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IMPACT OF EXPORT HORTICULTURE FARMING ON PER CAPITA CALORIE INTAKE OF SMALLHOLDER FARMERS IN EASTERN AND CENTRAL PROVINCES IN KENYA

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Abstract

In attempting to achieve household food security for smallholder farmers, synergies and tradeoffs exist between cash cropping, food cropping and food security. Available evidence on the impact of cash cropping on food security shows mixed results. The objective of this paper was to assess the impact of export horticulture farming on food security of smallholder farmers in Kenya in two provinces in different agro-ecological zones with different resource and infrastructural endowments, crop growing and marketing conditions. This was done using propensity score matching. The results indicate a positive impact on food security in high potential area and a negative impact in the arid area that is already food deficit. Encouraging export horticulture or cash cropping, aiming at achieving household food security, may not be a one size fit all. Regional differences and particular growing and marketing conditions as well as intra household income distribution patterns play a role and should be considered.

Key words; *Export horticulture; food security, per capita calorie intake; smallholder farmers; impact; propensity score matching.*

1. Introduction

Horticultural production for export is a major cash cropping practice among small holder farmers in Central, Eastern and Rift Valley provinces in Kenya. This study assessed the impact of this practice on the food intake of horticultural farmers in Eastern and Central provinces. The two areas of study are different in terms of agro ecological endowment environment and infrastructural development. The article proceeds as follows: section one provides a background of the practice in Kenya and introduces the research problem and objectives of the study, section two describes the methods of analysis in terms of how food intake was calculated and gives a brief description of sampling and data collection procedures followed and the empirical model employed. The results and discussions are presented in section three, while section four provides the conclusion and the policy recommendations.

1.1. Background

Commercialization of agriculture, comprising of a shift from food production for home consumption to production for the market, is often stipulated as the way out of poverty and a means to enhance food security (Kennedy & Cogill, 1987). One particular manifestation of commercialization is cash cropping. Whilst commercialization can include market oriented production of staple food crops, cash cropping involves crops produced for cash that have a higher value than those consumed within the household and tends to require a greater degree of specialization.

Horticultural production for export is a major cash cropping practice in Kenya and is ranked third in terms of foreign exchange earnings after tourism and tea (HCDA, 2009). It contributes 30 percent of agricultural GDP and continues to grow at between 15 and 20 percent per year (GoK, 2012). Kenya has been the most successful exporter of horticultural products in the sub-Saharan Africa. The European Union (EU) is the dominant market for Kenyan exports and after Morocco Kenya is the biggest fresh vegetable supplier to the EU (Legge, Orchard, Graffham, Greenhalgh and Kleih. 2006). The horticultural export sector in Kenya is characterized by participation of smallholder farmers faced by numerous technical and institutional challenges that majorly stem from stringent market regulations (Asfaw, Mithöfer, & Waibel, 2007). In the 1990s, researchers estimated that three quarters of fresh fruit and vegetable exports production came from smallholder growers. However, participation of smallholders has declined in recent years due to the high cost of managing smallholder out growers in the face of new food-safety and quality regulations such as GlobalGAP standards and the need to have a critical size and number (Legge et al. 2006). Nevertheless, McCulloch and Ota (2002), report that smallholders participating in export horticulture, whether as producers or the workforce employed in the sector, are better off than non-participating smallholders, with average annual household incomes of the former being higher.

Though the export horticulture sector has been a success in terms of foreign exchange earnings, its impact on smallholder household food security remains under investigated. Available evidence on the effect of cash cropping systems on food security shows mixed results. Different negative and positive impacts can be identified and vary with choice of cash crops and the situation in which they are being grown and marketed. Cash cropping is associated with increased staple food production due to the synergy between the two systems (Bolwig & Odeke, 2007; Govereh &Jayne, 1999; Von Braun & Kennedy, 1986). On the other hand, Anouk (2010) and Sorre (2011) indicate that cash cropping often increases the competition for resources between cash and food crops, thus posing a threat to food security. Langat et al. (2012), point to the deteriorating food security situation of tea farmers in Nandi Kenya and conclude that food security is not guaranteed by higher cash crop production and consequently recommend diversification of farm enterprises. An extensive review of studies on the impact of export driven cash crops on smallholder households by Schneider and Gugerty (2010) conclude that given the heterogeneity of crops and production structures across the African continent, drawing strong policy conclusions from the available evidence may not be right. The authors further observe that the empirical data available to evaluate the impact of cash crop production on smallholder welfare remains relatively weak.

Policies promoting export horticulture assume that realization of increased household incomes through cultivation of export oriented cash crops would guarantee improved household food security. However this market niche is surrounded by a myriad of non-uniform growing, marketing and intra-household conditions whose challenges and outcomes or effects are neither automatic nor uniform. Empirical findings are necessary to back policy interventions in order to ensure positive outcomes are reinforced and bottlenecks addressed. The information generated by the current study will assist policy makers in designing

horticultural production and export policies that ensure positive effects are enhanced while any negative impacts are minimized or entirely eliminated and farmers' welfare improved.

1.2. Conceptual Framework

Sen's (1981) entitlement theory outlines the different ways in which individuals can acquire food: a) production based entitlements i.e. through own food production; b) trade based entitlements that is through exchange of cash crops or physical assets; c) own labour entitlements through sale of labour power for wage; and, d) inheritance, and transfer entitlement which refer to informal gifts from individuals and formal gifts from government. The level and the mix of these entitlements depend on a households resource endowments including human capital, type of market integration for agricultural produce, food and labour. Effect on these variables, ultimately affect food intake.

