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Full Length Research Paper

Household food security in a commercialized subsistence economy: A case of smallholder tea famers in Nandi south district, Kenya

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Policies fronting commercialization of agriculture in Kenya assumed that realization of increased household incomes through cultivation of cash crops, would guarantee improved food security and subsequent reduction of poverty. However, most communities in Kenya growing cash crops still struggle to put food on the table. Population pressure has led to competition for limited land resource, coupled with unfavourable poverty indicators; they have impacted negatively on food access in the district. The focus of the study was on the population of smallholder tea farmers in Nandi South District of Kenya. The main objective was to investigate socio-economic factors influencing households' food security among smallholder tea farmers in the district. Multi-stage proportional-to-size cluster sampling was used to sample 165 households. Data was collected using both questionnaires and interviews. Translog Cost Function was used to specify the supply side factors influencing food security in the district. Household dietary diversity index (HDDI) had a positive correlation between the land size on maize and output. Months of adequate household food provisioning (MHAFP) also had positive correlation with tea income, outputs of maize and tea and their respective land sizes. Factors influencing household food security were; land productivity, off-farm income and land allocation to maize and tea, household characteristics: education, gender, and employment. Optimal allocation of land between tea and maize productions will guarantee household food security. Strategies aiming at increasing household food security should target increased access to inputs for food production and productivity of land and income diversification.

Key words: Food security, commercialization, smallholder tea farmers, Nandi south, Kenya.

INTRODUCTION

Agriculture in African is predominantly peasant. Smallholder farming plays a crucial role in food production for both rural and urban populations and remains a major source of income, employment, and export earnings (Krishna, 1977). Over time more and more people in these economies have shifted from a wholly subsistence farming to commercialized agricultural production. Adequate home production of food and/or adequate economic and physical access to foodare touted as major means through which household food security could be guaranteed. However, smallholder farming in less developed countries which is based on low-input and inefficient traditional farming practices coupled with population pressure on land have impacted negatively on sufficient food production. There is a general consensus from research findings and among policy makers that the future of food security and poverty

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poverty eradication in both the developing and less developed countries is hinged on commercialization of smallholder agricultural production (Jaleta et al., 2009; Massanjala, 2006; Nyaga and Doppler, 2006; Bouis andHaddad, 1990; Kennedy, 1988; Kennedy and Cogill, 1987; Braun et al., 1991; Govereha and Jayne, 2003). However, after several decades of commercialization in some parts of Africa, there seems to be no significant improvement in economic conditions and food security among commercialized smallholder farmers. Baer (1984) questioned the place of subsistence economies in agricultural strategies advocating for a shift to commercialization in developing nations. He pointed out that despite households engaging in market production they still experience a decline in food consumption and nutritional status. Most studies done in Africa have also established that whereas most households, who shifted to commercial crop production, realized increased incomes household nutritional status did not improve considerably (Stockbridge, 2007; Rubin, 1992; Kennedy and Cogill, 1988). Stockbridge (2007) asserts that despite significant improvement in household income, commercialization of subsistence economies could dramatically challenge household food security through increased child labour, gender roles and land tenure.

Tea subsector in Kenya, which is predominantly smallholder, is considered one of the success stories in Africa. However, despite realizing tremendous growth, the subsector is still characterized by resource poor farmers who seem to be caught in the vicious cycle of low investment, low productivity and low incomes. Most smallholder farmers in Kenya planted tea due to relatively high income it used to fetch, and they left no room for food crops and other undertakings such as livestock production. Estate smallholder land under tea production has persistently increased since Kenya got independent in 1963 from 21,448 to 141, 316 ha by 2005 (International Tea Committee, 2006). Smallholder farmers have converted most of their land into cash crop production while food crop production has been declining.

Nandi south district of Kenya is a maize deficit zone despite being 68% arable and having a good climate (GOK, 2005). Population pressure has led to competition for limited land resource, coupled with unfavourable poverty indicators; they have impacted negatively on food access in the district. More than 50% of the population lives below absolute poverty line. Maize production in 2005 was 43,767 MT accounting for over 98% of the total cereals produced in the district (MOA, 2005). Maize is by far the most important staple food crop in the region. The annual demand for the same period was estimated at 96,823 MT (GOK, 2005). Most households, in the division, derive nearly 50% of their incomes from cash crops with tea contributing over 70% of the total earnings (Livelihood Zones Data, 2003).

This paper examines the supply side socio-economic factors affecting household food security among smallholder tea farmers in Nandi south district.

