Options de survie, processus de changement et transformation structurelle. Diversification des moyens de subsistance chez les ménages agricoles des régions rurales de l'Afrique sub-saharienne

Sarah Alobo

Survival Options, Processes of Change and Structural Transformation

Livelihood diversification among smallholder households in rural Sub-Saharan Africa

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Sarah Harriet Alobo Loison

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Abstract

The overall objective of this thesis is to understand the role of diversification at household level, its patterns, determinants and effects on rural smallholder farmers in SSA, as well as its implications for the process of structural transformation in SSA. In the thesis, I use a mixed methodology and combine different types of data on rural smallholders in SSA to answer the objectives – a review of previous literature, empirical data from quantitative surveys and qualitative fieldwork. The findings are presented in three articles:

In the first article, I undertake a comprehensive review of the literature on the nature and evolution of rural livelihood diversification in SSA among smallholder farmers. It reveals mixed findings about the causes and consequences of livelihood diversification on the rural smallholders adopting this strategy. It shows that because of asset constraints increase in incomes and wealth based on livelihood diversification has not yet benefitted the large majority of smallholders in SSA. On the other hand, there are a lot of evidence from the literature suggesting that it is relatively better-off smallholders with sufficient assets, who achieve successful livelihood diversification, mainly by exploiting opportunities and synergies between farm and nonfarm activities.

In the second article, I investigate the spatial and geographical patterns and determinants of income diversification using cross-sectional data on rural farm households from six regions in Senegal and Kenya. In addition, I supplement the analysis of the quantitative data with information from qualitative fieldwork. The findings show that the specific patterns and determinants of diversification differ significantly between regions, with push and pull factors sometimes acting concurrently. Although geographical location matters for income diversification, the context of the region seems to matter even more, as it influences the type of diversification households may engage in.

In the third article, I use panel data to explore the geographical and gender dimensions of livelihood diversification and its determinants in two agricultural regions of rural Kenya (Kakamega and Nyeri). I complement the panel data with data from my own qualitative fieldwork. The empirical investigation into the dynamics and motivations for livelihood diversification shows that household asset wealth, the initial level of diversification, demographic factors such as age, gender (being a female headed household) and level of education of the household head (in Kakamega), and increased use of hired labour were significantly positive determinants of change in livelihood diversification. Whereas, increased access to farm-related assets such as agricultural input credit, and having more secure land rights through formal titling, promoted specialisation in farming rather than diversification out of farming. Finally, food security was important for increasing livelihood diversification, especially in Kakamega.

Key words: household economics, livelihood diversification, development, structural transformation

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Diversification des moyens de subsistance chez les ménages agricole des régions rurale de l'Afrique sub-saharienne

Sarah Harriet Alobo Loison

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SURVIVAL OPTIONS, PROCESSES OF CHANGE AND STRUCTURAL TRANSFORMATION

Livelihood diversification among smallholder households in rural Sub-Saharan Africa

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LUND UNIVERSITY

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I dedicate this PhD Thesis to the Almighty God who has made it possible, glory be to you Jehovah God!

Contents

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Abstract

Diversification of livelihoods in terms of incomes, assets and activities at household level is the norm in most parts of rural Sub-Saharan Africa (SSA). It is widely recognised that this can contribute to achieving the development goals of reducing poverty, improving food security, and economic growth. The overall objective of this thesis is to understand the role of diversification at household level, its patterns, determinants and effects on rural smallholder farmers in SSA, as well as its implications for the process of structural transformation in SSA. In the thesis, I use a mixed methodology and combine different types of data on rural smallholders in SSA to answer the objectives – a review of previous literature, empirical data from quantitative surveys and qualitative fieldwork. The findings are presented in three articles:

In the first article, I undertake a comprehensive review of the literature on the nature and evolution of rural livelihood diversification in SSA among smallholder farmers. It reveals mixed findings about the causes and consequences of livelihood diversification on the rural smallholders adopting this strategy. It shows that because of asset constraints increase in incomes and wealth based on livelihood diversification has not yet benefitted the large majority of smallholders in SSA. On the other hand, there are a lot of evidence from the literature suggesting that it is relatively better-off smallholders with sufficient assets, who achieve successful livelihood diversification, mainly by exploiting opportunities and synergies between farm and nonfarm activities. Moreover, the progress of Structural Transformation (ST) and Agricultural Transformation (AT) in SSA seems to be moving slowly, mainly due to many challenges in the smallholder agricultural sector that have led to persistent low agricultural productivity. In addition, the review shows that understanding the medium- to long-term impacts of livelihood diversification on smallholders and their environments, and the role in the broader process of ST and AT in SSA, has been severely restricted by lack of longitudinal data and the wide heterogeneity in the rural economy.

