, 127 from Mbooni and 169 respondents from Kirinyaga.

Table 2 describes the variables used in the regression and their hypothesized effects on poverty status. Access to extension services was expected to have a negative sign since extension was meant to provide greater access to information concerning poverty reduction strategies through improved agricultural technologies that will lead to improved livelihoods (Hasan *et al.,* 2013; Dercon, 2009). Social capital was hypothesized to have a negative sign. Through social capital smallholders are able to collectively reduce the effect of risk-coping strategies that deplete household assets (Bogale, 2011).

Table 2: Hypothesized effects of explanatory variables on poverty status

Explanatory variables	Description	Hypothesized effect
Compliance	Dummy variables =1 if the farmer had any interaction with GlobalGAP compliance at any point during the period.	+/-
Continuous_Comp	Dummy variables =1 if the farmer had GlobalGAP compliance continuously during the period	+/-
Gain_Comp	Dummy variables =1 if the farmer gained GlobalGAP compliance during the period	+/-
Loss_Comp	Dummy variables =1 if the farmer lost GlobalGAP compliance during the period	+/-
Extension_F	If farmer has received at least one extension visit; 1=Yes, 0= No	-
Social_Cap	If farmer is involved in any type of group (marketing/ farming/); 1=Yes, 0= No	-
Disturbn_Diff	Difference in distance from farm to the most important town / urban centre (Kms)	+
All_Weather_Road	Access to all weather road 1=Yes, 0= No	-
Ln_Asset_Diff	Log difference in value of household assets	-
Livestock_Diff	Log difference in total livestock units	-
Ln_Income_Diff	Log difference in household income	-
Hhsize_Diff	Difference in household size	+/-
Maxed_Diff	Difference in highest education in the household	+/-
Depratio_Diff	Difference in household dependency ratio	+
Fgender_F	Female headed household; 1=Yes, 0= No	+/-
Propland_Diff	Difference in proportion of land used for farming	-
Farming_Main_F	Farming main occupation; 1=Yes, 0= No	+/-

Source: Author's computation from survey data

Increasing distances to the urban centre translate to high transport and fare paid by farmers, most importantly when sourcing important inputs for farming. The higher the distance, the higher the cost associated with acquiring inputs. Higher input prices contribute to poverty. In most cases, proximity to the urban centre would also mean access to well-functioning market systems. The longer the distances to the urban centre, the less frequently the farmer is likely to visit the urban centre and hence, the less likely the farmer gets market information. When there is lack of adequate information about prices, farmers may deliver to grading sheds produce at times when

prices are low and buy when prices are high. The hypothesized effect on poverty status is thus positive.

Proximity to all weather roads can reduce transaction costs associated with agricultural activities. In so doing good quality roads have the potential to reduce the costs of acquiring inputs, increase prices of produce, reduce the impact of shocks, and permit entry into new and more profitable activities (Dercon, 2009). This variable was therefore hypothesized to reduce poverty

The variable on total household assets was hypothesized to reduce poverty. Households that continuously accumulate assets of high value have the ability to make use of the stored wealth (Hassan and Babu, 1991). This smoothens consumption in case of shocks to income hence reduces vulnerability to poverty.

Positive differences in livestock units is hypothesized to reduce poverty severity since keeping livestock presents a wide spectrum of benefits to reduce poverty such as provision of immediate cash needs, food, farm compost manure, draft power and hauling services, savings and insurance (Moll, 2005). Farmers can also specialize in livestock production as an income enhancing strategy (Barret *et al.,* 2005).

The standard assumption is that households with high income are better able to escape poverty. Increased income provides financial safety to a household and could be used to improve the welfare of a household thereby reducing poverty. Income could be used to increase consumption potential and provide better access to various capital and productive assets for investment hence reduce poverty (Chege *et al.,* 2013). The expected sign is thus negative.

The expected sign for household size is either positive or negative. Household size differences are mainly dependent on the composition of the household. In most cases household size

increases are due to the addition of members who cannot contribute to the income levels of the household hence become a cause of poverty (Swanepoel, 2005; Damisa *et al,* 2011; Muriithi, 2011). Alternatively, additional members of the household who are adult, healthy and educated members could translate to an increase in the number of income earning adults depicting a positive effect on poverty (Orewa and Iyangbe, 2009).

The maximum level of education in the household was included based on a previous study (Jolliffe, 2002) that showed it was the best indicator for education in developing countries. It was hypothesized that households who possess better individual skills, ability and motivation have lesser poverty. Returns to investing in education include a better awareness of improved technology and associated agricultural practices, improved managerial capacity even at the farm level and a greater set of off-farm employment opportunities (Adeoti, 2009). Having a high literacy level in the household enhances the capacity to adapt to change, understand new practices and technologies and hence improves a householdôs productivity and income (World Bank, 2002). The expected sign for differences in maximum household education was negative.

Dependency ratio varies with the asset holdings of a household. This ratio allows researchers to measure the burden on members of the labor force within the household. Low dependency ratios are associated with high asset holdings and *vice versa*. Hence increasing the dependency ratio of a household is hypothesized to increase the severity of poverty.

In Africa more women than men are involved in rural economic activities such as farming. However, at the same time majority of women in Africa have no rights to property, a factor that infringes on their access to either input or credit markets which drags their households towards poverty. Traditionally, no theoretical foundations exist on the relationship between gender and

poverty. For these reasons, the female headship was hypothesized to have either positive or negative effects on severity of poverty.

The difference in size of land allocated to farming by a household is measured in acres. Land is closely linked to crop and livestock production. The larger the proportion of land allocated to farming, the higher the production level. Hence, it was expected that households with large proportions of farm land would have lower poverty levels (Adeoti, 2009).

Farming as the main activity to reduce poverty of a household means the smallholder farmer focuses on enhancing the productivity of small-scale agriculture by using a combination of assets of land, access to technological improvements, skills and education to reduce poverty (Sarris *et al.,* 2006). However, farming also faces volatility of prices for produce and input and weather shocks hence can increase poverty. Hence this variable could either have a positive or a negative effect on poverty status.

3.5 Data analysis techniques

Collected data were analyzed using SPSS and STATA software. Principal Component analysis was used to calculate the household specific poverty indices in the sample, which were then divided into 3 pre-determined categories to reflect relative poverty status: Low, middle and high. The first objective was then achieved using descriptive statistics that compared the poverty status of horticultural farmers across different compliance arrangements. This included use of frequency, means, percentages, tables and standard deviation. The double differences model was fitted to analyze and compare different factors influencing poverty of smallholder farmers.

3.6 Limitations of the longitudinal research design

One of the problems experienced during the follow-up survey was locating the farmers who had been sampled from the baseline sample. Since the respondents had not been geo-referenced, it proved very difficult to trace some of them as the names on the list could sometimes be linked to 2-3 persons in a village. In some cases some farmers were deceased, had relocated from the area or absent spouses had not informed their partners that they had been interviewed. Some farmers even out rightly refused to be interviewed again. As a result a 71.3% response rate was achieved during data collection. However longitudinal research design was still applied in the study because it had the advantage of producing better estimates for changes in poverty status of the farmers by controlling for observed and unobserved time invariant characteristics of a household.

4. RESULTS AND DISCUSSIONS

4.1 General information on export vegetable farming and compliance to food safety arrangements

4.1.1 Trend of vegetable production

A decline in the participation of farmers who grew vegetables for the export market was observed in all the study areas (Figure 4). This was in contrast to the national figures which have shown an increasing trend of the volume of export horticultural produced in the country (Horticulture Validated Report, 2012). Among the reasons given for abandoning export vegetable farming were low profitability (losses incurred) from the crop and lack of and/or shortage of adequate water. The reduced participation of farmers in export horticultural farming was attributed to increasing cost of inputs (Gitau *et al.,* 2012; Adekunle *et al.,* 2012). Thus in addition to input costs, water is critical input deterring farmers to participate in horticultural export farming.

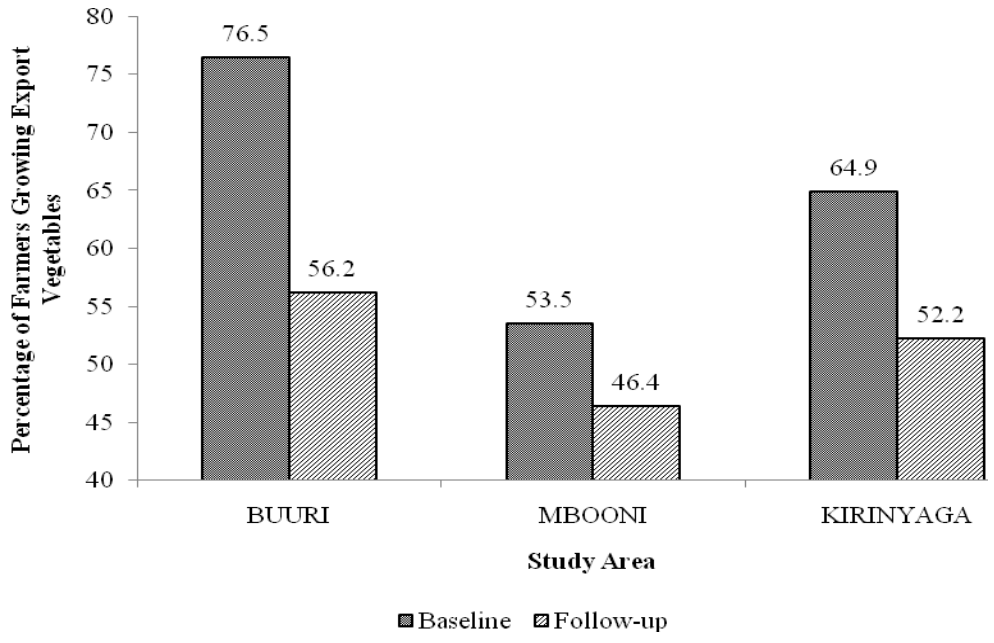


Figure 4: Proportion of export vegetable farmers

Source: Author's computation from survey data

The costs of inputs, especially fertilizers and pesticides, required for use in compliance with the compulsory private standards have continued to increase (Gitau *et al.,* 2012; Adekunle *et al.,* 2012). It is necessary that mechanisms are put in place to avail adequate water to the farmers and to reduce the costs of production to enable more farmers to stay in the market.

4.1.2 Compliance status of farmers and dynamics of compliance

Majority of the horticultural farmers preferred the group compliance options to individual compliance during both survey periods (Table 3). In the follow up survey, in Buuri, there was however a shift towards group compliance under scheme option whereby the exporter owned facilities, kept records and controlled production. This was attributed to the inability of smallholder farmers to afford the initial implementation costs required for GlobalGAP compliance and subsequent maintenance towards compliance.