MATERIALS AND METHODS

Theoretical model

Based on the theory of the firm, farms are considered as competitive commercial firms. The basic assumption of the theory is that farmers maximize profits, subject to the technical constraints imposed by their physical production functions (Varian, 1992). Firms make output and input decisions on the basis of input and output prices. The technology is also smooth, convex and exhibits decreasing returns to scale. Two approaches can be used to model agricultural production: the direct and the dual approach (Zaloshnja, 1997). In the direct approach, the production function must be specified in order to derive input demand and product supply functions. The dual approach requires that we specify cost (or profit) function, from which input demand and output supply functions are derived, without *a priori* specifying the production function. The second approach is by far the most used in the literature in recent years since it has several advantages. First, it provides a convenient way to obtain supply and demand equations, which is consistent with traditional (primal) economic theory. Secondly, the dual approach is useful in generating a functional specification for supply and demand equations for econometric estimation (Zaloshnja, 1997).

Finally, the approach provides a sound theoretic approach for using price and cost data to estimate a consistent set of factor demand equations. Besides, the production functions are largely unobservable since the data points will represent a sampling of input and output levels that will have taken place at different times, as factor or output prices change (Silberberg, 1990). Smallholder tea farmers in Nandi south mainly produce maize for subsistence since farmers have diverted more resources into tea production; large share of tea income is used to buy food. Profit function may not be appropriate in modeling farm households in Nandi south district. Since maize is exclusively produced for home consumption, it will make more sense to assert some functional form of the cost function so that costs could be estimated directly. Assuming that the cost function satisfies some elementary properties such as linear homogeneity and concavity in the factor prices, justify the fact that some real unique underlying production function exist. Therefore, the cost function will be more plausible, in view of the fact that, while producing all the outputs, farmers strive to allocate resources in an attempt to minimize input costs (Silberberg, 1990).

Empirical model

The functional forms that may be chosen to model producer behaviour include: Cobb-Douglas (Strauss, 1986; Varian, 1992), CES (Arrow et al., 1961; Denny, 1974), Leontief functions (Fuss Melvyn and McFadden Daniel, 1978; Hall, 1998) and Translog functions (Christiansen et al., 1973). Cob-Douglas function is commonly used in modeling producer behavior. It is the simplest, but at the same time, the most restrictive functional form. The maintained hypothesis of a model based on a Cobb-Douglas production, cost, or profit function is that the elasticities of substitution between input pairs are equal to unity for all input pairs over the entire input space. It is this property of Cobb-Douglas functions, among others, that has led econometric modellers to seek more flexible forms (Zaloshnja, 1997). Another simple but somewhat less restrictive function used in empirical studies is the constant elasticity of substitution (CES) function. This function is less restrictive than the Cobb-Douglas because elasticities of substitution between input pairs, although they remain constant over the entire input space; they are not constrained to equal one. On the other hand, while the Cobb-Douglas is very convenient for econometric estimation, the CES function is difficult to estimate because it is non-linear in parameters. The Leontief production function is easy to estimate since only factor shares are needed to estimate the function, but limited input substitution restrict its applicability.

Translog functional forms are of more recent vintage and belong to a class of flexible functional forms (Zaloshnja, 1997). They are pliant enough to capture all the distinct economic effects (Hall, 1998). The translog production function and the translog cost function do not generally correspond to the same technology, although they can be regarded as close approximations for the same technology. Although it is impossible to provide an explicit solution to the underlying production function mathematically (Christensen et al., 1973). The translog cost function has the advantage of flexibility of specification and can be applied to multiproduct, multifactor production.

Thus, the Translog cost function is most useful in studies of factor demand and product supply. Translog cost function is considered a second-order Taylor's series approximation in logarithms to an arbitrary cost function (Christiansen et al., 1973; Banda and Verdugo, 2007). A more general specification of the Translog cost function imposes no prior restriction on the production structure. It does not impose neutrality, homotheticity, homogeneity, constant returns to scale, or unitary elasticities of substitution; in effect it allows us to test these alternative production configurations. The function is specified as:

$$\ln C = \alpha_0 + \sum_{i=1} \alpha_i \ln P_i + \frac{1}{2}\sum_{i=1}\sum_{j=1} \gamma_{ij} \ln P_i \ln P_j + \alpha_y \ln Q + \frac{1}{2}\gamma_{yy}(\ln Q)^2 + \sum_{i=1} \gamma_{ij} \ln P_i \ln Q, \quad (1)$$