In the second article, I investigate the spatial and geographical patterns and determinants of income diversification using cross-sectional data on rural farm households from six regions in Senegal and Kenya. The quantitative data was collected in 2007-2008 by the RuralStruc (CIRAD/World Bank) project. The regions were a priori classified according to differences in agro-ecology, market access, the presence of integrated value chains, the level of public investments and public goods, and the availability of natural resources. In

addition, I supplement the analysis of the quantitative data with information from qualitative fieldwork. The findings show that the specific patterns and determinants of diversification differ significantly between regions, with push and pull factors sometimes acting concurrently. Although geographical location matters for income diversification, the context of the region seems to matter even more, as it influences the type of diversification households may engage in. In general, households in dynamic regions have significantly more diversified and higher incomes, and more access to nonfarm incomes. The major determinants of household income diversification differ significantly between dynamic and less dynamic regions in the two countries.

In the third article, I use panel data to explore the geographical and gender dimensions of livelihood diversification and its determinants in two agricultural regions of rural Kenya (Kakamega and Nyeri). The panel data comes from rural household surveys conducted by the Afrint Project (Lund University) in Kenya in 2008 and 2013. I complement the panel data with data from my own qualitative fieldwork. The Afrint data was collected from two regions with different market access, agro-ecological potential. The findings show that the study period was characterised by significant structural changes in the income composition of rural households that are consistent with the classical pathway of structural transformation at the household level – the farm income share of household cash incomes dropped considerably, whereas the nonfarm income share increased substantially. This was especially the case in the region characterized as having relatively poor agro-ecology and market access (Kakamega). The empirical investigation into the dynamics and motivations for livelihood diversification shows that whether or not household fixed effects are included in the econometric panel data models, there is a positive and significant relationship between changes in household asset wealth and changes in livelihood diversification at the regional level, ceteris paribus. In addition to asset wealth, other important determinants of positive changes in livelihood diversification over the study period include: the initial level of diversification, changes in demographic factors such as age, gender (being a female headed household) and level of education of the household head (in Kakamega), and increased use of hired labour. On the other hand, increased access to farm-related assets such as agricultural input credit, and having more secure land rights through formal titling, promoted specialisation in farming rather than diversification out of farming. Finally, food security was important for increasing livelihood diversification, especially in Kakamega.

Résumé

La diversification des moyens de subsistance ("livelihoods") des ménages en termes de revenus, des actifs et des activités est connue comme étant la norme en Afrique sub-saharienne Afrique rurale (SSA), et une option importante pouvant contribuer à atteindre les objectifs de développement de réduction de la pauvreté, d'amélioration de la sécurité alimentaire et de la croissance économique. L'objectif général de cette thèse est de comprendre le rôle de la diversification à l'échelle des ménages, ses caractéristiques, ses déterminants et ses effets sur les petits exploitants agricoles d'Afrique subsaharienne. La thèse utilise une méthodologie mixte en combinant différents types de données sur les petits exploitants ruraux d'Afrique subsaharienne pour répondre aux objectifs fixés – une revue bibliographique, des données empiriques tirées d'enquêtes de terrain quantitatives et qualitatives. Les résultats sont présentés en trois articles: Le premier article présente un état de l'art sur la nature et l'évolution de la diversification des moyens de subsistance en milieu rural ("rural livelihoods") en Afrique subsaharienne, et la situation à l'échelle des petits exploitants. Il révèle des résultats mitigés sur les causes et les conséquences de la diversification des moyens de subsistance des petits exploitants ruraux qui adoptent cette stratégie. De nombreuses études suggèrent que ce sont les petits exploitants les plus aisés ayant suffisamment d'actifs qui réalisent une diversification performante de leurs moyens de subsistance, principalement en exploitant les opportunités et les synergies entre les activités agricoles et non agricoles. Cela met en évidence qu'à cause de contraintes sur les actifs, l'augmentation des revenus et de la richesse grâce à la diversification des moyens de subsistance n'a pas encore bénéficié à la grande majorité des petits exploitants d'Afrique subsaharienne. En outre, les transformations structurelle et agricole en Afrique subsaharienne semblent progresser très lentement, principalement en raison des nombreux défis dans le secteur agricole des petits exploitants qui conduisent à une faible productivité agricole persistante. Enfin, la revue bibliographique a montré que la compréhension des impacts à moyen et à long terme de la diversification des moyens de subsistance des petits exploitants et de leurs environnements, et du rôle de celle-ci dans le processus plus large de transformations structurelle et agricole en Afrique subsaharienne a été sévèrement limitée par le manque de données longitudinales compte-tenu de la grande hétérogénéité de l'économie rurale.

