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Full Length Research Paper

Determinants of income diversification strategies amongst rural households in maize based farming systems of Kenya

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Since independence, poverty reduction and enhanced food security have been Kenya Government's objectives. At micro-level, households diversify income sources as a management strategy to enhance their welfare. However, this had not been satisfactorily achieved due to multiple factors. This research was aimed at analyzing factors influencing income diversification in maize based farming systems. It is hypothesized that these factors significantly contribute to the performance of agro-based household economies. A cross-sectional survey was carried out in 2004 covering 1850 rural households covering seven agro-ecological zones describing different sources of incomes and labour allocation using a structured questionnaire. Multi-stage sampling technique was used in selecting respondents. Descriptive statistics, multinomial logit and Tobit models were employed in the analyses. The results show that majority of farmers engage in cash cropping but with off-farm income supplementation. However, though there is evidence that most households have opportunities in cash cropping and non-farm activities, pricing, inefficiency in production and marketing negatively impact on the fight against poverty and food security. In addition, lack of capital, makes it difficult for farmers to diversify from subsistence agriculture to commercial farming. Household heads and their spouses spend about 70% of their time on-farm. The household members participate in low paying casual labour ranging from KSh. 84.00 to 120.00 per day which is relatively lower than the governments' recommended rate of KSh 210 to 245 depending on locality. In addition, households with bigger farm size are more likely to participate in the non-farm sector than those with illiterate or low educated heads. This implies that government role in catalyzing asset accumulation through job creation in both farm and a non-farm activity is still an important aspect if poverty and food insecurity have to be alleviated.

Key words: Income diversification, labour allocation, constraints, Kenya.

INTRODUCTION

Since independence, poverty reduction and food security have been priority objectives not only in Kenya's National development plans (Republic of Kenya, 2001; 2004a) but also in other sub-Saharan African countries. However, these objectives have not been fully achieved due to a number of factors at both household and national levels (Chopra, 2004; Republic of Kenya., 2004a). In an effort to meet policy objectives, most governments in sub-Saharan Africa promote output diversification. In response to diversification incentives, farmers diversify income generation in pursuit of a set of multiple objectives.

At farm household level, income diversification involves

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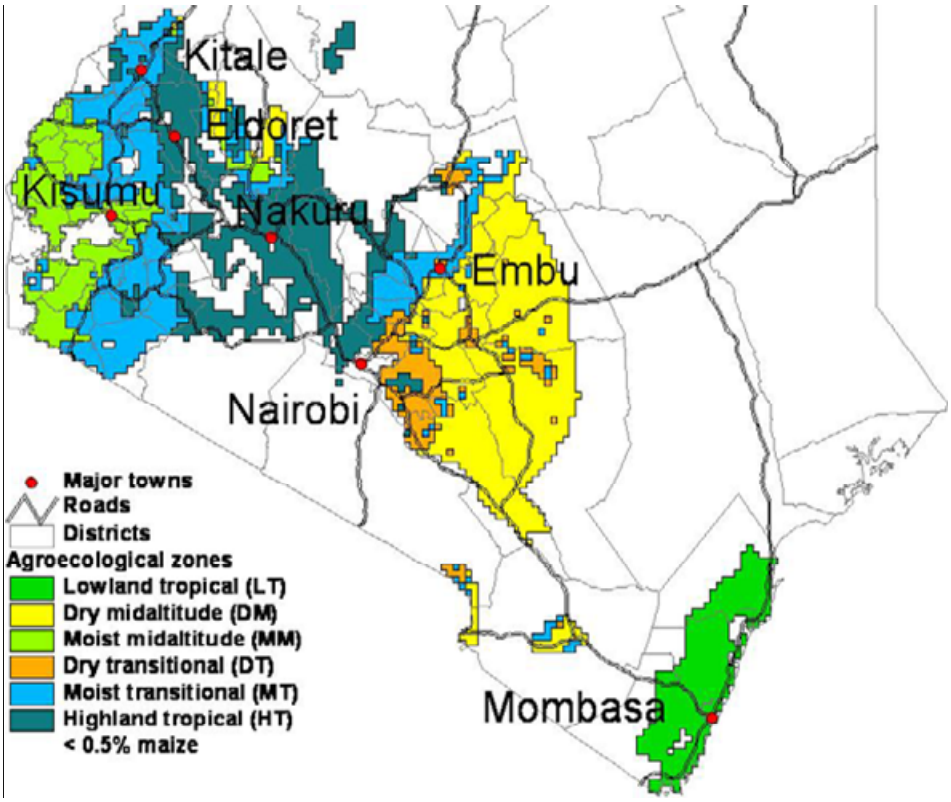

Figure 1. A map of Kenya showing different maize based agro-ecological zones (Hassan et al., 1988).

adding income-generating activities including livestock, crop, non-farm and off-farm activities (Barrett et al., 2000; 2001; Kydd, 2002; Reardon et al., 2006). They indicated that the activities generate a set of income portfolios with different degrees of risk, expected returns, liquidity and seasonality (Kydd, 2002; Muyunda, 2009). The process involves allocation of household productive assets among different income generating activities. According to Barret et al. (2001) multiple factors influence households to diversify assets, incomes and activities.