Where $i, j = 1, \dots\dots, N$ index of the N different inputs considered and $\gamma_{ij} = \gamma_{ji}, C$ is total cost, Q is output and Pi's are the prices of the factor inputs. A well behaved cost function must be homogeneous of degree one in prices, meaning that, for fixed level of output, total cost must increase proportionally when all prices increase proportionally (Verdugo, 2007). Therefore, the restrictions (2), (3) apply on Equation (1).

$$\sum_{i=1} \alpha_i = 1, \sum_{i=1} \gamma_{iy} = 0, \quad (2)$$

$$\sum_{i=1} \gamma_{ij} = \sum_{j=1} \gamma_{ij} = \sum_{i=1}\sum_{j=1} \gamma_{ij} = 0 \quad (3)$$

Homotheticity means that the cost function can be written as a separable function of output and factor prices (Truett et al., 1994; Banda and Verdugo, 2007). For homotheticity, therefore, it is necessary and sufficient that:

$$\gamma_{iy} = 0, \forall_i \quad (4)$$

If the elasticity of cost with respect to output is constant, then the cost function will be homogeneous in output, giving the following restrictions:

$$\gamma_{iy} = 0, \qquad \gamma_{yy} = 0, \quad (5)$$

Following Shepard's Lemma, the derived demand for an input is obtained by partially differentiating the cost function with respect to input prices to obtain cost-share equations as follows:

$$\frac{\partial \ln C}{\partial \ln P_i} = \frac{P_i}{C}\frac{\partial C}{\partial P_i} = \frac{P_i X_i}{C} = \alpha_i + \sum_{j=i} \gamma_{ij} \ln P_j + \gamma_{ij} \ln Q, \quad (6)$$

where:

$$\sum_{i=1} P_i X_i = C \text{ if } S_i \equiv \frac{P_i X_i}{C}, \text{ then } \sum_{i=1} S_i = 1 \quad (7)$$

The necessary restrictions given by Equations (2) and (3) are imposed to the constraint:

$$\sum_{i=1} S_i = 1 \quad (8)$$

That implies that only N-1 of share equations in Equation (6) are linearly independent. From the estimated coefficients, we can construct partial elasticities of substitution between two factors i and j (Uzawa, 1962). Elasticities will help to describe the pattern and degree of substitutability and complementarity among factors of production for example the percentage change in factor proportion due to a one-percent change in their relative prices is given by:

$$\sigma_{ij} = \frac{\gamma_{ij}}{S_i S_j} + 1 \qquad \text{for } i \neq j \quad (9)$$

Following Nyangweso et al. (2007), the intercept of Equation (9) is augmented in order to allow for the influence of household characteristics, factors of production and environmental factors:

$$\boldsymbol{S} = \alpha_i + \sum_{j=i} \gamma_{ij} \ln \boldsymbol{P}_j + \gamma_{ij} \ln \boldsymbol{Q} + \vartheta \boldsymbol{G} + \omega \boldsymbol{Z} + \phi \boldsymbol{H} + \varepsilon \quad (10)$$

where: S $\equiv$ a vector of share of survey year cost on each input i of total input cost. $\boldsymbol{P} \equiv$ a vector of input prices, $\boldsymbol{Q} \equiv$ a vector of household characteristics and maize output, $\gamma_{ij} \equiv$ Parameters to be estimated, $\boldsymbol{G}, \boldsymbol{Z}$ and $\boldsymbol{H}$ are vectors of farm household characteristics, factors of production and environmental factors together. $\boldsymbol{\alpha}, \boldsymbol{\gamma}, \boldsymbol{\vartheta}, \boldsymbol{\omega}, \boldsymbol{\emptyset},$ the parameters to be estimated, while ε is the error term.

During the survey period, input prices are assumed to have relatively constant variation over the period. This will subsequently reduce the model to be estimated to:

$$\boldsymbol{s} = \alpha + \gamma \ln \boldsymbol{Q} + \Gamma \boldsymbol{G} + \phi \boldsymbol{Z} + \vartheta \boldsymbol{H} + \varepsilon \quad (11)$$

Table 1. Distribution of respondents across the clusters.

	Cluster	Estimated number of tea farmers	Sample proportion
1	*Kaptien*	818	56
2	*Kosoiywo*	432	30
3	*Siret*	388	30
4	*Kaplelment*	411	35
5	*Kapsimotwo*	468	32
	Total	2517	180

Source: Authors survey, 2009. Data types and sources. 1 ha = 2.4711 acres.

