Vol. 17(5), pp. 780-793, May, 2021
DOI: 10.5897/AJAR2020.15310
Article Number: 5471CBA66891
ISSN: 1991-637X

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African Journal of Agricultural Research

Full Length Research Paper

Income mobility in diversified CSA households of Nyando Basin, South Western Kenya

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Received 4 November, 2020; Accepted 17 May, 2021

Climate-Smart Agriculture (CSA) strategies have been introduced in Nyando basin (comprising Kisumu and Kericho Counties) in Kenya, and farmers have comparatively taken up the practices. This has resulted in diversification of farming crops/livestock and incomes to bridge seasonal shortfalls under erratic harsh weather conditions due to climate change. The main objective of the study was to determine how smallholder farmers bridge seasonal incomes variations. This study demonstrates income diversification probabilities on four outcomes of climate-smart agriculture; agricultural practices, sales of goods and services, gifts/remittances, and savings (deposits/retrievals). Additionally, gender aspects were aggregated on the same in climate-smart villages (CSVs) and non-CSVs communities. The study used household-level financial diaries panel data, collected in 2019/2020 from 124 samples of farmers selected by a multistage sampling technique. Descriptive statistics and multinomial logistic model were used to determine risk/probability of income sources and mobility (livelihood diversification) from a set of strategies. Results indicated that agriculture diversification activities (sale of goods and services and agricultural practices) as income sources were seasonal-sensitive and during droughts households diversified to gifts/ remittances and savings. Education, age and household size were noteworthy aspects that influenced the choice of livelihood diversification strategies there were gender differences in sources of contributions to household transactions whereby women mainly relied on Gifts/Loans/Credit/Advances while sales of goods and services were exhibited in men. CSVs predictors on all the income sources over the year were negative and not significant indicating greater probability of CSVs shifting incomes sources to sales of goods than the non- CSVs.

Key words: Climate smart agriculture (CSA), financial diaries, gender, diversification, season, income bridging, rural Kenya.

INTRODUCTION

Climate change has led to extreme temperatures, frequent droughts and flooding in some areas, thus adversely agricultural production in Africa. Komba and Muchapondwa (2015) draw attention to the ample losses

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brought by alterations predominant to livelihoods of farmers. Rural farming households must therefore adjust to climate change by adopting coping and adaptive strategies in order to survive (Banka, 2016). In developing countries choice of coping strategies and adaptive capacity is limited and according to Bjornlund et al. (2018), households' livelihood coping mechanisms have become progressively more multifaceted and varied in southern Africa. Approach to response measures are made of farm earnings from rain-fed and irrigated crops including livestock and a mounting reliance. Responses' triumph is upheld on household capacity of formulating choices as regards exploitation of financial, labor, land and water resources. Unfortunately, these strategies are often unavailable for a majority of rural households. For these farmers, income is highly variable thus affecting key farm decisions on agricultural production especially those applying traditional methods on less than 2 acres of land becomes uneconomic. Low incomes limit agricultural development among poor families (Korir et al., 2015).

According to Anderson and Ahmed (2016) smallholder farmers with meagre resources present one of the most challenging clientele for financial service providers (FSPs). This is due to their unique environment which is characterised by: i) irregular and intermittent agricultural produce; ii) threats whose covariance and frequency can be complex to ease; and, iii) requirement of savings which must be made at specific times of the year. Besides farming, rural farming households get their incomes from diversifying and transiting into non-farm activities such as non-farming services, trade, and reliance on remittances from children and relatives working in urban areas. These alternative sources of income vary among smallholder farmers especially those relying on rain-fed agriculture where output maybe low (Barrett and Chawanote, 2014).

Studies on smallholders' responses to climate stress in Kenya, Uganda, Ghana and Bangladesh, by Jost et al. (2016); Ngigi et al. (2016; Chamberlin et al. (2015) and Ng'ang'a et al. (2017) suggested that livelihood diversification as a successful household adaptation strategy can undermine the interest and status of the married women within homesteads. Economic pressure has however forced women to change from their traditional roles as housewives to engagement in off-farm wage earning activities. Dasgupta (2016) notes that the greater spouse's off-farm earnings, the greater the bargaining power of a woman and the more likely that expenditure patterns are directed towards goods that she prefers. However, cultural beliefs and norms dictate that income earning by families is the responsibility of men, typically making the women and children dependent on them economically (Roy et al., 2017). Despite existence of several rural diversification studies, evidence shows that there is a dearth of literature estimating the multiple and interrelated dependence among variables in the relationship between income diversification and available strategies to CSA farmers. This study used the financial diaries panel data which provided an insightful scrutiny of financial transactions (cash flows and patterns) of small scale farmers of Nyando basin. This will provide a better view of how smallholders are affected by the agricultural cycle and deal with their money in response to its ebbs and surges, as well as point to ways through policies that might better meet smallholders' needs (Anderson and Ahmed, 2016).

LITERATURE REVIEW

The idyllic enabling environment for diversification choices would consist of institutions and markets that turn push factors into pull factors by facilitating higher income levels with lower levels of variability under the expected climatic shocks. Sardar et al. (2020) examined the role of livelihood diversification as part of CSA strategy in Punjab, Pakistan. They found out that crop, livestock and off-farm diversification, were significant on welfare. Additionally, asset endowment was main determinant of livelihood diversification. They suggested improvement on policy implications regarding the institutional interventions on asset endowment for farmers. The study did not focus on farmers' incomes from the adapted strategies and how they bridged shortfalls during the varying seasons.

Kimutai (2019) looked at effects of idiosyncratic and covariant on diversification of CSA practices in Nyando basin. Using Poisson model results indicated that death of a household member had a negative effect while drought cases due to pests and diseases including age of household head had positive effect on diversification. There was no age limit for diversification as indicated by the significant effect of age squared. Arslan et al. (2017) on diversification as part of CSA strategy in Zambia and Malawi found out that long term variation in growing period rainfall was associated with increased crop, labor and income diversification in Malawi, and only associated with increased livestock diversification in Zambia. Male-headed households had higher total labor diversification, indicating a potential barrier in labor markets for female headed households. Unlike in Zambia, female headed households were more likely to diversify their crops, but income diversification was higher in female headed households in both countries suggesting higher female-risk aversion. Ng'ang'a et al. (2017) conducted a cost benefit analysis study in Siaya, Bungoma, and Kakamega on the climate smartness, costs and payback of identified climate smart soil (CSS) applications. Researcher found out that all the eight CSS practices analyzed were profitable with positive private NPVs. Nonetheless, every technology had a long benefit period ranging two to more years which may have acted like an impediment to take up the practices. This study used the unitary model and therefore failed to realize incomes shortfalls bridging

strategies within households under varying seasons during adoption of CSA diversification choices of CSA practices applied.