Table 3: Comparison of compliance status of horticultural farmers between baseline and follow-up study in percentage

	Buuri N=98		Mbooni N=127		Kirinyaga N=169	
	2009	2012	2009	2012	2009	2012
Individually fully compliant	11.2	0.0	11.0	0.0	9.7	10.1
Group contract farmer	21.4	23.5	1.6	3.1	20.6	8.9
Group scheme farmer	4.1	14.3	18.1	18.1	11.5	10.1
Exitors		9.2		15.0	6.7	8.3
Non compliant	39.8	9.2	22.8	10.2	16.4	14.8
Non grower	23.5	43.9	46.5	53.5	35.2	47.9

Source: Author's computation from survey data

As a result, exporting companies contracted the farmers under their groups to ensure production was met on time, and at the expected volume and quality. In exchange the exporters met the bulk of the costs required for compliance. Similar to these results, an earlier study (Humphrey, 2008) reported that Kenyan exporters financed GlobalGAP standard implementation and took up 70%

of the costs required for putting up a grading shed. The exporters also provided for recurring costs like training, packing, transportation and having technical assistants[12] on site. The current study reaffirms the findings that it was necessary for exporters to intervene in terms of shouldering the bulk of compliance costs related to initial start-up, certification and maintaining compliance. This will ensure smallholder horticultural farmers continue to accrue the benefits of compliance like better health and assured export market participation, hence improved livelihoods.

The number of farmers who abandoned compliance after adopting (exitors) increased in all the study areas in the follow up survey (Table 3). The main reasons given for abandonment were costly investments required for compliance maintenance and larger quantities of rejects even when they believed they had followed all the requirements of GlobalGAP. This proportion of farmers preferred to divert their produce towards the less demanding regional markets instead of completely abandoning production of export vegetables. This finding was in line with a previous study (Muriithi, 2013) which observed an upward trend towards commercialization of vegetables in the domestic markets. It is necessary that avenues are provided for smallholder horticultural farmers who find GlobalGAP compliance costly despite external support from exporters. This could include providing them access to less stringent and efficient alternative markets for their produce. Furthermore, it is necessary to put in mechanisms that efficiently improve and coordinate the monitoring of maximum residue levels for in produce sold to export markets.

Generally, compliance reduced in all areas except Buuri which had a 1.1% increase in compliance. Although Kirinyaga had the highest drop in compliance (12.7%; as compliance

[12] Technical assistants provide the smallholder horticultural farmers with technical support and hands on training required to produce output meeting the food safety standards.

dropped from 41.8% to 29.1%), it was the only area that exhibited an increase under individually fully compliant farmers unlike the other areas where this compliance mechanism was abandoned (Table 3). A further breakdown of dynamics under compliance showed that Kirinyaga was the only area that had a positive shift (5.9%) under the category of individually fully compliant farmers (Table 4). Buuri which had all individually compliant farmers abandon this form of compliance mechanism had the highest addition under the categories of group contract compliance (13.3%) and group scheme compliance (12.2%). Mbooni had the highest proportion of farmers maintaining group scheme compliance and farmers who exited compliance (Table 4).

Table 4: Dynamics of compliance

Compliance dynamics	Percent of respondents in each study area		
	Buuri	Mbooni	Kirinyaga
Maintained Individual Compliance			4.1
Shifted to Individual Compliance			5.9
Maintained Group Contract Compliance	10.2		4.1
Shifted to Group Contract Compliance	13.3	3.1	4.7
Maintained Group Scheme Compliance	2.0	7.9	3.6
Shifted to Group Scheme Compliance	12.2	10.2	6.5
Maintained Exitor			3.6
Shifted to be an Exitor	9.2	15.0	4.7
Maintained Non-Compliance	9.2	2.4	7.7
Shifted to Non-Compliance		7.9	7.1
Maintained Non Grower	20.4	37.0	27.8
Abandoned Export Crop Farming	23.5	16.5	20.1
	100.0	100.0	100.0

Note: ósiftô in this context refers to new entrants into a specific mode compliance while ómaintainô refers to farmers who did not change their mode of compliance

Source: Author's computation from survey data

Overall, there were considerable shifts within the different compliance mechanisms in the full sample. The most notable were towards group scheme option and exitor schemes. As mentioned

earlier, external support is necessary to farmers to ensure they are able to adopt GlobalGAP compliance but are also able to supply less stringent markets with their produce incase compliance still proves unattainable.

4.2 Socio-economic and demographic characteristics of the household heads

The mean and standard deviations of selected household demographic and socio-economic characteristics are presented in Table 5. The results were provided mainly for farmers who were GlobalGAP compliant and non-compliant during the follow up survey period. The table also presents the tests for difference in means of the respective variables between the different compliance arrangements using t-values. The t tests for the difference were insignificant for most of the variables. This implies that compliant and non-compliant farmers more or less resemble in all aspects. The resemblance reflects a point highlighted earlier that both the interviewed compliant and non-compliant farmers were similar in all aspects, hence justification for using the difference-in-differences model. Application of the difference-in-differences method required that comparability between the treatment and non-treated groups was ensured. This resolved the problem of selection bias. Failure to ensure comparability would have implied that the indicators between the treated and non-treatment groups would be invalid. The selected variables for comparison of compliant and non-compliant farmers are discussed hereafter.

The GlobalGAP compliant farmers were appeared on average to be younger in all the study areas, except Kirinyaga. However t test revealed that there was no significant difference in the age of the farmers within the two compliant categories in all the study areas. The mean age of the household heads ranged between 47.78 and 52.32, which implied that most the household heads

were still within the active working age category in Kenya i.e. between 15 and 64 years (KIPPRA, 2013).

Household headship was male dominated in all the three study areas and across all compliance categories. The t-test revealed that the difference in gender of the household head was only significant in Mbooni district. A greater part of the female headed households were non-growers and those who participated in export vegetable farming preferred not to comply with food safety standards. This can be explained contextually based on an observation during data collection that most female-headed households preferred to engage in labor provision on other farms and grew other crops on their farms. Furthermore, those who were non-compliant diverted their products towards less stringent markets.

Table 5: Comparative summary statistics of selected variables by compliance status

		Buuri			**Mbooni**			**Kirinyaga**		
Variable	Description	Comp	Non Comp	Diff	Comp	Non Comp	diff	Comp	Non Comp	diff
		Mean	Mean		Mean	Mean		Mean	Mean	
Age	Mean head age (years)	47.78 (13.01)	49.25 (11.91)	-1.47	51.08 (14.84)	52.32 (17.08)	-1.24	49.11 (12.17)	47.55 (14.39)	1.55
Mean years in education	Schooling years	8.3 (4.06)	7.64 (3.71)	0.66	8.31 (3.89)	6.75 (4.93)	1.56	9.3 (3.43)	7.05 (3.45)	**2.24*****
Female Head	Gender (1=Female)	0.18 (0.39)	0.14 (0.36)	0.04	0.13 (0.34)	0.32 (0.48)	**-0.19****	0.08 (0.28)	0.16 (0.37)	-0.07
Household Size	Household size in adult equivalent	4.42 (1.7)	4.68 (1.85)	-0.26	5.6 (2.14)	5.07 (2.19)	0.52	4.04 (1.39)	4.26 (1.37)	-0.23
Dependency Ratio	Dependency Ratio	0.68 (0.58)	0.79 (0.9)	-0.1	1.04 (0.83)	0.91 (0.82)	0.14	0.52 (0.49)	0.68 (0.42)	**-0.16***
Social Capital	Member in marketing /farming group (1=Yes)	0.86 (0.35)	0.82 (0.39)	0.04	0.88 (0.32)	0.71 (0.46)	**0.17***	0.94 (0.24)	0.84 (0.37)	**0.10***
Farming Main	Main activity farming(1=Yes	0.78 (0.42)	0.68 (0.48)	0.1	0.6 (0.5)	0.57 (0.5)	0.02	0.62 (0.49)	0.74 (0.45)	-0.12
Income	Household monthly income (Kshs)	23574.51 (36483.19)	12740.2 (9010.56)	10834.3	10831.72 (6902.68)	13655.18 (16951.17)	-2823.45	12904.07 (11265.22)	11736.54 (15562.81)	1167.53

Note: ***, **and * implies significant at 1%, 5% and * 10% respectively

Figures in parenthesis represent standard deviation

Source: Author's computation from survey data

The dependency ratio of GlobalGAP compliant households in Kirinyaga was lower and significant (PÒ0.10) from that of non-compliant households. This implied that the ratio of non-working members to those working was lower in GlobalGAP compliant households. As a consequence labor availability in compliant households was higher.

More than half of the respondents had received education of primary level and below, with Mbooni having the highest of 62.2% (Table 6). In line with previous studies (Muriithi, 2011 and Nyota *et al.,* 2012), the results showed that across all the study areas, compliant farmers had on average received education for more years than the non-compliant farmers (Table 5). Using t-tests statistics, this difference was only significant (PÒ0.01) in Kirinyaga. This could be explained by the fact that while Kirinyaga not only had the highest proportion of household heads with education beyond the basic primary education, it also had the highest proportion of individually fully compliant farmers in the same category (Table 6). All the individually compliant farmers had received some form of formal education, with the most educated having pursued post-graduate studies and the least educated having at least 6 years of primary education. The low education level of the non-compliant farmers suggest that they might have been unable to fully understand the various aspects involved in GlobalGAP compliance and the requirements involved in the initial start up and maintenance of the standards (Table 6). Thus, in addition to providing financial support for compliance, it may also be necessary to educate farmers on the minimum skills and requirements needed to achieve compliance. Farmers may also need to be provided with a range of solutions and approaches for achieving compliance. Alternatively, the farmers may need to pursue alternative markets or engage in production of crops with less stringent obligations.

Table 6: Education levels of the household head by compliance categories

District	Buuri N=98		Mbooni N=127		Kirinyaga N=169	
	Primary and below	Secondary and above	Primary and below	Secondary and above	Primary and below	Secondary and above
Individually fully compliant	-	-	-	-	41.2	58.8
Group contract farmer	47.8	52.2	-	100.0	60.0	40.0
Group scheme farmer	64.3	35.7	60.9	39.1	41.2	58.8
Exitors	55.6	44.4	68.4	31.6	50.0	50.0
Non compliant	77.8	22.2	30.8	69.2	76.0	24.0
Non-grower	62.8	37.2	70.6	29.4	63.0	37.0
Overall	60.2	39.8	62.2	37.8	59.2	40.8

Source: Author's computation from survey data

At least each of the households had a source of income. Majority of the households had a primary occupation i.e. the activity in which they dedicated most of their time to was farming. On making comparisons across the various categories, the trend remained similar as farming was still the main occupation of the households across all the compliance modes and export growing categories in the study areas (Figure 5). While most of the farmers under the different export growing and compliance arrangements still preferred farming as their primary occupation, none of the individually fully compliant farmers from both Buuri and Mbooni were in this category (Figure 5). This implied that individually compliant farmers in Buuri and Mbooni preferred off-farm activities (e.g. wages, salaries and business activities) as their primary occupation. Based on the earlier discussion on age (Table 5) and education (Table 7), these individually compliant farmers were relatively younger and more educated and hence their chances of formal employment were higher. The same was observed in Kirinyaga under the category of group contract farmers and in Mbooni under non-compliant farmers where 53.3% and 61.5% respectively of the farmers relied on off-farm activities as their main occupation. Fewer

GlobalGAP compliant farmers under group mechanism in Kirinyaga took up farming as their main activity in comparison to the other study areas (Figure 5).