Le deuxième article examine les caractéristiques et les déterminants de la diversification des sources de revenus en utilisant des données transversales sur les ménages agricoles ruraux de six régions du Sénégal et du Kenya. Les données quantitatives ont été recueillies en 2007-2008 par le projet RuralStruc (CIRAD / Banque mondiale). Les régions étaient classées apriori en fonction de différences de conditions agro-écologiques, d'accès aux marchés, de la présence de chaînes de valeur intégrées, du niveau des investissements publics et des biens publics, et du niveau de ressources naturelles. L'analyse des données quantitatives a été complétée par des informations de terrain qualitatives. Les résultats montrent que les caractéristiques et les déterminants de la diversification sont spécifiques et diffèrent sensiblement entre les différentes régions, avec des facteurs "attractifs" et "répulsifs" agissant parfois en même temps. Bien que la région joue sur la diversification des revenus, le classement de celle-ci semble jouer d'avantage, car il influence le type de diversification auquel les ménages se livrent. En général, les ménages les plus riches dans toutes les régions, et les ménages dans les régions dynamiques diversifient plus et ont plus de revenus, et ont plus accès aux revenus non agricoles. Les déterminants de la diversification des revenus des ménages dans les zones rurales du Sénégal sont principalement liés à des possibilités de migration et à l'accès au crédit. Au Kenya, les caractéristiques de la diversification sont corrélées au travail domestique excédentaire et à aux différences d'accès à certains actifs productifs.

Dans le troisième article, j'utilise des données de panel pour explorer les dimensions géographiques et sexospécifiques de la diversification des moyens de subsistance et de ses déterminants dans deux régions agricoles du Kenya rural (Kakamega et Nyeri). Les données de panel proviennent d'enquêtes sur les ménages ruraux conduites par le projet Afrint (Université de Lund) au Kenya en 2008 et 2013. J'ajoute également aux données de panel, les données qualitatives de mon propre travail de terrain. Les données Afrint ont été recueillies dans deux régions ayant un accès au marché et un potentiel agroécologique différents. Les résultats montrent que la période d'étude a été caractérisée par des changements structurels significatifs dans la composition du revenu des ménages ruraux qui sont compatibles avec la voie classique de la transformation structurelle au niveau des ménages - la part du revenu agricole dans les revenus monétaires des ménages a considérablement diminué, tandis que la part du revenu non agricole a considérablement augmenté. C'est notamment le cas dans la région où l'agroécologie et l'accès aux marchés sont relativement médiocres (Kakamega). L'enquête empirique sur la dynamique et les motivations pour la diversification des moyens de

subsistance montre, que les effets fixes des ménages soient inclus ou non dans les modèles économétriques de données de panel, qu'il existe une relation positive et significative entre les changements dans la richesse des ménages et la diversification des moyens de subsistance, ceteris paribus. Outre la richesse patrimoniale, d'autres déterminants importants des changements positifs dans la diversification des moyens de subsistance au cours de la période étudiée sont: le niveau initial de diversification, les changements démographiques tels que l'âge, le sexe (étant un ménage dirigé par une femme) et le niveau d'éducation du chef du ménage à Kakamega, et l'utilisation accrue de la main-d'œuvre embauchée. D'autre part, l'accès accru aux actifs agricoles tels que le crédit d'intrants agricoles et l'obtention de droits fonciers plus sûrs par le biais de titres officiels ont favorisé la spécialisation dans l'agriculture plutôt que la diversification en dehors de l'agriculture. Enfin, le fait d'être en situation de sécurité alimentaire était important pour accroître la diversification des moyens de subsistance, en particulier à Kakamega.

