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Household Livelihood Diversification and Gender: Panel Evidence from Rural Kenya

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Abstract

There are high hopes that livelihood diversification could contribute to goals of poverty reduction in Sub-Saharan Africa (SSA). This study uses household panel data collected in 2008 and 2013, combined with a mixed methodology to examine the regional and gender disparities, as well as the determinants of change in livelihood diversification in the agricultural regions of Nyeri and Kakamega in rural Kenya. The study period was characterised by important structural changes in the composition and sources of household cash incomes, with farm incomes declining significantly, pushing female headed households into absolute poverty. Whereas the contribution of nonfarm income to total household cash incomes increased significantly, especially in Kakamega. The econometric results show that there is a positive and significant relationship between changes in household asset wealth and changes in livelihood diversification at the regional level, implying that diversification is mainly an accumulation strategy for wealthier farm households. In addition, changes in livelihood diversification are significantly correlated with the initial level of diversification, household demographic characteristics such as age, gender, education level, and hiring labour. Furthermore, increased access to agricultural input credit and more secure land rights seem to promote specialisation in farming rather than diversification. Whereas poverty has a negative and significant effect on change in livelihood diversification. The results have implications for development policy in rural Kenya – highlighting the need to harness the positive aspects of livelihood diversification for poverty reduction, while reducing the negative effects on poorer households by reducing asset entry barriers into remunerative activities.

Key words: Livelihood diversification, gender, panel data, rural Kenya

1.0 Introduction

Livelihood diversification is defined as a process in which rural households construct highly diverse portfolios of farm and/or nonfarm activities over time in order to secure survival and improve their standards of living (Ellis, 2000). There are high expectations that livelihood diversification can contribute greatly to reducing poverty and promoting economic growth in Sub-Saharan Africa (SSA) and other developing regions (Frelat et al., 2016; Haggblade et al., 2007; World Bank, 2007). For instance, Frelat et al. (2016) conclude based on their analysis of drivers of food availability among 13,000 smallholder farm households in 17 countries in SSA, that a singular focus on agricultural development will not be sufficient for poverty reduction, instead multi-sectoral options are required, including promoting the

diversification of employment sources. More specifically, they conclude that improving market access and off-farm opportunities to increase food security is a better way to reduce poverty than focusing on agricultural production and closing yield gaps for poorer smallholders with resource weak farms. In other words, it is better to help vulnerable smallholders into the rural nonfarm economy than to expect investment in yield increasing technology to improve their food security.

Livelihood diversification is a dynamic process, however, most previous studies in SSA have been based mainly on cross-sectional data rather than longitudinal data as shown by the literature review (Alobo Loison, 2015). This implies that for many regions in SSA, evidence on the patterns of dynamism or stagnation, and the drivers of change and transformation are still lacking. Moreover, the gender[1] dimensions of rural livelihood diversification have been largely ignored in the literature. And yet gender relations affect both the options and outcomes of diversification and living standards (Ellis, 1998). A number of previous studies on income and livelihood diversification in SSA (Andersson Djurfeldt et al., 2013; Andersson Djurfeldt and Wambugu, 2011; Canagarajah et al., 2001; Dolan, 2004; Jirström et al., 2011; Manjur et al., 2014; Newman and Canagarajah, 1999; Simtowe, 2010; Zakaria et al., 2015) have included gender perspectives in their analyses, with their results showing significant gender disparities. However, longitudinal evidence on gender differences in determinants, impacts and trends of livelihood diversification in different regions is largely lacking.

Although both men and women in SSA are actively engaged in livelihood diversification, women tend to lack the necessary productive assets to pursue high-return activities due to social, economic, physical and cultural barriers (FAO, 2011; Haggblade et al., 2007; HLPE, 2013). Participation of rural women in labour markets is also limited by gender-specific challenges (FAO, 2011). Hence women tend to be involved in food production and low-return household-based or labour-intensive nonfarm activities (Bryceson, 2002; Haggblade et al., 2007), including unremunerated domestic tasks, food processing and other household-based cottage industries (Lanjouw and Lanjouw, 2001). These gender differences in access to options for livelihood diversification have implications for pro-poor economic growth, since female headed households (FHH) tend to be among the poorest sections of the population. There is evidence that FHH and women in general participate actively in the nonfarm sector (Andersson Djurfeldt et al., 2013; Canagarajah et al., 2001;

[1] Gender refers to the social roles, responsibilities and identities associated with what it means to be a man or a woman, and are shaped by ideological, religious, ethnic, social, economic and cultural factors (FAO, 2011).

Haggblade et al., 2007), and that poverty rates among FHH that are able to access nonfarm livelihood diversification opportunities declines faster than for other households (Newman and Canagarajah, 1999). Also, there is evidence suggesting that there are generally no gender gaps in income between FHH and MHH (male headed households), except in certain regions (Andersson Djurfeldt et al., 2013). However, further evidence that demonstrate both geographical and gender dimensions are important to inform pro-poor policies, and to provide insights into the specific opportunities and constraints faced by individual men and women, or FHH and MHH in constructing viable livelihoods.

The main objective of this paper is to contribute to the understanding of the geographical and gender dimensions of livelihood diversification and its determinants using panel data from rural Kenya. The specific questions are: (i) What are the gender differences in access to farm and nonfarm livelihood diversification options? How do the patterns differ between regions and over time? (ii) What drives the changes in livelihood diversification? How do the determinants differ by region and by gender of the household head? The study is based on household-level panel data collected from two rural districts of Kenya (Kakamega and Nyeri) in 2008 and 2013. The panel of five years with only two points in time however does not reveal much about the long-term patterns of livelihood diversification as relates to structural change and transformation. However, the quantitative panel data is supplemented here with a literature review and qualitative fieldwork to provide insights into the gender differences in the patterns, opportunities and constraints for livelihood diversification among rural farm households. In addition, analysing the gender dimensions using sex disaggregated data is important in providing gender indicators to inform policy.

The rest of the paper is organised as follows: the next section gives a brief overview of some literature on gender and livelihood diversification, and the determinants. This is followed by a methodological section which includes a description of the study regions. Thereafter, the results are presented and discussed, before presenting the concluding remarks.

2.0 Literature review

This section gives a brief review of some previous studies in SSA that have investigated the gender dimensions of livelihood diversification and its determinants.

2.1 Livelihood diversification and gender in SSA

Rural households in SSA sustain their livelihoods mainly from farming, however recent studies show that livelihood diversification has become the norm for both survival and accumulation (Barrett et al., 2001). Rural farm households diversify their livelihoods by engaging in nonfarm activities including migration mainly to minimise risks and to increase their incomes (Alobo Loison, 2015). However, gender may restrict access by the poor to the most lucrative nonfarm activities (Haggblade et al., 2010). For instance, women's ability to engage in nonfarm activities is constrained by child-rearing obligations which sometimes force them into home-based, highly labour-intensive activities. The wage employment opportunities available for rural men and women tend to be mostly seasonal (FAO, 2011). However, women are more likely than men to be employed seasonally, part-time or in low-paying jobs because they tend to have less education and work experience (FAO, 2011). Nevertheless, it seems that in some regions new opportunities have emerged in high-value, export-oriented agro-industries offering much better opportunities for women than traditional farm work (FAO, 2011; Maertens and Swinnen, 2009).

Andersson Djurfeldt et al. (2013) studied the patterns of farm-nonfarm interaction among MHH and FHH in 21 regions in eight SSA countries in the AFRINT project between 2002 and 2008. The study found significant differences in cash incomes between MHH and FHH at the regional level, but not at the country level. The regional patterns showed that poor regions had strongly significant gender differences in cash incomes, while rich regions did not. However, FHH in richer regions had higher nonfarm cash incomes compared to those in poor regions. This was attributed to more equal commercial opportunities for women in agriculture in richer regions and to FHH's engagement in nonfarm activities.

In Uganda, Dolan (2004) studied the gender dimensions of rural livelihoods in three districts using cross-sectional data, and found that MHH obtained significantly higher incomes compared to FHH. This was attributed to cultural norms and inequality of access to productive resources, mainly land and capital. Whereas, Smith et al. (2001) examined the patterns and determinants of change in two rural districts in Uganda using mainly qualitative methods, and found gender differences in terms of occupational livelihood diversification. Women were mainly engaged in farm-related activities such as crop and small livestock

production, providing farm labour and traditional cottage industries (alcohol brewing, handicrafts), whereas men diversified their number and range of livelihood activities into both farm and nonfarm activities (such as carpentry, brickmaking and construction).

In Northern Ethiopia, Manjur et al. (2014) used farm household cross-sectional data to study the livelihood diversification strategies of MHH and FHH. They found that diversification strategies were conditioned by gender, with the choice of income-generating activities being culturally defined and influenced by differential ownership of working capital and access to assets. The FHH in their study were more likely to participate in an off-farm livelihood strategy, compared to MHH. This was because the dominant off-farm activities which were easily accessible for women were mostly low-return activities, such as unskilled labour and gathering from natural resources (wild fruit and fuel woods).

In rural Malawi, Simtowe (2010) analysed livelihood diversification and gender using cross-sectional household data, and found that FHH tended to combine agriculture and low wage labour, rather than relying purely on agriculture. The MHH obtained significantly higher incomes compared to FHH who were pushed into low-wage labour by low agricultural incomes. Whereas in Northern Ghana, Zakaria et al. (2015) using cross-sectional data on rural individuals found that significantly more men than women engaged in paid wage labour, although women dominated the generally low-income activities in the nonfarm self-employment sector.

Canagarajah et al. (2001), using individual and household data from rural Ghana and Uganda, also found that FHH were more likely to participate in nonfarm self-employment activities than MHH. However, in general, women earned less from nonfarm activities compared to men. Moreover, nonfarm earnings contributed more to income inequality among FHH than among MHH. In addition, being female had a strong negative effect on earnings, while being a female head of household had a strong positive effect. The differences in earnings potential between women in general and FHH was attributed to female heads having more liberty to pursue lucrative job opportunities further from home than women in general.

On the other hand, in Tanzania, Øvensen (2010) analysed gender and rural livelihoods using data from an agricultural census in 2002/2003, and found that gender was central in the assignment of specific livelihood activities. Whereas males dominated all activities related to monetary transactions (such as animal husbandry), females engaged in livelihood activities with neither a monetary nor entrepreneur dimension (such as household maintenance tasks like collecting firewood and water). This highlighted the difference in opportunity structures

for rural men and women. Moreover, regional variations in livelihood opportunities were more important than household level gender factors.