The average income for GlobalGAP compliant farmers was generally higher across all survey areas except Mbooni (Table 5). Most of the compliant farmers in Mbooni were under group scheme option whereby the exporter owned facilities, kept record and controlled production. Such farmers were therefore limited in terms of the quantity of produce. Furthermore, most of the groups did not have solid contracts with the exporters. As such, there were scenarios where either the produce was not collected or farmers received prices much lower than from the contract farmers. Individual and group contract farmers on the other hand were able to sell to brokers or ñbrief caseò exporters who offered better prices and hence higher income for these complaint farmers. This was in line with Humphrey (2008) who found that while smallholder horticultural farmers invest in time, labor and money during production, they are frequently prone to disappointments by their buyers who frequently breach their verbal contracts at the expense of the farmers. There is need to include mechanisms that create solid and enforceable contracts that are coupled with legal sanctions in cases of the breach of contract.

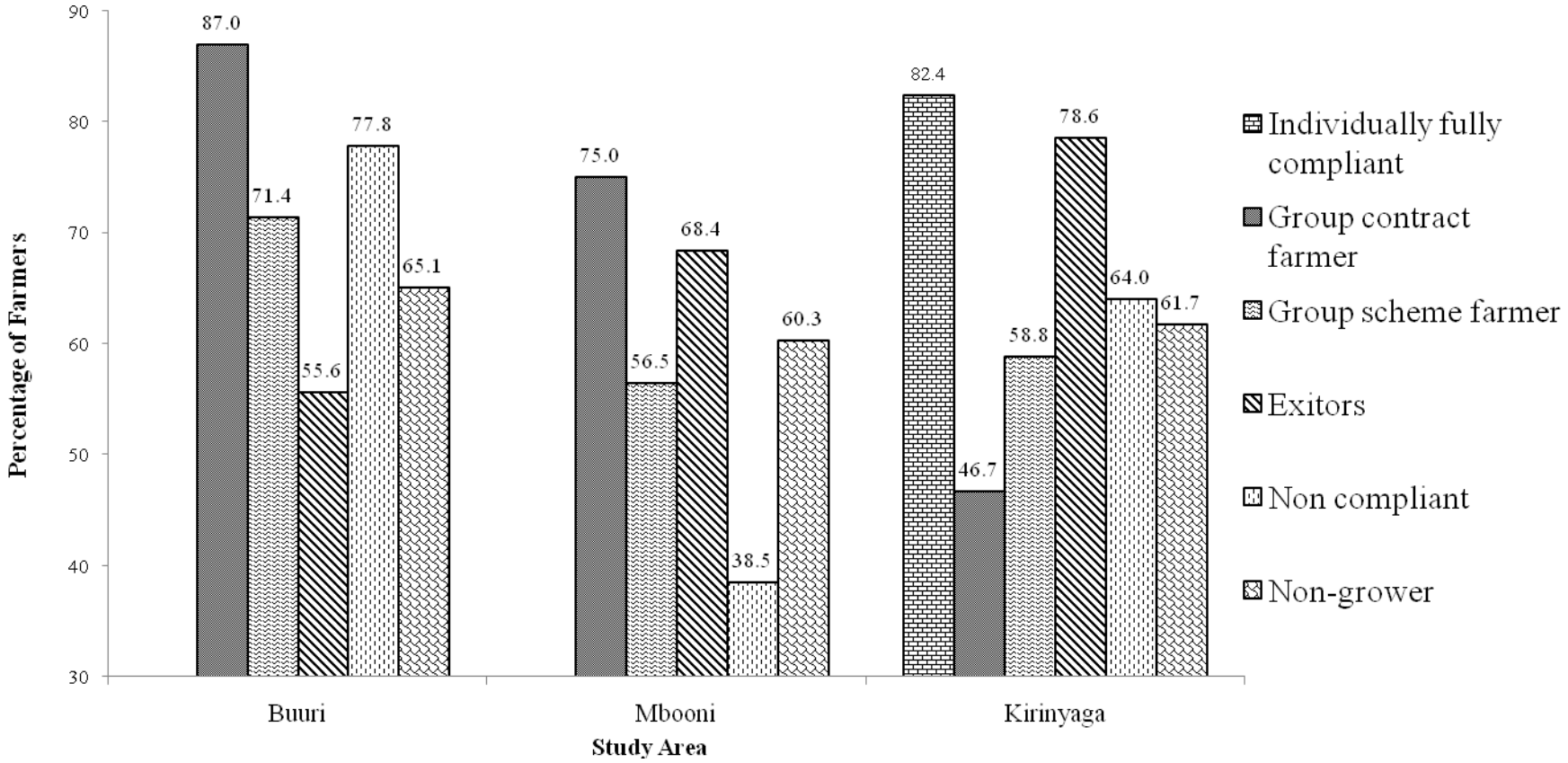


Figure 5: Distribution of proportion of farmers whose primary occupation was farming by compliance status

Source: Author's computation from survey data

Results on social capital as proxied by membership in marketing and/or financial savings and credit institutions showed that social capital was higher among GlobalGAP compliant farmers than for noncompliant farmers (Table 5). The t-test for difference in means showed the difference was statistically significant in Mbooni (PÒ0.01) and Kirinyaga (PÒ0.01). As in previous studies (Hatanaka *et al.,* 2005, Okello, 2007 and Nyota *et al.,* 2012), GlobalGAP compliance requires high investment costs (e.g. construction of grading sheds and cooling facilities, latrines etc) and recurrent costs (e.g. purchase of costly pesticides, fertilizers, safety clothes) to the horticultural farmers. Group compliance being the most common form of compliance presents an opportunity for the farmers to participate since they can share compliance costs. Muriithi (2011) also showed that group membership may be necessary for compliance of farmers to food safety standards. In the current study, compliant farmers obtained knowledge on market opportunities at faster rates through interpersonal links than through the normal systematic channels using exporters. Hence, in addition to encouraging farmers to form and/or participate in groups, it is necessary to devise methods of supporting these groups by ensuring that reliable marketing information is disseminated to the farmers.

4.3 Descriptive statistics on poverty status of horticultural farmers across different compliance arrangements:

4.3.1 Comparison of poverty indicators across the study areas

Principal component analysis (PCA) was used to identify underlying variables that explained the pattern of correlations within each of the set of observed variables. PCA analysis was run individually in each of the three study areas and both time periods. Highly correlated variables for each of the study areas were identified from the correlation matrices and then tested for factorability. A total of 21 indicators of poverty under different types of assets were used in all

study areas (Table 7). Household size was selected under all periods in all study areas except during the baseline in Kirinyaga and Mbooni. Age was only selected in Buuri during the follow-up and in Kirinyaga during the baseline. Education level of the household head was selected in all the study areas during both periods except in Buuri during the baseline. The indicator, ónumber of family who are wage laborersô was only selected in Buuri and Mbooni in both periods.

Table 7: Poverty indicators for computation of poverty index

Poverty indicator at household level		**Significant indicators in each study area**					
		Buuri		Mbooni		Kirinyaga	
Human capital		2009	2012	2009	2012	2009	2012
1	Household size	x	x		x		x
2	Age		x			x	
3	Education level of the household head		x	x	x	x	x
4	Number family labor who are wage laborers,	x	x	x	x		
5	Percentage of household members who have attained basic formal education						
Social capital							
1	Marketing group	x		x	x	x	x
2	Number of groups household is involved in	x	x	x	x		x
Natural capital							
1	Total farm size	x	x	x	x	x	
2	Productive land acreage	x	x	x	x	x	
Financial capital							
1	Income category	x	x	x	x	x	x
2	Credit access	x	x	x	x	x	x
3	Total livestock units	x	x	x	x	x	x
Physical capital							
1	Total household assets	x	x	x	x	x	
2	Type of road to access main market		x	x		x	x
3	Distance to most important town/ urban center		x	x			x
4	Distance from farm to the nearest health centre (Kms)				x	x	x
Dwelling							
1	Roof made of permanent material						
2	Walls made of permanent material						
3	Quality of flooring material		x		x		x
4	Ownership status of house						
Miscellaneous indicators							
1	Average daily per person calorie intake	x		x	x	x	
Total Number of Indicators		11	14	13	14	12	11

Source: Author's computation from survey data, 2012

Education level of the household seemed to be important across all study areas. The variable number of family labor who were wage laborers were selected in Buuri and Mbooni study areas during both time periods. Household size was only selected as an important indicator in all the study areas during the follow-up period. All the indicators representing social capital were selected across all the study areas during both periods. The two indicators selected to represent natural capital were total farm size and productive land size.

Both indicators were selected in all study areas during baseline and follow-up while none was selected in Kirinyaga during the follow up. Each study area selected all 3 financial capital indicators. Physical capital indicators were distributed across all three study areas. The variable of distance from farm to the nearest health centre was however not selected in Buuri in either of the study periods. Only quality of flooring material was selected as a dwelling indicator. Per capita daily calorie was only selected in both baseline and follow up period in Mbooni. It is important to note that the indicators picked by PCA varied as the since their correlations with the benchmark poverty indicator (expenditure) changed. Indicators with low correlations were eliminated from computation of the poverty index.

From the results in Table 8, Bartlett's Test of Sphericity (BTS) was highly significant across all three study areas. This implied that variables were correlated and the correlation matrix of the variables was not an identity matrix, hence PCA could be undertaken. All the Kaiser-Meyer-Olkin (KMO) measures indicated a ñmiddlingò sampling adequacy, i.e. the samples were all

suited for PCA. Since the variables were not standardized, the correlation matrix was used as an input to PCA to extract the factors[13].