Following this theory, the current study conceptualizes the food security status as an outcome of household/farmer social economic characteristic and non-controllable external environmental factors. The same factors also affect a farmer's decision to grow export horticulture or not to grow as shown in Figure 1. This decision affects the farmer's resource allocation decision, either to produce horticultural crops for export market, food crop and or engage in off farm employment or a level of mix among all these alternatives. Households that choose to grow export horticulture may undergo a transition from food crop farming for sale to domestic consumers and own consumption, to production for export market, implying a shift of resource allocation. The ultimate effect of a particular cash crop on food security or food intake will then be an outcome of different factors and specific household decisions hence complex interactions arise. This then becomes an empirical issue since the possible effects and interactions are not straightforward and vary from crop to crop as well as the prevailing growing, marketing and household conditions. There is consensus that cash cropping would increase income of smallholder farmers, though the variance of this income is high. However, effect of this increased income would vary from one household to another depending on household specific characteristics and the external environment as shown Figure 1.

Generally, households will result to reduced food intake if the price of the export crop is lower relative to the prevailing food prices. Market concentration in this case plays a vital role. Where markets are concentrated i.e. there are fewer buyers compared to a large number of smallholder farmer sellers, the prices may be low due to reduced bargaining power of the farmers. Price fluctuations in the global market increase variability of income. Consumer demand for high quality vegetables abroad means that export vegetables that fall short of the specifications are rejected or bought at very low prices. In cases where production of export horticulture results to a shift of productive resources from food crop production to production of export vegetables, production of food crop reduces. Consequently, if income realized from sale of the export crops, (depending on the decisions of the person in control) is not spent on purchasing food items, this reduce food available for household consumption. Research has shown that if women are in control of income, they tend to spend more on food consumption related expenditures. In contrast men are more inclined to non-food expenditures such as education and purchase of durable assets. On the other hand, if increased income from export horticulture is spent on increasing food crop production and or purchase of food products for the household then this will result into increased food intake. In addition, if production of export horticulture does not necessarily translate to shift of production resources away from food crop production, then the level of food intake could not be negative. The different interactions are illustrated in Figure 1.

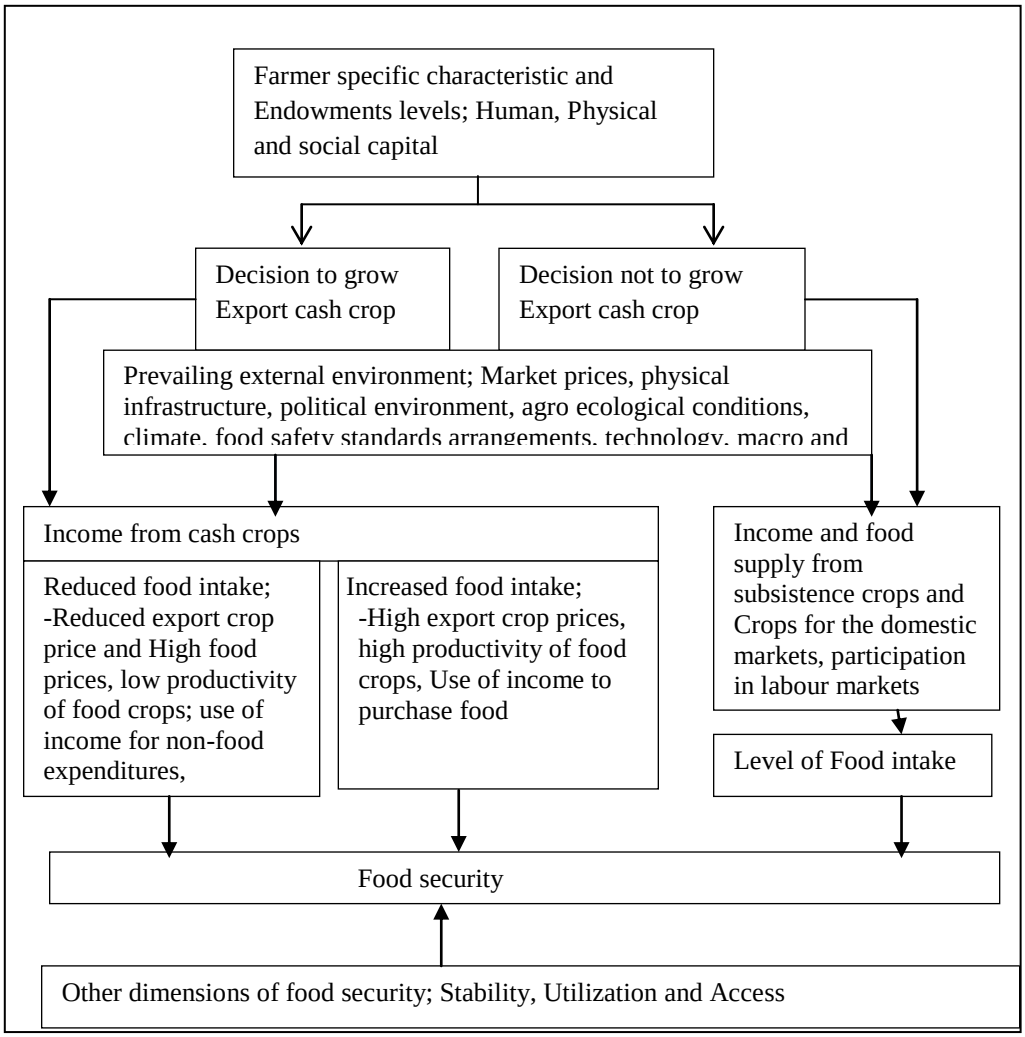

Figure 1. Conceptual framework of the linkages between horticultural export production and food security