List of Articles

Article 1

Alobo Loison, S. (2015). Rural Livelihood Diversification in Sub-Saharan Africa: A Literature Review. *The Journal of Development Studies*, 51(9): 1125-1138.

Article 2

Alobo Loison, S. and Bignebat, C. (2017). Patterns and Determinants of Household Income Diversification in Rural Senegal and Kenya. *Journal of Poverty Alleviation and International Development*, 8(1): 93-126.

Article 3

Alobo Loison, S. (*Under review*). Household Livelihood Diversification and Gender: Panel Evidence from Rural Kenya. Manuscript submitted to *Journal of Rural Studies*.

1. Introduction to the thesis

Background and context

Historical evidence from structural transformation (ST)[1] in Europe, North and South America and Asia indicate that rising agricultural (farm) productivity, together with industrialisation and urbanisation, has been the stimuli for growth in other non-agricultural (nonfarm) sectors leading to economic growth and development (Hayami and Ruttan 1985; Timmer 1988; 2007; 2009; Eicher and Staaz 1998; Mellor 1995; Tomich et al., 1995). Sub-Saharan Africa (SSA) is the last region of the world to undergo ST, but under a different context of economic liberalisation, globalisation and climate change (Losch et al., 2012). Moreover, the population in SSA is growing rapidly and is expected to double by 2050 (Losch et al., 2012). Furthermore, urbanisation is taking place without industrialisation (Losch et al., 2012), while smallholder agricultural productivity is persistently low and faced with many challenges (Djurfeldt et al., 2005; 2011). Therefore, evidence shows that the ST and AT processes taking place in SSA are following a different pattern from that prescribed by classical theories of ST, economic growth and development. Hence, development researchers are debating how SSA will develop. Will it be based on agricultural growth, or growth in the non-agricultural sector or a combination of both? Which policies should the governments of SSA adopt in order to promote economic growth and development in the context of globalisation? Should development policies promote smallholder agriculture or promote exits out of agriculture?

Smallholder agricultural production in SSA is mostly carried out on farms with diverse and constantly transforming characteristics in terms of size, forms of production, labour, incomes, assets, market integration, diversification of activities, reliance on migration remittances and vulnerability to risk (Bosc et al., 2015a; 2015b). Longitudinal studies examining changes in smallholder agriculture in eight SSA countries (Ethiopia, Ghana, Kenya, Malawi,

[1] The classical historical pathway of structural transformation is discussed further in chapter 2.

Mozambique, Nigeria, Tanzania and Zambia) between 2002 and 2008, drawing on data from more than 3000 farms, show that only a small proportion of farms surveyed exhibit any dynamism in terms of intensification, extensification or expansion, while many farms had stagnated in their production (Djurfeldt et al., 2008). According to Jirström et al. (2011), there is a crisis in the agricultural sector in SSA, characterised by declining farm sizes, low levels of output per farm, low productivity and a high degree of subsistence farming, with increases in production being driven mainly by area expansion rather than yield growth. Declining farm sizes in SSA, especially in land constrained areas, are attributed to high population growth resulting from high fertility rates (Headey and Jayne, 2014; Jayne et al., 2014). In addition, lack of capital and widespread poverty, as well as missing markets and insufficient public goods continue to constrain both agriculture and overall economic growth (Losch et al., 2012).