As a step in the computation of a poverty index, factor score coefficients, also call component scores were estimated using regression method. Factor scores were the scores of each household on each factor. To compute the factor scores for each household, the householdôs standardized score on each variable was multiplied by the corresponding factor loading of the variable for the given factor, and summed up these products. This calculation was carried out using SPSS procedure and factor scores were saved as variables in subsequent calculations involving factor scores (Field, 2009). Principal component analysis produced an index score of relative poverty for each household. To use the poverty index to make comparisons for assessing poverty status of the farmers, the households were divided into terciles based on their index score. The top third was grouped in the ñlow povertyò group, the middle third in the ñmedium povertyò group and the bottom third in the ñhigh povertyò group.

Table 8: PCA test scores

KMO and Bartlett's Test							
		Buuri		Mbooni		Kirinyaga	
		Baseline	Follow-up	Baseline	Follow-up	Baseline	Follow-up
KMO Measure		0.594	0.659	0.609	0.610	0.626	0.686
Bartlett's Test of Sphericity	Chi-Square	461.702	287.885	726.559	670.472	506.621	144.346
	df	45.000	78.000	66.000	66.000	55.000	45.000
	Sig.	0.000	0.000	0.000	0.000	0.000	0.000

Source: Author's computation from survey data, 2012

[13] PCA gives the option of either using a covariance or correlation matrix. Since PCA is sensitive to differences in the units of measurements of variables, the variables should be standardized before applying PCA. However since the correlation matrix is the standardized version of the covariance matrix, a correlation matrix should be used if the standardization was not done.

4.3.2 Profile of poverty status across the study areas

Generally, producers of export crops dominated the categories of low and medium poverty levels cumulatively i.e. 67.3%, 76.3% and 73.8% in Buuri, Mbooni and Kirinyaga, respectively (Figure 6). The same was true under non-growers though at a lesser proportion i.e. 67.4%, 58.8% and 59.3% in Buuri, Mbooni and Kirinyaga, respectively. Comparison between growers and non-growers of export crops showed that medium poverty was highest among the producers of export crops in all the study areas, with Mbooni recording the highest percentage of 39% under producers of horticultural crops (Figure 6).

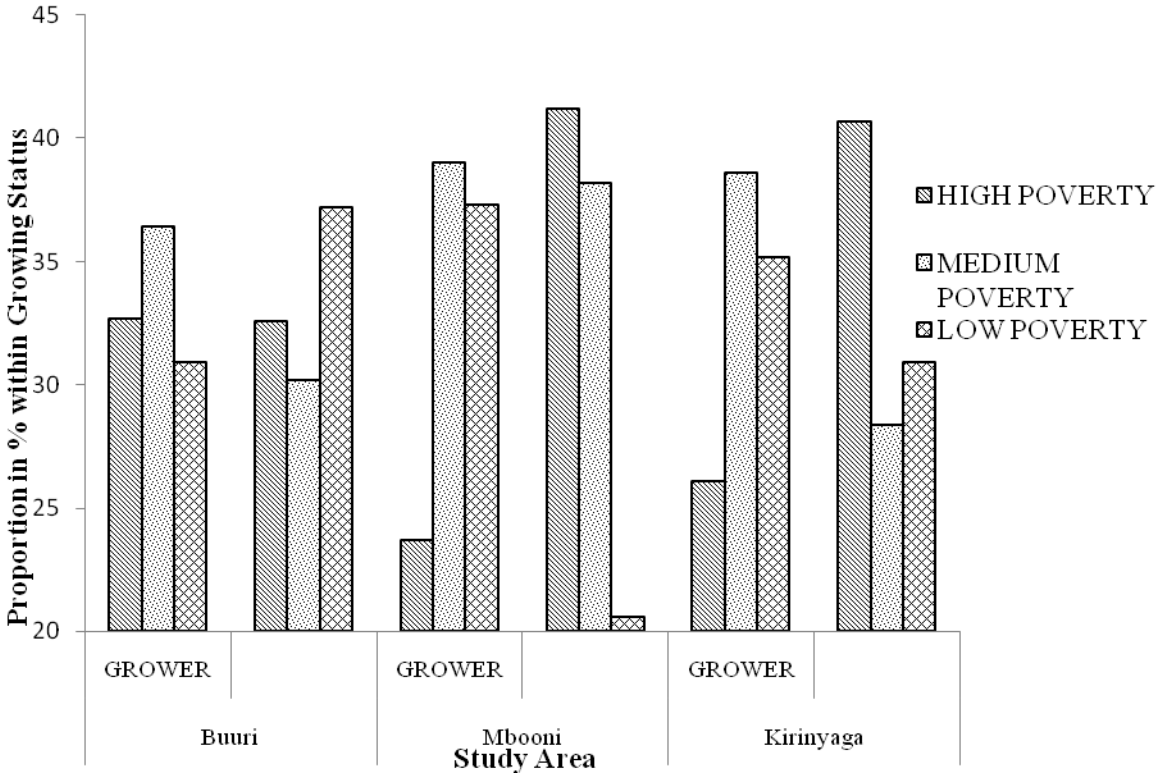


Figure 6: Poverty comparisions between growers and non-growers across studyareas
Source: Author's computation from survey data, 2012

Comparison across poverty categories showed that non-growers ranked the highest under the category of high poverty in all the study areas except in Buuri where this was almost similar to the producers of export crops. Horticultural farmers in Mbooni and Kirinyaga also had the

highest percentage under the category of low poverty in comparison to non-growers. Despite the differences in proportion across the study areas and the poverty levels, the z- test (used to determine whether the hypothesized population proportion differs significantly from the observed sample) revealed that the poverty profile between growers of export vegetables and farmers who did not grow export vegetables were not significantly different from each other at the 5% level of significance. This implied that the poverty levels in all the study areas were not statistically different with respect to growers of export vegetables and farmers who did not grow export vegetables.

4.3.3 Poverty status of horticultural farmers across compliance arrrangements

This sub-section tests the hypothesis that ñPoverty status of smallholder horticultural farmers was equal across all compliance arrangementsò. The descriptive statistics associated with the poverty indices across the three main compliance arrangements are presented in Table 9. The table compares poverty indices of the follow-up compliant farmers to their baseline poverty indices. As mentioned earlier (Table 3), during the follow-up there were no individually fully compliant farmers in Buuri and Mbooni hence comparison was only made between the two group compliance arrangements. In order to test the hypothesis that the poverty indices were equal across all compliance arrangements, a one-way analysis of variance (ANOVA) test was conducted on the GlobalGAP compliant farmers for both the baseline and follow-up periods. Prior to the ANOVA, the assumption of homogeneity of variances was tested and satisfied based on Leveneôs F test in all the study areas. Paired t-tests were also conducted to determine whether the means were the same between the two study periods across the different compliance arrangements.

Comparison of the poverty indices of these farmers during baseline and follow up periods showed that on average, there was an increase in poverty levels in all the study areas except Kirinyaga, which had a significant (PÒ0.10) reduction (Table 9). Group contract farmers in Buuri had lower poverty on average than group scheme in both periods. The one-way ANOVA test also revealed that the differences in means were also not significant across the different compliance arrangements in both years.

Table 9: Summary statistics of poverty indices within GlobalGAP compliant farmers

		BUURI			MBOONI			KIRINYAGA		
		Follow up (F)	Baseline (B)	Diff (F - B)	Follow up (F)	Baseline (B)	Diff (F - B)	Follow up (F)	Baseline (B)	Diff (F - B)
Individually fully compliant farmer		-	-	-	-	-		-0.304 (0.749)	0.285 (0.71193)	**-0.589*** (0.740)**
Group contract farmer		-0.105 (1.165)	-0.417 (1.798)	0.313 (1.281)	-0.154 (0.190)	0.610 (0.459)	**-0.764** (0.404)**	-0.033 (0.632)	-0.250 (0.818)	0.217 (1.172)
Group scheme farmer		0.056 (1.033)	-0.013 (0.599)	0.069 (1.256)	-0.041 (0.913)	-0.176 (1.112	0.136 (1.228)	-0.424 (0.946)	-0.067 (0.716)	-0.357 (1.231)
Total		-0.044 (1.105)	-0.2643 (1.464)	0.221 (1.260)	-0.057 (0.843)	-.060 (1.075)	0.002 (1.184)	-0.263 (0.793)	-0.001 (0.765)	**-0.262* (1.096)**
One way ANOVA	F statistic	0.180	0.657	0.319	0.059	1.888	2.047	1.002	2.141	2.379
	Prob > F	0.674	0.423	0.576	0.810	0.182	0.165	0.375	0.129	0.104
	Levene Statistic (Sig)	0.069 (0.795)	0.549 (0.464)	0.141 (0.709)	2.284 (0.143)	1.113 (0.302)	1.245 (0.275)	0.888 (0.419)	0.323 (0.725)	1.436 (0.248)

Note: ***, **and * implies significant at 1%, 5% and * 10% respectively
Figures in parenthesis represent standard deviation

Source: Author's computation from survey data

Mbooni had mixed trends when comparison was made on baseline versus follow up periods. Group contract farmers had the lowest poverty on average during the follow up period while during the baseline study it was the group scheme farmers who had lower poverty on average. Paired t-test revealed that the poverty levels of the group contract farmers showed a significant (PÒ0.05) reduction during the follow-up. It was only in Mbooni where poverty of group contract farmers reduced in the follow up (Table 9). However, as in Buuri the one-way ANOVA also revealed that the differences in means were also not significant across the different compliance arrangements in both years.

The group scheme farmers had the lowest poverty on average in Kirinyaga in the follow up, followed by individually fully compliant farmers and group contract farmers respectively (Table 9). In contrast, during the baseline study it was the group contract farmers who had the lowest levels of poverty on average. Paired t-test showed that the reduction of poverty among individually fully complaint farmers was significant (PÒ0.01) in Kirinyaga. However, just like the other study areas, the one-way ANOVA revealed the differences in means were not significant across the different compliance arrangements in both years.

The insignificant differences in results from ANOVA meant the null hypothesis was not rejected and thus the conclusion made that the poverty status of smallholder horticultural farmers in the study areas were equal across all types of compliance arrangements. This was true for both baseline and follow up periods.

Overall, more than a third of the compliant farmers were in the category of low poverty. For example, 48.6% of the farmers were under the low poverty category in Kirinyaga (Table 10). Both group and scheme farmers fell under the proportion of low poverty in Buuri though

comparisons under group scheme had a higher proportion under high poverty. The situation reversed in Mbooni whereby the group contract farmers ranked highest under high poverty. This is the only study area where group scheme farmers had the least proportion under high poverty status (Table 10). However, similar to Buuri, the group scheme farmers had the highest proportion under low poverty status. Majority of the individually fully compliant farmers fell under the high poverty category and had the least proportion under low poverty in Kirinyaga. Similar to Buuri, the group contract farmers had the lowest proportion under high poverty category (Table 10). Despite the differences in proportions in all the categories in the study areas, z-test showed that the column proportions did not differ significantly from each other. This implied that the categories were not statistically different with respect to the poverty profiles.