Makate et al. (2016) evaluated crop diversification impacts on two outcomes of climate smart agriculture; increased productivity (legume and cereal crop productivity) and enhanced resilience (household income, food security, and nutrition) in rural Zimbabwe. They found out that land size, farming experience, asset wealth, location, access to agricultural extension services, information on output prices, low transportation costs and general information access were significant on crop diversification. Increase in the rate of adoption improved crop productivity, income, food security and nutrition at household level.

Bernier et al. (2015) did a study in Nyando and Wote, Kenya on Institutional and gender aspects of CSA using Heckman selection model. Researchers found out that in Nyando, spousal awareness of some practices increased the likelihood that the other decision maker would know of it, but this was not the case in Wote. Cooperation, social capital and collective action memberships, trusting others, and working together had more of a positive influence in Nyando than in Wote. They concluded that gender, household, and institutional aspects that shape and drive the adoption of CSA practices still need more attention.

Majority of Empirical literature reviewed exhibit a missing link between cash flows/ shortfall and bridging strategies among CSA farmers. This has thereby under-estimated the benefits thereof. Financial diaries as a data collecting tool has hardly been used in sub Saharan Africa by researchers. In most of these studies their empirical approach only permits comparing male and female headed households in a unitary rather than in a collective approach. Gaps identified formed the motivation and contributes to literature by identifying gender relations/ decisions influencing incomes mobility due to shortfalls among other livelihood stresses in a rural Nyando basin context of multiple risks, shocks and stresses.

METHODOLOGY

Study area and sample size

The study was conducted in South western Kenya within Nyando basin comprising Kisumu and Kericho counties. To determine the sample size, a stratified random sample of 124 rural farmers was purposively selected. The stratas were based on: 1) administrative region, 2) with-in climate smart villages (CSV) or non-CSV villages; 3) ownership of improved or local small stocks 4) low/high crop and land management practice the longitudinal survey was conducted from February 2019 to March 2020. Farm-level data were collected from household heads, spouse and any adult child contributing to incomes and decisions on family budget. Respondents in total were 4,785. Each were interviewed separately for 52 weeks. A pre-tested standardized questionnaire was used, designed jointly by Amsterdam Centre for World Food Studies (ACWFS) with participation of CCAFS East Africa, University of Nairobi's School of Economics and Wageningen Economic Research University.The data was analyzed using both descriptive and inferential statistics. Descriptive statistics used primarily data to analyze the frequency, percentage, mean, and median of the farmers' socioeconomic attributes in the study area. The multinomial logistic model (MNL) was used to identify the gender relationship behind the contribution to household cash transactions and to analyze the probability of farmers seasonal bridging of incomes and the intensity use of available strategies.

Multinomial logit model (MNL)

Income diversification strategies among adopters and non adopters of CSAs in Nyando basin to cushion effects of month to month volatile net incomes from agriculture production constitutes a categorical variable. Where a farmer can choose to bridge incomes from a set of available diversification strategies. Econometric models such as multivariate probit or logit, multinomial probit, nested logit, conditional fixed effects logit, among others are useful for analysis of categorical outcomes. In the study, multinomial logit (MNL) using structural equation model for longitudinal data was applied to determine the probability of seasonal bridging of income source from among the set of diversification strategies. The model was preferred because it permits analysis of decisions across more than two categories in the dependent variable; hence it becomes possible to determine choice probabilities for the different sources of incomes (Maddala, 1983).

Model specification

MNL is anchored on the random utility theory. To motivate the model, assume, that smallholder CSA farmer i aims to maximize his/her income represented by utility, U_i by comparing the income generated by j alternative strategies (sources). The expected income, U_{ij}^{*} that the smallholder farmer derives from engaging in strategy j is a latent variable determined by a vector of observed farming family characteristics x_i and unobserved characteristics ε_{ij}. The random utility can therefore be expressed as:

$$U_{ij}^{*} = x_{ij}\beta_j + \varepsilon_{ij} \quad (1)$$

where β_j is the parameter associated with x_i that remains constant across alternatives and ε_{ij} is a random disturbance term that capture intrinsically random choice behaviour, measurement, or specification error, and unobserved attributes of the alternatives. The multinomial logit model is based on the premise that an individual compares her expected utility under different diversification strategies and his/her constrained conditions. The generic form of the multinomial logit is given as:

$$U_t^e = U\left(O_{tj}, lny_{t-1}, \boldsymbol{x}, \Delta V | O_{t-1j}\right) \quad \forall j = 1, \ldots, m \quad (2)$$

where O_{tj} is an indicator variable for income diversification in period t and j indicates the income strategies namely sale of goods and services, savings, gifts/remittances and agricultural practices The variable lny_{t-1} represents the log earnings reported in the previous season, an indication of the likelihood of the individuals to diversify income based on their past income drawn in last season's source, O_{t-1j}. The variable $\boldsymbol{x}$ is a vector of individual and household characteristics, just as in Equation 1. In this multinomial logit regressions ΔV was included in order to capture village level

Table 1. Definition of the variables.