2. Methods of Analysis

2.1 Measuring Food Security

Food security is a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (Bongaarts, 2007). This definition integrates distinct but inter-related dimensions of the concept of food security, that is; access to food, availability of food, the biological utilization of food, as well as the stability of all these factors. Due to its nature and complexity, there are approximately 200 definitions and 450 indicators of food security (Hoddinott, 1999). Like the concepts of health or social welfare, there is no single, direct measure of food security that can effectively capture the multiple dimensions to the problem (Bongaarts, 2007; Riely, Mock, Cogill, Bailey & Kenefick,

(1999); Webb et al. 2006). There is no any form of a consensus on the core household food security indicators that are needed in order to properly measure and monitor food security around the world (Carletto, Zezza and Banerjee, 2013) However, the field is rapidly growing and undergoing constant development towards a gold standard of monitoring hunger worldwide. The United States Department of Agriculture (USDA) Household Food Insecurity Access Scale and Food Insecurity Experience Scale (FIES) for example have been shown to be a stable, robust, and reliable food access measurement tools. USDA scale consists of 18 core-module questions, which work systematically together to provide a measurement tool for identifying, with considerable sensitivity, the level of severity of food insecurity/hunger experienced in a household.

However, in practice, a variety of indicators are used for food security analysis (Carletto et al. 2013). These indicators though, cannot measure the different dimensions of food security hence composite measures are preferred. In fact, due to multidimensionality of the concept, FAO has a suite of indicators variables for different dimensions, which together give an indication of the level of food security and are useful in building composite indices (Santeramo, 2015).

However, that notwithstanding, the current study have employed per capita calorie intake a measure of food availability as a partial indicator of food security. Per capita calorie intake is relevant in calculating the Average Dietary Energy Supply Adequacy (ADESA) an indicator of food availability under FAOSTAT. ADESA expresses the dietary energy supply as a percentage of the Average Dietary Energy Requirement. Comparably, per capita calorie intake employed in this study compares the per capita energy consumption in Kcal and compares it with the average dietary energy requirement in Kenya. Households are then termed as either food secure or food insecure depending on whether the energy consumption is more or less than the average dietary energy requirement. This principle is employed by FAO undernourishment measure used to report on the state of food security worldwide by capturing the average availability of food against requirements at the national level.

Per capita calorie intake was estimated using 7 day recall method where household total energy consumption was calculated (Swindale & Bilinsky, 2006). Using the formulae;

$$C_i = \sum_{i=1}^{n} W_i B_i \qquad (1)$$

Where;

C_i is the household total calorie intake estimate, W_i is the weight in grams of intake of food commodity i, and B_i is the standardized food energy content of the i^{th} food commodity (from nutrient conversion tables).

C_i was then divided by household size to get per capita calorie intake (PCI), and then compared to 2250 kilocalories average energy requirement as the threshold.

2.2. Study Area

The study was carried out between 2010 and 2011 in two districts of the major export vegetable producing provinces in Kenya (Mbooni district of Eastern province and Kirinyaga district of Central province). These two districts represent the highest number of smallholder farmers producing vegetables for export market in the two provinces respectively. It is important to note here that Mbooni district has since became a sub county within Makueni County from Eastern Province after the revision of administrative boundaries in Kenya in the year 2013, while Kirinyaga district is a county from the Central Province. However for the purpose of this study, these study areas are referred to as districts as they were when the research was undertaken. The two provinces are different in both natural climatic conditions

/agro-ecological zone and in infrastructural development and were selected to facilitate comparison of the impacts in different settings.

Mbooni district lies within the arid and semiarid zones of the country. It is a low-lying district rising from 700 meters above sea level at the lowlands to 1900 meters above sea level. With a population of 177,832 persons, the district covers an area of square kilometer 894.6 and has very high poverty level with absolute poverty standing at 64.3 percent (MPND, 2008a). The province's road and irrigation infrastructure is underdeveloped compared to Central Province. Kirinyaga district is one of the six districts in Central Province that lies in the high potential areas of the country and has a well-developed irrigation and road network. The district covers an area of square kilometer 1,437 and has a population of 528,054 persons. Kirinyaga District has absolute poverty of 36 percent. The district lies between 1150 to 5380 meters above sea level. It receives two rainy seasons, the long and the short rains between March to May and October to November respectively (MPND, 2008b).

2.3. Study Context, Data and Sampling Procedures

The study forms part of a larger project –Drivers, Viability and Livelihood Impacts of Compliance with private food safety standards in Kenya (DriVLIC Kenya), funded by International Development Research Centre (IDRC) undertaken by the University of Nairobi in collaboration with the Fresh Produce Exporters Association of Kenya and the Ministry of Agriculture in Kenya. The sampling unit in this study was a household, comprising of people living together headed by one person and having one cooking arrangement. Data used in this study was collected using structured questionnaire in two phases; the baseline data containing farmer socio-economic characteristics and production information was collected between July and October 2010, while the consumption and household characteristics data was collected between August and November year 2011. The list of farmers from an initial baseline survey of the DriVLIC Kenya project formed the sampling frame for the second phase. The sampling frame was used to generate seven categories of farmers based on their compliance status with Global GAP. Individually fully compliant farmers who are growers of exporters, Group contract farmers (who own facilities, production process and keep their own records), Group scheme farmers (exporters own facilities, keeps records and controls production), non-compliant farmers who abandoned standards after adopting, non-compliant farmers who have never adopted standards and finally farmers who do not grow export vegetables. From the sampling frame, a total of 372 households, (228 in Kirinyaga and 144 in Mbooni) were selected using proportionate to population size selection of the follow-up survey. These were later collapsed to two groups of growers and non-growers for the purpose of this study.