They went further classified the factors into “push” and “pull” factors. Some of the examples of ‘push’ factors include; risk reduction and response to diminishing production factor. The ‘push’ factors include the compli-mentaries of enterprise positive interaction while the pull factors are land, labour, working capital productivity due to escalating human population and diminishing farm sizes; decreasing output-input price ratio. Analyses of these factors are the subject of this study.

It is recognized that very few people collect all their incomes from any one source, hold their wealth in form of single asset, or use their assets in just one activity (Barretta et al., 2001). For example, work done by Tranguada (2005) indicates that pastoralists in Kenya diversify their income sources as a management risk while that by Barret et al. (2006) shows that major determinants of farmers livelihoods in central Kenya are risk and returns. However, there is limited information on the factors influencing income diversification in maize based agro-ecological zones. It is hypothesized that these factors significantly differ at household level. Study questions were: How do rural households allocate the labour between on-farm and off-farm? What is the rural household labor rates compared to gazzeted ones with agricultural labor? How do rural households in different AEZs operate in labour markets? How do incentives affect rural households indifferent households groups, their choice of what to grow? What factors influence household income diversification?

MATERIALS AND METHODS

Study area

Hassan (1998) identifies seven major maize zones in Kenya which included low tropics (LT), moist transitional tropics (MT), high tropics (HT), moist-mid-altitude zones (MM), dry transitional (DT) and dry moist tropics (DM) (Figure 1). However of these zones, HT, MT and MM grow more maize than the rest. The six zones occupy an estimated population size of more than two thirds of Kenya’s population (Republic of Kenya, 1999). Maize crop is a major crop in these zones though there is great variability in yield levels (Hassan, 1998).

Data type and source

Primary and secondary data were utilized for this study. Secondary data were mainly from past research studies and government policy papers while primary data for this study was generated from cross-sectional survey data generated in 2004. The primary data was collected through a semi-structured questionnaire from 1850 respondents who were randomly selected from established sample frames at location levels. The type of data collected included: Personal (age sex, education levels, marital status, employment status and type); farm (farm size, machinery, farm enterprises, yield levels, yield levels, input level and including prices, and institutional characteristics (markets and marketing, output prices, research and extension access, credit).

Sampling and sample design

The study was carried in maize growing regions of Kenya as reported by Hassan et al. (1988).

Multistage sampling methodology was used where 1850 farmers from the seven agro-ecological zones of Kenya. Farmers were first stratified by maize farming system zones as shown in the map (Figure 1). The distribution of farmers by zones was as follows: Moist transitional east (embu) (150), low tropics (coast) (300), moist mid-altitude (Kakamega) (250), dry transitional (Machakos) (100), dry mid-altitude/semi arid (200), high tropics (400), moist transitional south west (200), moist transitional north west (250), The sampling was based on 1999 human population census (Republic of Kenya, 1999). The sampling procedure was as follows: In the first stage, a purposive sample of the maize zones, while in the second stages a stratified random sampling of locations. The sample selection was based on proportionate to size sampling approach as below:

$$n = \frac{Z^2.p.q.N}{e^2(N-1) + Z^2.p.q} \quad (1)$$

where n = Sample size, p=Population proportion with the characteristic of interest, q is the weighting variable and is computed as (1-p), N is size of the population as per 1999 Kenya human population census (Republic of Kenya, 1999), e is margin of error, Z = critical value at the desired confidence interval (1.96). Given a population of farmers in the survey regions and assuming that the sample mean should be within a range of ± 1% of the population mean with 95% probability, the sample size was:

$$n = \frac{(1.96)^2 * (0.5) * (0.5) * N}{(0.01)^2 (N-1) + (1.96)^2 * (0.5) * (0.5)} = 1800 \quad (2)$$

Analytical framework

A farmer is likely to hold at least more than one of income portfolios on his/her farm depending on socio-economic, business and bio-physical characteristics environment. The farm business portfolios included: Maize, wheat, tea, coffee, horticulture, livestock, pyrethrum and others in addition to off-farm activities. Income diversification can be explained in household consumer behavior as the decision to be engaged in a given income generating activity, which is influenced by a number of factors (Barrett et al., 2000). Portfolio choice can be modeled within frameworks that explain individual choice behavior (Reardon et al., 2006). The decision to choose a given enterprise is a behavioral response arising from a set of alternatives and constraints facing the decision maker. In this study, household enterprise choices necessitated the use of discrete choice theory in analyzing the income diversification in maize based farming systems.