2.2 Livelihood diversification and its determinants

The determinants of livelihood diversification have been reviewed in much detail in Alobo Loison (2015). They include both capacity factors and a wide range of incentives that are categorised as push or pull factors (Ellis, 2000; Reardon et al., 2006). Capacity factors include different types of assets and endowments (Haggblade et al., 2007). In the livelihoods approach, assets include intangible or tangible resources owned or accessed by household members that are important in constructing a livelihood (Bosc et al., 2015; Scoones, 1998; Sourisseau et al., 2012). They include 5 categories: natural assets which mainly refer to the natural resource base (land, water, trees) and environmental services; physical assets are created from economic production processes, for example, infrastructure, tools and machines; human capital mainly includes education, skills, labour resources and good health status of household members; financial assets include the stock of cash, savings, credit and other economic assets; and social capital is derived from participation in social networks and associations for livelihood support. The livelihood approach regards the asset status of the household as fundamental to understanding the options available to them, the livelihood strategies they adopt, as well as their vulnerability to risks and shocks (Ellis, 2000). Livelihood strategies can be defined as the combinations of activities and assets that generate the means of household survival or progressive success (Martin and Lorenzen, 2016).

Push and pull factors are linked to distress/survival or accumulation/opportunity types of diversification, respectively as shown in the literature reviewed (Alobo Loison, 2015). Push factors (such as seasonality, climatic uncertainty, land constraints, missing or incomplete factor markets, market access problems) - are negative factors that may force households to diversify their livelihood activities. Distress diversification is viewed as a livelihood strategy of spreading risk to reduce vulnerability to unpredictable shocks and crises such as floods, droughts, illness or seasonal fluctuations of natural resources (Martin and Lorenzen, 2016; Scoones, 1998). Moreover, push factors tend to dominate in high-risk and low-potential agricultural environments (Haggblade et al., 2007). Due to missing or incomplete factor markets in many parts of rural SSA, household diversification behaviour is mainly viewed in the distress/survival-led perspective in the literature (Alobo Loison, 2015). Poorer households tend to be more risk averse and hence diversify ex-ante as a coping

strategy to minimise the variation in their income streams, by achieving an income portfolio with lower covariate risk among its components (Barrett et al., 2001; Dercon, 2002; Ellis, 2000). This is because poor households have fewer assets which can be sold to smoothen consumption, and less access to credit or insurance mechanisms (Dimova and Sen, 2010; Ellis, 2000). While relatively richer households have lower risk incentives than the poor, and are more capable of financing high-return diversification, even if it is costly and initially risky with high entry barriers (Martin and Lorenzen, 2016). This means that progressive success and wealth, which in turn lead to increased access to resources, may lead to increased livelihood diversification (Martin and Lorenzen, 2016). On the other hand, pull factors (such as commercialization of agriculture, emergence of improved nonfarm labor market opportunities, better market access, improved infrastructure, proximity to urban areas, improved technology, expansion of education) - are positive factors that attract pro-active households to diversify their livelihood activities in order to improve their standards of living (Barrett et al., 2001; Ellis, 2000).

3.0 Methodology

This section gives a description of the regions in Kenya where the study was carried out, and the methods which were used to collect and analyse the data.

3.1 The study regions

The data were collected from Nyeri district located in the Central province of Kenya, and from Kakamega district in the Western province. The two regions are diverse in terms of geographical location, agro-ecological potential, market access, household activity and demographic structure as shown in Appendix A. Nyeri is a generally more dynamic agricultural region and more urbanised than Kakamega. Kakamega has a higher rural population who are more engaged in agriculture compared to Nyeri where households are slightly more engaged in rural self-employment activities. In addition, the absolute poverty rate in Kakamega almost doubles that in Nyeri.

Nyeri has considerable variability in agro-ecological potential and market access. The district has a higher road density and better access to markets in the regional towns of Nyeri, Karatina, Nanyuki and the capital city, Nairobi. Consequently, its agriculture is relatively more developed. The district partly lies on the South-Western part of the moist windward side of Mount Kenya (a giant volcano) and also on the drier Western leeward side of this mountain. It also borders the semi-arid Laikipia plateau and the moist windward Eastern

slopes of the Aberdare ranges (Karugia, 2003). On the other hand, Kakamega, has a high population density (Muyanga and Jayne, 2014), with a rich and varied ecological base (high temperatures, reliable rainfall, fairly fertile soils and various rocks and forests) which have been significant drivers of human settlement, farming and other activities (Karugia, 2003). However, high population density, inadequate infrastructure and poor market access have prevented the district from realizing its full agro-ecological potential. As a whole the district has uneven distribution of the road network with a concentration in the southern and central parts but dispersion in the northern parts.

3.2 Quantitative Panel data

The quantitative panel data was collected from Kenya by AFRINT [2] project. The data was collected at household level through surveys in 2002, 2008 and 2013. AFRINT 2002 was part of a comparative project taking the Asian Green Revolution as its starting point (Djurfeldt et al., 2005). AFRINT 2008 was aimed at analysing the drivers of smallholder crop production in the study areas (Djurfeldt et al., 2011). AFRINT 2013 adds components aimed at analysing gender issues, and aspects of income diversification. The 2008 and 2013 rounds contain detailed data about the farm and nonfarm cash income sources of the sampled households, while this is lacking in the 2002 round. Additionally, in 2002, data on production, price, and marketing were only collected for the grain staple crops and not for tubers. Therefore, the analysis in this paper focusses on the 2008 and 2013 rounds. However, the interpretation of the results is supplemented with the wealth of published findings from previous AFRINT studies (Andersson Djurfeldt et al., 2018; Andersson Djurfeldt, 2013; Djurfeldt et al., 2011, 2005; Jirström et al., 2011) that have used the 2002 data in their analyses.

The AFRINT data were obtained using multi-stage purposive sampling.[3] The villages where the data were collected are typical of the farming environment in rural Kenya in the respective years. From each study region, five villages[4] were purposively selected for data collection, also primarily on the basis of differences in agro-ecological potential and market

[2]AFRINT is a collaborative project of researchers from Sweden (Lund University and Linköping University), and nine African countries (see Djurfeldt et al., 2011, 2005). The objective of the project is to study the performance of smallholders in areas of SSA that have the potential for substantial improvements in production and yields of staple food crops.

[3] A more detailed description of the methodology and questionnaire for AFRINT project are given in chapter one of Djurfeldt et al. (2011).

[4] Detailed descriptions of the regions and specific villages, and their characteristics are given in Karugia (2003) and Alobo Loison (2017).

access. The villages in Nyeri district have marked differences in market access, they show increased levels of agricultural production through intensification and they grow most of the common food and cash crops in Kenya. They have better market access (compared to Kakamega) owing to higher road density and proximity to a major market (Karatina) which is well linked to other important urban markets.

At the village level, enumerators with the help of location chiefs, sub-location assistant chiefs and village elders compiled lists of households in each village which were used as sampling frames. Hence from each of the 10 villages, 30 households were randomly selected from the sampling frame, giving a total of 300 households initially in 2002. The attrition rate between 2002 and 2008 was 11.3 per cent (Djurfeldt et al., 2011), and 9.3 per cent between 2008 and 2013. The problem of attrition was dealt with by including in the sample, randomly selected descendant households who were traced in case of partition, and descendant households sampled to replace the original ones. Where village in-migration was sizeable, in-migrant households were sampled to complement the re-interviewed households.

In 2013, a random sample was drawn from compiled lists of households who had settled in the village since 2008. The 2013 data contains the following categories of households: AFRINT 2008 sample re-interviewed (unpartitioned households with the same head as in 2008, who are the majority); descendant households (unpartitioned households with new head or newly sampled offspring households); and replacement for attrition (in-migrated households sampled from list of in-migrants and out-migrated households). The analysis in this paper is based on a panel of only 239 households, who were interviewed in both 2008 and 2013. The focus is on households where the gender of the household head remained the same in both periods. The drawback as noted by Andersson Djurfeldt and Djurfeldt (2013), is that analysing gender disparities only based on the gender of the household head may not really capture the situation of women farmers in MHH. However, household headship is commonly used in gender analysis because it is analytically practical and easily understood (Øvensen, 2010).

Household heads in the panel can be characterised into two main categories: MHH and FHH. The *de jure* head of the household is also the farm manager, who answered all questions on behalf of the household during the surveys. The *de jure* FHH have either single, widowed, divorced or separated household heads. In very few cases, the farm manager is the *de facto* head of the household, and therefore the *de facto* FHH are wives of male migrants.

3.3 Qualitative fieldwork

To enrich the analysis for a better understanding of the livelihoods of the rural households and to achieve triangulation, the quantitative data are supplemented with own data from qualitative fieldwork. The purpose of the qualitative fieldwork was not to be representative in the sampling of respondents, but to capture diversity in the types of households and their activities. It was also meant to obtain additional information beyond the quantitative data to enrich the analysis, build in-depth understanding of the research objectives, and to support the interpretation of the results. This mixed methods approach is used to find out whether other types of data might reveal different facets of the phenomenon, or suggest new variables, concepts and propositions (Bryman, 2008).

The qualitative fieldwork was carried out between January and February 2013 in the districts of Kakamega and Nyeri. Two villages from each district were selected based on the criteria of differences in agro-ecological potential and market access. The author conducted in-depth interviews with rural farm household heads and some of their spouses, and key informants (government officials, extension agents, leaders of farmer groups and village chiefs). A list of farm households for the in-depth interviews was drawn out together with the sub-location chief, in consultation with the area extension agent. To create the list of farm households, purposive selection was based on gender and wealth considerations. The respondents were then purposively selected from each study region based on the household lists and on certain criteria (such as gender, wealth, social status, location, occupation) in order to obtain a diversity of respondents.

The qualitative in-depth interviews were based on a checklist of semi-structured questions that were prepared in advance to explore issues on gender, livelihoods, diversification, and general changes in the social, economic and political context. The key informant and household in-depth interviews were conducted much like a dialogue between the respondent and the researcher, with the help of a local translator. The interviews always began with an informal introduction of the objectives of the study. The relevant topics were explored in-depth as the respondent brought them up during the interview. Personal observation was used to directly observe interactions and record actual behavior of individuals or households, including their physical, social and economic environments. In the

end, the qualitative data which were collected were analysed using content analysis, synthesis and interpretation.

3.4 Analytical Approaches

3.4.1 The components of livelihood diversification and its measurement

The components of rural livelihood diversification in terms of incomes, activities or assets can be assigned to different categories by sector, function or location (Alobo Loison, 2015; Barrett et al., 2001). By sector, the "farm" category includes the sale or production or gathering of unprocessed crops or livestock or forest or fish products from natural resources, while the "nonfarm" category includes all other non-agricultural sources. By function, the "off-farm" category typically includes all in the nonfarm category, in addition to wage or exchange labour on other farms. During the surveys, households were asked to estimate how much money different sources of cash income generated for their household in the course of the past year. Household income sources are disaggregated into 12 categories described in Appendix B.