Table 10: Distribution of poverty status under different compliance arrangements

Study area	Compliance Arrangement	POVERTY PROFILE		
		HIGH POVERTY	MEDIUM POVERTY	LOW POVERTY
Buuri	Group Contract Farmer	21.7	30.4	47.8
	Group Scheme Farmer	42.9	7.1	50.0
	Overall	29.7	21.6	48.6
Mbooni	Group Contract Farmer	60.0	20.0	20.0
	Group Scheme Farmer	31.8	31.8	36.4
	Overall	37.0	29.6	33.3
Kirinyaga	Individually Fully Compliant	38.9	33.3	27.8
	Group Contract Farmer	13.3	46.7	40.0
	Group Scheme Farmer	31.3	25.0	43.8
	Overall	28.6	34.7	36.7

Table figures are in percentages
Source: Author's computation from survey data, 2012

4.4 Econometric analysis of impact of GlobalGAP on poverty status of smallholder farmers

This sub-section tests the hypothesis that ñGlobalGAP compliance had no impact on poverty status of smallholder farmers.ò The study used STATA software for the econometric analysis of the data. Before running the econometric model, diagnostic tests for multicollinearity and heteroskedasticity were run (Appendices 2 and 3). Tests for multicollinearity were done using correlation matrix and the variance inflation factor (VIF) technique. VIF was used to quantify the severity of multicollinearity in order to measure how much of the variance of the estimated regression coefficient increased due to collinearity. A common rule of thumb (Gujarati, 2007) is that if VIF ($?_i$) is greater than 10 then multicollinearity is high. As shown in Appendix 2D, the choice of variables included in the final model was also based on the VIF which were not showing high multicollinearity. Some variables hypothesized to be in the model were dropped due to multicollinearity. For example loss of compliance during the study period was dropped in the regression in all the study areas. The Breusch-Pagan test designed to detect any linear form of heteroskedasticity, which is inbuilt in STATA was used. Heteroskedasticity was only noted in Mbooni area; hence data was corrected using robust standard errors (Gujarati, 2007).

The difference-in-differences model was used to determine the impact of GlobalGAP compliance on the poverty status of smallholder horticultural farmers. The double differences model also included differenced variables of socioeconomic, farm-specific and institutional factors that determine poverty status of horticultural farmers. In applying the difference-in-differences model, Tobit regression censoring at the minimum was used. The dependent variable on difference in poverty status was censored at minimum since it allowed for an unknown and

non-zero threshold in order to produce better out-of-sample forecasting performance than the standard Tobit model; which overestimates the effect of the proxy variables (Appendix 4).

The model was appropriately specified for all the study areas with an overall chi-square of 4.19, 3.07 and 8.97 for Buuri, Mbooni and Kirinyaga respectively. The chi-square values were all significant (PÒ0.01 which indicated that the variables included in the double differences model best specified the functional relationship in the model. The results of this procedure also provided the factors affecting the poverty status of smallholder horticultural farmers.

The variable representing whether a household had any interaction with GlobalGAP compliance had a positive and significant (PÒ0.10) relationship with poverty in Buuri (Table 11). This result in Buuri implied that having any interaction with GlobalGAP compliance increased poverty compared to farmers who never complied. This can be explained from observations made in the field which revealed that the main compliance scheme in Buuri was group contract farming. The disadvantage of this scheme was that most of the groups had verbal contracts with the exporting companies. As a result situations arose whereby the exporting companies dishonored the ócontractsô by either paying less or returning a substantial amount of rejects.

Table 11: Difference-in-differences estimates on poverty status

	BUURI		MBOONI		KIRINYAGA	
Dependent variable: POV_CEN						
Variables	**Coef.**	**P>t**	**Coef.**	**P>t**	**Coef.**	**P>t**
_Constant	-4.795	**0.004*****	-5.741	**0.003*****	-5.676	**0.000*****
Compliance	0.678	**0.055***	-0.140	0.678	0.213	0.517
Continuos_Comp	-1.120	**0.018****	-0.843	**0.055***	-0.638	0.115
Gain_Comp	-1.124	**0.015****	0.383	0.269	-0.463	0.232
Extension_F	-0.653	**0.075***	-0.720	**0.021****	-0.705	**0.040****
Social_Cap	-0.495	0.229	0.065	0.844	0.780	0.158
Disturbn_Diff	-0.031	0.144	0.004	0.519	-0.003	0.947
All_Weather_Road	-0.798	0.267	-0.195	0.581	-0.019	0.955
Ln_Asset_Diff	0.484	**0.000*****	0.231	**0.020****	0.280	**0.014****
Livestock_Diff	0.083	**0.018****	0.147	0.102	0.013	0.845
Ln_Income_Diff	-0.100	0.405	0.364	**0.025****	0.250	**0.020****
Hhsize_Diff	0.827	**0.000*****	0.128	0.143	-0.094	0.310
Maxed_Diff	-0.144	**0.020****	0.022	0.774	0.123	**0.020****
Depratio_Diff	0.387	0.159	-0.242	0.173	0.726	**0.027****
Fgender_F	0.276	0.602	-0.181	0.706	-0.087	0.848
Propland_Diff	0.645	0.204	-0.795	0.220	-0.460	0.390
Farming_Main_F	-0.495	**0.089***	0.316	0.262	-0.639	**0.006*****
LR chi2	55.330		30.370		44.560	
Prob.> chi2	0.000		0.016		0.000	
Pseudo R2	0.640		0.292		0.266	
Log-likelihood	-15.577		-36.870		-61.356	

Note: ***, **and * implies significant at 1%, 5% and * 10% respectively

Source: Author's computation from survey data

When the impact of compliance among the horticultural farmers varied according to timing of compliance during the study period, some differences emerged. Continuous GlobalGAP compliance had a negative influence on poverty severity in Buuri (PÒ0.05) and Mbooni (PÒ0.10). These results showed that continuously complying with GlobalGAP had the effect of reducing poverty status by 1.120 times and 0.843 times in Buuri and Mbooni, respectively (Table 11). These findings were similar to a previous study by Asfaw (2009c) who found that sustaining compliance enabled farmers reach a payoff period whereby compliance began to be advantageous to the farmers. The current study highlighted the importance of sustaining compliance to food safety standards in order to enable farmers recover their investment costs, accrue compliance benefits and improve livelihoods.

Short-term impacts of gaining compliance during the study period showed that gaining compliance had a negative and significant (PÒ0.05) relationship with poverty in Buuri. The negative relationship in Buuri suggested that adopting GlobalGAP standards during any time within the study period had the effect of reducing the severity of poverty in a household 1.124 times while holding all other factors constant (Table 11). This was attributed to commercialization of vegetables towards less demanding regional markets. The incomes from the less demanding markets could be low but were more stable hence providing opportunities to improve livelihoods and reduce poverty.

The joint hypothesis was used to test null hypothesis that none of the hypothesized variables on relative impact of GlobalGAP compliance had explanatory power on the poverty status of the household i.e. all slope coefficients were simultaneously equal to zero. At PÒ0.01, the null hypothesis was rejected in Buuri and Mbooni, hence the conclusion was that not all coefficients relating to GlobalGAP compliance were simultaneously equal to zero. This meant that they

mattered in explaining the variations in the poverty status of a household. However, in the other study areas, the null hypothesis was not rejected hence the conclusion that none mattered in explaining the variations on poverty status of households in Kirinyaga or Buuri.

Extension had a negative and significant with poverty severity in all the study areas; Buuri (PÒ0.10), Mbooni (PÒ0.05) and Kirinyaga (PÒ0.05). This implied that receiving a visit from an extension officer had the effect of reducing the severity of poverty in a household 0.653, 0.720 and 0.705 times in Buuri, Mbooni and Kirinyaga respectively, compared to households that had not received any extension visit. These findings were in line with Hasan *et al.,* (2013) who found that access to extension services provided greater access to information concerning poverty reduction strategies through improved agricultural technologies that lead to reduced poverty.

Against a prior expectation, there was a positive and significant relationship between the value of household assets owned and the severity of poverty in all the study areas; Buuri (PÒ0.01), Mbooni (PÒ0.05) and Kirinyaga (PÒ0.01).This implied that an additional high valued asset in a household had the effect of increasing the severity of poverty 0.484, 0.231 and 0.280 times in Buuri , Mbooni and Kirinyaga respectively, holding all other factors constant. In the current study, most households in all the study areas had depreciating assets as their highest valued assets and as such showing that there is need to invest in productive assets that could be sold in periods of temporary financial distress hence reduce the severity of poverty.

The results showed a positive and significant (PÒ0.05) relationship between the differences in livestock units reared in a household and the severity of poverty in Buuri. An additional unit of livestock increased a householdôs poverty by 0.083 times, holding all other factors constant. This was against the hypothesized effect. Buuri is predominantly an agricultural export crop farming

primarily due to its agro-ecological characteristics. Due to this, households that take the initiative to rear livestock predispose themselves to poverty since livestock is not viable in the area and this could have a negative impact on poverty reduction.

Against the hypothesized sign, the income variable had a positive and significant relationship with poverty in Mbooni (PÒ0.05) and Kirinyaga (PÒ0.05). An additional unit of income increased the severity of poverty by 0.364 times and 0.250 times in Mbooni and Kirinyaga respectively, holding all other factor constant. The current study showed that increase income was not sufficient to contribute to poverty reduction. The increases in incomes were insufficient to allow the households to set aside money for investments (capital formation) that could reduce their poverty status.

Household size had a positive and significant relationship with the severity of poverty in Buuri (PÒ0.01). This implies that an additional household member increased the severity of poverty by 0.827 times (Table 11). These findings were in line with previous studies on poverty (Swanepoel, 2005; Damisa *et al.,* 2011; Muriithi, 2011) where large family size with more dependants increased the severity of poverty since it decreased per capita expenditure. The increase in poverty was significant when an additional household member was a dependant who did not contribute to any income or labor provision to the household.

The results of the variable maximum education in the household had a negative and significant relationship with poverty severity in Buuri (PÒ0.05) as shown in Table 11.This result shows that increasing the level of education within the household by a year reduced the severity of poverty 0.144 times holding all other factors constant. This implied that household became less vulnerable to poverty by having a member with increasing educational level. With an increase in

educational attainment, a member in the household could secure a job and take opportunities which would otherwise not be possible and be better poised to cope with risk and uncertainty and therefore less vulnerable to poverty. However, for the same variable, Kirinyaga had a positive and significant (PÒ0.05) relationship with the severity of poverty. Holding all other factors constant, an additional year of education of any household member increased the severity of poverty 0.123 times. Households in Kirinyaga are mainly dependent on farming as their main source of livelihood and as such the priority is to invest in it. The current study showed that diverting spending towards education strained household resources to the point that the householdôs poverty status higher.