Variable	Code	Description	Measurement	Expected sign
Dependent variable				
Y(incomes)	**Δy_{it}** Livelihood diversification/income variation		Dummy	+
Independent variable				
Incomes (t-1) -	Inc	Continuous	Number	+/-
Source transitions				
Sales of goods (base)	Salgds	Dummy	Yes/No	
Agric practices/farm produce	agricpract	Dummy	Yes/No	+
Gift/remittances	gifts	Dummy	Yes/No	
Savings(deposits/retrieval)	savs	Dummy	Yes/No	
Household characteristics				
Age of individuals	agecat	Continuous	Years	+
Household gender	Hhgender	Dummy	0.Male 1.Female	
Education level	Educlevel	Years	1.None 2.Primary 3.Secondary 4.Post secondary	+
CSV	Csv	Dummy	0. non csv 1. csv	+
Marital status	Maritalhh	Dummy	0.married 1 single	+
Household size	Hhsze	Continuous	Number	+
Group member	Grpmber	Continuous	Yes/No	
Institutional/environmental variables Quarters	qtr	Number	1.Mar-June 2. June- Aug 3. Sep-Nov 4. Dec-Feb	+/-
Hours to motorable road	Hrsmotrdw	Dummy	Minutes	+

variables such as distance to motorable road and agricultural circumstances that reflect evolving environmental conditions. Therefore, given individuals' initial income source, we estimate the multinomial logit:

$$Pr(y = j|m = \frac{exp(\Gamma(j))}{1 + \sum_{j-1}^{m} exp(\Gamma(j))} \quad (3a)$$

$$\Gamma(j)_i = \alpha_0 + \alpha_1 lny_{t,i} + \alpha_2 x_i + \alpha_3 \Delta V_c + \varepsilon_i \quad (3b)$$

The subscript c on ΔV_c implies that village level variables are constant within a particular village. To ensure model identification, the term $\Gamma(j)_i$ is set to zero when individuals stay in their previous strategy, choice m. In particular, if the base case is 0 that is, one chooses to continue practicing agriculture, then $j = 1, \ldots, m$) refers to: 1) the shift from agricultural practice to 1) sale of goods and services; 2) savings 3) gifts/remittances respectively. The coefficients are then interpreted with respect to staying in one's initial income strategy (farming). The base category was sales of goods and services. The model for estimating income diversification shifts probabilities is given as:

$$\Delta lny_{ti} = \gamma_0 + \mu_i + \lambda_t + \delta lny_{t-1,i} + \eta \Delta \boldsymbol{x}_{it} + \omega \boldsymbol{z}_i + \varepsilon_{it} \quad (4)$$

where Δlny_{ti} is the change in log reported real earnings from season $t-1$ to season t, $\boldsymbol{z}_i$ denotes a matrix of time-invariant, individual and household characteristics, as observed over the year/ panel data collected; $lny_{t-1,i}$ are lagged income earnings of household i; μ_i and λ_t are individual and time specific fixed effects; δ, η, and ω are parameters to be estimated.

Definition of variables

In this study, the dependent variable is how smallholder farmers of Nyando basin bridge seasonal incomes variations. The explanatory variables taken were those which are thought to influence bridging of incomes variations (Table 1).

RESULTS AND DISCUSSION

Social economic features

Table 2 illustrates a summary of the socio-economic and demographic information of the sampled respondents in the study area. The table shows that most of the respondents belong to the age group 44 to 54. The age of farmers plays a vital role in farming and management

Table 2. Socio-demographic characteristics of the sampled farmers in the study area.

Variable	Means	Standard deviation
Age of the household head	54	17
Age of spouse	44	15
Dependency ratio	1	1
Household Size	6	3
Distance to motorable road	1	1
Distance to food market	3	3
Distance to livestock market	9	4
Education level of the household head	**HH head proportions (n=122)**	**Spouse proportions (n=122)**
No formal education	8	7
Primary incomplete	30	39
Primary complete	28	27
Secondary incomplete	12	13
Secondary complete	13	9
Tertiary/university incomplete	1	1
Tertiary/university complete	9	4
Group membership	56	61
Access to extension services	63	
Access to credit	54	
Occupation proportion (n=122)		
Farming crops	53	4
Farming livestock	8	50
salaried employment	13	12
self-employed off-farm	14	2
casual laborer on-farm	2	6
casual laborer off-farm	9	21
household chores	1	4

practices. Mostly mature and energetic farmers are embracing emerging technology more rapidly than their older and younger peers. The average household size was 6 and a dependency ratio of 1.18. It was observed that 28 and 27 of respondents had primary education while 8 and 7 had no formal education. Results also show that 63 of the respondents had access to extension services, and around 53 and 4 primary occupation was crop farming in the study area. On average 54 of farmer's had access to credit. The average distance to the nearby food and livestock market was 3.1 and 8.8 km respectively. In general around 117 of respondents are involved as members of various social organizations/groups.

Sources of household livelihoods

A season was based on an economic calendar subdivided into four quarters rather than on climate variability aspects. Data collected was clustered into 4 quarters (four seasons namely: March-May, June-August, September-November, December-February). Four types of livelihood/ income diversification strategies (Remittances/gifts; Savings (deposits/retrievals); Farm produce and Sale of goods and services) were identified in the study area. Figure 1 shows that farmers altered their livelihood diversification with main income source being from sale of goods and services at highs of 40% in March-May. Goods that smallholder farmers sold included crops (mainly maize, beans, sorghum, millet, cassava, sugar-cane), livestock, labour for service both on-farm and off-farm and from small enterprises like motor cycle transport, kiosks and hotels. The curve declined steadily to 27% in September- November as incomes from farm produce were rising explained by on-going harvest season which peaked to (42%) during November. The line curve on gifts/remittances source of income is shown to exhibit a rise from (24%) in March-April to intercept the declining sales curve in September. Savings (deposits/retrievals) which generally indicated lowest dependency by farmers as a source of incomes, declined in March-May (18%) with a slight steady rise thereafter as source from farm produce were rising. This