Household diversification behaviour is commonly estimated using three approaches - the asset-based approach, activity approach and the income approach (Barrett et al., 2001). The asset-based approach analyses the assets employed in different activities, with the drawback of difficulty in measurement, since asset markets are relatively less developed in rural SSA (Barrett and Reardon, 2001). Whereas the activity approach analyses the shares of incomes generated from different activities, making it problematic because activities cannot be aggregated into a single money-metric aggregate in order to examine diversification patterns. Moreover, income sources in-kind or unpaid are completely ignored when the focus is on activities. The income approach, on the other hand, is commonly used to measure livelihood diversification because income is the outcome of activities to which both productive and non-productive assets are allocated (Ellis, 2000). In addition, in-kind payments can be easily converted into money-metric income measures. The share of nonfarm income in total household income (nonfarm income share), which is the most commonly used indicator of household diversification (Barrett et al., 2001), is used as an indicator of the level of livelihood diversification in this study. This definition conceptualises diversification as an expansion in the importance of nonfarm income in sustaining the household's livelihood. The assumption is that rural households with greater nonfarm income share have higher levels of diversification, and are less vulnerable to various risks and shocks in the rural environment

where agriculture is the main source of livelihood (Ersado, 2006).

3.4.2 Specification of empirical model and description of the explanatory variables

The determinants of changes in livelihood diversification are estimated using panel data models, which make it possible to minimise omitted variable biases (Cameron and Trivedi, 2010), and to control for unobserved household characteristics (unobserved heterogeneity) that may correlate with household diversification behaviour (Dimova and Sen, 2010). In addition, the advantage of using panel data compared to cross-sectional data is the flexibility in modelling differences in diversification behaviour across households (Weldegebriel et al., 2015). The reduced form equation for the panel data models is given by:

$$Y_{it} = \alpha + X_{it}\,\beta + h_i + e_{it}$$

Where:

Y_{it} is the dependent variable - the nonfarm income share of household i at time t

X_{it} is a vector of exogenous explanatory variables (observable variables that change across *t* but not *i*, variables that change across *i* but not *t*, and variables that change across *i* and *t*) (Wooldridge, 2002).

h_i is the unobserved individual heterogeneity

e_{it} is the error term component.

α and β are the parameters to be estimated, where α is the constant term.

In panel data models, the unobserved heterogeneity is called a "random effect" if it is treated as a random variable and a "fixed effect" if it is treated as a parameter to be estimated for each individual observation *i* (Wooldridge, 2010). The random-effects (RE) model assumes that the unobserved heterogeneity h_i is purely random, with zero correlation between the observed explanatory variables and the unobserved effect. The advantage of the RE model is that it allows inferences to be drawn beyond the sample used in the model (Baltagi, 2008). However, the RE model usually introduces bias in estimates of β, but can significantly reduce the variance of those estimates (Wooldridge, 2010). In contrast, the FE model allows correlation between the unobserved household effects and the explanatory variables (Weldegebriel et al., 2015). The FE model controls for all time-invariant differences between

the households, so the estimated coefficients of the FE models cannot be biased because of omitted time-invariant characteristics such as gender, religion, culture, among others. The FE estimator makes it possible to minimise omitted variable biases and has the advantage of yielding unbiased estimates of β, but the estimates can be subject to high variability (Cameron and Trivedi, 2010). However, FE models cannot be used to investigate time-invariant causes of the dependent variables, hence the models estimating the gender differences in livelihood diversification are estimated using RE methods. Hausman specification tests are used to choose between RE and FE estimators in the other models (Wooldridge, 2002).

The explanatory variables included in the models were selected using insights from the livelihood approach (Ellis, 2000), empirical literature reviewed (Alobo Loison, 2015) and the qualitative fieldwork. These include: the *asset wealth index* (see Appendices C and D) which is included in the models to capture the household's wealth measured by its asset holdings. Assets are important in determining the household's capacity to diversify (Barrett et al., 2001; Ellis, 2000). Furthermore, according to Dimova and Sen (2010), the relationship between diversification and household assets can be used to identify the main motives for diversification. Following this concept, when "distress/survival" is the primary motive for diversification, the expected relationship between diversification and the household's asset wealth index should be negative. If households are risk averse, as wealth increases diversification is expected to decline, implying that poor households (with little or no assets) will be likely to diversify more than wealthier households (with sufficient assets). On the other hand, if "accumulation" is the primary motive for diversification, the expected relationship between diversification and the household's asset wealth index should be positive. This indicates that wealthier households will be likely to diversify more than poorer households. This is because wealthier households can easily access the lucrative or high-return diversification opportunities which require certain assets (Bezu et al., 2012). In this case, diversification is used by wealthier rural households for accumulation and is a matter of choice (rather than necessity) (Dimova and Sen, 2010).

The *initial level of diversification* (in the 2008 period) is included in the models because other studies (Block and Webb, 2001; Lemi, 2006) found that the previous year's diversification was an important determinant of the subsequent year's level of diversification. Household demographic variables such as *age and level of education of the household head*, *household size (number of active males, females, young and old members),* and *use of hired labour* also capture the different dimensions of human capital. Moreover, some studies (van

den Berg and Kumbi, 2006) show that the size and structure of the household is correlated with participation in nonfarm activities. Social capital is proxied by *membership to local farmer group*/organisation dealing with agriculture. While having a *land title* is a natural capital indicator included to capture the influence of land tenure and ownership rights (Lay et al., 2008). Financial capital is included using the variable for *agricultural input credit* which also indicates whether access to inputs are necessary for farming. Hence lack of such credit can also indicate distress diversification, if households are unable to fund their agricultural inputs. Whether a *household borrowed money* to be able to cover their expenditures in the past year, is used to capture the livelihood strategy of poorer households.

4.0 Results and Discussion

This section presents and discusses the results of the study, starting with a description of the initial socio-economic characteristics of rural farm households in the panel, their farm and nonfarm income characteristics, and eventually results from the regional and gender-based models of changes in livelihood diversification.

4.1 Socio-economic characteristics of farm households in the panel by region and gender

The distribution of different socio-economic characteristics of the MHH and FHH in the panel for the period 2008, by region, are presented in Table 1. The overall results (Kakamega + Nyeri) show that the average age of the farm household heads in the panel was about 54 years of age, with significant regional differences. The FHH in Nyeri were significantly older than the MHH. The overall level of education was about 7 years of schooling, with MHH in both regions being significantly more educated than FHH. The overall mean farm size was 1.5 hectares, but farm sizes in Nyeri were significantly smaller than the mean. However, there were no gender differences in farm size at the regional level. Households in Kakamega kept significantly more TLU (Total livestock units) compared to those in Nyeri. Moreover, there were no gender differences in TLU at the regional level.

Table 1. Socio-economic characteristics of rural households in the panel, 2008

	Overall		All Kakamega		All Nyeri		Difference		MHH Kakamega		FHH Kakamega		Difference		MHH Nyeri		FHH Nyeri		Difference	
Characteristic	Mean	SD	Mean	SD	Mean	SD			Mean	SD	Mean	SD			Mean	SD	Mean	SD		
Age of household head	54.4	14.0	56.3	14.3	52.4	13.4	3.9	**	56.3	14.1	56.4	15.3	-0.1		51.0	13.8	57.2	10.7	-6.1	**
Education level of head (years)	7.4	4.6	6.1	4.2	8.6	4.7	-2.5	***	6.7	4.2	4.5	3.8	2.1	**	9.5	4.3	5.4	4.6	4.1	***
Household size	7.1	3.3	8.0	3.4	6.1	3.0	1.9	***	8.3	3.4	7.3	3.3	1.0		6.1	2.7	6.1	3.9	0.1	
Farm size (hectares)	1.5	1.7	1.8	1.8	1.2	1.5	0.6	***	1.8	1.5	1.9	2.6	-0.1		1.3	1.7	1.0	0.7	0.3	
Total livestock units (TLU)	1.6	1.2	1.7	1.4	1.4	1.0	0.3	*	1.8	1.4	1.6	1.3	0.2		1.5	1.1	1.2	0.7	0.3	
Have a land title (%)	76.6		72.7		80.5		-7.8		71.7		75.9		-4.1		80.4		80.8		-0.3	
Hire farm labour regularly (%)	54.0		45.5		62.7		-17.3	***	45.7		44.8		0.8		63.0		61.5		1.5	
Have agricultural input credit (%)	30.1		8.3		52.5		-44.3	***	9.8		3.5		6.3		52.2		53.9		-1.7	
Membership in farmer group(s) (%)	36.8		11.6		62.7		-51.1	***	14.1		3.5		10.7		63.0		61.5		1.5	
Households with nonfarm income (%)	33.0		23.0		42.0		-19.0	***	26.0		14.0		12.0		46.0		31.0		15.0	
Households without nonfarm income (%)	67.0		77.0		58.0		19.0	***	74.0		86.0		-12.0		54.0		69.0		-15.0	
Total number of panel households	239		121		118				92		29				92		26			
Total number of panel households (%)	100		51		49				39		12				38		11			

Notes: ***, **, * denote statistical significance at 1%, 5% and 10% levels. SD represents the standard deviation.

For characteristics, such as the proportion of households having titled land, hiring farm labour regularly, having agricultural input credit and membership in farmer groups, there were strongly significant differences between the two regions, but no significant differences between MHH and FHH in each region. In terms of access to nonfarm income sources, only 33 per cent of the total number of farm households in the panel had one or more sources of nonfarm income in 2008. The proportion of households with nonfarm income was significantly higher in Nyeri compared to Kakamega. However, there were no significant gender differences in having nonfarm income in each region. Overall, 67 per cent of households in the panel did not have any nonfarm income sources in 2008, showing that they were completely dependent on farm incomes.

4.2 Changes in livelihood diversification activities of farm households in rural Kenya

Declining farm cash incomes, low nonfarm cash incomes, FHH in absolute poverty

The mean levels of different sources of cash income of the farm households over the study period, expressed in constant 2010 US dollars per adult equivalent[5] are presented in Table 2. The cash income figures presented do not account for the value of output retained for own consumption by the household, due to data limitations. Moreover, it has been noted by Andersson Djurfeldt and Djurfeldt (2013) that converting retained output of crops such as tubers, vegetables, and fruits (which are often grown by women) into income is usually difficult because of irregular harvesting, and therefore the income may be easily underestimated.

The overall results show that total household cash incomes (henceforth referred to as total incomes) declined slightly over the study period. More specifically, farm incomes declined significantly because of a major drop in the sale of other food crops, despite a significant rise in the sale of food staples.[6] Overall, farm incomes remained significantly higher than nonfarm incomes, in both periods.

