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ABSTRACT

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 are currently struggling to put food on the table. Nandi South is a maize deficit zone despite being 68% arable and having 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. Specifically significant is smallholder tea population in Nandi Hills division. The study focused the population of smallholder tea farmers in Nandi South who supply their tea leaves to the Multinational tea estates. The main objective was to investigate the factors influencing households' food security among smallholder tea farmers in Nandi South. A modified Almost Ideal Demand System (AIDS) was used to model food demand of the smallholder households. Multi-stage proportional-to-size cluster sampling was used to sample 180 households. Data was collected using both questionnaires and interviews. Results point out that income, savings, food storage, land productivity, off-farm income, ratio of land allocated to tea significantly influence household food security. Policies that aim at improving household food security among smallholder cash crop farmers should target at increasing and diversifying household income sources and farm enterprises, provision of saving opportunities, storage facilities and proper allocation of land resource between cash crops and food crops.

Introduction

Background

A guarantee of household food security requires adequate home production of food and/or adequate economic and physical access to food; economic access is the adequate purchasing power of the household, while physical access refers to the proximity to markets or other distribution channels through which food may be acquired (WFD, 1989). Underutilization,

inefficient or non-use of available resources and lack of maximum benefits from the available resources significantly contribute to poor economic conditions in Africa. Smallholder farming based on low-input and traditional farming practices coupled with rapid population growth have negatively impacted on sufficient food production. The steady decline in production is further exacerbated by frequent droughts and the devastations of civil strife leading to increased hunger and poverty (Rutto, 2008). According to FAO, despite improvement in overall daily food consumption levels, the number of chronically undernourished people in sub-Saharan Africa is projected to rise to nearly 300 million by the year 2010, which is about one-third of the projected population. Notwithstanding a projected annual agricultural growth rate of 3.0% by 2010, it will scarcely keep pace with the food demand of the growing population. On average, Africa spends \$18 billion on food imports; this is also projected to double to more than 20 million tones a year by 2010. This is further compounded by post harvest losses of food grains which are estimated at 25% of the total crop harvest.

Developing countries face a number of risks associated with trade. Generally known is declining terms of trade, as the world prices of the primary commodities they export tend to fall over time relative to the prices of the manufactured goods they import. A related problem is the volatility of world prices for the primary (especially agricultural) commodities they export. Furthermore, these prices are determined in markets beyond the influence of individual poor farmers and typically affected by factors beyond their control. Related to this are supply side risks of their exports and demand side risk of food, especially the sensitivity of output to climatic variability and rising food prices. Droughts, frost, excess rain and hailstorms can cause serious damage to agricultural output.

Tea subsector in Kenya is predominantly smallholder, characterized by resource poor farmers who seem to be caught in the vicious cycle of low investment, low productivity and low incomes. These farmers also face various exogenous risks emanating from the biophysical and socio-economic environment in which they operate. These risks, coupled with farm specific resource endowments and constraints affect the level and variability of household incomes and subsequently access to household nutritional requirements.

Nandi South 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 food crop in the region. The annual demand for the same period was estimated at 96,823 MT (GOK, 2005). This indicates that the district's own production can only last for five months (between November and May). It therefore relies on imports from neighboring districts of Nandi North and Uasin Gishu districts. Apart from the traditional foods, maize and milk, there is little diversification for home consumption and nutritional deficiencies are rampant in the district coupled with poor nutritional knowledge. Malnutrition in the district is also associated with inadequate facilities in major sectors such as water and health. Specifically significant is the population under mixed: horticultural/tea/livestock livelihood zone in Nandi Hills division where there is greater reliance on market for foodstuffs consumed. Nearly 80% of foods consumed by households under the zone are obtained from the markets (WFP/ALRMP/FEWSNET, 2003). The division also has the highest proportions of the poor with corresponding counts of 59% and 57%. Under-utilization and inequitable distribution of resources, high cost of farm inputs, poor and inadequate education, unemployment (8.8%), lack of ownership of projects, poor infrastructure and culture, and inaccessibility to credit are the major causes of poverty in the district. Oblivious of the risks and uncertainties imminent in tea subsector, farmers continue to increase land size on tea production at the cost of food production.