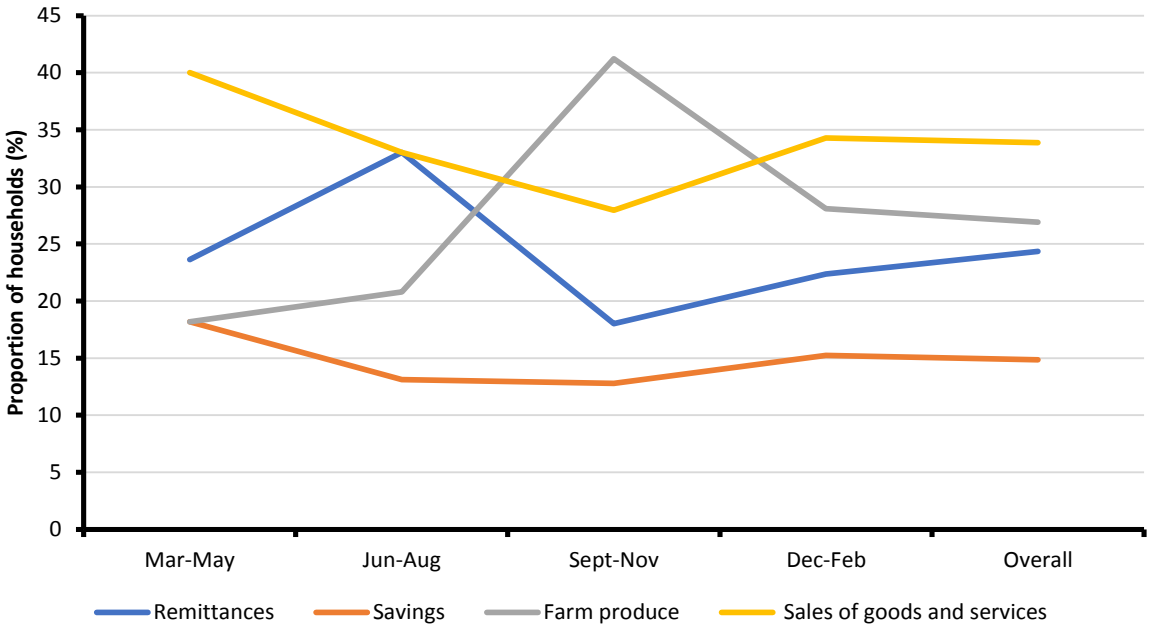

Figure 1. Income sources by season.

results pointed out that agricultural diversification activities (sale of goods and services, farm produce) as incomes sources were seasonal-sensitive and were impacted more by the changes in weather. To counter this farmers alternated with nonfarm activities (gifts/remittances and savings). A combination of various livelihood strategies was noted, in which a respondent could adopt more than one choice of livelihood strategies at a time. This is supported by Oduniyi (2018) and Gebru et al. (2018), who reported that majority (83.1%) of the farmers were able to diversify their livelihoods using various strategies.

Livelihood contributions to household financial transactions aggregated by gender

Results indicated in Figure 2 show that in the first quarter (March- May) husband contribution to household financial transactions from sales of goods and services was at 38% while that from wife was 20%. Women contribution from harvests and consumption was 22% while men were 28%. Husband contribution came from savings at 18% and wife at 16%. Women contribution to household financial transactions was highest during this season from gifts (remittances), loans, credit at 37% and men at 16%. Husband contributed 3% from agricultural practices while women were 2%.

In the 2nd quarter (June- August) husband engagement in sales of goods and services increased from previous quarter to 43%, similarly a slight raise from women to 22%. Wife contribution from harvests and consumption increased from previous quarter to 25%, however, men contribution from the same declined to 22%. Husband savings contributions increased to 20% more than the women which remained constant at 18%. Wife received less gifts, accessed loans and credit from previous quarter 37 to 30%, whilst in men this amounts decreased to 13%. Wife contribution from agricultural practices was more than the husband and increased from 3 to 5% while the men remained constant at 2%.

During the 3rd quarter (September - November) contribution to household financial transactions from harvests and consumption increased (peak) for wife to 32% and husband's at 23%. Men sales of goods and services declined to 34% while amounts women increased to 24%. There was a decline in contributions from gifts (remittances), loans, credit for women at 25% despite a slight increase for men from 13 to 15%. Men savings (retrievals/ deposits) was similar for both men and women at 18%. Men contribution from agricultural practices was at highest 10% while that of women was at 1%.

In the final quarter (December-2019 to February-2020) women contribution from harvests and consumption declined from previous season from 32 to 23% and men was close at 24%. Men contribution from sales of goods and services was at 36% while that from women was 24%. Wives had a bigger share of the gifts, loans and credit at 28% than men at 18%. Men contribution from savings was 19% and women 18%. Contribution by wife to agricultural practices increased from previous quarter 1 to 7% while men declined to 3%. These results provide a very concise picture of livelihood strategies in Nyando basin. Non-farm income (sale of goods and services) appears to play an important role in their livelihoods as it

Figure 2. Contribution to household financial transactions aggregated by gender.

accounts for highest percentage of the total household income across the seasons. Implying that rural households are diversifying away from agriculture. Wife seemed to contribute more than men from harvests and consumption except during the (March-May) season. This is no surprise considering that wife contribute milk, eggs, chicken meat, maize, beans and exotic/local vegetables from kitchen gardens and granaries which they control for household consumption and source of some incomes from the products. However, from field observations men contributing more could be explained by the fact that this is generally a land preparation and planting season, whereby stored crops from previous harvest belong to the men who hoard for better prices for cash sales to cushion the family. From the men' share family recoup foodstuffs for daily consumption.

Wife's contributions to household transactions from agricultural practices/ CSAs was more than the men/ husband though at below 10% across the seasons. These agricultural practices included use of high yielding, early maturing and pest resistant varieties including kales and cabbages in kitchen gardens by women .From general observation women often did the planting while ploughing of land was left to the men. Secondly, application of greenhouses which was introduced through CBOs and self-help groups by CCAFS, that proceeds from sale of produce was shared amongst active members who were mainly women. Thirdly, CSAs like agro-forestry, introduction of galla goats, red Masai sheep and bee- keeping were mainly embraced by men and to realize profits from these takes time. This then explains why men contribution from CSAs was low.