Furthermore, the context of economic liberalisation in SSA through structural adjustment programs (SAPs), which in the agricultural sector were characterised by cutting back the role of the state in crop marketing and input provision, have had major consequences on smallholder agriculture (Bryceson 2002; Mkandawire and Soludo 1999; Stein 1999). The implementation of SAPs and economic liberalisation has led to restructuring of agri-food markets (Reardon and Timmer, 2007), growing differentiation between production and marketing structures (Losch et al., 2012), and rapid progress toward globalisation of competition (Reardon and Timmer, 2007). Global marketing systems are transforming from commodity to product markets opening new market opportunities for smallholder farmers, especially through production of nontraditional export crops, contract farming with agro-industry as well as niche markets (Reardon and Timmer, 2007; Maertens et al., 2011). However, due to limited assets and market failures, many smallholders are unable to take advantage of the new market opportunities created by liberalisation and globalisation processes (Losch et al., 2012; Hazell et al., 2010; Barrett and Mutambatsere 2008). Moreover, in the wake of SAPs, which removed agricultural support structures, many farmers in SSA lacked agricultural inputs and were unable to face the challenges of competitiveness and globalisation (Bryceson 2002).

Against the background of these constraints facing smallholder agriculture in SSA, there are different opinions on whether agriculture (Staatz and Dembele 2007; Diao et al., 2007) or the rural nonfarm economy (Haggblade et al., 2007; Barrett et al., 2001a; Ellis 1998) will be the engine for rural growth, employment and poverty reduction. Will smallholder agriculture in SSA be

able to replicate the Green Revolution experience in Asia (Djurfeldt et al., 2005) or which pathway will the ST in SSA take (Dorin et al., 2013; HLPE, 2013; Losch et al., 2012, 2013)? A common answer is that SSA should take a development pathway that is more inclusive of smallholder family agriculture and other rural nonfarm sector activities. This is already taking place as most rural nonfarm activity tends to be linked directly or indirectly to local agriculture or small towns (Christiaensen et al., 2013; Haggblade et al., 2007; Rigg 2006; Ellis and Biggs 2001; Ellis 1999; Reardon 1997). Hence, the "World Development Report 2008", focusing on the role of agriculture in promoting development, suggested that the pathways out of rural poverty should include agricultural entrepreneurship, the rural labour market and the diversification of activities, as well as migration (World Bank, 2007). These pathways can be complementary, nonfarm income diversification may for instance strengthen the agricultural potential as a pathway out of poverty, while agriculture can promote other pathways including rural employment and migration (World Bank, 2007).

Agriculture is still on top of the global development agenda post-2015 as it is linked to the first two Sustainable Development Goals (SDGs) of eradicating poverty in all its forms and ending hunger, achieving food security, improving nutrition and promoting sustainable agriculture by 2030 (Markus, 2013). In SSA, smallholder agriculture is the predominant activity for most rural households, contributing about 29% to GDP and employing up to 65% of the labour force (World Bank, 2007). Yet smallholders in Africa are very heterogeneous with many of them lacking the necessary resources to "farm their way out of poverty" (Staatz and Dembele, 2007, p.2). Therefore, there is need for combined strategies such as to increase the demand for agricultural labour, create jobs in nonfarm sectors that can support agriculture (through forward and backward linkages), invest in education to facilitate exit from agriculture, and generate resources that are invested in other sectors to create new jobs (Staatz and Dembele 2007).

Problem Statement and Objectives

The context and challenges of the smallholder agricultural sector in SSA have created uncertainty as agriculture, for many rural households, does not seem to provide sufficient means of livelihood (Bryceson 2002). Although smallholder households in rural SSA are mainly engaged in agriculture, this thesis does not focus much on diversification within farming activities (agricultural diversification). Rural households in SSA often maintain a diverse portfolio of both farm and nonfarm activities, including migration, to sustain their livelihoods (Barrett et al., 2001a; Reardon 1997; Ellis 1998). Recent studies show that the contribution of nonfarm activities and migration to the overall incomes of rural farm households in SSA is increasing (Davis et al., 2016; Losch et al., 2012; Haggblade et al., 2007; Barrett et al., 2001a; Ellis 2000; Reardon, 1997), and that diversification is now a key factor in sustaining rural livelihoods (Haggblade et al., 2007; Barrett et al., 2001a). Farm households diversify their activities over time mainly to secure survival, diversify risk, finance farm inputs, reduce income variability, and increase incomes (Reardon et al., 2006; Ellis, 2000b). This diversification in the context of risk and uncertainty is mainly seen as a livelihood strategy[2] that may be pursued merely for survival or coping with poverty and negative shocks (Ellis 1998; 2000a; 2000b; Barrett et al., 2001a; 2001b; 2001c). At the same time diversification is viewed as part of the broader process of ST, a way by which smallholders can increase their incomes, accumulate wealth, specialise in production and improve their standards of living (Losch et al., 2012; Timmer, 2009). However, whether diversification of rural livelihoods will provide impetus for improving standards of living in SSA is still a subject of much debate (World Bank, 2007).