2.4. Propensity Score Matching Theory

The impact of participation in production of horticulture for export market on food intake is given by the difference in the food intake when a household participates in export horticulture production and the food intake when the same household does not participate; that is, the food intake outcome with and without treatment. Clearly, we cannot have both outcomes for the same household at the same time. Hence, one has to develop a proxy for the missing data or counterfactual as referred to in impact assessment literature. Taking the mean outcome of nonparticipants as an approximation of the counterfactual is not advisable, since participants and non-participants usually differ even in the absence of treatment. This problem is known as selection bias (Caliendo & Kopeinig, 2008).

The basic idea in propensity score matching method is to find in a large group of non-participants, households who are similar to those participating in all relevant pretreatment characteristics ***X***. Once this is achieved, differences in outcomes of this well selected and thus adequate control group (non-participants) and of treatment group (participants) can be attributed to the participation in export horticulture farming. Since conditioning on all relevant covariates is limited in the case of a high dimensional vector *X*, we use balancing score *b*(*X*) which is a function of the relevant observed covariates X such that the conditional distribution of *X* given *b*(*X*) is independent of the assignment into treatment. This balancing score is the propensity score i.e. (the probability of participating in export horticultural farming given the observed characteristic *X*). Given by,

$$b(X) = Pr\,(Z=1/X) \tag{2}$$

Where *Z* denotes the participation status in production for the export market, and 1 denotes a household participates and 0 otherwise. *X* is the multidimensional vector of pretreatment characteristics.

The propensity score is a function such that the conditional distribution of *X* given *b*(*X)* is the same in both groups. Given that the propensity score is a balancing score, the probability of participation conditional on *X* will be balanced such that the distribution of observables *X* will be the same for participants and non-participants. Consequently, the differences between both groups are reduced to the only attribute of treatment assignment and unbiased impact estimates can be produced (Rosenbaum & Rubin, 1983). Propensity scores are estimated using choice models either probit or logit model which yield similar results.

An estimate of the propensity score is not enough to estimate the ATT. The reason is that the probability of observing two units with exactly the same value of the propensity score is in principle zero since *b*(*X*) is a continuous variable. Various methods (matching procedures) have been proposed in the literature to overcome this problem. Matching procedures based on this balancing score are known as propensity score matching (PSM). Three of the most widely used are Nearest Neighbor Matching (NNM), Radius Matching (RM) and Kernel Based Matching (KBM)**.** All matching procedures contrast the outcome of a treated individual with outcomes of comparison group members. ATT can be noted as;

$$E[Y_1|D = 1] - E[Y_0 D = 0] = ATT + E[Y_0|D = 1] - E[Y_0 D = 0 \tag{3}$$

The difference between the left hand side of the equation and *ATT* is the so called 'selection bias'. The true parameter *ATT* is only identified if, (Caliendo & Kopeinig, 2008)

$$E[Y_0|D = 1] - E[Y_0 D = 0] = 0 \tag{4}$$

In non-experimental studies, one has to invoke some identifying assumptions when using propensity score matching to solve the selection problem namely -Unconfoundedness or conditional independence assumption (CIA), and the Common Support Condition (CSC). Conditional independence assumption indicates that the selection is exclusively based on the vector of observables ***X*** that determines the propensity score and that treatment is random and uncorrelated with the outcome once controlled for ***X*** (Caliendo & Kopeinig, 2008; Rosenbaum & Rubin, 1983). Sensitivity analysis a test of fulfillment of conditional independence assumption examines how strong the influence of unobservable characteristics on the participation process needs to be, in order to attenuate the impact of participation on potential outcomes.

In order to ensure randomized selection the common support condition needs to be applied which guarantees individuals with identical observable characteristics a positive

probability to belong both to the treatment and controls groups. ATT is only defined within the region of common support. This is because only in the overlapping subset of the comparison group and treatment group comparable observations can be matched. A violation of the CSC is a major source of bias due to comparing incomparable individuals (Heckman, Ichumura, & Todd 1997). Given that CIA holds and assuming additionally that there is overlap between both groups, the PSM estimator for ATT can be written in general as

$$ATT = E\{E\{Y_1|Di = 1, p(Xi)\} - E\{Y_0|Di = 0, p(Xi)\}|Di = 1\} \quad (5)$$

Where ATT is the average treatment effect on the treated conditioned on participation, Y_1 denote the food security outcome for an individual if the person is a participant, Y_0 the food security outcome if the person is nonparticipant. In a regression framework, the treatment effects model is given by

$$Y = a + \beta b_i + c X_i + e_i \quad (6)$$

Where Y is the household food intake level as measured by per capita calorie intake, b_i is the propensity score, of the i^{th} farmer, X_i is a vector of control variables such as farmer/ household characteristics, and β measures the impact of participation on food intake.

Table 1. Summary Statistics of Smallholder Farmers in Kirinyaga and Mbooni

		Kirinyaga N=241		Mbooni N=140	
Variable code	Variable description	Mean	SD	Mean	SD
HHGENDER	Gender of household head(1=Male 0 Female)	0.82	0.38	0.79	0.41
HHSIZE	Size of the household	3.91	1.73	5.79	2.2
HHEDUC	Years of education of the household head	8.26	3.92	7.95	4.26
GROUPMEMBER	Whether the household head belong to a group (1= Yes, 0 = Otherwise)	0.64	0.48	0.45	0.50
HHOCCUPATION	The primary occupation of the household head	0.85	0.36	0.70	0.45
HHFARMEXPR	Number of years of farming	20.54	13.25	20.4	12.35
TOTLABOURERS	Family & hired labourers	3.90	2.40	3.38	1.62
FAMLABOURERS	Number of family labourers	1.84	0.87	2.10	1.17
OWNLAND	Land area owned by the household	0.53	1.29	0.50	0.77
AGRICLAND	Land area under cultivation	2.48	1.67	1.65	1.02
HHAGE	Age of the household head	49.92	13.52	48.52	13.93
LVSTKUNITS	Number of livestock equivalent	2.99	1.80	3.21	1.86
DISTMARKET	Distance in Km to the nearest market	3.37	2.87	6.10	5.00
DISTINPUT	Distance to the nearest input shop (walking hours)	1.14	0.96	1.43	0.93
DISTWATER	Distance in Km to the nearest water source	0.32	0.87	0.62	1.73
TOTACRES	Total acres of land owned plus rented	2.92	2.38	2.53	1.68
EXPVEGAREA	Land area under export vegetables	0.53	0.54	0.24	0.13