The analytical models

Descriptive (mean, standard error and proportions) statistics and regression analysis were used in the analysis of the data. In analyzing the determinants of income diversification portfolios, a multinomial Logit and Tobit models were used (Greene, 2003; Maddala, 1977). These models have been largely been used in various research areas: Transportation, economics, marketing, behavioral sciences, and agriculture for decision making. However, major technology issues relate to the extent and intensity of use at the individual farm level rather than to the initial decision to adopt a new practice can be analysed using Tobit model. The Tobit model has an advantage that its coefficients can be disaggregated into the probability of adoption and the expected use intensity of the practice (Carson and Sun, 2007; Rajasekharan and Veeraputhran, 2000).

Multinomial Logit

In analyzing factors affecting the choice of income portfolio options, a multinomial logit (MNL) model was used. The multinomial logit is a widely used model in econometrics to explain the choice of an alternative among a set of exclusive alternatives. The MNL model is based on the random utility theory. The model is based on the hypothesis that the unobservable parts of the utility functions are independently and identically distributed with the type 1 extreme value distribution. The utility to a household who selects an income portfolio (U) is specified as a linear function of the individual and farm specific characteristics, the attributes of the alternative income portfolios and other institutional factors as well as stochastic component. In this study, individual specific and institutional characteristics (X) were used as shown in Equations 3 to 7.

$$U(incomeportfolio0) = \beta_j X_0 + e_j \quad (3)$$

$$U(incomeportfolio1) = \beta_j X_0 + e_j \quad (4)$$

$$U(incomeportfolioj) = \beta_j X_0 + e_k > \quad (5)$$

If the observed outcome (dependant variable) = choice income portfolio j and if U

$$U(incomeportfolioj) > U(portfoliok) \quad \forall j \neq \text{k then} \quad (6)$$

$$\beta_j X + e_j > \beta_k X_k + e_k \quad (7)$$

The MNLM defines probabilities as function of *Xi* of unknown parameter e

$$P_i = (P_s(X_i, \Theta) \quad (8)$$

The standard MNM, the probability function defined by Maddala (1983). The reference income portfolio is maize and this was compared to other farm income sources. Hence, for each income portfolio there was 8-1=7, predicted log of odds, one for each income portfolio relative to maize income portfolio. When M=1 you get ln(1) = 0 = Z11 and exponential (0) = 1. The probability of

choosing the income portfolio is equal to the probability that the utility of that particular income portfolio is greater than or equal to the utilities of other alternatives in the choice set. The farmer maximizes utility from an income choice source in the sense that, that particular choice best minimizes the cost of production, maximizes profits or ensures achievement of a threshold level of income of any other objectives.

The dependent variable was discrete variable taking values 0, 1, 2, 3, 4, 5, 6, 7 and 8 for cases where income portfolio was maize = 1, wheat = 2, tea = 3, coffee = 4, Horticulture = 5, Livestock = 6, Pyrethrum = 7 others = 8) = f(age, education, sex, relation of household member to the HHH, family size, time on-farm, employment type, farm size, credit access, extension access, distance to markets error term, maize acreage). The independent variables (X0s) were as shown in Table I.

The Tobit model

The Tobit model is as follows: Let 1A = intensity of selecting a given income portfolio; 1A* = the solution of utility maximization problem of intensity of selecting an income portfolio subject to a set of constraints per household and conditional on being above a certain threshold limit (Greene, 2003). 1A0 = the minimum amount income portfolio per household. Here, 1A = 0 amount of income portfolio received per income portfolio. Therefore:

$$1A = 1A^* \text{ if } 1A^* > 1A0 \quad (9)$$

and

$$1A = 0 \text{ if } 1A^* \leq 1A0$$

To analyze factors assumed to influence the intensity of income portfolios, Tobit model was used. A choice of given income portfolios was defined as a truncated continuous variable where non-adopters were using no insecticide and adopters were using varying amounts of Insecticides. The tobin regression model is as defined by Maddala (1983) and Green (1991).

RESULTS AND DISCUSSION

Descriptive statistics

Table 2 summarizes the distribution of households in various income portfolios and its gives a hint on equity distribution. There were significant differences amongst the income quartiles with most of the households falling in the first three quartiles across all the seven maize zones. The mean income levels between successive quartiles are more than double indicating unequal distribution of incomes.