In the process of diversification, rural farm households expand their farm activities and/or engage in nonfarm activities in order to increase their incomes or to reduce income variability by exploiting new or existing market or non-market opportunities, migration and waged employment in the local nonfarm sector, as well as the exploitation of natural resources (FAO and World Bank, 2001). Where diversification out of agricultural production is not economically feasible locally migration and remittances play important roles (Bélières et al., 2002; Losch et al., 2012). This livelihood diversification in SSA is generally being facilitated by infrastructural developments, the emergence of rural towns

[2] A livelihood strategy is the combination of assets and activities that are used to generate a means of living. The concept in relation to livelihood diversification is explained further under the livelihoods approach in chapter 2.

and improving accessibility to urban areas (Losch et al., 2013). However, there are significant spatial and geographical differences in the patterns and determinants of diversification (Barrett et al., 2001a; Haggblade et al., 2007; Ellis 2000b; Reardon 1997), even within similar regions (Jirström et al., 2011; Losch et al., 2012). Moreover, most empirical studies on this subject in SSA have used cross-sectional data from individual countries or from sample regions within countries, and relatively few have been based on longitudinal panel data. In some cases, studies compare two or more country or regional situations (Barrett et al., 2001b; Canagarajah et al., 2001; Dercon & Krishnan, 1996; Losch et al., 2012; Winters et al., 2009, 2010). A few studies have used panel data from specific countries to add a time dimension to their analyses (Bezu and Barrett, 2012; Bezu et al., 2012; Block and Webb, 2001; Djurfeldt et al., 2011; Porter, 2012). This suggests that more is revealed about rural livelihoods and diversity in different contexts and at different points in time, than about the dynamics. Because of the wide heterogeneity of the rural economy and of data limitations, much remains to be understood about the nature and causes of livelihood diversification, its medium to long term consequences on rural smallholder households and their environments, as well as its role in the broader process of ST and AT in SSA.

My overall objective in this thesis is to improve our understanding of the role of diversification, particularly into nonfarm activities at household level, its patterns, determinants and effects on rural smallholder family farmers in SSA.

The following specific questions guided the study:

- What is the nature and evolution of livelihood diversification in SSA?
    - What are its causes and consequences for rural smallholders?
    - What are the implications for the overall process of structural transformation?
- What are the geographical patterns and determinants of rural household income diversification?
    - How do the patterns and determinants differ between dynamic and less dynamic agricultural regions?
- What are the geographical and gender patterns and determinants of change in rural household livelihood diversification?

- What are the gender differences in access to farm and nonfarm livelihood diversification options?
- How do the patterns differ between geographical regions and over time?
- What drives the changes in livelihood diversification?
- How do the determinants differ by geographical region and by gender of the household head?

Structure of the thesis

This thesis is a compilation of three articles and this introductory part, which in turn consists of five main chapters. In the first chapter, I present the background and context of the thesis, the research problems and the objectives. In chapter two, theory and perspectives on structural transformation (ST), diversification and economic development is presented. The third chapter, contains the empirical considerations in the study of diversification at household level. Then in the chapter four, I describe the methodology of the thesis, and in the fifth chapter, contains a synthesis of the findings of the thesis, conclusions, policy implications and recommendations for future research. In the thesis, I use a mixed methods approach of combining different types of quantitative data with qualitative fieldwork to answer the research questions:

Article 1 answers the first question in the thesis on the nature and evolution of livelihood diversification in SSA, its causes and consequences for rural smallholders and its implications for the overall process of ST. I critically review literature on rural household livelihood diversification and the challenges of ST and AT in SSA. This article was my stepping stone for Articles 2 and 3. It motivated the empirical investigation and helped to identify the important areas for reflection and further research in the thesis.