3. Results and Discussions

3.1. Social Economic Characteristics of Smallholder Farmers

Table 1 presents summary statistics for the data collected in the two survey districts. On average, households in Mbooni are larger (5.79 persons), compared to those in Kirinyaga (3.91 persons). Households in Mbooni have on average more livestock probably as a buffer against crop failure in a region which receives little and unreliable rainfall and the fact that the resident community was traditionally agro pastoralists. A smaller percentage of smallholder farmers in Mbooni reported farming to be their main occupation compared to Kirinyaga. This could be attributed to the need to diversify livelihoods owing to the unreliability of rainfall in the area and the lack of well-established irrigation systems that are present in Kirinyaga. Residents in Mbooni cover longer distances to the nearest urban center and to the source of water and take more time walking to the nearest input shop than those in Kirinyaga. These distances translate to higher transaction costs in Mbooni than in Kirinyaga. Land allocated to production of horticultural crops for export market in Mbooni is on average less (0.24 acres) that that allocated to same crops by their counterparts in Kirinyaga district (0.53 acres). However, the two districts are not considerably different in terms of education level, gender, age, farming experience, total acres and extension contact rate.

Table 2. Social Economic Characteristics of Export Vegetable Growers and Non-Growers

	Kirinyaga				Mbooni			
Variable	Growers n=152	Non growers N=89	Test of difference in means		Growers n =78	Non growers N=62	Test of difference in means	
	Mean	Mean	t stat	P value	Mean	Mean	t stat	P value
DISTINPUT	1.13	1.16	0.23	0.82	1.43	1.40	0.05	0.96
DISTMARKET	3.32	3.50	0.41	0.68	5.86	6.40	0.63	0.53
DISTURBAN	9.05	9.58	0.41	0.68	14.48	14.75	0.10	0.92
DISTWATER	0.28	0.43	1.15	0.25	0.53	0.71	1.62	0.11
EXTCONTACT	0.63	0.51	1.15	0.25	0.87	0.48	5.39	0.00***
FAMLABOURERS	1.83	1.87	0.36	0.72	2.08	2.13	0.26	0.80
GROUPMEMBER	0.67	0.58	-1.2	0.22	0.56	0.32	-2.55	0.01***
HHAGE	47.43	55.07	4.10	0.00***	48.81	48.17	0.27	0.78
HHEDUC	8.66	7.32	-2.36	0.02***	8.19	7.65	0.76	0.45
HHFARMEXPR	19.45	22.82	1.78	0.08*	21.90	18.46	-1.66	0.10*
HHGENDER	0.87	0.72	-2.91	0.00***	0.80	0.77	-0.37	0.71
HHOCCUPATION	0.86	0.83	-0.49	0.63	0.72	0.68	-0.50	0.62
HHSIZE	4.13	3.47	-2.71	0.01***	6.16	5.33	-2.26	0.03**
LNTOTASSETS	11.98	11.93	-0.21	0.83	12.46	12.47	0.03	0.97
LVSTKUNITS	3.21	2.58	-2.67	0.01***	3.50	2.86	-2.07	0.04***
OWNLAND	0.55	0.49	-0.19	0.85	0.76	0.29	-1.83	0.07*
TOTLABOURERS	4.08	3.55	-1.47	0.00***	3.90	2.76	-4.43	0.00***

3.2. Comparisons of Growers' and Non-Growers' Characteristics

Table 2 presents comparisons for the smallholder export horticulture growers and non-growers in the two districts. It shows the means of variables and the t-tests of differences in mean between the two groups. In Kirinyaga, the two groups exhibit significant differences with respect to their gender, age, farming experience and education of the household head,

total labourers, livestock unit's equivalent, with the growers having a larger percentage of men farmers, having more livestock equivalent units, more years of formal education and more total labourers than non-growers. However growers had less years of farming experience. In Mbooni on the other hand, growers had more years of farming experience larger family sizes, higher number of total labourers, more livestock units and higher percentage of contacts with extension officers than non-growers. The high percent of extension contacts could be attributed to the number of extension officers hired by horticulture export companies to oversee smallholder out-growers' horticulture production.

3.3. Food Intake Levels

Table 3 presents the results of the food intake assessment. The average per capita calorie intake in Kirinyaga was 2410 Kcal with growers and non-growers attaining an average of 2462 Kcal and 2303 Kcal respectively. The average per capita calorie intake in Mbooni is 2188 Kcal with the growers having an average of 2152 Kcal and the non-growers having an average of 2231 Kcal.

Table 3. Average Per capita calorie intake by district and growing status

District	Growers/ Non growers	Per capita calorie intake
Kirinyaga	Growers	2462
	Non growers	2303
	Average	2410
Mbooni	Growers	2152
	Non growers	2231
	Average	2188

Based on the recommended per capita calorie intake of 2250 kcal, we can conclude from the above analysis that both growers and non-growers of export horticulture in Kirinyaga are food consuming enough. Furthermore, both groups were above the average dietary energy requirement, thus can loosely be considered food secure. In contrast, both growers and non-growers in Mbooni consumed less than the average dietary energy requirement, thus can be considered as food insecure. Figure 2 and 3 illustrate the percentage food secure and food insecure households in the two groups in Kirinyaga and Mbooni.