[5] Following Andersson Djurfeldt and Hillbom (2016), household cash incomes are converted into cash incomes per adult equivalent, to account for differences in household size and age composition. Adult household members (male and female) aged between 16 and 60 years are assigned a value of 1, children less than 15 years were assigned a value of 0.50, while elderly household members of more than 61 years are given a value of 0.75. The household cash incomes in each year were converted into 2010 constant dollars using the consumer price index (CPI) for the respective year, in order to take care of inflation and changes in the exchange rate (1 US$ = 77.71 Kenya shillings in 2008, 1 US$ = 86.31 Kenya shillings in 2013).

[6] This was probably because the category “other food crops” includes high value crops like fruits and vegetables that fetch higher prices in the market compared to “food staples” like maize.

Table 2. Changes in rural household cash incomes from farm and nonfarm sources

Income source	Year	Overall	All Kakamega	MHH Kakamega	FHH Kakamega	All Nyeri	MHH Nyeri	FHH Nyeri
1. Sale of food staples	2008	10.9	13.7	15.0	9.7	8.0	5.6	16.5
	2013	52.3	30.6	35.2	16.3	74.4	80.8	52.0
	change	41.4***	16.9**	20.2**	6.6	66.5***	75.2***	35.5
2. Sale of other food crops	2008	105.9	19.6	22.5	10.5	194.3	198.7	179.0
	2013	42.6	23.9	26.7	15.0	61.8	69.3	35.2
	change	-63.3***	4.3	4.2	4.5	-132.5***	-129.4***	-143.8**
3. Sale of non-food cash crops	2008	119.8	54.9	59.5	40.2	186.3	199.0	141.4
	2013	98.0	81.1	90.6	50.8	115.4	123.7	86.0
	change	-21.7	26.2	31.1	10.6	-70.9	-75.2	-55.4
4. Sale of animals/animal	2008	133.5	40.4	51.8	4.0	228.9	212.3	287.8
	2013	99.4	43.3	49.6	23.2	157.0	180.3	74.7
	change	-34.0	2.9	-2.2	19.1*	-71.9*	-32.0	-213.1*
5. Work on others' farms	2008	27.9	35.2	43.0	10.4	20.5	22.9	12.3
	2013	13.4	6.6	7.7	3.2	20.4	23.8	8.3
	change	-14.5	-28.6	-35.3	-7.2	-0.2	0.9	-4.0
6. Leasing out machinery	2008	0.2	0.4	0.6	0.0	0.02	0.02	0.0
	2013	3.4	4.4	5.8	0.0	2.41	2.69	1.4
	change	3.2**	3.9**	5.3**	0.0	2.39	2.67	1.4
7. Salaried employment	2008	88.6	18.9	24.9	0.0	160.1	167.1	135.3
	2013	95.9	75.2	80.4	58.9	117.1	146.1	14.5
	change	7.3	56.3**	55.5*	-58.9	-43.0	-21.0	-120.8
8. Micro-business	2008	12.8	0.9	1.1	0.0	25.0	22.9	32.1
	2013	33.1	31.5	29.9	36.7	34.7	39.4	18.2
	change	20.3**	30.7***	28.8**	36.7*	9.8	16.5	-14.0
9. Large-scale business	2008	9.3	0.0	0.0	0.0	18.9	24.3	0.0
	2013	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	change	-9.3	0.0	0.0	0.0	-18.9	-24.3	0.0
10. Rent, interest	2008	3.0	5.9	7.8	0.0	0.003	0.003	0.0
	2013	11.2	8.3	11.0	0.0	14.2	18.05	0.4
	change	8.2	2.4	3.2	0.0	14.2	18.04	0.4
11. Pensions	2008	18.1	3.1	4.1	0.0	33.5	43.0	0.0
	2013	13.6	15.4	20.2	0.0	11.8	11.2	13.7
	change	-4.5	12.2	16.1	0.0	-21.7	-31.8	13.7
12. Remittances	2008	11.9	11.4	9.2	18.7	12.4	14.6	4.6
	2013	19.0	20.5	19.4	24.2	17.4	18.1	15.0
	change	7.1	9.1*	10.2*	5.5	5.1	3.6	10.4
Farm income (1-5)	2008	397.9	163.7	191.8	74.8	638.1	638.3	637.1
	2013	305.7	185.4	209.7	108.4	429.0	477.9	256.2
	change	-92.2**	21.7	18.0	33.6	-209.0***	-160.5*	-380.9***
Nonfarm income (6-12)	2008	144.0	40.7	47.7	18.7	249.9	271.9	172.1
	2013	176.3	155.4	166.7	119.8	197.6	235.6	63.2
	change	32.3	114.7***	119.0**	101.1**	-52.2	-36.3	-108.8
Total household income (1-12)	2008	541.9	204.5	239.4	93.5	888.0	910.2	809.1
	2013	482.0	340.9	376.4	228.2	626.7	713.5	319.5
	change	-59.9	136.4**	136.9*	134.7*	-261.3**	-196.7	-487.7***
Number of households		239	121	92	29	118	92	26

Notes: ***, **, * denote statistical significance at 1%, 5% and 10% levels, for paired sample T-tests. Changes are computed as 2013 minus 2008 figures. The figures are mean cash incomes expressed in constant 2010 US dollars per adult equivalent.

There were considerable differences depending on region, and gender of the household head. For Kakamega, over the study period, total incomes increased significantly across the board for both MHH and FHH, due to significant increase in nonfarm incomes. More specifically, the FHH increased their total incomes mainly by selling animals and animal produce, and engaging in micro-business activities. Whereas, MHH increased their total incomes mainly through selling food staples and nonfarm incomes (leasing out machinery, salaried employment, remittances and microbusiness). However, generally MHH had higher total incomes compared to FHH, in both periods. The results corroborate Bikketi et al. (2016) who found that men in Kakamega received more total cash incomes than women because they had additional incomes from sugarcane and off-farm activities. The results that FHH generally have lower total cash incomes than MHH are consistent with findings of other studies in SSA (Canagarajah et al., 2001; Dolan, 2004; FAO, 2011; Simtowe, 2010). Furthermore, although total incomes in Kakamega increased significantly for both MHH and FHH over the study period, they fell significantly below the US dollar 1.9 per day per capita poverty line in both periods, indicating that households mostly engaged in low-return nonfarm activities. Hence, it seems the increased nonfarm diversification was mainly driven by survival/distress motives.

On the other hand, in Nyeri, overall total incomes declined significantly due to a major drop in farm incomes over the study period. This was due to a significant drop in the sale of other food crops, and animals/animal products. Similarly, the farm incomes of both MHH and FHH dropped significantly. The FHH were most affected by the drop in farm incomes as their total incomes declined more significantly. In contrast, it seems the MHH were able to offset the fall in farm incomes mainly by selling food staples, hence their total incomes did not change much. The total incomes for FHH in Nyeri fell significantly below the US dollar 1.9 per day per capita international poverty line in the 2013 period, while that of MHH remained above this poverty line. The results suggest that FHH in Nyeri became poorer and more vulnerable over the study period because of failure in their alternative sources of income. This corroborates findings of FAO (2011) that that FHH are more likely to be poor than MHH in some countries.

The results from other AFRINT researchers in the same regions in 2002 and 2008 (Jirström et al., 2011) showed a crisis in the smallholder farm sector. The significant drop in farm income in Nyeri is what influenced the overall pattern of farm income over the study period. This drop can be attributed to climatic shocks (shifting rainfall patterns and droughts)

and poor road conditions in some regions. For instance, qualitative fieldwork in one of the villages in Nyeri in 2013 revealed that farm production was badly affected by climatic conditions and difficult market access. Some of the respondents interviewed reported that they left horticultural produce to rot on the farms, because the roads became impassable during the rainy season such that traders could no longer access the village.

According to Government of Kenya (2012), Kenya suffered intense and widespread drought periods between the 2008 and 2011, in which drought was responsible for economic losses valued at several billions of Kenya shillings in reduced food and cash crops. Moreover, the economic damage and losses suffered was higher in Central Kenya compared to the Western Kenya. In 2012, there were poor rains coupled with frost in the months of March, April and May which affected especially the tea growing areas. Additionally, the Kenya Human Development Report (2013) indicates that there were high economic losses in livestock production because of the drought between 2008 and 2011 which led to depletion of pasture and water, and triggered massive migration of livestock from the affected areas to higher altitude areas such as Mount Kenya and even to national parks. Whereas the process of livestock migration led to many livestock deaths due to outbreaks of Foot and Mouth Disease (FMD) and Newcastle disease.

Declining farm income share – drought, lack of crop diversification and food insecurity

The changes in the contribution of different farm and nonfarm income sources to total household cash incomes over the study period are shown in Table 3. The overall "contribution of farm income to total household income," referred to as the *farm income share* (FIS) fell significantly by 8.3 per cent. More specifically, the share of household income from the sale of food staples increased significantly, showing increased grain marketing. Additionally, the share of income from the sale of animals/animal produce, and leasing out of machinery increased significantly. Whereas the share of income from the sale of other food crops and work on other farms declined significantly. The patterns in the staple crop sector corroborate the findings of Andersson Djurfeldt and Djurfeldt (2013) when comparing the 2002 and 2008 AFRINT panel, which includes the same regions in Kenya, and found that commercial diversification either declined significantly or remained unchanged between 2002 and 2008, whereas Kenya (compared to other countries in the panel) was above average in terms of grain intensification. This also corroborates recent studies (Davis et al., 2016) showing that farming still dominates the rural economy in SSA.