General socio-economic characteristics

General socio-economic characteristics influence household decision-making on income diversification choice (Ellis, 1993). Personal, farm and institutional characteristics were solicited from respondents. Table 3 shows farm, farmer and institutional factors by quartile income groups. There were significant differences amongst the four income portfolio groups of the following variables: Age of household head (HHH), percentage of time off and on-farm, distance to the nearest markets, farm size, family size and wage rate. The age of HHH range was between 39 and 46 years while the period in school ranged from six to seven years indicating that most of the HHH attained primary level of education. The percentage time of HHH off-farm was lowest in the first quartile (51%) and highest in the third (58%). The average distance to the nearest output market varied from 18 to 22 km signaling likely higher transaction costs for both inputs and outputs for farmers. There is also great variability in amount of credit received in the four groups with an increasing amount from the first to the fourth quartiles.

Type of work

Households are involved in various agricultural, non-farms, household and other activities in order to maximize benefits and reduce or minimize costs, risks and uncertainties. Evidence from Figure 2 suggests that most of rural households are engaged in casual non-farm and permanent in non-farm activities. This indicates that households allocate labour and other farm assets to various income generating activities that are more lucrative. In addition, there is evidence that households are engaged in multiple activities to meet household goals as described by Barret et al. (2000). The wage rate earned varied from KES 84 to 120 (US$ =75KES) (Figure 3). This differs from the gazzeted government rates indicating of 2.80 to 3.33 depending on the location and type of work. The losers are the labourers, majority of who are in the first quartile range.

Farm income generating activities in crop and livestock engagements

There is an emerging concern about the viability of small farm agriculture, particularly in the context of on-going process of globalization. It is contended that viability of small farms can be improved through diversification of agriculture into higher-value crops and those whose consumer demand is high (Joshi et al., 2006). In addition, the interaction of off-farm, crop and livestock income generating activities are perceived to augments total incomes levels. Table 3 summarizes number of livestock units (LUs) by quartile income ranges. The general trend is that the number of LUs increased from the first to the fourth quartile portfolios. Farmers grew different farm enterprises in addition to maize which is the main staple food crops in many zones in Kenya. Some of these enterprises had dual function of income generation and food while others were only either for food or cash generation. This shows that households having any income opportunities in cropping activities such as maize

Table 1. Variables used in the logit and tobit models for regression analyses.

Variable name	Nature of variable	Unit	Variable description	Sign
Dependent variable				
Crop code (mlogit)	Discrete		1 = Maize, 2 = Wheat, 3 = Tea; 4 = Sugarcane, 5 = Coffee, 6 = Sugarcane, 7 = Horticulture, 8 = Livestock (dairy/beef), 9 = Coconut, 10 = Others)	
Amount income (Tobit)	Continuous	KSh	Amount of income per household	
Independent variables				
Distnear	Continuous	Km	Nearest distance to product and input markets	-ve
Fmsz	Continuous	Ha.	Total farm size which is main asset for allocation to competing of farm income source	+ve
Prdmze	Continuous	Kg	Maize production which is an incentive for farmers to allocate more resources to it for enhanced income.	+ve
Tractot	Continuous	No.	Ownership of a tractor as an incentive to allocate resources in farm activities.	+ve
Oxplough	Continuous	No.	Ownership of oxplough as an incentive to invest in farm activities but on small scale compared to tractor owners.	+ve
Wagetime	Continuous	No.	Number of days allocated to wage earned activities which is hypothesized to positively influence farmers to select a given income portfolio	+ve
Age	Continuous	Year	Age of household head can be a proxy to experience and was hypothesized to positively/negatively influence a household to select a given income portfolio	+ve
Gender	Binary		Gender of household head. This was dichotomous variable (1=male; 0=female), which influences access and control of capital.	+ve
Educ	Continuous	Year	Education of household head in years. Was hypothesized to influence the farmer. More years in school meant higher probability to select a higher income portfolio	+ve
%timeonfam	Continuous	%	Time on-farm of household head was an indicator of sourcing for cash to complement farm expenditures.	+ve
exttrain	Binary		Farmer training was hypothesized to positively influence farmers to choose a given income portfolio	+ve
Extcont	Binary		Extension contact hypothesized to positively influence farmers to chose a given income portfolio	+ve
Coop	Continuous		Membership to co-operative society hypothesized to positively influence farmers to choose a given income portfolio	+ve
Credit	Continuous	KSh	Amount of credit hypothesized to positively influence household to select a given income portfolio	+ve
Nonfam	Binary		Non-farm income influences the investment in farm enterprises. 1 = Non-farm; 0 = Otherwise	+ve

KSh means Kenya shilling, 1 US dollar = 72 KSh.

production, tea, coffee, horticulture, sugarcane, wheat, cotton, coconut, and livestock rearing and non-farm work, and hence effect on diversification of incomes. In addition to livestock enterprises, there are more than one type of

Table 2. Distribution of households by quartiles.