Article 2 answers the second question in the thesis, concerning the geographical patterns and determinants of rural household income diversification. In this article, I combine quantitative cross-sectional survey data on rural households from different types of regions with my own qualitative fieldwork. Both the quantitative and qualitative data I used were collected from contrasting geographical regions in two countries in SSA -

Senegal and Kenya. The surveyed regions were a priori classified based on differences in agro-ecological potential, market access, the presence of integrated value chains, the level of public investments and public goods and the situation regarding natural resources.

Article 3 answers the third question in the thesis, i.e. on the geographical and gender patterns and determinants of change in rural household livelihood diversification. In this article, I combine quantitative panel data with my own qualitative fieldwork. I use panel data which was collected in 2008 and 2013 from rural households in two contrasted geographical regions in Kenya, from where I also collected the qualitative data. The surveyed regions were a priori classified mainly based on differences in agro-ecological potential and market access.

2. Theory and perspectives on structural transformation, diversification and economic development

In this chapter, I review different theories and perspectives on Structural transformation (ST), Agricultural transformation (AT), diversification of the economy, and diversification at the household level, as they relate to overall economic growth and development. Finally, I place and criticise/question some of the perspectives in the general context of rural livelihoods, diversification, economic growth and development in SSA.

Defining diversification

The literature review in this thesis (Article 1) reveals that the term *diversification* is used either to refer to multiplicity of activities (farm and nonfarm) at the household or individual level and/or to overall processes of change and ST. The term diversification is therefore linked to processes taking place at different levels of the economy, which are usually but not always linked (Start, 2001). For instance, diversification of the rural economy refers to a shift of rural activities away from farm (agricultural) towards nonfarm (non-agricultural) activities associated with the expansion of the rural nonfarm economy (Start, 2001). This is normally part of a broader process of ST, which can lead to economic growth and development of the entire economy (Timmer, 2009).

Diversification at household level

Diversification refers to income strategies of rural households in which households increase their number of economic activities regardless of the sector or location (Start, 2001). A household can have multiple livelihoods, even though each member is specialising in one activity. *Income diversification* refers to the increase in the number of economic activities (farm and/or nonfarm) at a given point in time (Ellis, 1998). Whereas, *livelihood diversification* is defined as an active social process of individual or household diversification, involving the maintenance and continuous adaptation of a highly diverse portfolio of activities (farm and/or nonfarm) over time in order to secure survival and improve standards of living (Ellis, 2000b).

In general, distinctions are made between two types of diversification, as explained in Article 1: (a) *accumulation/opportunity-led diversification* – characterised by an active choice of household strategies to invest in diversification for accumulation and reinvestment, (b) *survival/distress diversification* - aimed at coping with temporary adversity or shocks, or more permanent adaptation of livelihood activities for survival when other options (especially agriculture) are failing to provide a sufficient livelihood (Rigg 2006; Orr and Mwale 2000; Ellis 2000a; b; Scoones 1998).

Diversification at the rural household level is an important feature of the overall processes of change, ST, economic growth and development of the rural economy and of the economy at large. The extent to which the long-term changes in income and livelihood diversification can contribute to the process of ST of the rural economy and the overall economy depends on whether household diversification is mainly driven by opportunities/accumulation or by survival/distress motives, and whether they lead to significant economy-wide changes.

Diversification of the economy and structural transformation

The ST is a defining characteristic of the process of economic growth and development. It is a process that occurs over long periods of time. ST theory is about reallocation of economic and household activity from the traditional agricultural sector to modern sectors, such as industry (manufacturing and services), as a way to bring about economic growth and development. Economic development is aimed at creating wealth for a nation, improving the

quality of life of its population, and making development sustainable (Dang et al., 2015). Development is a continuous long-term rise of physical living standards for the poor and least advantaged, as well as for society as a whole (Andersson 2003). Over several decades, academic thinking on how to achieve economic development has been evolving, as shown by historical evidence.