Table 3. Changes in the share of farm and nonfarm income sources in total household income

Income source	Year	Overall	All Kakamega	MHH Kakamega	FHH Kakamega	All Nyeri	MHH Nyeri	FHH Nyeri
1. Sale of food staples	2008	8.6	16.5	16.8	15.6	1.5	1.3	2.2
	2013	12.4	13.1	14.5	8.6	11.7	12.4	9.3
	change	3.9*	-3.4	-2.3	-6.9	10.2***	11.1***	7.1**
2. Sale of other food crops	2008	23.2	20.9	22.7	14.8	25.1	26.9	19.0
	2013	13.9	13.4	12.2	17.3	14.5	15.2	12.0
	Change	-9.2***	-7.6*	-10.5**	2.5	-10.6***	-11.7***	-7.0
3. Sale of non-food cash crops	2008	24.3	21.6	18.7	31.5	26.7	24.5	34.3
	2013	20.2	18.3	21.1	9.1	22.2	20.7	27.4
	change	-4.1	-3.3	2.4	-22.4**	4.6	-3.8	-6.9
4. Sale of animals/animal produce	2008	15.2	5.3	5.4	5.0	24.0	22.4	29.5
	2013	20.5	11.8	13.2	7.5	29.3	28.6	32.1
	change	5.3**	6.5***	7.7**	2.5	5.3	6.1	2.6
5. Work on others' farms	2008	10.6	19.4	18.8	21.7	2.7	2.9	1.8
	2013	6.3	8.4	9.8	3.9	4.2	5.2	0.9
	change	-4.2*	-10.9***	-8.9*	-17.8**	1.5	2.2	0.9
6. Leasing out machinery	2008	0.03	0.07	0.09	0.00	0.00	0.01	0.00
	2013	1.14	1.97	2.58	0.00	0.30	0.18	0.70
	change	1.1***	1.9**	2.5**	0.00	0.29	0.18	0.70
7. Nonfarm salaried employment	2008	9.1	4.4	5.6	0.0	13.3	14.7	8.7
	2013	9.1	7.4	5.8	12.8	7.3	8.9	1.5
	change	1.8	3.1	0.1	12.8**	-6.1*	-5.8	-7.3*
8. Micro-business	2008	2.2	1.0	1.3	0.0	3.3	3.3	3.4
	2013	6.8	8.3	6.7	13.4	5.4	4.9	7.1
	change	4.6***	7.3***	5.5**	13.4**	2.1	1.6	3.7
9. Large-scale business	2008	0.2	0.0	0.0	0.0	0.4	0.6	0.0
	2013	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	change	0.2	0.0	0.0	0.0	-0.4	-0.6	0.0
10. Rent, interest	2008	0.1	0.2	0.3	0.0	0.0	0.0	0.0
	2013	1.8	1.8	2.3	0.0	1.8	1.8	1.7
	change	1.7***	1.6	2.0	0.0	1.8***	1.8***	1.7
11. Pensions	2008	1.07	0.50	0.65	0.00	1.57	2.02	0.00
	2013	1.14	1.25	1.63	0.00	1.04	0.97	1.28
	change	0.08	0.74	0.98	0.00	-0.53	1.05	1.28
12. Remittances	2008	5.4	10.1	9.7	11.3	1.3	1.3	1.0
	2013	8.3	14.2	10.2	27.3	2.3	1.3	6.0
	change	2.9	4.1	0.5	15.9	1.0	0.1	4.9*
Farm income share (1-5)	2008	81.8	83.8	82.4	88.7	80.1	78.1	86.9
	2013	73.5	65.1	70.8	46.6	82.0	82.0	81.8
	change	-8.3***	-18.7***	-11.6**	-42.1***	1.9	4.0	-5.1
Nonfarm income share (6-12)	2008	18.2	16.2	17.6	11.3	19.9	21.9	13.1
	2013	26.5	34.9	29.2	53.4	18.0	18.0	18.2
	change	8.3***	18.7***	11.6**	42.1***	-1.9	-4.0	5.1
Number of households		239	121	92	29	118	92	26

Notes: ***, **, * denote statistical significance at 1%, 5% and 10% levels, for paired sample T-tests. Changes are computed as 2013 minus 2008 figures.

At the regional level, the FIS in Nyeri as a whole did not change significantly over the study period. In fact, this pattern was consistent for both MHH and FHH. In contrast, for Kakamega as a whole, the FIS declined significantly due to a major drop in the share of household income from the sale of other food crops and work on other farms. The FIS for both MHH and FHH in Kakamega also declined significantly. For MHH, the FIS declined because of significant reduction in the share of household income from selling other food crops and working on other farms, similar to the overall pattern in Kakamega. Whereas for FHH, the FIS declined because of a significant drop in the share of income from the sale of non-food cash crops and work on other farms. Moreover, these patterns suggest that a number of households, especially those in Kakamega, may have adopted coping strategies due to the significant decline of farm income over the study period. Such coping strategies indicated by the overall results for Kakamega include – retaining other food crops for home consumption (mainly the MHH), selling more animals/animal products (mainly the MHH), and diversifying into low-return micro-business activities (both MHH and FHH).

The negative farm income patterns in Kakamega can be attributed to push factors, such as seasonality, drought, lack of crop diversification and food insecurity during the lean seasons. This interpretation is supported by previous studies in Western Kenya which indicate that lack of crop diversification is linked to persistent food insecurity (Waswa et al., 2009), while heavy dependency on maize pushes many farm households to depend on the market during the lean seasons (Oluoch-Kosura and Karugia, 2005). The qualitative interviews revealed that a number of farm households in Kakamega are heavily dependent on sugarcane as the main cash crop, while maize doubles as a food and cash crop. Most of the farmland is locked up in sugarcane production and hence there is low production of other food crops except maize. This lack of crop diversification makes farm households vulnerable to food insecurity when maize crops fail, especially during droughts. One of the households interviewed in Kakamega reported that: there are two maize harvesting seasons - the first is between July and August after the long rains, and the second is between November and December after the short rains. Hence there are periods of maize shortage when prices become very high, and there are periods of high supply after harvest when prices are lower. The common pattern in the months between March and June, is a shortage of maize supply in Kakamega – with high maize prices and high risks of food insecurity. During this period, most of the food (mainly maize) consumed in Kakamega comes in from other surplus

producing areas such as Trans Nzoia, Uasin Gishu where farmers have larger plots and are engaged in commercial production of maize and wheat.

Increasing nonfarm income share – signs of survival/distress livelihood diversification

In contrast, the overall "contribution of nonfarm income to total household income," referred to as the *nonfarm income share* (NFS) increased significantly by 8.3 per cent. This was mainly due to a significant increase in micro-business activities[7] and rents/interest. The regional patterns in NFS were different. Whereas in Nyeri the NFS did not change much irrespective of the gender of the household head, in Kakamega NFS increased significantly over the study period by 16.8 per cent due to significant increase in micro-business activities. It is this change in Kakamega that explains the overall pattern of NFS. Although, the NFS increased significantly especially in Kakamega, this is a sign of distress/survival diversification. This is because, as already shown, the mean total household cash incomes of both MHH and FHH households in Kakamega fell below the US$1.9 a day per capita international poverty line in both periods of the study. This means on average rural farm households in the panel for Kakamega remained in absolute poverty, although they diversified their income sources, suggesting they mostly engaged in low-return nonfarm activities.

More specifically, the increase in NFS in Kakamega was much more for FHH compared to MHH. Moreover, reliance on nonfarm income sources in Kakamega was higher among FHH, compared to MHH. This is line with Andersson Djurfeldt (2012), who found that women in western Kenya predominantly participate in nonfarm activities such as small-scale trading. The results also corroborate other findings from Kenya and elsewhere in SSA (Andersson Djurfeldt and Wambugu, 2011; Canagarajah et al., 2001; Jirström et al., 2011; Manjur et al., 2014; Zakaria et al., 2015) showing that females and FHH tend to rely heavily on nonfarm incomes to sustain their livelihoods, because they have limited access and control over agricultural resources such land, credit and other inputs.

In general, the results above are consistent with Haggblade et al. (2007) who indicate that nonfarm sources have grown in importance, accounting for between 35 and 50 per cent of rural household incomes in developing countries, including SSA. Specific to Kenya, Valbuena et al. (2015) who studied the trajectories of change in rural livelihoods at household-level between 2003 and 2013 in Western Kenya, found a 30 per cent increase in

[7] Some common microbusiness activities reported from the qualitative fieldwork include petty trading activities, transport (boda boda), masonry, tailoring, brick making, sand harvesting, stone quarrying, etc.

nonfarm income among their surveyed households. Although there are some regional and gender differences, in general, both the quantitative results here and the qualitative fieldwork contradict the findings of Bryceson (2002) resulting from household surveys in six African countries (Ethiopia, Nigeria, Tanzania, Malawi, Zimbabwe and South Africa) where NFS were between 60 to 80 per cent of household incomes. Because of this the study claimed that *de-agrarianisation* or rapid livelihood diversification has taken place in SSA, characterised by income earning reorientation and spatial relocation of rural households away from farm-based livelihoods. However, the findings in this paper are consistent with other studies based on AFRINT 2002, 2008 and 2013 data (Djurfeldt et al., 2011, 2005; Jirström et al., 2017) showing relatively low NFS in the total household incomes of the Kenyan households in the panel, and confirming that farming is still their most important source of cash incomes. However, the general patterns reflect the overall processes of rural transformation in the early stages, described in Rigg (2006) and Haggblade et al. (2007). One of the main patterns of rural transformation that are seen here, and also mentioned by Rigg (2006), is the declining share of smallholder agricultural production over time and the emergence of new opportunities in the nonfarm sector.

4.3 Determinants of change in livelihood diversification

This section uses panel data models to analyse the overall and gender-based determinants of changes in livelihood diversification in the two agricultural regions of Kakamega and Nyeri (Table 4). Livelihood diversification is proxied by the NFS and is the dependent variable in all the models. The descriptive characteristics for the variables in the econometric models are given in Appendix E. Model 1 estimates the determinants for the entire panel of 239 households. Models 2 and 5 estimate the determinants for the panel of households by region - Kakamega and Nyeri, respectively. The rest of the models 3, 4, 6 and 7 are gender-based, estimating the determinants of change in NFS for MHH and FHH by region.

Livelihood diversification increases with asset wealth

In the overall model, the relationship between change in asset wealth and change in livelihood diversification was not significant. However, for the regional and some gender-based models (except models 4 and 6), the *asset wealth index* was positively and significantly associated with change in the NFS over the study period, *ceteris paribus*. This indicates that increase in asset wealth is significantly associated with an increase in livelihood

diversification mainly at the regional level, and there are significant gender differences. The implication is that "accumulation" is the primary motive for diversification in both agricultural regions, since it is richer households with sufficient assets who have access to nonfarm income opportunities. Nonfarm employment activities in general tend to be hindered by high entry barriers, meaning that it is relatively richer households with assets who are in a better position to participate. This result is consistent with previous literature based on longitudinal data, that it is mainly pro-active wealthier households with assets who increase their level of diversification for accumulation (for Mali: Abdulai and CroleRees, 2001; for Ethiopia: Bezu et al., 2012; Bezu and Barrett, 2012; Block and Webb, 2001; Weldegebriel et al., 2015; for Tanzania: Dimova and Sen, 2010).

All the interviews from qualitative fieldwork in Boxes 1, 2 and 3 illustrate that it is farm households, who can access and increase their asset wealth that are able to diversify their income generating activities more and eventually improve their standards of living. Moreover, the interviews also illustrate that such households were able to combine and exploit the synergies or strategic complementarities between farm and nonfarm activities in order to improve their livelihoods. This finding corroborates Jirström et al. (2017) who find that rural households who supplement their farm incomes with nonfarm income are able to increase their total incomes. As indicated by Rigg (2006), nonfarm activities reduce the employment constraints of agricultural seasons by allowing farmers to earn more regular income throughout the year, while permitting the creative combination of farm and nonfarm activities.