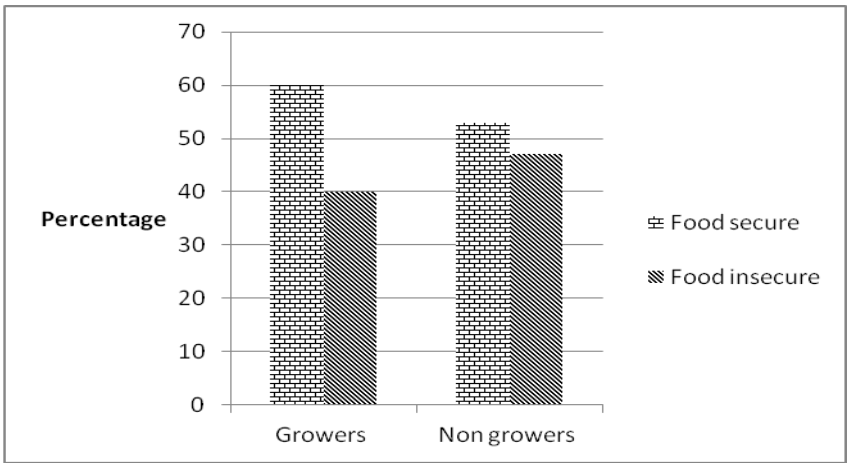

Figure 2. Food secure and food insecure households in Kirinyaga district

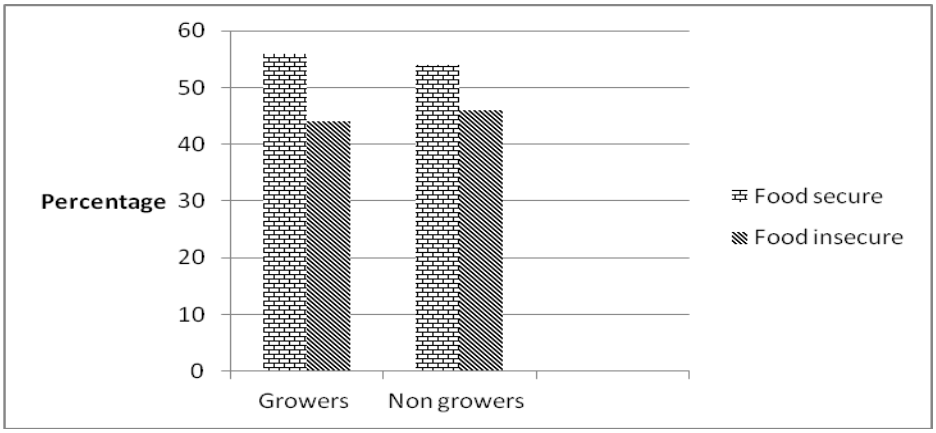

Figure 3. Food secure and food insecure households in Mbooni district

3.4. Impact of Export Horticulture Farming On Household per Capita Calorie Intake

Employing PSM in the estimation of the impact of export horticulture farming on the per capita calorie intake, the first step involves estimation of the probability (or the propensity scores) of being in the treatment group of all sample units on the basis of observed characteristics. This is done using choice models, probit or logit models. The results of this procedure also give us the factors affecting participation in export horticultural farming. The results are shown in Table 4 for Kirinyaga and Mbooni. These have however been subjects of an earlier study by McCulloch and Ota (2002), and thus the current study does not expound on the same. Our focus is on estimating the impact of participation in production of horticulture for export market on food security. The next step in PSM entails choosing a matching algorithm. The current study utilized three of the most widely used matching methods.

Table 4. Propensity scores estimates

	Kirinyaga			Mbooni		
Variable	Coefficient	SD	P value	Coefficient	Std err	P value
FAMLABOURERS	-0.30	0.22	0.16	**0.23**	**0.26**	**0.36**
GROUPMEMBER	0.68	0.38	0.07*	1.61	0.54	0.00***
HHAGE	-0.06	0.16	0.00***	0.00	0.02	0.87
HHEDUC	-0.03	0.05	0.53			
HHGENDER	0.50	0.47	0.29	0.05	0.66	0.94
HHSIZE	0.21	0.12	0.09*	**0.29**	**0.14**	**0.04****
LIVESTOCKUNITS	0.20	0.11	0.08*	0.29	0.16	0.07*
LNTOTASSETS	0.34	0.19	0.07*			
WALLTYP	0.35	0.46	0.05			
MAINOCCUP				0.53	0.60	0.38
EXTENSION				2.02	0.56	0.00***
CONSTANT	-1.65	2.37	0.49	-5.03	1.70	0.00***
Pseudo R^2	0.1515			0.25		
LRχ2	35.66***			34.17***		