Variable	% Response of household holding income portfolios			
	I	II	III	IV
HT (400)	32.90	38.69	26.20	9.40
'MM-KAK (250)	31.80	36.40	25.00	6.80
DT-MACH (100)	16.20	19.20	22.20	42.40
DMSA (200)	28.60	23.10	18.10	30.20
MT-SW (200)	27.7	7.9	21.5	42.9
MT-NW (250)	30.3	10.8	25.1	34.2
LT (300)	18.0	30.40	33.20	18.40
Mean incomes (KSh./HHH)	23477	54815	94031	13647610

Table 3. General household socio-economic factors by different AEZs.

Variable	% Response of HHH holding by income portfolios (mean±SE)				All	Sig
	I	II	III	IV		
Age of HHH	42.72±1.42	46.28±1.09	43.48±1.37	38.63±1.54	42.78±0.69	S
Education of HHH in years	6.58±0.31	6.85±0.27	6.37±0.29	7.17±0.27	6.73±0.14	NS
Female adults educated in years	6.94±0.33	7.22±0.27	6.76±0.31	7.44±0.29	7.08±0.15	NS
Male adults educated in years	4.50±0.87	4.47±0.81	3.40±0.90	5.43±0.85	4.43±0.43	NS
% time off-farm	51.17±2.67	59.43±2.40	58.91±2.55	46.31±2.71	53.96±1.30	S
Female % time on-farm adults	81.35±5.45	83.54±5.46	90.43±4.05	86.00±4.69	85.10±2.35	S
Male % time on-farm	71.47±2.42	69.85±2.15	72.43±2.28	70.19±2.28	70.99±1.17	NS
Distance to nearest output market	17.52±1.41	20.78±1.68	19.54±1.72	21.56±1.75	19.85±0.82	S
Farm size	2.74±0.20	2.99±0.22	3.32±0.24	2.97±.25	3.00±0.11	NS
Family size	5.50±0.16	5.71±0.17	6.17±0.18	6.31±.17	6.01±0.12	NS
Credit	798.29±322.31	1417±592.90	1335±499.72	2424.83±877.43	1494.77±300.16	S
% Extension train	11.10	15.10	23.00	20.60	17.5	S

Source: Farm survey 2004; NS = not significant; S = significant at $p<0.1$.

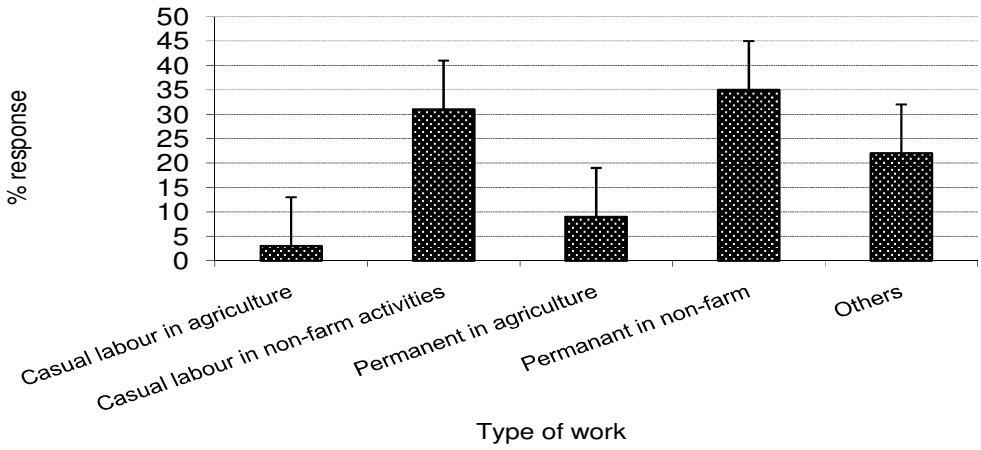

Figure 2. Percentage household heads involved in different types of work.

socio-economic factors. It is recognized that increasing foreign exchange problems and deteriorating prices of traditional export commodities in Kenya and other sub-Saharan African countries have led farmers policy makers and donor agencies to seek diversification in not only high valued farm enterprises but also export crop