Box 1. Combining farming and transport micro-business

Mary (not real name) is a second wife with five children. Three of them migrated to Nairobi after completing senior four education. Two of them found jobs in Nairobi – one in a hotel and another in a factory. The third one in Nairobi is still looking for a job. She is engaged in a motorcycle transport business (*boda boda*) which she runs with one of her sons. Another son is a casual worker on the Mumias sugarcane farms. She started her business with one motorcycle bought using a group loan from Faulu MFI (Micro-finance institution). Currently, she has three motorcycles which are used for transporting people to generate income. She hires two riders to do the work. She was allocated ¾ of an acre of land by her husband, and this is where she stays with her children and grows maize for home consumption. She also inherited an acre of land from her parents where she plants maize for sale and saves the money in her own account with Equity bank. She used some of her own savings to pay off the loan with Faulu MFI. She was able to get another loan to purchase two more motorcycles. She uses the money from the business to educate her remaining children and to buy farm inputs (maize seed and fertiliser). She plans to invest in dairy cattle using the money from her business. She also plans to start up an M-PESA business using the proceeds she has been saving in Equity bank from selling maize. She occasionally sends some money and food to her mum in another village. She sometimes receives money from her children who live in Nairobi.

Source: qualitative fieldwork interviews in Kenya, Kakamega, Jan-Feb 2013.

For Kenya, to my knowledge, panel data for a similar period has not been used to study the dynamics of livelihood diversification, its determinants, while incorporating both the regional and gender dimensions. However, cross-sectional data from a previous work examining the patterns of income diversification in rural Kenya and Senegal (Alobo Loison and Bignebat, 2017) showed that investment in certain kinds of assets (livestock, productive facilities) were significantly important for income diversification. Lay et al. (2008) using cross-sectional data from Kakamega found that richer households in their study diversified in both low-return and high-return activities to increase their incomes and agricultural productivity. In their study, more than a third of households who were engaged in high-return nonfarm activities were also engaged in some low-return activity. Whereas Valbuena et al. (2015) in Western Kenya between 2003 and 2013, found that it is better endowed households that tended to diversify their livelihood strategies and acquire land that enabled them to adapt and benefit from the major changes observed in external drivers. Whereas the more vulnerable households sold their labour and land in order to cope, hence remaining in a poverty trap.

Box 2. Combining farming and petty trade

Linda (not real name) is a single mother who owns a shop in the nearby town. She started the business in 1997 using her savings from previous wage employment. She dropped out of secondary school in senior four, and started selling produce in Karatina market. Eventually she got employed as a shop steward in Karatina town. Using her savings, she started a shop where she sells a range of products from foodstuffs, fertilisers, poultry feeds, including hardware materials. She is also a registered co-operative bank agent - through her shop people come to do bank transactions at a fee. She is also a farmer with 2 acres of farmland which she bought using a grant from a relative. She grows mostly food crops including maize on the farm. She usually hires four labourers to work on the farm, while she attends to the shop. She also has another plot in the valley of 1/8 acre (allocated to her by family) where she grows mostly vegetables. She sells some of the vegetables from her farm in the shop. She also sends some food to her relatives in Nyeri. She is currently saving with Co-operative bank and she is able to access credit from them. She also keeps 2 dairy livestock animals and sells 4 litres of milk daily to brokers at 28 Kshs per litre. She uses the milk proceeds to buy fodder crops, vet drugs and for maintenance. She uses money from her business mostly to pay school fees for her son and some of her relatives.

Source: Qualitative fieldwork interviews in Kenya, Nyeri, Jan-Feb 2013.

Overall, a higher *initial level of nonfarm income* is positively and significantly associated with the subsequent increases in the level of nonfarm income. This finding was consistent for both regions, and the result was strongly significant among MHH. This suggests that mainly MHH are able to build on previous nonfarm incomes and wealth in order to increase their level of livelihood diversification. This can be illustrated by the

qualitative interview in Box 3, which shows that previous income from salaried employment enabled the household to invest in a high-return nonfarm activity such as a shop.

Box 3. Combining farming and nonfarm salaried employment

Henry (not real name) is a shop owner in the nearby trading centre. He is married with six children, four of whom live and work in nearby towns. He started his shop using savings from his salaried job at the post office. He sells mainly basic items like sugar, salt, tea-leaves, cooking oil, soap. He gets the stock for his shop from nearby towns of Makutano and Turbo. His wife manages the shop while he goes to work. He uses the income from the shop mainly to pay school fees for the younger children, and to buy food and non-food items for his family. In addition to the shop, he has 1.5 hectares of land which he uses to grow maize and beans. The maize is mainly for sale, while the beans are for home consumption. After harvest he sends a few bags of maize to his older children who live in nearby towns, and to some of his relatives in the nearby village. He keeps most of the maize to sell in the shop, especially during the lean season when prices are high. He also keeps dairy livestock. He sells the milk to traders who come to the village to buy milk to sell to Brookside company. From the milk sales, he buys some farm inputs (seeds, fertilisers and chemicals) for the maize crop and invests some of it in the shop. He sometimes receives money from his older children living in nearby towns, which he uses as need arises. He plans to buy land to expand his farm in order to grow sugarcane and to keep more livestock.

Source: Qualitative fieldwork interviews in Kenya, Kakamega, Jan-Feb 2013.

Household demographic factors are important drivers of change in livelihood diversification

The *age of the household head* was an important factor in explaining livelihood diversification among the farming households in Kakamega, especially among the FHH. This implies that in Kakamega, older age was associated with increase in NFS over the study period. This is probably because older farmers are likely to have more wealth and experience to invest in nonfarm sector activities. However, the results contrast the findings of Lay et al. (2008) who found that in Kakamega, as the age of the household head increased, the share of nonfarm income dropped significantly. In addition, from the qualitative fieldwork, it was reported that older farmers are more involved in farm activities. For instance, fieldwork in one of the villages in Kakamega showed that old farmers are mainly engaged in sugarcane production as outgrowers.

Table 4. Determinants of changes in livelihood diversification in rural Kenya, 2008-2013

Dependent variable: NFS	*Model 1*	*Model 2*	*Model 3*	*Model 4*	*Model 5*	*Model 6*	*Model 7*
Explanatory variables	Overall (RE)	All Kakamega (RE)	MHH Kakamega (FE)	FHH Kakamega (FE)	All Nyeri (RE)	MHH Nyeri (FE)	FHH Nyeri (FE)
Asset wealth index	0.019	0.074***	0.159***	0.075	0.042**	0.045	0.073**
	(0.015)	(0.026)	(0.057)	(0.068)	(0.021)	(0.032)	(0.036)
Initial level of NFS (2008)	0.782***	0.849***	0.770***	0.121	0.819***	0.725***	0.379*
	(0.028)	(0.053)	(0.133)	(0.378)	(0.036)	(0.087)	(0.206)
Age of head (years)	0.001	0.003**	0.003	0.028**	-0.0001	0.005	0.002
	(0.001)	(0.001)	(0.003)	(0.012)	(0.001)	(0.003)	(0.004)
Gender of head (male), dummy	-0.063**	-0.112**			-0.034		
	(0.032)	(0.054)			(0.032)		
Education level of head (years)	0.002	-0.002	0.007	0.069***	0.004	-0.006	-0.008
	(0.003)	(0.005)	(0.012)	(0.020)	(0.004)	(0.008)	(0.011)
Household size	-0.006	-0.010	-0.002	-0.016	-0.006**	-0.011	0.001
	(0.004)	(0.006)	(0.010)	(0.022)	(0.003)	(0.007)	(0.008)
Membership of group, dummy	-0.012	0.095*	0.139	0.051	-0.039	0.035	0.076
	(0.031)	(0.057)	(0.088)	(0.133)	(0.030)	(0.045)	(0.117)
Use of hired labour, dummy	0.056**	0.121***	0.190***	0.164	0.011	0.074	-0.015
	(0.027)	(0.040)	(0.063)	(0.182)	(0.030)	(0.059)	(0.055)
Agricultural input credit, dummy	-0.135***	-0.157***	-0.268***	-0.504	-0.085***	-0.082*	-0.089
	(0.030)	(0.060)	(0.093)	(0.383)	(0.031)	(0.049)	(0.054)
Land title, dummy	-0.014	0.032	-0.021	0.122	-0.056	-0.231***	0.132
	(0.029)	(0.036)	(0.060)	(0.200)	(0.040)	(0.069)	(0.099)
Borrow to cover needs, dummy	-0.014	-0.096**	-0.044	-0.315***	0.031	-0.009	-0.085
	(0.027)	(0.041)	(0.057)	(0.105)	(0.031)	(0.048)	(0.077)
Constant	0.208***	0.226**	-0.004	-1.424**	0.208**	0.097	-0.045
	(0.072)	(0.106)	(0.186)	(0.713)	(0.086)	(0.200)	(0.277)
No. of observations	455	221	170	51	234	182	52
No. of groups	238	120	92	28	118	92	26
R-squared	0.418	0.370	0.467	0.612	0.671	0.569	0.446

Notes: ***, **, * represent statistical significance at 1%, 5% and 10% respectively. The models include either household fixed effects (FE) or random effects (FE). All the models are corrected for heteroscedasticity using robust Huber/white standard errors which are given in parentheses. The "within" R-squared is presented for the FE models and the "between" R-squared is presented for the RE models.

The results show that *gender of the household head* is significant in explaining differences in the changes in livelihood diversification over the study period. Model 1 shows that overall, being a MHH (compared to FHH) had a significantly negative association with change in NFS. This was also the case in Kakamega (Model 2). This implies that MHH generally had lower nonfarm incomes compared to FHH. This finding is consistent with the findings of Lay et al. (2008) for Kakamega. However the overall result contradicts the findings of Andersson Djurfeldt et al. (2013) based on the 2002 and 2008 AFRINT data, who found no significant differences in both farm and nonfarm cash incomes for members of FHH and MHH for the Kenya sample. The gender differences in livelihood diversification over the study period, especially for Kakamega can probably be explained in general by differences in access to productive resources. For instance, cultural factors in Kakamega are important in

limiting women's ownership or control over certain productive resources, especially agricultural land (Lay et al., 2008). Moreover, the qualitative fieldwork in Western Kenya showed that many farm labourers tend to be women because they do not own land for farming. Women can mainly access farmland when allocated through their husbands after marriage or through other family members. However, women with wage or self-employment can be able to rent or buy land for farming through the market (Box 2).

It is only in Kakamega where *education level of the household head* was positive and significant in explaining changes in NFS among FHH over the study period (Model 4). Qualitative interviews with some women farmers in Kakamega, who had some level of formal education, indicated that they actively participated in nonfarm activities, especially petty trading of food products and basic items, as illustrated in Box 2. This corroborates Lay et al. (2008) who found that in Kakamega, education had a significant positive impact on entering low-return nonfarm employment. Moving on, *household size* was negatively and significantly associated with change in NFS only in Nyeri region (Model 5), implying that households with relatively more family members were likely to concentrate on farming, rather than diversifying out of farming. This finding is as expected, since Nyeri is a relatively dynamic agricultural region with a number of villages having high agro-ecological potential and good to medium access to agricultural markets as described by Karugia (2003).