Dependency ratio had a positive and significant (PÒ0.01) relationship with the severity of poverty in Kirinyaga. A unit increase in dependency ratio increased the severity of poverty by 0.726 times, holding all other factors constant (Table 11). This result implied that the poverty status of a household increased if the household had many members categorized as dependants. Higher dependants (non-working members) in a household presented a burden on the working members, who provided for them in the household.

The variable representing farming as the main occupation had a negative and significant relationship with the severity of poverty in Buuri (PÒ0.10) and Kirinyaga (PÒ0.01) as shown in Table 11. This result implied that households who partook in farming as the main occupation of the household head had the effect of reducing poverty than householdôs who concentrated on other forms of livelihoods, holding all other factors constant.. This may be attributed dedicating their time to diverse on-farm activities hence generating extra income. The farmers in Kirinyaga, for example, include other high income generating crops like tomatoes and rice, in addition to export vegetables. The findings support the emphasis of using agriculture to reduce poverty.

5. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

The main aim of the study was to evaluate the impact of GlobalGAP Compliance on the Poverty Status of Smallholder Horticultural Farmers in Eastern and Central Kenya. Specific objectives were to establish the poverty status of smallholder horticultural farmers under different compliance arrangements and to determine the effect of compliance on the poverty status of smallholder horticultural farmers in Eastern and Central Kenya. The difference-in-differences model was used to determine the effect of compliance on the poverty status of the farmers while descriptive statistics were used to establish the difference of poverty status of the smallholder horticultural farmers. The study found that in addition to inputs cost, water was a critical input deterring farmersô participation in horticultural export farming. Male headed households dominated the full sample and across all compliance categories and majority derived their livelihood from farming. As expected extension was found to be a factor reducing the severity of poverty among smallholder farmers. Majority of the farmers had received some form of basic formal primary education and were still within the active working age category. Mbooni had the only significant (PÒ0.05) poverty reduction among the group contract farmers while Kirinyaga had the only significant (PÒ0.01) poverty reduction under individually fully compliant farmers.

Similar to previous studies, the impact of GlobalGAP compliance on poverty status showed mixed results. Different negative and positive impacts were identified and these varied across the study areas relatively based on the time compliance was taken up by the farmer. The study considered differential impacts for horticultural farmers who gained, lost, always complied or had any interaction with GlobalGAP compliance relative to other farmers who had never had compliance.

The negative effect of compliance appeared to be mainly driven by households that both gained and always complied to GlobalGAP standards over the study period in Buuri. Continuous GlobalGAP compliance had a negative and significant effect on poverty status in Buuri (PÒ0.05) and Mbooni (PÒ0.10). The variable of assessing impact based on if the farmer had any interaction with GlobalGAP compliance had positive and significant relationship Buuri (PÒ0.10) implying that having any interaction with GlobalGAP compliance increased poverty compared to farmers who never complied.

5.2 Conclusions

Since there was no significant difference in the mean poverty status between GlobalGAP compliant farmers, this lead to failure of rejection of the null hypothesis put forth i.e. Poverty status of smallholder horticultural farmers is equal across all compliance arrangements. This was true for both baseline and follow up periods.

The joint hypothesis was used to test null hypothesis that none of the hypothesized variables on relative impact of GlobalGAP compliance had explanatory power on the poverty status of the household i.e. all slope coefficients were simultaneously equal to zero. At 1% level of significance, the null hypothesis was rejected in Mbooni and Buuri, hence the conclusion was made that not all slope coefficients relating to GlobalGAP compliance were simultaneously equal to zero, i.e. they mattered in explaining the variations in the poverty status of a household. However, Kirinyaga, the null hypothesis was not rejected at any of the significance hence the conclusion made that none mattered in explaining the variations on poverty status of households.

5.3 Recommendations

The study showed that GlobalGAP compliance reduced poverty status of a household when a smallholder horticultural farmer complied continuously. As such, the ultimate goal of stakeholders should be to find means that all farmers can not only achieve GlobalGAP compliance but also find mechanisms that facilitate its maintenance. Hence policies should be formulated that improve on consistent implementation, certification and maintenance of GlobalGAP compliance. However, in the efforts to encourage GlobalGAP compliance, it is important to consider choosing compliance arrangements suitable to the smallholders based on the area. For example, in Mbooni there is need to provide capacity building to enhance and organize increased compliance through group contract. This could be through improved social capital to enable farmers monitor themselves as individuals and collectives in their processes of producing safe, horticultural products and hence obtaining benefits for themselves e.g. ensuring market access, profit from sales and revenue from which they can reduce poverty status.

5.4 Suggestion for further studies

The current study focused on the direct impact of GlobalGAP compliance on household poverty status. However, considering that produce from GlobalGAP compliance is sold to different markets (local and international), there may be other indirect impacts. Future studies should as such also focus on spillover effects of GlobalGAP compliance interventions such as employment. Additionally, future studies should analyze the intra-household ownership and utilization of asset-based capital related to the different GlobalGAP compliance mechanisms to provide a better understanding on the relationship between GlobalGAP compliance and rural poverty.

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APPENDICES

APPENDIX 1: SURVEY QUESTIONNAIRE

UNIVERSITY OF NAIROBI
DEPARTMENT OF AGRICULTURAL ECONOMICS
QUESTIONNAIRE SURVEY FOR ASSESSING THE IMPACT OF GLOBALGAP ON THE POVERTY STATUS OF SMALLHOLDER FARMERS IN EASTERN AND CENTRAL KENYA

SURVEY IDENTIFICATION

1	Name of enumerator:			Enumerator code:	
2	Date of interview :		District:		
3	Division		Sub location		
4	Village		START TIME:		
5	Reference respondent from Baseline Survey				
6	Name of current respondent: (skip if respondent is the same)				
7	Position of respondent in household		Head [ ] Spouse [ ]		
8	Age of respondent		Sex of respondent	Male[ ] Female[ ]	
9	GPS Coordinates	Latitude:		Longitude:	

SECTION A- C : GENERAL INFORMATION ON FRENCH BEANS/SNOWPEAS/SNAP BEANS PRODUCTION

A1.1	Do you grow export vegetables?	1 [___] YES 2 [___] NO	(*If Yes, specify the MAIN export vegetable* [___] 1.French beans 2.Snow peas 3. Sugar snaps 4. Baby corns 5.Others(specify) _____
A1.2	If you don't grow export vegetables (No, in *question A1.1*) why? (codes) [___][___][___]	1 =No market 2 =High production costs 3 =low returns 4 =Small piece of land 5 =Not interested 6 =Other specify_____	
A1.3	If *No (question A1.1*) were you previously growing any export vegetable and then abandoned production?	1 [___] YES YEAR_____ 2 [___] NO	
A1.4	What were the reasons for abandonment? Rank with the most	[___]Many compliance requirements [___]Low productivity of the crop	

	important first	[___]Lack of buyers [___]High costs of required inputs [___]Low profitability (losses) [___]Large amounts of rejects by exporters [___]Lack/unavailability of required inputs [___]Other (specify) _____
A_1.5_i	During a normal last season, what is the size of plot used for your French bean production in acres?	_____
A_1.5_ii	State the quantity of French beans harvested during a normal production season?	_____KGS
A_1.5_iii	How do you rate the fertility of your French bean plot?	1. [__] Infertile 2. [__] Fertile 3. [__] Highly fertile
C 1.1	Are you aware of the GlobalGap/EUREPGAP requirements?	1 [___] YES 2 [___] NO
C 1.2a_i	Categorize the compliance status of the farmer (tick)	1 [___]Individually fully compliant farmer who is an out grower of exporters 2 [___]Group contract farmer (own facilities, production process and keep records) 3 [___]Group scheme farmer (exporter owns facilities, keeps records and controls production) 4 [___]Non-compliant who abandoned standards after adopting 5 [___]Non-compliant who has never adopted standards 6 [___]Does not grow French beans
C 1.2a_ii	If option 1, 2 or 3 in C1.2a_i, What are your 3 <u>main reasons</u> for choosing to produce under compliance status? Please rank [__] [__] [__]	1. [___] Assured market for my French beans 2. [___]Easier access to current information 3. [___]Higher prices 4. [___]Easier access to new pesticides 5. [___] Easier access to cash credit 6. [___] Easier access to quality seed 7. [___] Stable prices 8. [___}Other (Specify) _____
C 1.2a_iii	For how long have you been compliant?	_____
C 1.2a_iv	If option 4 in C1.2a_i, what were the reasons for abandoning compliance? Rank with the most important first [__] [__] [__]	1. [___]Many compliance requirements 2. [___]Low productivity of the crop 3. [___]Lack/unavailability of required inputs 4. [___]Large amounts of rejects by exporters 5. [___]Other (specify) _____
A2.1	Are you or a member of your household a member of French bean/snow peas producers' marketing group?	1 [___] YES / 2 [___] NO (If NO go to A2.9)
A2.4_i	Reasons why you became a member? Rank	1. To gain access to larger markets

	starting with the most important [__][__][__][__][__][__]	2. To avail of collective purchase of inputs 3. To learn better agricultural practices 4. For better price negotiations 5. To pool resources/product bulking 6. To gain access to credit 7. Requirement by exporter/donor 8. To avail of large scale transportation 9. Other(specify)_____

A2.4_ii	What services does the group offer to the members? Rank starting with most important [__][__][__]	1. Training 2. Record keeping and grading of produce 3. Buyer/supplier forums 4. Calenderised production programs 5. Collective savings plan 6. Certification 7. Collective collateral/credit 8. Farm demo plots/ Intergroup exchange visits 9. Input supply 10. Other(specify_____
A2.9	If No (*question A2.1*), Why haven't you joined a group? [__][__][__][__][__][__]	1=Never heard of one 2=Not interested 3=No change for those who are members 4=Membership too costly 5=Not sure of the benefits 6=Other (specify) [_____]

SECTION E: FINANCING AND ACCESS TO CREDIT

E1.1	Have you ever had credit for use in French beans /snow peas/ sugar snaps production?	1 [__]YES 2 [__]NO **(If NO go to E1.3)**
E1.3	If **No** (***question E.1.1***), why haven't you obtained credit? (**Rank codes**) [_] [_] [_] [_]	1 Not needing any loan 2 No collateral as required 3 Not a member of the (Microfinance institution (MFI) 4 High cost to obtain the loan/credit **5 Other (specify)_____**

SECTION F: EXTENSION

F 1.Provide the following information on extension access and suitability

All enterprises

Did you receive extension contact for **any** of the **farm crop** for the last one year? **1=Yes 2=No (I*f***	If yes, who was the provider? ***(Codes) RANK.***	What type of services were provided? ***(codes)***

***NO,** go to **G**)*		

Extension services provider		**Types of services provided**	
1 = Government	**5**= Input dealers	1=Product handling	5=Record keeping
2 = NGO/donor	**6=** Farmer group	2=Pest management	6=Field hygiene
3=exporter	**7=**Co-operative society	3=Soil and water use	7= others
4= Local traders	**8** = Other specify	4=chemical handling	(specify_____

SECTION J: FARMSIZE

J.1.1 Please provide the following information about the land used by the household in the last 12 months (also include rented land and fallow / grazing land in **acres**)

Total Acres (Owned + rented in)	Own land left fallow	Total agricultural cultivated land		Land given to other family members / Friends		Grazing land			Home stead land
		Own land	Rented-in	Rented out	Gift	Own	Rented-in	Obtained as gift	

If you rented out land, how much did you earn in the last 12 months? Kshs_____
If you rented in, how much did you pay in the last 12 months? Kshs_____
If you rented in your French bean production plot, how much did you pay in the last 12 months? Kshs_____

J.1.1_1	How did you acquire the land you currently use for farming?	1 [__]Purchased 2 [__] Inherited 3 [__] Government allocation	4 [__]Gift 5 [__] Leased 6 [__] Owned and Rented 7 [__] Borrowed
J.1.3	State the number of laborers in each category:	Family= _____ Permanent workers =._____ Casual workers=_____	
J.1.5	Do you keep livestock?	1 [__]YES 2 [__]NO	
J.1.6	If Yes (*question I 1.5)*, indicate the number kept.		