Note: *significant at 10% **significant at 5% and *** significant at 1%

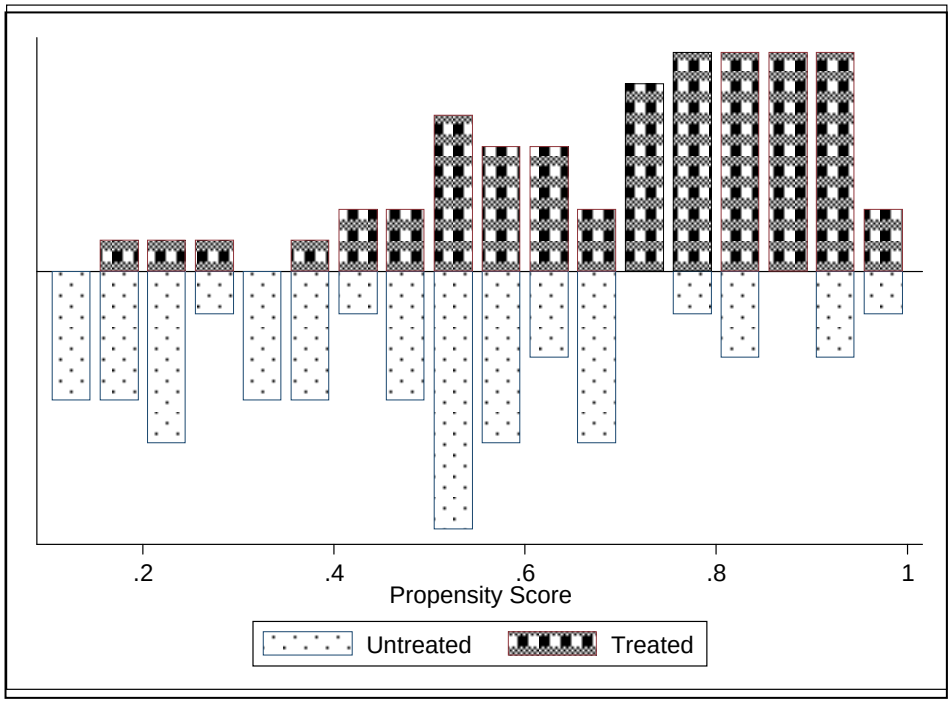

Figure 4. Propensity score histogram Kirinyaga district

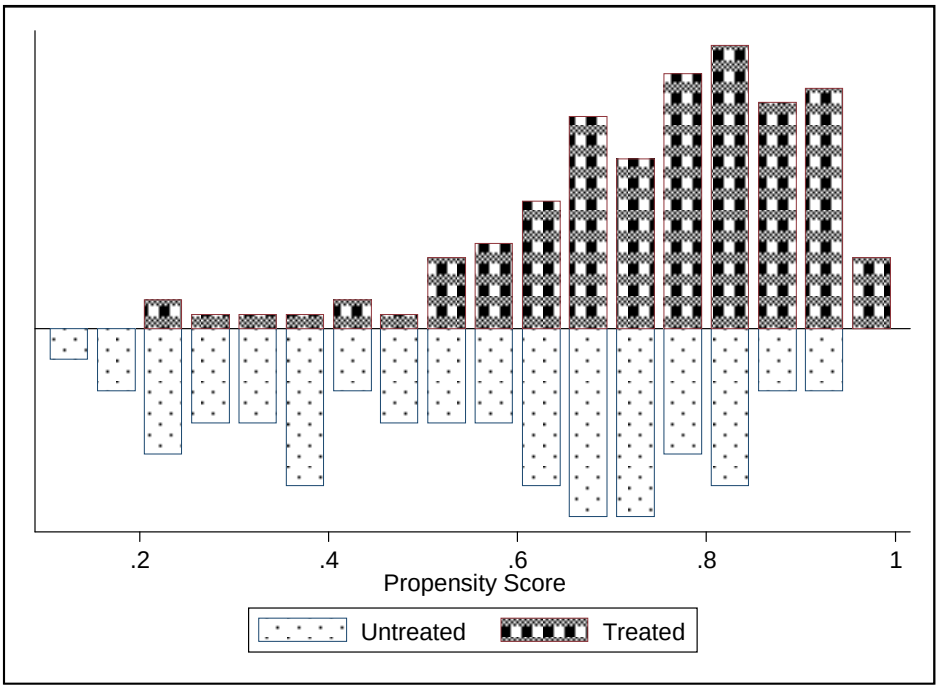

Figure 5. Propensity score histogram Mbooni district

The third step in PSM entails testing or checking overlap or the common support condition. Implementing the common support condition ensures that any combination of characteristics observed in the treatment group can also be observed among the control group. The histograms in figure 4 and 5 show that the distribution of the propensity scores between the groups of growers and non-growers in Kirinyaga and Mbooni respectively were within the region of common support.

Once the common support condition is satisfied and matching algorithm chosen to match the different scores of participants to those of non-participant, then treatment effect are estimated. In Table 5 results show that the three matching methods used indicated positive impact in Kirinyaga and a negative impact in Mbooni, with an average ATT of 264 Kcal and -355 Kcal for Kirinyaga and Mbooni respectively. The result can be explained by the differences in Agro-ecological zones of the two districts and the level of development of irrigation networks. Mbooni is a semi-arid area with high incidence of poverty and often is struck with famine from year to year. This is exacerbated by the poor if any irrigation and infrastructural networks. Moreover, small holder horticultural farmers in Mbooni were producing export horticulture on small land areas averaging 0.24 acres as opposed to 0.53 in Kirinyaga. The results are thus in line with those of Kuhlgatz and Abdulai (2011) who assessed the determinants and welfare impacts of export crop cultivation in Ghana, and found that household welfare was hardly affected at low levels of export revenue shares, but rose with increasing level of specialization. This suggests that there is a probable optimal level of production that smallholder farmers ought to have to ensure benefits of export horticulture participation are accrued. The marginal benefits from a low export intensity may be easily outweighed by immeasurable benefits of non-export agriculture, such as predictability of local markets and risk insurance through consumption of own produce. Moreover, uncertainties about foreign markets especially the price levels, increased input prices, reduced bargaining power, the private food safety standards that comes with a cost, rejection of produce due to defects are all challenges faced by the export horticulture farmers. These results coincide with those of Dewalt (1993), who after reviewing the results of studies examining the impacts of agricultural commercialization on food consumption and nutritional status concluded that increased income does not translate directly into increased food consumption at either the household or individual level. The author concluded that those schemes in which subsistence production were protected or stabilized are more likely to show positive results with an increase in income generated from cash cropping.