Membership in farmer groups was expected to be important in increasing NFS, but surprisingly it was not statistically significant in almost all the models, except in the model for Kakamega (model 2), were it was only significant at 10% level. This is probably because most of the farmer groups are mainly engaged in farm activities, rather than nonfarm activities. A number of households interviewed during the qualitative fieldwork were involved in farmer groups[8] which access capital and start-up skills from government, donors, NGOs or banking institutions (Box 1). Some households can access land, capital and inputs for farming through such farmer groups. The farmers were mainly involved in livestock production, horticulture and other new high value enterprises.[9] Moreover, joining groups is important for mobilizing savings for smoothing income and consumption (Dimova and Sen, 2010).

[8] Some of the groups reported in the fieldwork interviews were SACCOs (Savings and Credit Associations), ROSCAs (Rotating Savings and Credit Associations), table banking groups, which mobilise savings and give credit to members.

[9] Such as production of ornamental Arabica flowers (Nyeri), silkworm and mulberry (Nyeri), building energy stoves (Kakamega).

Hiring labour positively influences change in livelihood diversification

Overall, the *use of hired labour* was a positively and significantly associated with change in the NFS (Model 1). There was a similar pattern in Kakamega (Model 2), especially among the MHH (Model 3). This suggests that MHH who employed paid labour on their farms significantly increased their level of livelihood diversification over the study period. This is probably because hiring labour may increase farm production, but it also gives household members time to look for more remunerative work in nonfarm sector activities. The qualitative fieldwork in Kakamega showed that hiring labour was especially important for sugarcane production which is labour intensive. One of the respondents reported that he mainly hires labour for preparation, planting and harvesting, which is done manually by hand hoes, and sometimes ox-ploughs and tractors. Sugarcane is a major cash crop in Western Kenya and was reported as being mainly a male domain. Most sugarcane farmers are outgrowers contracted by Mumias sugar company which provides seed, fertilisers and agro-chemicals. One of the requirements reported for becoming an outgrower is owning land. Most women however are unable to become outgrowers because they lack control and ownership of land based on *Abaluya* cultural norms. Although women were engaged in sugarcane production mostly as hired labourers. Sugarcane incomes were an important source of money for paying school fees and investing in nonfarm activities. However, Lay et al. (2008) found that in Kakamega sugarcane farmers were less likely to participate in the nonfarm sector, except when the period between cash flows from sugarcane harvests became longer (sometimes more than three years), then they were driven to participate in the nonfarm sector due to lack of access to financial markets.

Agricultural credit, more secure land rights, promote intensification rather than diversification

Overall, change in *agricultural input credit* was negatively and significantly associated with change in NFS (Model 1). This finding was consistent at the regional level (models 2 and 5). It was also the case for MHH in both regions (models 3 and 6). This indicates that in both regions increased access to agricultural input credit has generally promoted agricultural intensification over the study period, rather than diversification out of farming. Moreover, it is mainly MHH who seem to have benefitted from the input credit, probably because they control most of the land resources for farming. The AFRINT authors

have already indicated that although farm sizes seem to be declining rapidly in Kenya (Andersson Djurfeldt and Jirström, 2013), intensification especially in grain production has been happening already, and this is linked to increased input use (Djurfeldt et al., 2011, 2005). However, according to Mathenge et al. (2015), there is no organised credit system to support the main staple (maize), hence some rural households are driven to seek off-farm income sources to finance farm inputs. Although the qualitative interviews suggested a widespread use of chemical fertilisers especially on hybrid maize. It was reported that fertiliser prices are subsidised to some extent by government, but farmers sometimes fail to access them on time from NCPB (National Cereals and Produce Board) stores. Therefore, most farmers buy from private input dealers in the market.

The results further indicate that *obtaining a land title* was negatively and significantly associated with change in NFS, only among MHH in Nyeri (Model 6). Again this result suggests that land in Nyeri is mostly controlled by MHH. Anyhow Nyeri is a high potential cash crop region, therefore it makes sense that farm households with more secure land rights would focus on farming. Moreover, the previous results (recall Table 2) show that farming provides higher returns in Nyeri compared to nonfarm activities. The results corroborate what was concluded by Lay et al. (2008), that more secure land rights seem to provide an incentive for people to engage more heavily in farming, rather than to diversify into nonfarm employment. In addition, Lay et al. (2008) found that not having a land title deed was a significant determinant of low-return nonfarm employment when compared to agricultural employment in Western Kenya.

Poverty negatively influences change in livelihood diversification

The variable on *borrowing to cover subsistence needs* was included in the models as an indicator of poverty. The results show that borrowing to cover subsistence needs was negatively and significantly correlated with NFS in Kakamega, and even more strongly for FHH in Kakamega. This implies that FHH in Kakamega were relatively poor compared to MHH, and that poverty excluded some households from participating in the nonfarm sector. And yet nonfarm income sources are important for coping with seasonality and food insecurity, according to the findings of Andersson Djurfeldt (2012) in Western Kenya. The study found that poorer and richer households coped with seasonality in agricultural production differently. While the poor with few nonfarm income sources were forced to

reduce their consumption burdens during the dry season, the rich on the other hand could profit from seasonality using trade-based or barter exchanges for agricultural produce. This is confirmed by the qualitative fieldwork in one of the villages in Kakamega, where one of the respondents reported that during the lean season when maize prices are high, some poor households borrow maize from petty trade shops or from friends with a promise to pay later at the next harvest. Some better-off households have invested in petty trade shops selling maize, and they are able to profit from seasonality in such a way that during the lean season they sell maize at higher prices, but also lend maize to poorer households in search of food (Box 3). The poorer households are mandated to pay what they owe at the beginning of the next harvest, thereby reducing their food availability. In addition, poorer households also remit maize to relatives, after which they often do not have enough for the lean season. Food transfers are a common cultural practice with many households usually remitting maize to relatives in neighbouring villages after the harvest (Box 3). These food transfer patterns are described in much detail by Andersson Djurfeldt (2012), Andersson Djurfeldt and Wambugu (2011) and Djurfeldt et al. (2011).

4.0 Summary and conclusions

This study shows that rural farm households do not rely only on farm incomes to sustain their livelihoods, but they also diversify their income sources into the nonfarm sector driven by various motives. The quantitative data showed significant differences in the major livelihood activities depending on the region. In the relatively dynamic agricultural region (Nyeri) rural households relied mainly on cash incomes from farming (dairy cattle and high value cash crops) in addition to nonfarm self-employment, although over the study period farm incomes dropped because of a drought shock. In contrast, in the relatively less dynamic agricultural region (Kakamega) rural households relied mainly on cash incomes from farming (sugarcane cash crop and non-staple food crops), in addition to remittances from absent household members. Over the study period, possibly due to drought, lack of crop diversification and food insecurity, a number of rural households in Kakamega were pushed to diversify into low-return nonfarm activities for survival. Overall, cash incomes from farming were the most important source of livelihood, mainly crop sales. Although, the contribution of nonfarm incomes to total household cash incomes increased significantly, and this was mainly from microbusiness activities.

The study period was characterised by important structural changes in the composition and sources of household cash incomes. There were significant differences depending on the region and the gender of the household head. The overall FIS dropped significantly, driven by changes in Nyeri region. Compared to MHH, the FHH in Nyeri became more vulnerable as they were more affected when farm cash incomes declined. Moreover, the total cash incomes of FHH fell significantly below the international poverty line in the 2013 period, while that of MHH did not change significantly. Whereas the overall NFS increased significantly over the study period, driven by significant changes in Kakamega region. However, it seems that the dynamism in nonfarm livelihood diversification in Kakamega was mainly associated with survival or distress motives, as the total incomes of both MHH and FHH remained significantly below the international poverty line in both periods.

The motivations and changes in livelihood diversification of farm households in the two regions and the gender disparities were investigated through the theories of diversification due to survival/distress-push motives and accumulation/opportunity-pull motives. One of the main findings from the econometric work is that whether or not household fixed effects are included in the models, together with other determinants of diversification identified in previous literature, there is a positive and significant relationship between changes in household asset wealth and changes in livelihood diversification at the regional level. In general for both regions, farm households who significantly increased their asset wealth over the study period, also significantly increased their level of livelihood diversification into the nonfarm sector. This suggested that it is relatively wealthier pro-active households with greater assets that used livelihood diversification as an accumulation strategy in the different regions. Furthermore, the qualitative fieldwork illustrated that such wealthier farm households succeed in improving their standards of living over time by combining and exploiting the synergies or strategic complementarities between farm and nonfarm activities.

Other important determinants of changes in livelihood diversification over the study period included: the initial level of diversification, which had a positive and significant effect for both MHH and FHH in both regions. Household demographic factors such as age, gender (being a FHH) and education level of the household head (for FHH in Kakamega) were positively and significantly associated with change in livelihood diversification. However, relatively larger households in Nyeri were more likely to have reduced their level of

livelihood diversification, in effect concentrating on farming. On the other hand, membership to farmer groups was surprisingly not significant in driving changes in livelihood diversification, except to some extent in Kakamega region. Whereas, overall, hiring labour (most especially for MHH in Kakamega) had a positive and significant effect on the change in livelihood diversification. Overall, increased access to agricultural input credit, and having more secure land rights (for MHH in Nyeri) promoted specialisation in farming rather than diversification out of farming. Furthermore, the results show that poorer households that borrowed to meet their subsistence needs over the study period significantly reduced livelihood diversification into the nonfarm sector. This was especially the case for Kakamega, and it was significant among FHH.

The results have several implications for development policy in rural Kenya and SSA in general – highlighting the importance of recognising and harnessing the positive determinants of rural household livelihood diversification in order to increase its impact as a tool for poverty reduction. The results show that asset wealth is an important driver of changes in livelihood diversification at the regional level. Moreover, the qualitative results illustrate the important role of combining farm and nonfarm activities in order to increase incomes and wealth. Therefore, poverty reduction policy initiatives need to invest in diversification of both the farm and nonfarm sectors to increase income opportunities and improve the livelihoods of rural MHH and FHH. In addition, policy initiatives targeting poverty reduction need to mitigate the negative effects of livelihood diversification on poorer rural households, especially because they are limited in accessing more remunerative activities due to lack of necessary asset wealth. Hence, pro-poor policy initiatives need to increase access to important farm and nonfarm assets (education opportunities, land resources, farm inputs, credit and labour markets) and lower entry barriers into rural nonfarm sectors to benefit poorer households. This can help close the gender gap in access to remunerative livelihood diversification options especially for FHH, which tend to be poorer and more vulnerable, and constrained from accessing or owning certain assets by social, economic and cultural factors.