The Households, in the division, derive nearly 50% of their incomes from cash crops with tea contributing over 70% of the total earnings. Households' food entitlement in this division is therefore trade base. Attainment of household's food access, consequently, is highly constrained, through demand side, by household's incomes earned from tea. Tea also competes with maize for farm resources. The households' purchasing power have been eroded by relatively static and low tea prices in international market over time, coupled with increasing food prices and input costs. For the last two decades, international export prices of tea have been fluctuating putting households' food access in the district at risk. Since the household livelihoods are integrated to both national and international markets, inflation rates and other macroeconomic shocks significantly impact on household income. Consequently food security is not guaranteed by any increased cash crop produced. Tea is also highly dependent on weather conditions. During dry periods low output of tea leaves together with high food prices squeezes the household purchasing power.

A shift from food production for home consumption to cash crop production presents a better opportunity to peasant households to increase their incomes and subsequent access to wider household dietary needs. However, persistent negative poverty indicators coupled with poor household nutrition underscore the need to identify the underlying causes. Dietary

determinants will aid in understanding the factors influencing household food security among smallholder tea farmers in Nandi South District, Kenya. This paper has been subdivided into five sections. Section one is a general introduction and exposition of the problem, section two reviews and presents the model used to estimate the parameters. Section three gives the methods and materials used to collect data while sections four and five contain results and discussions, and conclusions and recommendations respectively.

Modeling Consumer Behaviour

Food demand analysis describes and explains the level of demand for food commodities an individual consumes, given the structure of relative prices faced, real income, and a set of individual characteristics. A set of elasticities give important results of food demand analysis. Consumer theory assume that consumers choose a consumption bundle x , so as to maximize utility $u(x)$ subject to their budget constraint $m = px$ such that the optimal consumption bundle x^* depends on the prices of goods p and the available income m (Varian, 1992 and Nicholson, 2001). The utility maximization problem for the consumer is given by;

$$\begin{aligned} & \max_{x \geq 0} u(x) \\ & \text{s.t. } px \leq m \end{aligned} \quad (1)$$

Assuming that $p > 0$, $m > 0$ and $x \in \mathbb{R}^n_+$. The above solution is given by $x(p, m) = g(p, m)$, this is basically a primal preference problem also referred to the Marshallian demand equations. It is, however, difficult to derive compensated demand functions empirically from utility maximization. A different, but related problem would be to minimize expenditure, subject to a minimum level of utility (u^* from utility maximization problem). This is plausible since smallholder tea farmers while addressing their dietary needs they try to minimize their expenditure. By substituting the optimal values of the decision variables x into the utility function we obtain the indirect utility function.

$$u(m, p) = \max_x [u(x) : px = m] \quad (2)$$

The indirect utility function specifies utility as a function of prices and income. The indirect utility function is homogeneous of degree zero in prices and income, therefore a more useful fashion given by as follows.

$$u(m, p) = \max_x [u(x) : \left(\frac{p}{m}\right)x = 1] \quad (3)$$

$$= \max_x [u(x) : qx = 1, q = \frac{p}{m} = \left\{ \frac{p_1}{m}, \frac{p_2}{m}, \dots, \frac{p_n}{m} \right\}] \quad (4)$$

$$= \max_x [u(x) : qx = 1] \quad (5)$$

$$-\psi(q) \quad (6)$$

Dual to the utility maximization problem is the expenditure (cost) minimization problem. Consumers' expenditure (cost) functions: $m(u, p)$ give the minimum expenditure required to attain a specific utility level at given prices

$$\begin{aligned} \min_m m &= px \\ \text{s.t. } v(x) &= u \end{aligned} \quad (7)$$

The solution to equation 12 gives the Hicksian demand functions $x = h(u, p)$. The Hicksian demand equations are sometimes called "compensated" demand equations because they hold u constant. The solutions to the primal and dual problems coincide in the sense that

$$x = g(p, m) = h(u, p) \quad (8)$$

For the dual problem the indirect objective function is

$$m = \sum_{j=1}^n (p_j h_j u, p) = c(u, p) \quad (9)$$

This is the expenditure (cost) function which specifies expenditure or cost as a function of prices and utility. Because $c(u, p) = m$, we can rearrange or invert it to obtain u as a function of m and p . This will give $\psi(m, p)$. Similarly inversion of $\psi(m, p)$ will give $c(u, p)$. Expenditure functions are commonly utilized instead of utility since it is more convenient to deal with empirically.