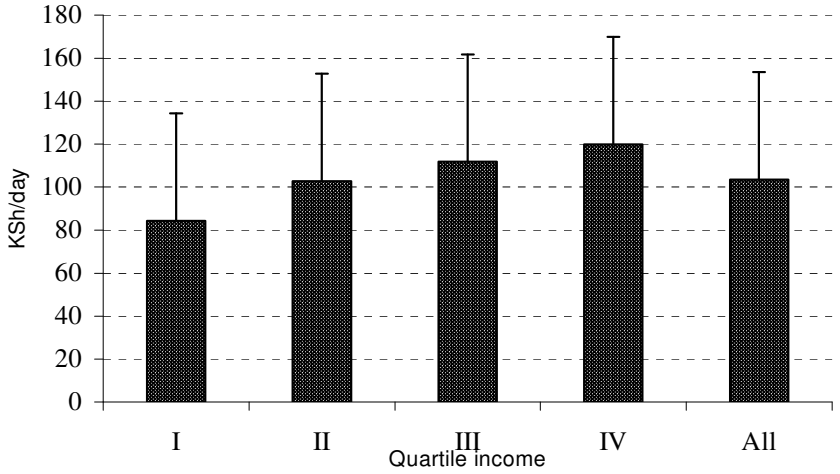

Figure 3. Wage rate per day by quantile incomes portfolio.

Table 4. Per capita number of livestock units owned by Households in Kenya.

Variable	% Response of HH holding Income portfolios (mean±SE)				All
	I	II	III	IV	
No. oxen LU	0.27±0.04	0.30±0.04	0.30±.04	0.52±0.06	0.34±0.02
No. dairy LU	0.28±0.04	0.34±0.07	0.46±.09	0.75±0.09	0.45±0.04
Other cattle	0.53±0.07	0.53±0.07	0.54±.07	0.64±0.10	0.56±0.04
Sheep	0.43±0.09	0.34±0.07	0.49±.08	0.65±0.09	0.48±0.04
Goats	2.21±0.23	2.34±0.27	2.54±.31	3.03±0.35	2.53±0.15
Poultry	2.34±0.21	2.40±0.15	2.72±.22	2.77±0.21	2.56±0.10
Camels	0.00	0.01±0.07	0.01±0.01	0.000	0.01±0.03
Donkeys	0.13±0.08	0.12±0.04	0.13±.03	0.11±0.02	0.12±0.01
Pigs	0.05±0.02	0.02±0.01	0.04±.02	0.04±0.03	3.87±0.01

Source: Farm survey, 2004.

production (Republic of Kenya., 2007; Vatta et al., 2008)

Other non-farm household income sources

Income diversification particularly from off-farm activities is increasing becoming an important component in alleviating poverty and increasing food security among rural households (Muyunda, 2009). Households get incomes from other sources other than the farm and employment opportunities that are used to fund farm activities. Such sources mentioned by respondents included gifts and transfer payments from relatives and friends, petty business and formal employment. These incomes were aggregated and the highest amounts of incomes were realized in HT and MT-NW zones and the lowest was in DT and MDT. However, the highest variability was experienced in the same zones because very high standard errors (Table 4). This showed that some income sources (Table 5) could be risky to depend on by households and cannot be a panacea for income generation and food security as indicated by Muyunda (2009). Probably the most stable income source could be those household that had their members with stable monthly income from formal employment. This could be some of the driving forces that make farmers seek for off-farm employment (Reardon et al., 2006) and formally employed people to do farm and other businesses.

Regression results

Multinomial logit results

From the multinomial regression results in Table 6 in each column, the coefficient shows the effect of the independent variables on the utility of the enterprise under consideration relative to utility of maize the base outcome. It should be recognized that utility close to zero indicate that they do not affect the probability of the state to which it applies relative to maize. The results indicate that distance of good road to input and output markets positively and significantly influences the probability of farmers participating in all the farm enterprises relative to

Table 5. Income sources and proportion of amounts from non-farm.

Maize zone	Amount per HH by AEZ (mean±SE)	
	Transfer earnings	Value of gifts
HT	23948.51±5337.90	1143.03±388.12
MT-SW	15230.00±353.38	17034.75±2253
MT-NW	19264.80±2811.89	3114.16±974.35
DT	5599.35±1217.62	1039±184.29
MDT	23202.50±4655.26	985.88±236.22
LT	3033.77±723.30	554.00±184.29
All	11371.63±1343.14	10003.32±163.13

1US$=75 KShs.

Table 6. Multinomial logit on factors influencing income diversification (dependent variables 1 = Maize, 2 = Wheat, 3 = tea; 4 = Coffee, 6 = Horticulture, 7 = Livestock (Dairy/beef), 8=Pyrethrum, 9 = others).