Households' livelihood transactions by gender and season variability

Results in Figure 3 indicate that on average amounts transacted by men was higher than that from women. Amounts transacted ranged between Ksh. 1800 to 6200 the curve was evenly distributed and increased at a steady rate. Though the women amounts transacted ranged between Ksh. 200 to 2100, there was sporadic sharp rise in amounts they transacted during weeks (1, 9, 31, 35, 46, 46, 47 and 51) that ranged Ksh. 15,600 to 18,000. This results provide a very succinct picture about income portfolios indicating inequalities existing between male and women in the study area. The intermittent amounts transacted by women can be attributed to reliance on savings and credit access from CBOs and SHGs. From study observations, it was noted that start of the year members start contributing (savings) on weekly basis cash that is borrowed by members amounts subject to availability of funds and time taken to refund. This

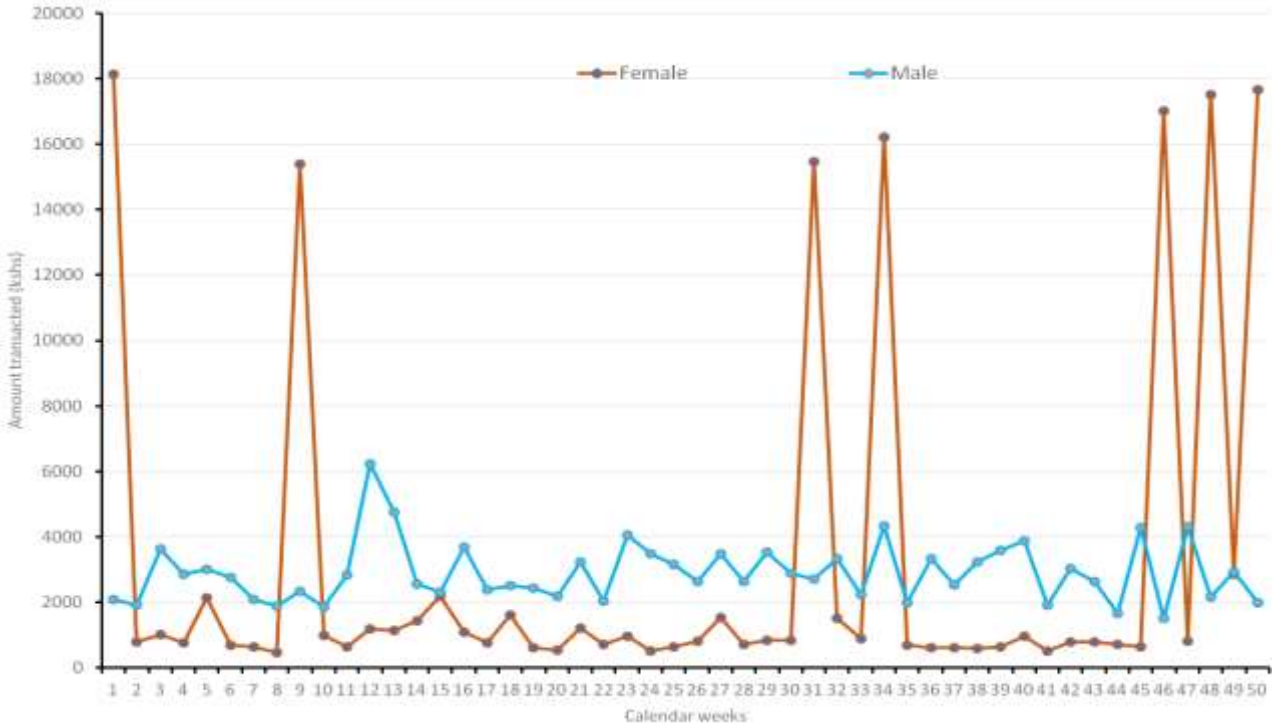

Figure 3. Average amount transacted aggregated by gender and seasonal variability.

exhibited high borrowing in march- May and January-February seasons. Further, towards end of the year dividends and amounts saved are paid to members thus explaining the intermittent attribute and very high amounts transacted by women during these periods.

Results in Table 2 demonstrate the average amount of cash from each source by gender and season. There was gender difference in the main source of income whereby Gifts/Loans/Credit/Advances had higher contributions across the year for women amounts ranging Ksh. (2223.1 – 3362.4). While sales of goods and services was the main source of income for men ranging Ksh. (7792.7-8414.6). Amounts transacted from savings (deposits/ retrievals) men ranked higher at Ksh (3088.1 - 4143.6) compared to women at Ksh. (1440.1 - 1540.2). Additionally men also transacted more amounts from harvests and consumptions Ksh. (4036.2 - 5678.6) as well as agricultural practices Ksh (529.6 - 2533.2) than women Ksh (2036.3 - 2879.2); (133.5 - 667.3) respectively.

Generally the income portfolios was found to exhibit inequalities between men and women. The answer to this puzzle lies in the differences in household composition and gender roles. As reported earlier, men are more potential income earners than women and this partly explains the difference in incomes between the two groups. Women lack of time, business skills and capital to invest in sales of goods and services (entrepreneurship) (which appears to be most lucrative).

Seasonal bridging of incomes by amounts transacted (2019-2020)

From the cash means in Figure 4, there was some inverse trend between the sales of goods and services (including agricultural produce) and remittances, instances where sales of goods reduced the average remittance increased indicating that there was bridging effect between the two sources of income but with varying degrees in the transacted amounts. This result suggest that income and livelihood diversification seem to help households deal with weather shocks.

Incomes from gifts (remittances), loans, credit during beginning of quarter 1 were highest at Ksh. 3300 when harvests and consumptions were low at Ksh. 2500. However there was a negative (gentle slope) declining to Ksh.2500 by mid 2nd quarter when concurrently the harvests and consumptions were increasing to peak in September-November. In the 4th quarter contributions from harvests and consumption were declining (negative slope) however gifts, loans and credit were increasing.