Table 5. Treatment effects on Adult equivalent calorie intake (gamma level for sensitivity analysis*)*

	Kirinyaga			Mbooni		
Matching Algorithm	*ATT*	*t stat*	*Gamma level*	*ATT*	*t stat*	*Gamma level*
NNM	263	**2.00**	1.9-1.95	-389	**-2.29**	2.65-2.7
KBM	267	**2.02**	1.65-1.7	-337	**-2.06**	2.3-2.35
RM	262	**2.17**	1.6-1.65	-341	**-2.17**	2.25-2.3
Mean	264			-355		

Step 5 involves assessment of sensitivity analyses using Gamma levels. As presented in Table 5 with the treatment effects Sensitivity analysis was conducted using Rosenbaum bounds to ascertain the robustness of the estimates. The higher the gamma levels, the more insensitive to hidden bias are the results. The goal is to determine how strongly an unmeasured variable must influence the selection process to undermine the implications of the matching process. The sensitivity analysis indicated that the estimated treatment effects

were insensitive to hidden bias with gamma values being from 1.9 to 1.95 for the nearest neighbor matching, 1.65 to 1.7 for kernel based matching and 1.6 to 1.65 for the radius matching in case of Kirinyaga. Estimated effects in Mbooni are even more insensitive to hidden bias with gamma values being from 2.65 to 2.7 for the nearest neighbor matching, 2.3 to 2.35 for kernel based matching and 3.25 to 2.3 for the radius matching. These value imply that, for instance in the case of Kirinyaga, nearest neighbor matching a gamma level of 1.9, if individuals that have the same X vector differ in their odds of participation by a factor of 90 percent, the significance of the participation effect on per capita calorie intake may be questionable. The implication is the same for the others. We can therefore conclude that even considerable amount of unobserved heterogeneity would not alter the inference about the estimated effects. In other words the average treatment effects are insensitive to hidden bias.

The final step involves checking the matching quality. The basic idea of this step is to compare the situation before and after matching and check if there remain any differences after conditioning on the propensity score. One suitable indicator of balancing powers of the estimations is ascertained by considering the reduction in the mean absolute standardized bias between the matched and unmatched models as shown in Table 6. The high percentage values of reduced standardized bias indicate the effectiveness of matching in reducing biases in the estimates. Pseudo R^2 from the propensity score estimation and from re-estimation of the propensity score after matching are also presented together with the P values of the likelihood ratio tests before and after matching. In all the different matching algorithms for the two areas, the joint significance of the regressors hypothesis, is always rejected after matching. However, the same hypothesis was never rejected at any significance level before matching, suggesting that there is no systematic difference in the distribution of covariates between adopters and non-adopters after matching in all the cases.

Table 6. Covariate Balancing Tests

Test indicator	Kirinyaga	Mbooni
Before matching		
Mean bias before matching	29.19	32.38
Pseudo R^2	0.1515	0.244
LR $\chi 2$ (P value)	35.22(0.000)	33.94(0.000)
After matching using nearest neighbor matching (NNM)		
Mean bias after matching	6.55	10.80
Percentage bias reduced	78	67
Pseudo R^2	0.05	0.05
LR $\chi 2$ (P value)	4.63(0.87)	7.95(0.44)
After matching using kernel based matching (KBM)		
Mean bias after matching	6.54	10.26
Percentage bias reduced	78	68
Pseudo R^2	0.02	0.03
LR $\chi 2$ (P value)	6.22(0.72)	5.46 (0.70)
After matching using radius matching (RM)		
Mean bias after matching	8.12	11.60
Percentage bias reduced	72	64
Pseudo R^2	0.03	0.04
LR $\chi 2$ (P value)	9.19 (0.42)	6.19(0.63)

4. Summary, Conclusion and Recommendations

Export horticulture farming can be considered a cash cropping system in Kenya. It is ranked third in terms of foreign exchange earnings after tourism and tea. The contribution of export horticulture to food intake and food security is less direct than that of domestic horticultural products and staple crops that are readily consumed in the farm household.

Available evidence in the debate of the impact of cash cropping system on food security shows mixed results. Both negative and positive impacts can be identified which vary with choice of cash crops and the situation in which they are being grown and marketed. Review of existing literature concludes that the available evidence is insufficient to draw strong policy recommendations. The current study contributed to the existing literature by assessing the impact of export horticultural farming, a major cash cropping practice in Kenya on the food intake of smallholder farmers, in Mbooni district in Eastern Province a semi-arid area and Kirinyaga district in Central district, which lies in the high potential zone as case studies.

Household per capita calorie intake was estimated using a seven-day recall method. Smallholder farmers in Mbooni were found to be consuming less than enough food while those of Kirinyaga were consuming enough. Participation in export horticulture farming had a positive impact in Kirinyaga but negative impact in Mbooni. The results of the two districts, which represent two diverse setting, can be generalized to represent their respective provinces and any other part in Kenya or in East Africa with similar characteristics.

Mbooni smallholder farmers' food consumption level for both growers and non-growers of export vegetables should be addressed. Holding all factors constant, promotion of export horticulture in the region may worsen the food insecurity situation. Alternative strategies to ensure food security at household and district level should be promoted as well as improvement of the road network, and irrigation in the area to ensure food and cash crops production and marketing systems are well functioning.

A comprehensive evaluation on farming systems and gross margins of different scales of export horticulture cultivation in Mbooni and probably other growing areas need to be carried out. It may be more profitable to participate in domestic horticulture and staple food production than engage in export horticulture farming in some areas considering the infrastructure and the lack of reliable food marketing systems. Further research should also consider assessing how income resulting from export horticulture farming is utilized as this could also contribute to food insecurity in a household. Considering the positive impact of participating in export horticulture production in Kirinyaga, on the per capita calorie intake, smallholder farmers in this district and others with similar agro-ecological and socio characteristics should be encouraged to participate in producing horticultural crops for the export market.

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