Variable	Wheat		Tea		coffee		Horticulture		Livestock		Pyrethrum		Others	
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
Age of HHH	0.0163	0.0253	0.0603	0.0646	-0.0452	0.5910	0.0054	0.0072	0.0019	0.0077	0.0120	0.0124	-0.0003	0.0101
Gender (sex of HHH)	38.3244	0.0001	-35.2647	0.0001	-36.6967	0.0002	-1.6880	0.4947	-1.9890	0.7246	-1.6629	0.9984	-1.6665	0.9898
Education of HHH	0.0346	0.0931	0.2031	0.2580	0.6640	0.2723	0.0350	0.2797	0.0119	0.0297	0.0281	0.0483	-0.0908	0.0386
Timeoff-farm of HHH	0.0047	0.0114	-0.0026	0.0203	-0.0119	0.0169	0.0012	0.0028	0.0078	0.0029	-0.0019	0.0052	0.0214	0.0037
Maize production per HHH	-0.0008	0.0001	0.0051	0.0031	-0.0024	0.0033	0.0068	0.0003	-0.0030	0.0006	-0.0010	0.0008	-0.0020	0.0037
Distance to market	0.0472	0.0120	0.0374	0.0225	0.0069	0.3361	0.0197	0.0043	0.0297	0.0044	0.0272	0.0074	0.0215	0.0599
Credit	2.0423	0.7523	-36.6818	0.0001	-37.0984	0.0001	0.5806	0.2602	0.8721	0.2517	1.2023	0.3902	0.8781	0.3286
Own Tractor	4.7114	1.1016	-31.8768		-38.9820		2.2180	0.7304	4.4151	0.7492	4.0601	0.9489	1.7823	1.1376
Own ox-plough	-2.6665	1.2382	-36.2211	0.0001	0.1429	0.9845	-1.2245	0.2975	-2.6650	0.5724	-2.8952	0.9361	-1.0035	0.3851
Wage time of HHH	-1.1223	77500.1000	-1.1034	1244.0000	-1.1007	11689.0000	-0.0772	0.3377	-1.1318	0.2549	-1.1315	46761.0000	-1.1343	362624.1000
Constant	-6.7770	1.0000	-14.2378	6.1639	10.6818	4.3487	-3.3730	0.5031	-2.9787	0.5317	-4.7638	0.8879	-3.3820	0.6921
Number of observations	1850.0000													
LR ch2 (70)	472.5800													
Pseudo R2	0.1728													
Log likelihood ratio	-1131.4800													

maize. This demand that since roads infrastructures is a public good, the government should invest more in these as stipulated in Vision 2030 (Republic of Kenya., 2007). The age, sex and ownership of tractor positively and significantly influence the likelihood of households to participate in wheat production relative to maize. This means making farmers accessible to farm machinery will enhance likelihood of participation in wheat production. This crop is highly mechanized in all its operations from land preparation, planting weeding, disease and pest

Table 7. Tobit models factors affecting levels on income at household level (dépendent variable is estimated amount of income per household).

Variable	Coefficient	SE	t-value	p-value
Age	68.30	115.84	0.56	0.56
Gender (sex)	10203.61	4960.72	2.06	0.07
educyears	196.16	438.00	0.45	0.65
famsize	5.52	2.85	1.94	0.05
timeoff	-9.26	46.62	-0.20	0.84
famtotal	0.39	0.64	0.60	0.55
cropcode	333.71	4463.43	0.07	0.94
distnear	532.31	152.36	3.49	0.00
borowedcr	9875.71	4858.43	2.03	0.04
extencontact	374.55	209.04	1.79	0.70
famtrain	16136.25	4347.06	3.71	0.00
tractors	59869.37	9505.58	6.30	0.00
ploughox	9434.80	3485.28	2.71	0.01
wagetim	0.04	0.03	1.56	0.12
mtsswdumy	-777.36	9669.72	-0.08	0.94
ht_kdumy	76491.01	5169.41	14.80	0.00
dm_mdumy	12668.88	6090.46	2.08	0.04
lt_dumy	7174.64	5464.22	1.31	0.19
Constant	7808.72	8883.90	0.88	0.38
Number of observations	1850			
LR ch2 (1)	741.46			
Pseudo R2	0.30			
Log likelihood ratio	-14862.32			

Source: farm survey 2004.

control and harvesting. However, sex of HHH negatively influences the participation in wheat production. Distance of good road to markets positively and significantly influences households to participate in tea production. This is because distance of bad road increases traction costs and also delays the delivery of tea in tea factories. Participation of households in livestock production is significantly influenced by age, sex, time off-farm, distance to markets, credit access and machinery ownership. However, ownership of farm machinery negatively influences the participation of households in pyrethrum production relative to maize.

Tobit model results

As shown in Table 7, the factors that significantly influence amount of cash received and spend within households as maize producers are gender, family size, distance to markets, farmers extension contact and training on agricultural practices, machinery ownership (tractors and ox-ploughs), and the agro-ecological zone (DM, HT). This implies that household members have unequal access and control of farm assets. This demands that any policy intervention tailoring towards poverty and food security should be specific to the needs and circumstances of a given target group. For example income diversification policy may not be uniform across all rural households. Some of them may demand specializing in specific farm enterprises which they have relative advantage in production, processing for value addition and marketing.