Sampling procedure

All smallholder tea farm households in Nandi south district were targeted. A multi-stage proportional-to-size cluster sampling involving four stages was used. Since Nandi hills division constituted majority of households engaged in mix farming with tea being the major cash crop in the area, it was purposively selected. The households were then clustered into five groups based on their geographical locations. The clusters included *Kaptien, Siret, Kosoiywo, Kaplelmet* and *Kapsimotwo* clusters (Table 1). The number of respondents from each cluster was then obtained by determining the proportion of total number of households supplying their tea leaves to various tea estates in the district against the desired sample size of between 150 and 180 households. Finally, households surveyed from each cluster were picked systematically at an interval of four households to obtain at least a sample size of 30 from each cluster which is considered acceptable for making any statistical inference.

Smallholder tea households owning less than 4.05 ha of land on tea production were surveyed. Both primary and secondary data were used. Primary data was collected through a household survey. Data collected included household characteristics, production factors, household dietary diversity data, geographical factors and environmental factors. Household characteristics data comprised mainly age in years, gender, type of employment, education level of head of household, household size and nutritional knowledge. Production factors included land size in hectares allocated to various farm enterprises and their respective yields, quantities of input use in production comprising labour; family and hired labour, fertilizer, seeds, pesticides as well as weeding and land preparation costs. Household dietary diversity data included quantities and household expenditure on food commodity groups such as, cereals, white roots and tubers, vegetables, fruit, meat, eggs, fish, legumes, nuts and seeds, milk, oils and fat, spices, beverages and miscellaneous. Other data collected included the months in a year in which the households considered to be difficult in providing adequate food to the household, the off-farm and on-farm income, food transfers from friends and relatives, Savings, access to credit facilities, and cooperative membership, geographical location and distance to the nearest market in kilometres. Secondary data was obtained by perusing annual agricultural reports, economic surveys, statistical abstracts and development plans.

Instruments of data collection

Both interviews and questionnaires were used as instruments for data collection. Interviews were used to supplement the questionnaires. Household surveys were administered using the questionnaires while interviews were used on key informants in the district. To validate survey instruments, 10 questionnaires were pre-tested on some household respondents and key informants in the division. The instrument was then reviewed and corrected as necessary. Five enumerators were recruited and trained to assist in administering the questionnaires on households.

Data analysis

The survey questions were numerically coded and responses stored in computer spread-sheet software, Microsoft Excel Version 2007. Descriptive statistics; bar charts, histograms and measures of central tendency were used to describe existing relationships between household variables. The data on household dietary diversity and the household information on food provisioning were used to capture the factors of household food security. Correlation analysis was applied to measure the correlation of the variables and two indices measuring household food security. The indices were household dietary diversity index (HDDI) and months of adequate household food provisioning (MHAFP) multiple regression analysis was used to estimate factors influencing household food security among smallholder tea farmers in Nandi south district Kenya from the survey data using statistical package for social sciences (SPSS) version 16.0 software. Before the analysis, key econometric assumptions were considered and tested as necessary.

RESULTS AND DISCUSSION

Figure 1 shows that, from months of adequate household food provisioning scale (MAHFP), 57% of the households in Nandi south had experience of household food insecurity for an average of four months in the course of the year. Majority of farmers' households face food shortage during the moths of April, May, June and July. These are the periods coinciding with the long rainy season when farmers are planting maize and the tea output is also expected to be high during the season. During these periods farmers can only access food through markets which will be largely dependent on the tea incomes.

From the results, fertilizer constitutes the largest cost shares of farm input followed by labour, seeds and herbicides their cost shares are 41, 37, 19 and 3% respectively in Figure 2. Hired labour for general land preparation constituted 18% of the total cost of production while ploughing and weeding were 12 and 7% respectively. All farmers applied DAP (Diamonium Phosphate) in the amendments of soil for maize