Type	Number owned and present at your farm	Type	Number owned and present at your farm
Cows		Goats	
Calves		Horses	
Bulls		Donkey	
Heifers		Rabbits	
Chicken		Bee hive	
Pigs		Fish	

	Sheep				

SECTION K : HOUSEHOLD DEMOGRAPHIC AND WEALTH INFORMATION

K.1.2	What is the primary occupation (***in terms of time spent on that activity***) of the household head	1 [__]Farming 2 [__]Salaried worker 3 [__]Self-employed	4 [__]Laborer 5 [__]Retired 6 [__]Other(specify)_____ ____

K.1.4. Please provide the following demographic information concerning the household members. (*NB: people who cook and eat together from the same pot and /or depend on the household resources*)

	Name for the household member *(Full name of the household head, first name for the others, start with household head)*	Relation- ship with household head (***codes below table)***	In which **year** was this person born?	What is the **gender** of this person? ***1=male 2=female***	What is the **highest** level of education completed in years?
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					

Codes for relationship with household head: 1=head 2=spouse; 3=own child; 4=step child; 5=parent; 6=brother/sister; 7=nephew/niece; 8=son/daughter-in-law; 9=grandchild; 10=other relative (specify) ; 11=unrelated; 12=brother/sister-in-law; 13=parent in law: 14=worker

SECTION L: SOCIAL CAPITAL

L1.1	Do you or any member of this household belong to a farming group or any other group?	1 [__]YES 2 [__]NO
L1.2	How many groups is your household involved in? _____	

L1.3 How strongly do you agree or disagree with the following statements?	Strongly disagree	disagree	Neutral	Agree	Strongly Agree
I regularly get help from my neighbors					
I generally know people in my area.					
If I had to borrow money in an emergency, I could borrow it from a neighbor without struggle					
I get along well with people in my area					

I fully trust people in my area					

SECTION M: INCOME, CONSUMPTION AND WEALTH

M1.1	In which of the following categories do you estimate your total monthly household income (Kshs), **from all activities, working members, business income, pensions and remittances**?	1. [ ] < 1500 2. [ ] 1,500 – 2500 3. [ ] 2,500 – 5000 4. [ ] 5,000- 10,000	5. [ ] 10,000 – 20,000 6. [ ] 20,000 – 30,000 7. [ ] 30,000 – 40,000 8. [ ] above 40,000
M1.1b_i	Rank source of income in the past 12 months starting from main to the least(Rank from list provided)		

INCOME SOURCE	RANK
Export crops	
Other horticultural crops	
Other farm crops	
Livestock and livestock products (e.g. milk)	
Other farm activities (e.g. bee keeping, brew making, charcoal burning)	
Wages/ salaries/ non-farm, pension and business activities	
Remittances/ gifts from absent family members and other external income	
Other sources (Specify)_____	

M1.1c	Please indicate your monthly household expenditure. (**Estimate monthly school fees from the annual or term figure)** Food_____ Clothing_____ School fees_____ Medicare_____ Entertainment_____ Donations_____ Other (Specify)_____	
M1.2	How many months of the year are you able to get employment outside your farm?	_____
M1.3.1_i	What is the daily wage rate in the area?	
M1.3.1_ii	Would you say that your daily income from both farm and off-farm activities= daily wage in the area?	[__]YES [__]NO
M1.3.1_iii	If no in **M1.3.1_iii** how much is your daily wage?	
M1.3.2_1	How do you suppose your FRENCH BEAN INCOME was in 2010 (during baseline survey?	1 **[__]Higher** 2 **[__]Lower** 3 **[__]About the same** 4 **[__]Can't remember / Don't know**
M1.3.2_2	How do you suppose your FARM INCOME was in 2010 (during baseline survey?	**1 [__]Higher** **2 [__]Lower** **3 [__]About the same** **4 [__]Can't remember / Don't know**

M1.3.2_3	How do you suppose your TOTAL INCOME was in 2010 (during baseline survey?	**1 [__]Higher** **2 [__]Lower** **3 [__]About the same** **4 [__]Can't remember / Don't know**

M1.4	Please provide the following information about your housing conditions		
i	Type of roofing material of household's most important residence (main house)	1 [__]Straw/grass 2 [__]Iron sheets	3 [__]Asbestos 4 [__]Other (Specify)____
ii	Walls material of household's most important residence	1 [__]Stone 2 [__]Mud 3 [__]Timber	4 [__]Iron sheet 5 [__]Bricks
iii	Ownership status of the house	1 [__]Owned 2 [__]Rented	3 [__]Other specify _____
iv	House type (main house)	1 [__]Traditional 2 [__]Semi-permanent	3 [__]Permanent
v	Floor material of household's most important residence	1 [__] Tiles 2 [__]Mud 3 [__]Timber 4 [__] Cement 5 [__] Other (specify)_____	
vi	Number of rooms (minus kitchen and bathrooms)		
vii	Main cooking device in the main kitchen	1 [__]Three stone traditional stove 2 [__]Improved traditional stove 3 [__]Traditional charcoal cooker 4 [__]Improved charcoal cooker	5 [__]Kerosene stove 6 [__]Electric cooker 7 [__]Gas cooker
viii	Where do you usually get your drinking water from?(Tick **MAIN**)	1 [__]Private tap water 2 [__]Piped into plot/yard 3 [__]Public tap 4 [__]Open well (borehole/tubewell) in compound 5 [__]Public 6 [__]Covered/protected well in compound 7 [__]Surface water Protected spring 8 [__]No protected spring	9 [__]River 10 [__]Lake/pond 11 [__]Canal 12 [__]Roof rain water 13 [__]Tankers/truck delivered water 14 [__]Bottled water 15 [__]On-farm water catchment 16 [__]Other(Specify)
ix	Where do people in your household usually go to the toilet? _____	1 [__]Flush toilet 2 [__]Latrine 3 [__]Uncovered pit 4 [__]Covered pit	5 [__]Bucket 6 [__]No facility (nature/behind the bush or tree) 7 [__]Other (Specify)_____
x	Do you share this latrine/toilet with some neighbors?	**1 [__]YES**	**2 [__]NO**

M1.5 Does the household or farm have the following (tick)

Assets	No. owned now	Current Total Value (Kshs)	Who owns (codes)	Asset	No. owned now	Current Total Value (Kshs)	Who owns (codes)
1=houses				27=posho mill			
2=stores				28=weighing machine			
3=water tanks				29=grinder			
4=radio				30=cattle dip			
5=TV				31=power saw			
6=telephone/mobile				32=spray pump			
7=solar panels				33=irrigation equipment			
8=battery (car)				34=water pump			
9=gas cooker				35=cart			
10=bicycle				36=animal traction plough			
11=wheel barrow				37=donkey			
12=Beehives				38=motorcycle			
13=sewing/knitting machine				39=car			
14=milking equipment/shed				40=truck			
15=zero-grazing units				41=trailer			
16=chaff cutter				42=tractor			
17=water trough				43=harrow/tiller			
18=poultry houses				44=ploughs for tractor			
19=pig-stys				45=planter			
21=borehole				46=sheller			
22=well				47=ridger/weeder			
23=dam				48=generator			
24=jaggery unit				49=boom sprayer			
25=cane crusher				**50=Furniture (total)**			
26=pestle and mortar				51=Boat (rowing)			
53= Fishing hook				52=Motor boat/engine			

1=Head 2=Spouse	3=Household(all) 4=Head's father	5=Head's mother 6=Son	7=Daughter 8=Other joint (specify codes)	9=Other (specify) _____

M1.5 What was the consumption level of the following food items

	Food items	What is the quantity of consumption in a normal week? **(specify units)**
A=Cereals	Maize (githeri)	
	Maize flour (ugali)	
	Wheat flour (chapati)	
	Rice	
	Sorghum/ millet	
	Other (specify)	
B=Root & tubers	Irish Potatoes	
	Sweet potatoes	
	Cassava	
	Arrow roots	
	Yams	
	Other (specify)	
C=Vegetables	Sukuma wiki	
	French beans (	
	Spinach	
	Cabbages	
	Local vegetables	
	Other (specify)	
D=Fruits	Bananas	
	Oranges	
	Pawpaws	
	Water melon	
	Others (specify)	
E=Meat , Poultry	Beef	
	Goat meat	
	Chicken	
	Other meat(specify)	
F=Eggs	Eggs	
G=Fish & Seafood	Fish	
	Other sea food (specify)	
H=Pulses/ legumes / nuts	Beans	
	Other pulses	
I=Milk & milk products	Milk	
	Others (specify)	
J=Oil/ fats	Edible oils	
K= Sugar / honey	Sugar	
	Honey	
Miscellaneous (specify)		