Selection and Specification of Consumption Model

Estimation of single demand equation is not fully consistent with economic theory. Complete systems are needed to be consistent with the theory, but trade-off between cost of estimation and theoretical foundation is essential. Complete systems are particularly important when used in general equilibrium models, and complex simulation exercises. Different systems of approaches can be used that differ in their specification of the utility function and additional assumptions (Ecker, 2006). Different demand and production systems have been used to estimate agricultural household model; (Strauss, 1986) used Quadratic Expenditure System (QES). Despite meeting neoclassical restrictions, QES is limited by semi-definiteness of the Slutsky matrix. Singh, et al (1986) used Almost Ideal Demand System (AIDS) to derive consumer demand equations of agricultural household model. Kachova and Chern, (2004) examined a nonnested test of comparison between the quadratic expenditure system (QES) and the Almost ideal demand system (AIDS). In determining which model is more suitable, they analyzed the value of significance of the common coefficients of the two models. By use

of specific database they concluded that AIDS is more suitable model than the QES, especially when one is interested in food demand structure. AIDS model is also a popular model for estimating demand system over other methods; Linear Expenditure System is excessively restrictive to the assumptions while AIDS is more robust, less restrictive, inexpensive and suitable for cross-sectional household data. AIDS belong to a class of demand systems that are derived from a class of indirect utility functions (Deaton and Muellbauer, 1980).

$$w_t = \alpha_t + \sum_i \gamma_{ti} \log P_i + \beta_t \log(x/P) + \mu_t \quad (15)$$

Where P is the price index defined by: $\log P = \alpha_0 + \sum_i \alpha_i \log P_i + 1/2 \sum_i \sum_j \gamma_{ij} P_i \log P_j$

Where P_i is the price of food i , w_t is the expenditure share of food i , and x is the total expenditure. The parameters α, β, γ imposed are tested to meet the following conditions:

$$\sum \alpha_i = 0 \quad \sum \gamma_{ij} = \sum \gamma_{ji} = 0 \quad \sum \beta_i = 0 \quad \gamma_{ij} = \gamma_{ji}$$

But within a survey period the prices for most foods are found to be approximately constant, therefore, it renders the model to the following form:

$$w_t = \alpha_t^* + \beta_t \log(x) + \mu_t \quad (16)$$

Where $\alpha_t^* = \alpha_t + \sum_i \gamma_{ti} \log P_i - \beta_t \log P$

Following Deaton and Muellbauer (1986) income is expressed per capita using simple headcount of household members and the intercept in the model is augmented to allow for influence of household composition. For consistency with farm household model, Strauss (1986) replaced the total expenditure on food x with full income in a Quadratic Expenditure System. Nyangweso et al, (2007) modified the AIDS model by replacing the expenditure share for food (w_t) with household dietary diversity index (HDDI) which reflects the value attached to the quality of food consumed by the household. Food diversity in the household diet is an important indicator to food security (FAO, 2005). The indicator is used as a proxy measure of the socio-economic level of the household (Swindale and Bilinsky, 2006). Incorporating the modifications in the model yields a model of the following form: The following model will be estimated for household consumption.

$$HDDI = \alpha_0 + \beta_t \ln[x^*/n] + \alpha M + \alpha N + \alpha H + \mu_t \quad (17)$$

Where; n = number of household members

$HDDI = \sum_i h_{it}$ $i = 1, 2, 3, \dots, 11, h = 1$, when a household consumes a particular commodity group and 0 , otherwise).

x^* = household monthly total expenditure on food from farm and off-farm income

\mathbf{M} is a vector of household characteristics, while \mathbf{N} is a vector on household land ratio on maize to tea, access to credits, transfers and cooperative membership, \mathbf{H} is a vector on geographical terrains and access to the market. $\alpha_0, \alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5$ are the parameters to be tested, and ϵ is a normally distributed random error term.

Methods and Materials

The study targeted a population of all smallholder tea farmers in Nandi South District. A multi-stage proportional-to-size cluster sampling involving four (4) stages was used. Smallholder tea households owning less than 10 acres of land on tea production were surveyed. 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 select. The households were then clustered into five groups based on their geographical locations. The clusters included *Kaptien*, *Siret*, *Kosoiywo*, *Kaplelmet* and *Kapsimotwo* clusters. The number of respondents from each cluster was then obtained by determining the proportion of total households selling their tea leaves to various tea estates in the district against the desired sample size of 180 households. Finally households surveyed from each cluster were picked systematically at an interval of four households.