The results also show that it is also important for policy makers to pay attention to the motives for increased rural household livelihood diversification, because increased levels of household diversification is not necessarily a good thing - sometimes it is a sign of survival/distress diversification, especially in relatively less dynamic agricultural regions. This can be used as a way to identify/target relatively poor and vulnerable households such as

FHH for support. Nevertheless, the results showing dynamism in nonfarm diversification indicate that there is a growth potential in the nonfarm sector that should not be ignored by development policy. Hence policy strategies should promote the development of high-return nonfarm rural sectors. However, they must also take into account the differences between regions and between types of households (MHH or FHH), and their specific needs. For instance, the poorer and more vulnerable FHH may need continued support through relief, social safety nets, development aid and other support programs to reduce absolute poverty.

The overall results indicate that although farming was the most important source of livelihood, farm cash incomes were negatively affected by drought, food insecurity and lack of crop diversification over the study period. Therefore, policy strategies to promote livelihood diversification opportunities can help rural households to find alternative sources of income and survival. This can be done in addition to continued support to the smallholder agricultural sector to improve performance and productivity.

The econometric results show that increase in access to farm-related assets such as input credit and more secure land rights through formal titling are likely to promote specialisation in farming rather than diversification. The policy implication is that initiatives for provision of agricultural input credit and improving land tenure security and rights should be supported in order to increase smallholder agricultural performance.

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Appendix A. Demographic and Socio-economic indicators by region

Demographic Indicators	*Kakamega district*	*Nyeri district*
Population (2002)	643,457	677,216
Population growth rate (%)	2.12	2.54
Rural population (2002)	514,447	499,152
Urban population (2002)	125,599	175,289
Female population	54	51
Male population	46	49
Youth population (15-25yrs)	146,886	158,741
Labour force (15-64yrs)	222,089	381,960
Dependency Ratio	100:108	100:77
Socio-economic indicators		
Number of households	125,901	168,786
Number of female headed households	40,288	56,000
Average household size	4.8	4
Absolute poverty rate	57	31
Employment indicators		
Agriculture (%)	62	53
Rural self-employment (%)	8	10
Wage employment (%)	20	20
Urban self-employment (%)	2	2

Source: (Ministry of Planning and National Development, 2005; Kakamega District Strategic Plan 2005-2010; Nyeri District Strategic Plan 2005-2010).

Appendix B. Description of the household cash income source categories

The first three categories are crop sales – the value of gross production of crops that is sold (excluding the value of crops retained for own consumption). Crop sales are disaggregated into: (1) *Sale of food staples* (includes maize, sorghum and rice), (2) *Sale of other food crops* (such as bananas/plantains, cassava, beans, peas, irish potatoes, sweet potatoes, millet, groundnuts, yams, cocoyams, arrow roots, fruits and vegetables), and (3) *Sale of non-food cash crops* (such as cotton, sugarcane, nuts, cocoa, tobacco, coffee, tea, sisal, pyrethrum, oil palm, flowers, spices). The remaining categories are: (4) *Sale of animals and/or animal produce* – value of sales of animals and animal products such as milk and eggs. (5) *Work on others' farms* (farm wage or 'kibarua') – refer to wages or salaries received from labour on other farms. (6) *Leasing out machinery* – income from hiring out mainly farm machinery, including ox-ploughs, push carters, and others. (7) *Nonfarm salaried employment* – income from waged or salaried nonfarm employment. (8) *Micro-business* - refers to any kind of small-scale cash generating business or self- employment carried out on an individual or family basis, such as beer brewing, petty trade and retailing, selling foods and beverages, crafts, artisanal activities like masonry, carpentry, welding, as well as service-related businesses like tailoring, hair dressing teaching, among others. (9) *Large-scale business* – refers to self-employment activities that in terms of scale, investments and returns surpass those of micro-business. For instance, various kinds of transportation, construction, manufacturing and trade belong to this category. (10) *Rent, interest* - incomes generated by rental revenues from physical assets or securities. (11) *Pensions* - incomes received from government/public bodies. (12) *Remittances* - incomes received from absent household members, children or relatives living elsewhere.

Appendix C. Construction of the asset wealth index

The asset wealth index is constructed from some productive and non-productive assets owned by a given household, on which data were collected in both surveys (2008 and 2013). The asset wealth index is validated by including assets which are considered as wealth indicators in the context of Kenya, using insights from the qualitative fieldwork and previous literature. These include: (a) *Total livestock units (TLU)* – In the data, livestock includes a wide range of animals such as cows, oxen, goats, sheep, donkeys, pigs and poultry. Hence livestock units were assigned following Makeham and Malcolm (1986). In Kenya, livestock are productive farm assets that are important for milk and meat, both for sale and for home consumption. Moreover, for some households, oxen are used for draught power in land preparation while donkeys are used for transport on the farm. The qualitative fieldwork found that dairy cows are an important source of collateral to obtain credit from formal lenders, hence it is an important financial asset. Whereas livestock incomes are used for saving in table banking groups, purchasing food, farm inputs, paying school fees and solving pressing cash needs. Some households lease out oxen during the farming season to earn extra income. (b) *Land holdings (hectares)* - Land is a key asset in rural Kenya which serves multiple purposes such as crop and livestock production, storing wealth, and providing collateral for financial credit (Lay et al., 2008). (c) *Telephone* - mobile phones are important in rural Kenya not only for communication, but also sending money to family and friends, as well as paying for purchased inputs or hired labour through M-Pesa mobile money transfer services. Moreover, M-Pesa is a widespread mobile-phone-based financial service in Kenya (Mugambi et al., 2014). (d) *Television* - non-productive household valuable (e) *Bicycle* - productive asset (farm/nonfarm) which is important for own transport, for transporting farm products to the market, and can be used to generate income through boda boda transportation (Lay et al., 2008). (f) *Sewing machine* - productive nonfarm asset. (g) *Kerosene stove (or other modern stove)* – nonfarm asset which may be considered non-productive or productive (such as home preparation of food products for sale). (h) *Housing characteristics* - during the surveys, households were asked which kind of house they had. Either block/brick house with corrugated iron roof or other advanced housing types and/or corrugated walls, with cement floor, or otherwise. The asset wealth index is constructed from the household assets described above, using the statistical technique of principal component analysis (PCA), as in previous studies (Dimova and Sen, 2010; Dzanku, 2015; Filmer and Pritchett, 2001; Martin and Lorenzen, 2016). The first principal component is the linear combination that explains the maximum amount of variation for a set of asset variables and it captures the household's asset wealth (Martin and Lorenzen, 2016). The theoretical justification is that a given household's asset index measures not asset ownership per se, but rather the main unobserved variable underlying the pattern of asset ownership across the sample of households – which is explicitly or implicitly assumed to consist of wealth (Howe et al., 2009) or long-run economic status (Filmer and Pritchett, 2001). The approach of PCA provides more accurate weights than the arbitrary approach of weighting multiple assets by summation to obtain a single value of asset holdings (Dimova and Sen, 2010). In this study, dummy variables are used for the assets (yes or no, in terms of ownership), because the surveys did not collect data on the value of different household assets. This approach also eliminates the problems which are frequently encountered in trying to accurately value assets in rural Africa (Barrett et al., 2001).

Appendix D. Factor loadings from the first principal component of the asset wealth index

Asset variable	Factor loadings	Mean	Std. Dev	Min	Max
Telephone	0.6894	0.724	0.447	0	1
Television	0.7436	0.478	0.500	0	1
Bicycle	0.3411	0.608	0.489	0	1
Sewing machine	0.4134	0.140	0.347	0	1
Kerosene stove or other modern stove	0.5594	0.418	0.494	0	1
Number of livestock units	0.157	0.962	0.191	0	1
Land holdings (hectares)	0.263	1.487	1.512	0.01	14
Block/brick house, iron roof, cement floor	0.6496	0.530	0.500	0	1

Notes: The first principal component of the asset wealth index explained 26.8% of the variance. Owning a television had the highest factor weighting, implying that it was the most important in explaining the asset wealth index. All other assets being held equal, a household with a television would be ranked higher in terms of socio-economic status than a household without one. This is followed by having a telephone, block/brick house with iron roof and/or cement floor, kerosene stove, sewing machine, bicycle, land holdings and lastly livestock. The farm-related productive assets (land and livestock) turned out to be the least important in explaining asset wealth.

As a robustness check, households were grouped into quintiles of the asset wealth index and compared with the quintiles according to the self-reported average annual income per adult equivalent, from the poorest to the richest. The results (not shown) indicate that the asset wealth index is significantly associated with the self-reported mean total household income, suggesting that it is a good proxy for wealth.

Appendix E. Descriptive Statistics for variables in the econometric models

	Overall		All Kakamega		MHH Kakamega		FHH Kakamega		All Nyeri		MHH Nyeri		FHH Nyeri	
Variable	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Nonfarm income share (NFS)	0.23	0.32	0.25	0.35	0.22	0.33	0.34	0.41	0.19	0.29	0.20	0.30	0.15	0.24
Asset wealth index	-0.001	1.01	-0.63	0.80	-0.59	0.79	-0.76	0.83	0.64	0.76	0.74	0.71	0.32	0.86
Initial level of NFS, 2008	0.08	0.23	0.07	0.22	0.08	0.23	0.04	0.19	0.10	0.24	0.11	0.25	0.07	0.19
Age of household head (years)	55.96	14.21	57.14	15.02	57.04	14.50	57.45	16.71	54.75	13.24	53.25	13.29	60.06	11.70
Gender of head (male), dummy	0.77	0.42	0.76	0.43	0.76	0.43	0.24	0.43	0.78	0.42	0.78	0.42	0.22	0.42
Education level of head (years)	7.29	4.44	6.27	4.36	6.80	4.29	4.60	4.16	8.33	4.30	9.09	4.00	5.63	4.24
Household size	6.76	3.60	7.76	3.56	8.13	3.54	6.59	3.40	5.73	3.34	5.57	2.92	6.29	4.53
Membership of group, dummy	0.40	0.49	0.19	0.40	0.21	0.41	0.16	0.37	0.69	0.50	0.60	0.49	0.62	0.49
Use of hired labour, dummy	0.62	0.49	0.55	0.50	0.55	0.50	0.55	0.50	0.69	0.46	0.70	0.46	0.67	0.47
Agricultural input credit, dummy	0.27	0.45	0.11	0.31	0.13	0.33	0.05	0.22	0.44	0.50	0.43	0.50	0.48	0.50
Land title, dummy	0.78	0.41	0.77	0.42	0.77	0.42	0.78	0.42	0.79	0.41	0.78	0.41	0.81	0.40
Borrow to cover needs, dummy	0.47	0.50	0.58	0.50	0.56	0.50	0.62	0.49	0.37	0.48	0.37	0.48	0.35	0.48
Number of households	239		121		92		29		118		92		29	