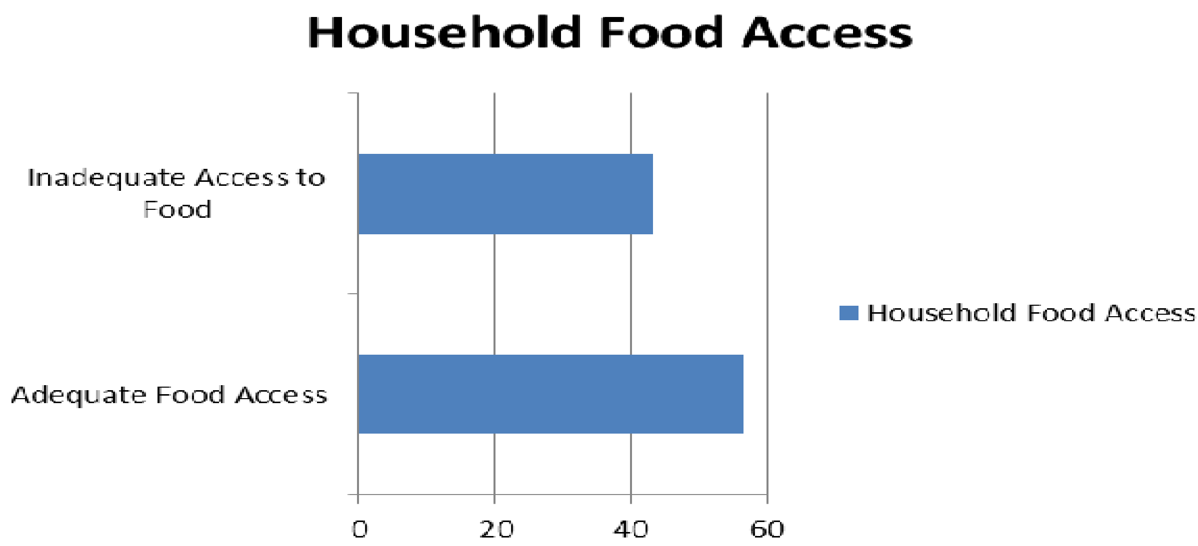

Figure 1. Months of adequate household food provisioning. Source: Author's survey data, 2009.

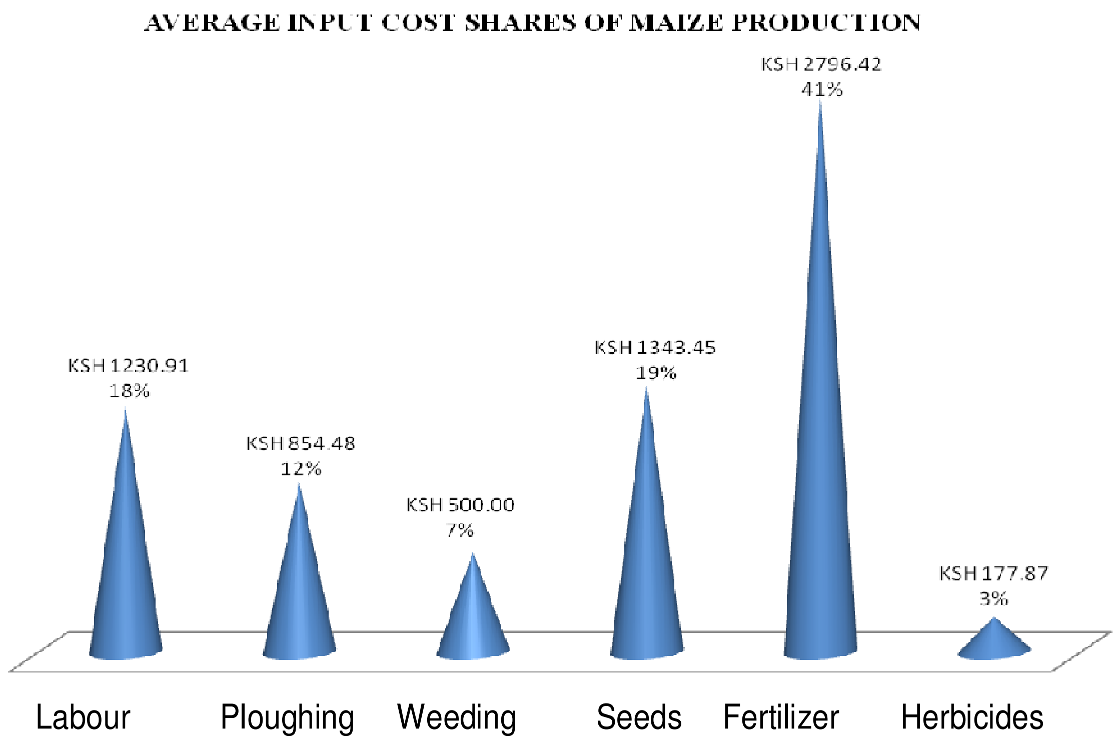

Figure 2. Input cost shares. Source: Author's Survey Data, 2009.

production while CAN was used mainly for tea.

Figure 3 presents the scale of production and enterprise allocation between food production (maize) and cash crop production (tea); the trend shows that maize and tea compete together for land resource. But generally tea production has taken the prominence among these farmers. The trend of land resource allocation demonstrates a lot of similarity across all the scales of production. Majority of farmers give more preference to cash crops and subsequently reallocation of resource, consequently more land is put on tea production and less on maize production.