Both primary and secondary data was used. Primary data was collected through a household survey. Household characteristics data included age, gender, employment, and education level of head of household, household size and nutritional knowledge. Household age structure was also captured in order to establish dependency ratio. The total arable land owned by each household in acres and the effective area allocated to produce of tea and maize and their respective yields in Kilograms, Metric tons. Quantities and household expenditure of various commodity food groups consumed. A total of eleven food groups were used to construct a HDDI (Household Dietary Diversity Index), they included: Cereals; White root and tubers; Vegetables; Fruit; Meat; Eggs; Fish; Legumes, nuts and seeds; Milk; Oils and Fat; Sweets; Spices, Beverages and Miscellaneous. The last two groups (sweets; spices, honey, beverages and miscellaneous) are indicators of economic access to food, but do not contribute substantially to micronutrient intake; these groups are collapsed into one group. Households were asked if they consumed food items belonging to eleven food group within the last seven days of the week. Data on other off-farm and on-farm income generating activities was also collected from the households. Savings, access to credit facilities, and cooperative membership of the household head. The terrain of household geographical location and distance to the nearest market in Kilometers. Data on household information on

any family transfers from friends and relatives. Key informants were selected and interviewed to shade light on food security issues based on their experience with the target population. They included top officials of various cooperative societies, Red-Cross officials, Tea Estates managers, Officers in the DAO's office. The secondary data was obtained by perusing annual agricultural reports, economic surveys, statistical abstracts and development plans.

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. Group discussions and interviews with key informants were conducted to obtain a general consensus on factors influencing food security in the district. Key informants included farmer's co-operative top officials and employees, food security committee members of out-grower based empowerment organization, tea estate out-grower managers, district agricultural officer, district development officer, and heads of district non-governmental organizations, divisional agricultural extension officers, field extension workers and local administration. General observation was carried out to countercheck some findings.

The survey questions were numerically coded and responses stored in computer spreadsheet software, Microsoft Excel Version 17. Descriptive statistics such as bar charts, histograms and measures of central tendency were used to describe existing relationships between household variables. 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 Discussions

According to the empirical results of the sampled data about, 85% of the respondents reported a farm and off-farm income of less than Kshs 20,000 per month; 10% had between Kshs 20,000-40,000; 4% had between Kshs 40,000-75,000/month; while those who had between 75,000-100,000/month and Kshs 100,000/month and above were 1% each respectively. The sample mean of farm and off-farm income was found to be Kshs 11,133/month, while the mean farm income from tea alone was found to be Kshs

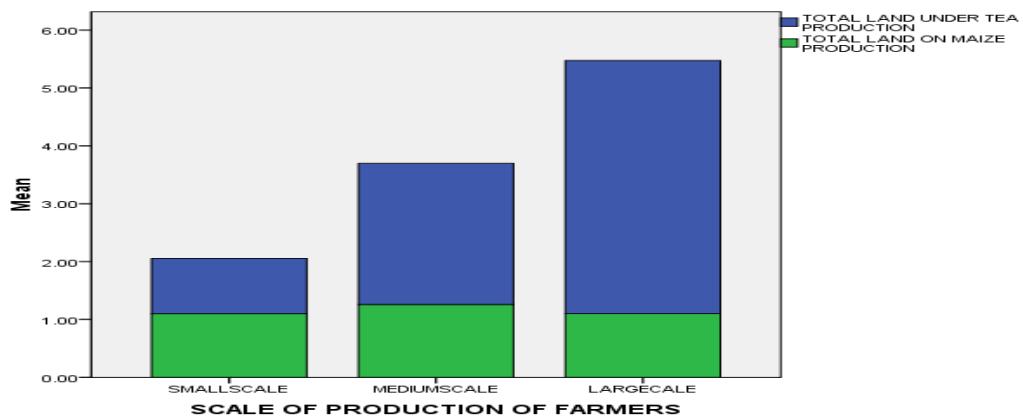
7,922/month. Out of the total respondents, only 48% reported off farm income. The results imply that majority of respondents are dependent on farm as a major source of income in the division.

According to the results from the sample, 70% of the respondents owned less than 5 acres of land, 22% owned a land size more than 5 acres but less than 10 acres, while only 8% had a land size between 10 acres and 20 acres. The mean size of total land owned by the households sampled was 4.1182, while the means for total land allocated to tea and maize is 1.537 and 1.1345 respectively. The results point out that the majority of farmers in the area are small scale farmers who would essentially be peasant households if they were producing mainly food crops.

Land Size and Enterprise Allocation

Source: Author's Survey Data, 2009

Land Allocation between Maize and Tea Production



Source: Author's Survey Data, 2009

An observation of graphical presentation generally indicates that maize and tea compete together for land resource. However, the trend tends to change as the scale of production increase, majority of farmers give more preference to cash crops and subsequently reallocation of resources. As expected more land is put on tea production and less on maize production.

The table below presents the results for household dietary diversity parameters. Dietary diversity of the household is significantly influenced by household income, savings, geographical terrain, off-farm income, effective land allocated to tea, food storage.