Multinomial Logit Model results

Determinants of risk/probability of shifting income sources (livelihood diversification) within a set of strategies

Data from longitudinal study on financial diaries was used

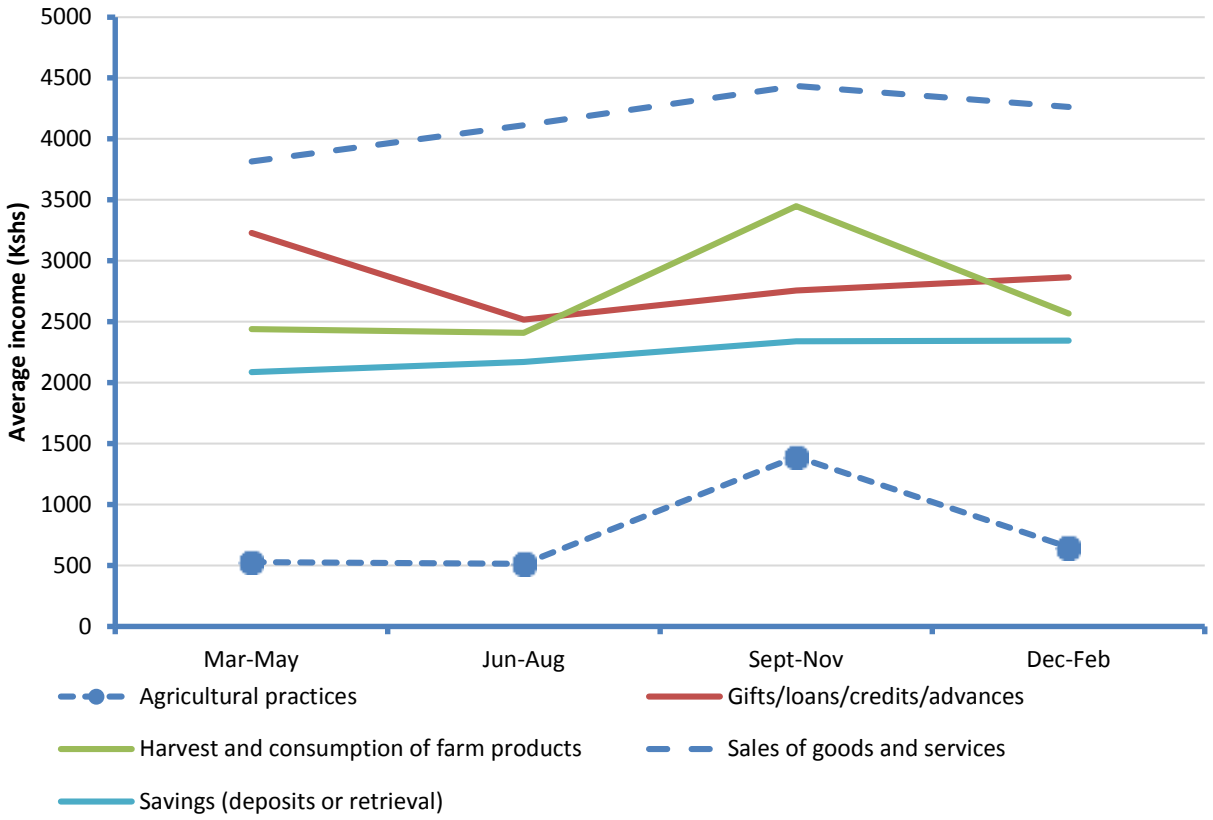

Figure 4. Predicted mean income adjusted for season and source.

Table 3. Average amounts of cash (Ksh) from each source by gender.

Season	Gender	Gifts/loans/credits/advances	Savings (deposits or retrieval)	Harvest and consumption of farm products	Agricultural practices	Sales of goods and services
Mar-May	Female	3362.4	1540.2	2036.3	355.0	1823.0
	Male	2976.5	3088.1	5054.2	653.6	7098.6
Jun-Aug	Female	2525.8	1441.0	2050.4	497.7	1879.3
	Male	2498.5	3627.6	4036.2	529.6	7959.8
Sept-Nov	Female	2223.1	1458.8	2879.2	133.5	2162.6
	Male	3694.2	4143.6	5678.6	2533.2	8414.6
Dec-Feb	Female	2383.7	1440.1	2062.2	667.3	2092.3
	Male	3727.9	3954.8	5472.2	641.7	7792.7

to model probability of households adjusting their income sources. A multinomial logistic regression using generalized structural equation model (sem) was fitted and analyzed for income sources per season (yearly quarters), household characteristics and other institutional variables.

Savings (deposits or retrieval) income source vs. sales of goods and services (base)

Results of the MNL model on Table 3 indicated that the marital status predictor was negative and significant (b= -0.9864, p=0.032). The regression slope for each unit

increase on the variable, the log-odds of married households falling into the savings category relative to sales of goods and services decreased by 0.986 units. Results indicate that married households that depended on savings as a source of income were at a lower risk in this category and at greater risk of depending on sale of goods and services than single households. This result put forward that single households are likely to take risks than married households who have responsibility to the spouse and children.

Farm produce (agricultural produce and consumptions) source of income vs. Sale of goods and services (base)

Findings indicate that during the 3 seasons (June-August, September- November, December- February) all predictors were positive and significant interpreted as the log-odd of belonging to farm produce category (relative to the sales of goods and services category) was predicted to be greater than that of March –May season (base). Results of a positive slope suggest that during the 3 seasons farmers were at a greater risk of depending on incomes from farm produce, and at a lower risk of depending on sales of goods and services than in March to May the base season. The gender predictor was negative and significant (b= -1.9026, p=0.001), this was interpreted as the log-odds of men falling into the farm produce source of income category (relative to the sales of goods and services) was predicted to decrease by 1.902 units. This result suggests that men were at a greater risk in the farm produce category, and at lower risk in the sales of goods and services category than the women (base).

The marital status predictor was negative and significant (b=-0.935, p= 0.935) suggesting that married households were at a greater risk/ probability in the farm produce category, and a lower risk in the sales of goods and services than the single households (base). The hours to motorable road predictor was positive and significant (b= 2.275, p=0.059) suggesting that a 1 unit increase in time (minutes) increased the probability of being in the farm produce income source category than in the sales of goods and services (base). This suggests that farmers who lived further away from motorable found it difficult to diversify incomes and sold farm produce at farm level.

Gifts/ remittances/ loans/ credit/advances Vs Sales of goods and services (base)

The June to August season predictor was positive and significant (b= 0.978, p=0.003) this suggests that farmers were at lower probability of adjusting incomes from gifts/loans/ credit to sales of goods and services than during March-May season category (base). Gender predictor was negative and significant (b= - 1.459, p = 0.002) suggesting that the men were at a higher probability of adjusting incomes source from gifts/credit/ loans to sales of goods and services than the women (base). Hours to motorable road predictor was positive and significant (b= 4.369 p= 0.008) indicating that a 1 unit increase in time (minutes) taken to motorable road increased the probability of small scale farmers not adjusting from gifts/loans category relative to sales of goods and services.