Results (Figure 3) show that about 70% of respondents own less than 5 acres of land, 22% owned a land size

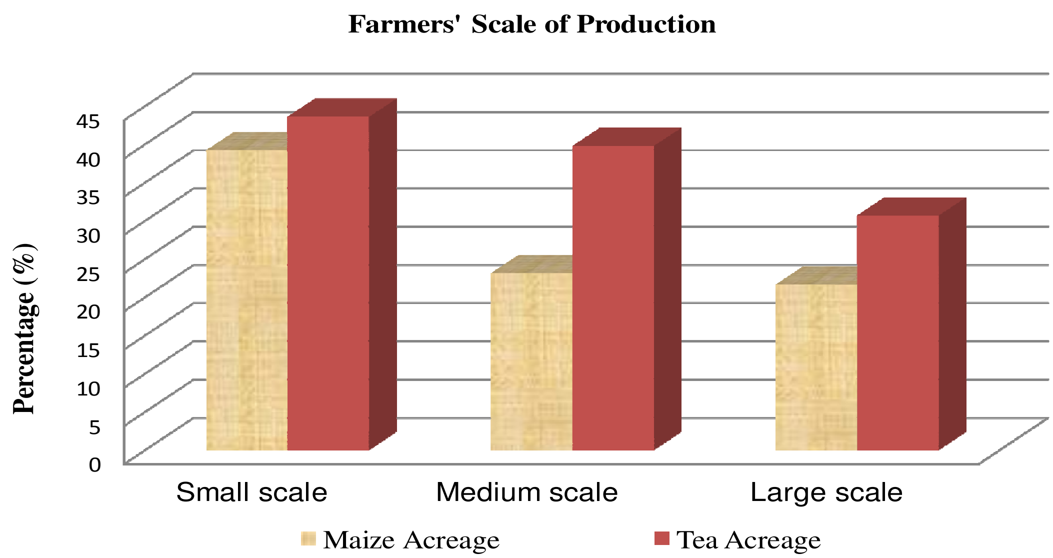

Figure 3. Pattern of land and enterprise allocation of tea farmers in Nandi south. Source: Author's survey data (2009).

more than 2.02 ha but less than 4.05 ha, while only 8% had a land size between 4.05 and 8.05 ha. The graph shows that in small, medium and large scale production a larger proportion of land is allocated to tea implying competition between tea and maize for land resource. The graph also shows that as the scale of production increases the proportion of land allocated to both tea and maize decreases implying that small scale farmers allocate a larger proportion of their land to tea and maize while the large scale farmers diversify their production.

Correlation Table 1 shows a positive correlation between the HDDI and the size of land allocated to maize production and the scale of maize production, but there was no significant correlation between HDDI and the income from tea production and the size of land allocated to tea. The findings imply that household dietary diversity improves tremendously due to increased scale of staple food (maize); however, there was no such evidence for increased scale of tea production and the cash crop incomes. MAHFP had positive Correlation Table 3 with tea income, output of maize and tea, and land size allocated to tea and maize. The findings imply that household's optimal trade-off between cash crop and food crops may guarantee some stability of food supply throughout the year. Whereas increased incomes from tea production may provide stability of household food access, households who produce most of its food are more food secure. Access to food through markets is challenging to most households since basic needs must be met before considering dietary quality of food. Therefore the households accessing food through markets may go for quantity rather than quality food as compared to the households who produce more food at home (Correlation Table 2). Households producing more food will use any extra income to complement household food diets from the market.

Table 1 (Appendix 1) presents parameter of the constraints to household food supply. The results indicate that the cost-shares of weeding are significantly influenced by the scale of food production. As the scale of food production increases total cost share of weeding declines showing that farm households substitute labour for weeding with herbicides as it becomes uneconomical to continue engaging hired labour for weeding.

Gender, education level, employment, and off-farm income had a significant influence on input cost shares for some inputs with varied results. Gender of head of household significantly influenced the cost of fertilizer, ploughing, weeding, and seeds. Male headed households were found to spend less cost on fertilizer, ploughing and weeding, while female headed households were spending less cost on seeds. Education level had a significant influence on the cost of herbicides. A more educated head of household tend to favour the use of herbicides than their less educated counterparts. Household employment had either positive or negative sign since it is a source of income for the household and at the same time it competes with demand of labour for food production. Employment of head of household had a positive and significant influence on the cost of weeding and the overall cost of food production; employment being a source of alternative income enables the households to engage more labour for weeding. Overlay employment of head of household influence the total cost of input use in food production. Off-farm income influenced the cost of general labour, fertilizer and ploughing. As the off-farm income increases the cost of labour, fertilizer and ploughing significantly diminish.