Table 1: **Estimated Parameters of the Dietary Diversity Index.**

	Coefficient	Std. Error
(Constant)	1.0143647	(1.628070056)
HOUSEHOLD INCOME	2.353876611	(0.501947056)***
DEPENDENTS RATIO	-0.018393959	(0.097364212)
AGE OF HEAD OF HOUSEHOLD	0.015260612	(0.111009576)
GENDER OF HEAD OF HOUSEHOLD	0.404521193	(0.326468332)
HIGHEST EDUCATION OF HEAD OF HOUSEHOLD	0.012297804	(0.144445115)
KIND OF EMPLOYMENT	-0.045973541	(0.105193476)
FOOD STORE	0.386730211	(0.216218291)*
SAVINGS	0.857203789	(0.225721976)***
BUSINESS	-0.05041546	(0.197095895)
MARKET ACCESS	0.0100243	(0.019081262)
FOOD TRANSFERS	0.334620759	(0.244761168)
GEOGRAPHICAL TERRAIN	0.219276877	(0.080422701)**
KNOWLEDGE ON BALANCE DIET	-0.186385632	(0.260343158)
NO. OF ADULTS IN THE HOUSEHOLD	-0.038872988	(0.071388245)
OFF FARM INCOME	0.590607206	(0.231494301)**
TEA PROFITS	-0.108105991	0.132995609
RATIO OF LAND ON TEA TO MAIZE	0.083699934	(0.035298635)**
R	0.606	
R ²	0.368	
Model F-Value	5.379***	
Level of significance denoted as *, **, *** representing 10%, 5% and 1% respectively		

Source: *Authors Survey Data, 2009*

The results from Table 1 indicate that as income increases the households expand their expenditure on more and better quality diets, while the corresponding low income households strive with their little income to provide minimum affordable quantity of food for their families. Accordingly low income households experience malnutrition. Strategies that aim at improving household food security should therefore target increased household income.

The Proportion of total income set aside as savings at the time of the year when income is highest is spent later for daily needs. Majority of these households who save not only afford enough food but they are also very keen to provide quality diet for their families throughout the year. Savings cushions households from uncertainties and it can be used to meet some huge household expenditure like school fees and medical bills which could otherwise make the household go hungry if food expenditure was diverted.

Increased off-farm income is associated with improved household food diet quality. This is due to the fact that the heads of households who receive off-farm income on top of the farm income afford to provide quality diet for their households compared to those who depend on farm income only. It is plausible to note that this is purely income scenario since associating increased off farm-income to the level of education, age and business ownership of head of household is not supported by the findings. It is recognized here that to guarantee household food security among smallholder tea farmers in Nandi South, efforts must not be solely confined to farm enterprise but diversification from farming to other off-farm enterprises.

The behaviour of smallholder tea farmers in land resource allocation between maize and tea significantly influences the outcome of their household diet quality at 5% level. This is a ratio with a positive and significant impact on quality diet of the household. The results imply that, as the household's trade-off land allocation from maize-for-food to tea-for-cash-income, household's income increases. The income is realized throughout the year ensuring steady household access to quality food.

Conclusions and Recommendations

Household income, savings, geographical terrain, off-farm income, the ratio of land allocated to tea and food storage significantly influence household dietary diversity. 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 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 or purchase enough food from the markets. Strategies that target

increased household income, savings, food storage, geographical terrain, off-farm income, the ratio of land allocated to tea to that allocated to maize and household ownership of food store are likely to significantly improve household food security.

Households should be encouraged to diversify their income sources and enterprises. Households who solely depend on tea as a major source of income face a precarious food security situation. Over time input prices have been on the rise while the output prices have remain relatively constant coupled with this is the increased prices of the purchased food in the market. Besides, farmers have been integrated to the global market which is subject to market forces and distortions beyond the influence of the individual smallholder farmer. Consequently, the purchasing power of the smallholder farmer is squeezed out over time.

Household savings greatly improves household access to food. Savings provide the households with the ability to borrow and meet emergencies and basic needs during low seasons. Therefore, the households are cushioned from food insecurity. Policies and interventions should therefore be geared towards improving opportunities for savings. This includes support of farmer cooperative societies (SACCOS) and other micro-financial institutions in the rural areas. Proper financial infrastructure in rural areas will encourage smallholder farmers to save and provide cheaper access to credit facilities. Household food storage facilities should also be targeted to promote household food security. This will ensure that households do not incur any post harvest losses and to guarantee consistent food supply.

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