CONCLUSIONS AND IMPLICATIONS

Labour allocation and income portfolio have been analyzed focusing on crops, livestock, and off-farm activities. From the analysis households hold diverse income portfolios which in turn are influenced by age of HHH, gender (sex), time off-farm, ownership of farm machinery (tractor and ox-ploughs), distance to markets, access to credits, wage time and maize production.

In addition, household seek to generate a portfolio of income with different degrees of risk expected returns, liquidity and seasonality. Thus, farmers allocate different

household resource at their disposal to different income generating activities, however there are indications of farmers giving attention more than one major activity, aimed at not only stabilizing but also increasing and maximizing farm income as indicated by Kydd (1991). It is also noted that households diversify into activities that are of higher values like tea, horticultural crops than those with low price and income elasticity's of demand for the latter as pointed out by Marenya et al. (2003). Given that Kenya depends on agriculture diversification, it is still an important strategy. Given the diminishing farm size small hold-led agriculture is an important aspect in Kenya and therefore diversification need to be promoted particularly for rural population. The inclusion of high valued agricultural products arguments diversification portfolio and therefore increased income. Further more, contract farm seem to be working in some region growing tea and coffee as a surety for market and price. The limitation is that poor infrastructure will continue to be a disincentive to farmers diversifying in other activities due to high transaction costs. In addition, labor rates in some majority of zone are below the gusseted, this could be due to supply and demand and lack of information on labour suppliers. However, if agricultural sector improves in economic performance, then this gap will be reduced. In addition to raising the minimum wage rate in agricultural industry, the Kenya government should also make a follow-up to ensure that the laws are obeyed.

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REFERENCES

Barrett BC, Bezuneh H, About M (2000). The response of income diversification to macro and micro policy shocks in Cote dÍvoire and Kenya.

Barretta CB, Reardonb T, Webb P (2001). Nonfarm Income Diversification and Household Livelihood Strategies in Rural Africa: Concepts, Dynamics, and Policy Implications: pp 1-31.

Carson RT, Sun Y (2007). The Tobit model with a non-zero threshold. Econ. J., 10: 488-502.

Chopra D (2004). Food security, rural development and health equity in Southern Africa. EQUINET University of the Western Cape South Africa.

Ellis F (1993). Peasant economics Farm household and agrarian development. Second edition ed. Cambridge University press, Cambridge, Great Britain.

Greene WH (2003). Econometric Analysis, New Yolk University, . fifth edition ed., New Yolk University, Upper Saddle River, New Jersey USA.

Hassan RM (1998). Maize Technology Development Transfer: A GIS Application fort Research Planning in Kenya CABI publishing, Wallingfors, UK.

Joshi PK, Joshi L, Birthal PS (2006). Diversification and its Impact on smallholders: Evidence from a study on vegetable production. Agric. Econ. Res. Rev., 19: 219-236.

Kydd J (2002). Agriculture and Rural livelihoods: Is globalization opening or blocking paths out of rural poverty? ODI. Agricultural Research and extension network Net work, p. 121. January.

Maddala GS (1977). Econometrics. 1977 ed. MacGraw-Hill Book company, p. 516, New York, USA.

Muyunda C (2009). Icome diversification among pastoralists: Lessons for policy. Common market for eastern and southern Africa (COMESA).

Rajasekharan P, Veeraputhran S (2000). Adoption of intercropping in rubber smallholdings in Kerala, India: a Tobit analysis. Agrofor. Syst., 56: 1-11.

Reardon TJ, Berdegué CB, Stamoulis K (2006). Household Income Diversification into Rural Nonfarm Activities, In Haggblade SH, P. Reardon T (ed.) Transforming the Rural Nonfarm Economy, Vol. 2006. Johns Hopkins University Press. p. 34.

Republic of Kenya (1999). Results of 1999 Population and Housing Census. Government report. Ministry of Finance and Planning, Nairobi, Kenya.

Republic of Kenya (2001). Poverty reduction strategy paper for the period 2001-2004. Prepared by the people and government of Kenya. June 2001. 2001 ed. Government printers., Nairobi, Kenya.

Republic of Kenya. (2004a). Strategy for revitalizing agriculture 2004-20014. Ministries of Agriculture, Livestock and Fisheries Development, and Cooperative Development and Marketing, Nairobi, Kenya.

Republic of Kenya (2007). Kenya Vision 2030. A competitive and prosperous nation Status Report. Ministry of Planning and National Development in partnership, Kenya and Government of Finland., Nairobi, Kenya.

Vatta K, Garg BR, Sidhu MS (2008). Rural Employment and Income: The Inter-household Variations in Punjab. Agric. Econ. Res. Rev., 21: 201-210.