These results imply that households who depend on off-farm income incur less cost than those who depend on farm income.

Land size allocated to maize and tea production and the geographical terrain of the farm had significant influence on all the cost shares of inputs used. Increase land size on food production increases the costs of all the inputs this imply that farmers apply increased levels of inputs as the scale of food production increase. Land size on tea also influenced the cost shares of all the inputs used. As the land size on tea increases the input cost of all the inputs considerably increase. The geographical location influenced the costs of inputs; this may be attributed to the soil conditions and soil conservation practices. Households in the hilly locations experience increased cost of inputs while those in less hilly locations enjoy less input costs.

CONCLUSIONS AND RECOMMENDATION

This study established that socio-economic factors indeed had significant influence on household food security among smallholder tea farmers in Nandi south district. Supply side constraints influencing household food security among smallholder tea farmers included scale of food production, gender of head of household, education, employment, of-farm income, land size on tea, maize and the geographical location. These results lead to the conclusion that household food security is constrained by supply side factors. Household access to enough food is highly dependent on household characteristics, production characteristics, household resource allocation among several farm enterprises and environmental factors.

HDDI had a positive correlation with the scale of food production and no significant correlation with the scale of tea production nor farm incomes. However, MAHFP had a positive correlation with both the scale of food production and tea production and farm incomes.

Increased production of staple food (maize) and efficient allocation of land resource between tea and maize is likely to guarantee household food security. Households should also maintain a reasonable size of land while increasing tea production. The findings alsoestablished that households are likely to realize increased food security if they apply standard levels of inputs to increase their per-capita output. Increased application of fertilizer on maize would significantly increase per unit output which consequently provides adequate supply of food throughout the year. This implies that even though a shift to cash crop improves household food security, it may be necessary but not sufficient to pledge household food security in the long run. Households who enjoy off-farm income beside farm income are likely to be food secure throughout the year than those who depend mainly on farm income.

These results highlight the centrality of supply side factors in guaranteeing household food security. To achieve a sustained improvement in household food security among smallholder tea farmers, the longer-term structural causes, especially the potential of productive resources and diversification of farm output and income sources should be prioritized through broad-based agricultural and rural development programmes.

Successful policies and interventions should be targeted at ensuring that all households have the means to produce enough food. Ministry of Agriculture in Kenya should design policies promoting household food security among smallholder cash crop producers by targeting increased access to inputs for food production.

Further research is recommended on the impact of household labour use in cash crop production; especially women and children, on the nutritional and households' food security.

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Appendix

Table 1. Parameters of estimated inputs.

Input i	Constant A	Maize output γ	Depd. ratio ϑ_{i1}	Gender Of H. head ϑ_{i2}	Education ϑ_{i3}	Employment ϑ_{i4}	Off-farm income ϑ_{i5}	Land size on maize ω_{i1}	Land size on tea ω_{i2}	Geogr. Terrein $\emptyset_{i1}$	Market access $\emptyset_{i2}$	Credit access $\emptyset_{i3}$	R	R^2
Labour	-253.052[a]	-12.649	42.263	-419.655	-33.44	72.249	-0.033[c]	532.262[a]	145.577[b]	-10.984	4.566	48.938	0.777[a]	0.603
Fertilizer	924.696[a]	-173.685	42.263	-419.655[c]	-33.447	72.249	-0.033[c]	532.262[b]	145.577[b]	-10.984	4.566	48.938	0.923[a]	0.851
Ploughing	1294.397[a]	-181.220	-94.758	-696.185[c]	47.390	215.469	-0.057[b]	651.612[a]	178.141[b]	-368.536[a]	36.820[c]	200.111	0.660[a]	0.436
Herbicides	972.369[a]	-303.487	-83.792	-270.730	147.420[c]	161.247	-0.004	381.892[a]	190.282[a]	-83.005[c]	-4.856	-252.235	0.582[a]	0.338
Weeding	1912.404[a]	-380.704[c]	-57.481	-511.438[b]	-90.926	459.241[a]	-0.026	390.719[a]	163.868[a]	-283.158[a]	9.355	-69.092	0.680[a]	0.463
Maize seeds	-797.622[a]	271.362	-14.918	384.793[c]	32.403	88.300	0.000	1017.111[a]	-110.330[b]	17.517	-1.601	-118.937	0.800[a]	0.640
Total cost	4038.219	-799.542	-249.710	-1373.327[c]	252.345	1401.570[b]	-0.102	4743.779[a]	957.299[a]	-965.454[a]	22.497	-380.503	0.920[a]	0.847

[a] denotes significance at 1% level, [b]at 5% and [c]at 10%.