Generally the CSVs predictors on all the income sources across the seasons were negative and not significant. The negative slopes indicated that the odd ratios of small holder farmers in CSVs in the 3 categories relative to sales of goods and services was declining. Results indicate that there was a greater probability of CSVs shifting incomes sources from the 3 categories to the sales of goods and services than the non- CSVs.

Education and age probabilities relative to sales of goods and services

On education all predictors were not significant, however on savings category those with primary (b= 0.354) and secondary level (b= 0.1915) indicated that there was a higher probability of not shifting income source to sales of goods and services (base) as compared to the category with no education (base). However, those with post-secondary education were likely to adjust income to sales of goods and services (odds ratio – 0.288) compared to non-educated small scale farmers. On the farm produce category the higher the education (primary b= 0.048, secondary b= -0.988, postsecondary b= -0.544) the higher the probability that they would shift to sales of goods and services. In the gifts/loans category results suggested that at all levels of education (odds ratios -0.862, -0.568, -0.680), there was a probability of adjusting income sources to sales of goods and services compared to those with no education (base) (Tables 4 and 5).

Results on the age category signify that those above 35- 65 years mainly considered as mature and energetic had a higher probability of shifting income source from savings to sales of goods and services (odds ratio -0.194) than the less than 35 years old. However those at 65 years and above were less likely to shift income source (odds ratio 0.780) compared to those less than 35 years old (base). In the farm produce category those at 35 - 65 years and above had a higher probability of adjusting income sources to sales of goods and services (odds ratios -0.1.197, -0. 202 respectively). Farming is deemed to be a tedious activity and requires energy and therefore the less than 35 years (base) are better off. In the gifts/ loans category those at 35 -65 had a greater probability of shifting income source (odds ratio -0.636)

Table 4. Multinomial logic model on determinants of risk/probability of a choice of livelihood from a set of income generating strategies/ diversifications.

Code	Income source	Number of respondents	Percentage	Cumulative (%)
1	Sale of goods and services	291	33.92	33.92
2	Savings	128	14.92	48.83
3	Farm produce	230	26.81	75.64
4	Gifts/Remittances	209	24.36	100

Total number of observations = 4,785.

Table 5. Multinomial logistic regression results.

Income sources	Coefficient	Std. error	z	P>|z|	[95% Conf. Interval]	
Sales of goods and services	Base outcome					
Savings (deposits/retrievals)						
CSV	-0.0249979	0.3661101	-0.07	0.946	-0.7425605	0.6925648
Seasonal quarters						
Jun-Aug	0.0646238	0.3208785	0.20	0.840	-0.5642864	0.6935341
Sept-Nov	0.2083173	0.3335037	0.62	0.532	-0.4453379	0.8619725
Dec-Feb	0.056227	0.3148651	0.18	0.858	-0.5608971	0.6733512
Age category						
35	-0.1942093	0.7200955	-0.27	0.787	-1.60557	1.217152
65	0.7801814	0.7727042	1.01	0.313	-.734291	2.294654
Household gender						
Man	-0.4434251	0.3243995	-1.37	0.172	-1.079236	.1923864
Educational level						
Primary	0.3541345	0.4023384	0.88	0.379	-0.4344343	1.142703
Secondary	0.1915325	0.5186367	0.37	0.712	-0.8249768	1.208042
Post-secondary	-0.2882804	0.5855221	-0.49	0.622	-1.435883	0.8593219
Household size	0.0639716	0.0734415	-0.87	0.384	-.2079144	0.0799712
Marital status	-0.9864534	0.460983	-2.14	0.032**	-1.889964	-0.0829433
Group membership	0.8047914	0.6284276	1.28	0.200	-0.4269041	2.036487
Hours to motorable road	0.7344241	1.308098	0.56	0.574	-1.829401	3.298249
M1[HouseHoldMemberKey]	(constrained)					
_cons	-0.5603112	1.015947	-0.55	0.581	-2.55153	1.430908
Farm produce						
CSV seasonal quarters	-0.0831196	0.4258152	-0.20	0.845	-0.917702	0.7514628
Jun-Aug	0.6403449	0.3291298	1.95	0.052*	-0.0047377	1.285427
Sept-Nov	1.566001	0.3266709	4.79	**0.000*** **	.9257374	2.206264
Dec-Feb	0.7474873	0.31971	2.34	**0.019** **	.1208672	1.374107
Age category						
35	-1.197698	0.7811391	-1.53	0.125	-2.728702	0.3333067
65	-0.2026108	0.8483806	-0.24	0.811	-1.865406	1.460185
Household gender						
Man	-1.902658	0.3947349	-4.82	**0.000*** **	-2.676324	-1.128991
Educational level						
Primary	0.0484584	0.4577505	0.11	0.916	-0.8487161	0.9456328

Table 5. Contd.