APPENDIX 2A: BUURI CORRELATION MATRIX

	POVERT~N	COMPLI~E	CONTIN~P	GAIN_C~P	LOSS_C~P	EXTENS~F	Social~F	DISTUR~F	ALL_WE~F	LN_ASS~F	LIVEST~F	LN_IN~FF	HHSIZE~F	MAXED_~F	DEPRA~FF	FGENDE~F	PROPLA~F	FARMI~_F
POVERTY_CEN	1.0000																	
COMPLIANCE	-0.0695	1.0000																
CONTINUOS_~P	-0.1892	0.4019	1.0000															
GAIN_COMP	-0.0904	0.3694	-0.2626	1.0000														
LOSS_COMP	0.1949	0.4019	-0.2857	-0.2626	1.0000													
EXTENSION_F	0.0384	0.3314	0.2379	0.1835	-0.0297	1.0000												
SocialCap_~F	-0.3772	-0.0818	-0.0236	-0.0496	-0.0236	-0.1574	1.0000											
DISTURBN_D~F	-0.0964	0.0840	-0.0196	0.1871	-0.0615	0.2981	0.0684	1.0000										
ALL_WEATHE~F	0.2844	0.1810	0.1195	-0.2197	0.2988	0.1244	-0.0791	-0.0631	1.0000									
LN_ASSET_D~F	0.5697	0.0235	0.2464	-0.0675	-0.1551	0.0176	-0.3281	-0.0882	0.2314	1.0000								
LIVESTOCK_~F	0.2918	-0.0419	-0.3282	0.3063	-0.0118	-0.0484	-0.1855	-0.0371	0.0424	0.2828	1.0000							
LN_INCOME~FF	0.0440	0.1545	0.2213	0.0621	-0.1019	0.0525	-0.1434	0.3652	-0.0105	0.3657	0.1528	1.0000						
HHSIZE_DIFF	0.2107	-0.3015	-0.3414	0.1769	-0.1753	-0.2171	0.2258	0.3613	-0.2162	-0.1723	0.0756	-0.0984	1.0000					
MAXED_DIFF	0.0393	-0.1572	-0.0393	0.2424	-0.3731	-0.1513	0.2338	0.4687	-0.1205	0.1328	0.1127	0.2851	0.6367	1.0000				
DEPRATIO_D~F	-0.0567	0.1208	-0.0684	-0.1202	0.3224	0.0788	0.0415	0.0221	0.1336	-0.2217	-0.4543	-0.1559	-0.1333	-0.1161	1.0000			
FGENDER_F	-0.1107	0.3362	0.1195	0.1569	0.1195	0.1244	-0.0791	-0.0164	0.2000	0.0970	-0.0015	-0.0128	-0.3551	-0.2081	0.4803	1.0000		
PROPLAND_D~F	-0.0402	-0.1999	0.0536	-0.3188	0.0189	0.3135	0.1217	0.3211	-0.0433	-0.1195	-0.2432	0.0064	-0.0568	-0.0224	0.2466	0.0260	1.0000	
FARMING_MA~F	-0.1924	0.2546	0.0645	0.3259	-0.0806	0.0973	-0.0426	0.2720	-0.1888	-0.1202	0.1934	0.0482	0.1145	0.2348	0.1144	0.2966	-0.0550	1.0000

APPENDIX 2B: MBOONI CORRELATION MATRIX

	POVERT~N	COMPLI~E	CONTIN~P	GAIN_C~P	LOSS_C~P	EXTENS~F	Social~F	DISTUR~F	ALL_WE~F	LN_ASS~F	LIVEST~F	LN_IN~FF	HHSIZE~F	MAXED_~F	DEPRA~FF	FGENDE~F	PROPLA~F	FARMI~_F
POVERTY_CEN	1.0000																	
COMPLIANCE	-0.1272	1.0000																
CONTINUOS_~P	-0.2135	0.3053	1.0000															
GAIN_COMP	0.1996	0.3053	-0.2222	1.0000														
LOSS_COMP	-0.1111	0.4657	-0.3390	-0.3390	1.0000													
EXTENSION_F	0.1182	0.4093	0.3120	-0.0430	0.1751	1.0000												
SocialCap_~F	-0.1477	0.2113	-0.0833	0.0694	0.2147	0.0430	1.0000											
DISTURBN_D~F	-0.1744	0.0891	0.1916	-0.2577	0.1395	0.0027	-0.0465	1.0000										
ALL_WEATHE~F	0.0254	0.1761	-0.2222	0.0833	0.2825	0.0753	0.0694	0.1005	1.0000									
LN_ASSET_D~F	0.4289	-0.1187	-0.1056	-0.0656	0.0251	0.0390	-0.1239	-0.1500	0.2297	1.0000								
LIVESTOCK_~F	0.2500	0.0199	-0.0342	0.1295	-0.0584	0.0596	-0.1746	-0.1848	0.1274	0.1902	1.0000							
LN_INCOME~FF	0.2938	-0.3908	-0.2076	-0.1651	-0.0730	-0.2645	0.0968	-0.2272	-0.0374	0.1797	-0.1888	1.0000						
HHSIZE_DIFF	0.2492	-0.0056	-0.2280	0.2809	-0.0484	-0.2483	0.0463	0.0229	0.2445	0.1081	-0.0336	0.0750	1.0000					
MAXED_DIFF	0.2218	-0.1717	-0.0373	0.0506	-0.1761	-0.0867	-0.1678	-0.1742	0.0506	0.0392	0.3470	-0.0765	0.2833	1.0000				
DEPRATIO_D~F	-0.3377	0.0166	0.0376	-0.0626	0.0362	-0.0199	0.1105	-0.1026	0.1100	0.0354	-0.0513	-0.1468	-0.2724	-0.3973	1.0000			
FGENDER_F	-0.0822	-0.1418	-0.1491	-0.1491	0.1061	0.1299	0.1491	-0.0403	0.2609	-0.0620	-0.0365	0.0175	-0.1773	-0.0643	0.2485	1.0000		
PROPLAND_D~F	0.2043	0.0065	-0.2900	0.0681	0.1868	0.2394	-0.1030	-0.1783	0.3124	0.2352	0.2305	0.0345	0.1287	0.0162	-0.0313	0.0112	1.0000	
FARMING_MA~F	-0.1766	0.0091	0.0753	-0.0430	-0.0175	-0.0083	-0.0753	-0.0702	-0.0430	-0.2745	0.0179	-0.1842	-0.0512	0.0949	0.3182	0.2887	0.0719	1.0000

APPENDIX 2C: KIRINYAGA CORRELATION MATRIX

	POVERT~N	COMPLI~E	CONTIN~P	GAIN_C~P	LOSS_C~P	EXTENS~F	Social~F	DISTUR~F	ALL_WE~F	LN_ASS~F	LIVEST~F	LN_IN~FF	HHSIZE~F	MAXED_~F	DEPRA~FF	FGENDE~F	PROPLA~F	FARMI~_F
POVERTY_CEN	1.0000																	
COMPLIANCE	0.2209	1.0000																
CONTINUOS_~P	0.0242	0.4720	1.0000															
GAIN_COMP	-0.0373	0.3165	-0.2533	1.0000														
LOSS_COMP	0.2680	0.3956	-0.3166	-0.2123	1.0000													
EXTENSION_F	0.2134	0.5259	0.4504	0.2158	-0.0563	1.0000												
SocialCap_~F	0.1092	0.2061	0.0142	0.1082	0.1353	0.1399	1.0000											
DISTURBN_D~F	0.0779	0.1062	-0.1907	0.0981	0.2502	0.0892	0.2137	1.0000										
ALL_WEATHE~F	0.1249	0.2217	0.0546	-0.0398	0.2377	0.1241	0.1082	0.2142	1.0000									
LN_ASSET_D~F	0.4569	0.1940	0.0378	0.0713	0.1271	0.1307	0.0058	-0.0100	-0.0089	1.0000								
LIVESTOCK_~F	0.2886	-0.0458	-0.0474	-0.0857	0.0719	-0.0565	-0.1154	-0.0093	0.2280	0.3311	1.0000							
LN_INCOME~FF	0.3642	0.1333	0.1102	0.0389	0.0037	0.0376	0.1756	0.1267	0.1597	0.3117	0.1815	1.0000						
HHSIZE_DIFF	-0.0749	-0.0789	0.1375	-0.0836	-0.1720	-0.2407	0.0776	-0.1166	0.0079	-0.1409	0.0157	-0.0012	1.0000					
MAXED_DIFF	0.1766	-0.0278	0.1042	-0.0062	-0.1418	-0.0011	-0.1352	-0.1307	-0.2581	0.1393	0.0370	0.0290	0.2713	1.0000				
DEPRATIO_D~F	0.1488	-0.2114	-0.1726	-0.2447	0.1500	-0.2329	-0.0714	-0.1524	0.0475	-0.0421	0.1622	-0.1158	0.3344	-0.1927	1.0000			
FGENDER_F	-0.0943	-0.1404	-0.1820	0.0461	-0.0070	-0.1874	-0.1633	-0.0130	-0.1220	-0.0022	-0.0707	-0.0067	-0.1566	-0.2821	0.0086	1.0000		
PROPLAND_D~F	0.0299	-0.2504	-0.1860	-0.0086	-0.0859	0.2079	0.2233	0.0703	-0.1409	-0.0106	0.0132	0.1619	-0.0953	0.1889	-0.0822	-0.1212	1.0000	
FARMING_MA~F	-0.2676	-0.1305	0.0431	0.0455	-0.2414	0.0256	-0.0739	-0.0731	-0.1425	0.1003	-0.0234	0.0021	0.1025	0.1254	-0.0735	0.1138	0.1053	1.0000

APPENDIX 2D: VARIANCE INFLATOIN FACTORS

	BUURI	**MBOONI**	**KIRINYAGA**
ANY HISTORY OF COMPLIANCE	2.509	2.485	2.465
CONTINUOS_COMP	2.912	2.001	2.948
GAIN_COMP	2.911	1.653	1.856
EXTENSION CONTACT	2.054	1.762	2.456
SOCIAL CAPITAL	1.406	1.254	1.369
DISTURBN_DIFF	2.727	1.703	1.281
Access to all weather road	1.448	1.780	1.400
LN_ASSET_DIFF	1.978	1.436	1.414
LIVESTOCK_DIFF	2.152	1.455	1.333
LN_INCOME_DIFF	1.922	1.694	1.404
HHSIZE_DIFF	2.918	1.590	1.798
MAXED_DIFF	3.284	1.921	1.691
DEPRATIO_DIFF	2.585	1.762	1.634
FEMALE HEADED HOUSEHOLD	2.169	1.434	1.311
PROPLAND_DIFF	1.922	1.553	1.819
FARMING MAIN OCCUPATION	1.579	1.927	1.205
Mean VIF	**2.280**	**1.713**	**1.712**

APPENDIX 3 BREUSCH-PAGAN / COOK-WEISBERG TEST FOR HETEROSKEDASTICITY

	BUURI	MBOONI	KIRINYAGA
Ho: Constant variance			
chi2(16)	14.13	26.17	20.4
Prob > chi2	0.5887	0.0517	0.2027