Table 2. Correlation tables of dietary diversity index with socio-economic variables.

	Correlation									
	HDDI	**EXPD**	**GHH**	**LNDTEA**	**LANDMZE**	**OUTPUT(M)**	**OUTPUT(T)**	**LANDLVSTK**	**LNFAMY**	**OFFY**
HDDI	1	0.126	0.048	0.075	0.179*	0.246**	0.095	-0.061	0.107	0.119
EXPD	0.126	1	-0.034	0.187*	0.152	0.142	0.259**	0.132	0.251**	-0.027
GHH	0.048	-0.034	1	-0.038	-0.014	0.044	-0.093	-0.087	-0.047	0.005
LNDTEA	0.075	0.187*	-0.038	1	0.449**	0.475**	0.664**	0.337**	0.608**	-0.025
LANDMZE	0.179*	0.152	-0.014	0.449**	1	0.853**	0.451**	0.357**	0.402**	0.125
OUTPUT(M)	0.246**	0.142	0.044	0.475**	0.853**	1	0.490**	0.316**	0.394**	0.160*
OUTPUT(T)	0.095	0.259**	-0.093	0.664**	0.451**	0.490**	1	0.164*	0.693**	0.054
LANDLVSTK	-0.061	0.132	-0.087	0.337**	0.357**	0.316**	0.164*	1	0.281**	0.019
LNFAMY	0.107	0.251**	-0.047	0.608**	0.402**	0.394**	0.693**	0.281**	1	0.070
OFFY	0.119	-0.027	0.005	-0.025	0.125	0.160*	0.054	0.019	0.070	1

*. Correlation is significant at the 0.05 level (2-tailed).**. Correlation is significant at the 0.01 level (2-tailed).

Table 3. Correlation tables of MAHFP with socioeconomic variables.

	Correlation										
	MAHFP	**PRDFD**	**MKTFD**	**GHH**	**LNDTEA**	**LANDMZE**	**OUTPUT(M)**	**OUTPUT(T)**	**LANDLVSTK**	**LNFAMY**	**OFFY**
MAHFP	1	0.230**	0.334**	0.074	0.212**	0.365**	0.369**	0.202**	0.014	0.290**	0.168*
OWNPRDFD	0.230**	1	0.071	0.129	0.095	0.144	0.171*	0.075	-0.073	0.157*	0.075
MKTFD	0.334**	0.071	1	-0.021	0.091	0.157*	0.225**	0.153*	0.019	0.096	0.157*
GHH	0.074	0.129	-0.021	1	-0.038	-0.014	0.044	-0.093	-0.087	-0.047	0.005
LNDTEA	0.212**	0.095	0.091	-0.038	1	0.449**	0.475**	0.664**	0.337**	0.608**	-0.025
LANDMZE	0.365**	0.144	0.157*	-0.014	0.449**	1	0.853**	0.451**	0.357**	0.402**	0.125
OUTPUT(M)	0.369**	0.171*	0.225**	0.044	0.475**	0.853**	1	0.490**	0.316**	0.394**	0.160*
OUTPUT(T)	0.202**	0.075	0.153*	-0.093	0.664**	0.451**	0.490**	1	0.164*	0.693**	0.054
LANDLVSTK	0.014	-0.073	0.019	-0.087	0.337**	0.357**	0.316**	0.164*	1	0.281**	0.019
LNFAMY	0.290**	0.157*	0.096	-0.047	0.608**	0.402**	0.394**	0.693**	0.281**	1	0.070
OFFY	0.168*	0.075	0.157*	0.005	-0.025	0.125	0.160*	0.054	0.019	0.070	1

*. Correlation is significant at the 0.05 level (2-tailed). **. Correlation is significant at the 0.01 level (2-tailed).,food expenditure; GHH, gender of head of household; LNDTEA, size of land under tea production in acres; LANDMZE, land size under maize production; OUTPUT(M), maize output in metric tones; OUTPUT(T), tea output in metric tones; LANDLVSTK, land size allocated to livestock production; LNFAMY, Log off-farm income; OFFY, Off farm income; OWNPRDFD, food produced at home; MKTFD, food obtained from the market.