Secondary	-0.9885745	0.6325153	-1.56	0.118	-2.228282	0.2511326
Post-secondary	-0.5443265	0.6792851	-0.80	0.423	-1.875701	0.7870479
Household size	-0.1345255	0.0878224	-1.53	0.126	-0.3066542	0.0376032
Marital status	-0.9350944	0.5185125	-1.80	0.071*	-1.95136	0.0811714
Group membership	0.5480817	0.6938049	0.79	0.430	-0.8117509	1.907914
Hours to motorable road	2.675982	1.417552	1.89	0.059*	-0.1023692	5.454333
M1[HouseHoldMemberKey]	1.440593	0.2830287	5.09	**0.000*** **	0.8858674	1.995319
_cons	1.490679	1.121109	1.33	0.184	-0.706655	3.688012
Gifts/ loans/ credit/advances/ remittances						
CSV	-0.6848726	0.5213186	-1.31	0.189	-1.706638	.3368931
Seasonal quarters						
Jun-Aug	0.9789225	0.3325151	2.94	**0.003** **	0.327205	1.63064
Sept-Nov	0.4386536	0.3662204	1.20	0.231	-0.2791252	1.156432
Dec-Feb	0.2276917	0.3443713	0.66	0.508	-0.4472636	0.902647
Age category						
35	-0.6366137	0.9653722	-0.66	0.510	-2.528708	1.255481
65	0.995018	1.039758	0.96	0.339	-1.042871	3.032907
Household gender						
Man	-1.45974	0.4685929	-3.12	**0.002*** **	-2.378165	-0.5413144
Educational level						
Primary	-0.8620757	0.5641731	-1.53	0.127	-1.967835	0.2436833
Secondary	-0.5684307	0.7435237	-0.76	0.445	-2.02571	0.888849
Post-secondary	-0.680472	0.833987	-0.82	0.415	-2.315056	0.9541125
Household size	0.0073174	0.1059444	0.07	0.945	-0.2003298	0.2149647
Marital status	-1.032633	0.637977	-1.62	0.106	-2.283045	0.2177789
Group membership	-0.1429069	0.8315881	-0.17	0.864	-1.77279	1.486976
Hours to motorable road	4.369267	1.655883	2.64	**0.008*** **	1.123795	7.614739
M1[HouseHoldMemberKey]	1.938192	0.3564951	5.44	**0.000*** **	1.239475	2.63691
_cons	0.8020786	1.37083	0.59	0.558	-1.884698	3.488855
Var (M1[HouseHoldMemberKey])	2.024034	0.8589899			0.8809926	4.650113

***, ** and * indicate significance levels at 1, 5 and 10%, respectively.

than those below 35 years old (base). However those at 65 and above had a higher probability of not shifting incomes (odds ratio 0.995) than the < 35 years old (base). The all predictors for household size were not significant, there was an indication that smallholder farmers depending on gifts and savings were less likely to diversify incomes than those depending on farm produce.

Study limitations and areas of future research

Limitation to the study included language barrier in communication, weekly interviews for 52 weeks repeatedly was tiresome and some respondents became less responsive, heavy rainfall destroyed roads and getting to some households across the two counties at times was very difficult using a motor cycle. Areas of future research to focus; extending the research to other locations in Kenya and assessing impact of mobile money transactions amongst CSA small holder farmers on cash flows and money borrowing from mobile phone lenders and betting gains/ losses.

CONCLUSION AND RECOMMENDATIONS

In this study, we examined income diversification probabilities on four outcomes of climate smart agriculture; agricultural practices, sales of goods and

services, gifts/remittances, and savings (deposits/ retrievals). Additionally, we also aggregated the same by gender in climate smart villages (CSVs) and non-CSVs in the Nyando basin's small scale farming communities in Kenya. Our results show a very concise picture of livelihood strategies in Nyando basin. From the cash means, there was some inverse trend between the sales of goods and services (including agricultural produce) and remittances, instances where sales of goods reduce the average remittance increases indicating that there is bridging effect between the two sources of income but with varying degrees in the transacted amounts. Agriculture diversification activities (sale of goods and services and agricultural practices) as income sources was more inclined to men and were seasonal sensitive at lowest during to June to October during dry spells. These was countered by diversification to gifts/ remittances and savings especially by women. A combination of various strategies was observed where some households were observed to adopt more than one strategy at a time.

There was gender differences in the main source of income whereby Gifts/Loans/Credit/Advances have higher contributions across the year for women while sales of goods and services was the main source of income for men. Women seemed to contribute more than men from harvests and consumption except during the (March-May) season. Female contributions to household transactions from agricultural practices/ CSAs were more than the men. CSAs like agro-forestry, introduction of galla goats, red Masai sheep and bee- keeping were mainly embraced by men and to realize profits from these takes time.

The results of MNL model show that CSVs predictors on all the income sources across the seasons were negative and not significant showing a greater probability of CSVs shifting incomes sources from the 3 categories to the sales of goods and services than the non- CSVs. Marital status predictor was negative and significant married households that depended on savings as a source of income were at a lower risk in this category and at greater risk of depending on sale of goods and services than single households. All predictors were positive and significant gender predictor was negative and significant that men were at a greater risk in the farm produce category, and at lower risk in the sales of goods and services category than the women (base). Time taken to motorable road predictor was positive and significant suggesting that a 1 unit increase in time (minutes) increased the probability of being in the farm produce income source category than in the sales of goods and services (base). June to August season predictor was positive and significant this suggests that farmers were at lower probability of adjusting incomes from gifts/loans/ credit to sales of goods and services than during March-May season category (base).

Gender predictor was negative and significant suggesting that men were at a higher probability of adjusting incomes source from gifts/credit/loans to sales of goods and services than the women (base). On education all predictors were not significant although on savings category those with primary and secondary level indicated a higher probability of not shifting income source to sales of goods and services (base) as compared to the category with no education (base). The age category signified that those above 35- 65 years had a higher probability of shifting income source from savings to sales of goods and services than the less than 35 years old (base). However those at 65 years and above were less likely to shift income source compared to those less than 35 years. In the farm produce category those at 35 - 65 years and above had a higher probability of adjusting income sources to sales of goods and services. In the gifts/ loans category those at 35 -65 had a greater probability of shifting income source than those below 35 years old (base). However those at 65 and above had a higher probability of not shifting incomes than the < 35 years old (base).

In light of these findings, it is therefore recommended that CSA farmers be sensitised on investment of external incomes from sale of goods and services into agricultural practices to increase yields. Policies should be formulated on enhancing agri-business and value addition of produce as a profitable venture for CSA smallholder farmers. Membership to farmer groups/cooperative decision-making within key institutions in promoting technologies, trainings, structuring marketing opportunities and information, among smallholders is recommended. This will promote collective action in marketing of produce as well as access to cheaper inputs thus more yields resulting to more cash flow.We conclude that, it is clear and evident of growing stress in smallholder farming systems from climate change among other household shocks and variability in the study area. Greater implementation of diversified income systems emphasizing more active role by women and favourable products offers from financial institutions equally distributed across the year. Increased cash flows and patterns will promote the currently less diversified costly strategies on agricultural practices, which can significantly improve yields and incomes.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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