Historical evidence from developed economies

ST is a part of the classical theories that have been proposed since the 1950s as a way to fuel the process of economic development. In the 1950s and 1960s, development economists and researchers were mainly concerned with analysing the relationship between agricultural and non-agricultural sectors in the process of economic growth and development (Eicher and Staatz 1998). The theories on ST became dominant in the 1960s mainly led by classical works of Arthur Lewis, Hollis Chenery and Simon Kuznets. Lewis (1955) proposed in the book "theory of economic growth" that in order to bring about progress and development there must be a growth in the output per head of a population. Lewis argued that the factors that determine growth are numerous. Growth is a result of human effort and people must make use of opportunities in order to increase productivity. Consequently, people must be willing to experiment and engage in economic activities to manoeuvre and to seek out opportunities. Accordingly, there are three proximate causes of economic growth: first, the effort to economise – human efforts in terms of experimentation, risk-taking, mobility, specialisation, trade and investment, which can lead to cost reduction and increasing yield; second, the increase in knowledge and its application, which can fuel increases in production, and third, increasing the amount of capital or other resources per head of the population. Lewis emphasised that different institutions, beliefs and environments in a given nation can either promote, prevent or slow down economic growth. Moreover, economic growth may vary across societies due to differences in factors such as attitudes to work, wealth, invention, thrift, demography, among others.

Furthermore, Lewis (1954) proposed a simple two-sector model of economic growth (agriculture and industry). In this model, reallocation of labour from the agricultural sector to be employed in the industrial sector would be the engine of economic growth. Lewis assumed that there is a large surplus of underemployed labour in the agricultural sector that could be transferred to employment in other sectors without affecting agricultural

output. In this theory, moving surplus labour from the agricultural sector to the industrial sector would bid up wages in the agricultural sector and hence increase output and productivity. Increased productivity in the agricultural sector would increase people's purchasing power and encourage investment in industry, thereby expanding its output. The excess of profits over wages and investments in the industry sector would expand and generate further economic growth, assuming that all profits are reinvested. This process of self-sustaining industrial growth and employment expansion would facilitate the ST from a traditional to a more modern developed economy (Dang et al., 2015). However, this simplistic model and the assumption of surplus labour in agriculture that can be easily moved to other sectors without hurting agriculture are unrealistic in the context of SSA and most other developing countries. Another major criticism is that the assumption that faster rate of capital accumulation leads to higher growth rate of the modern industry sector and hence faster rate of new employment creation is not valid - there is no guarantee that there will be no capital flight or that capitalist profits will be re-invested in labour-saving technologies.

Other scholars such as Chenery (1960) Chenery and Taylor (1968), and Chenery and Syrquin (1975), proposed that in addition to accumulation of capital, a set of other changes in the economic structure of a country are required for the transition from a traditional to a modern economy. Accordingly, in the process of ST the patterns of development can differ among countries depending on the size, endowment of resources, government policies and objectives, the availability of external capital and technology and the international trade environment (Todaro and Smith 2009). Chenery (1960) examined patterns of development for developing countries at different per capita income levels and proposed the theory on different patterns of development. The theory views increased savings and investment as a necessary but not sufficient condition for economic development (Dang et al., 2015). In addition to capital accumulation, transformation of production, composition of demand and changes in socio-economic factors, domestic and international constraints are all important factors. Chenery identified several characteristic features of economic development based on empirical studies from developing countries, including: shifting from agriculture to industrial production, steady accumulation of physical and human capital, change in consumer demands, increased urbanisation, decline in overall family size and in population growth rate (Dang et al., 2015).

During the 1970s and 1980s, development economists and researchers became more concerned with developing a more detailed theoretical and empirical understanding of the rural economy. One of the leading scholars at time, Kuznets (1973) described modern economic growth as a long-term rise in the capacity of a nation to supply increasingly diverse economic goods to it population using advanced technology and of institutional and ideological changes. Kuznets identified six main characteristics of modern economic growth based on the experience of developed countries: high rates of growth of per capita product and of population, rise in productivity, a high rate of ST of the economy characterised by a shift from agriculture towards industry and services, and changes in occupational status of labour, social and ideological changes of society including urbanisation, modern technology to reach the rest of the world. However, as regards the latter, the spread of modern economic growth has so far been limited despite the potential of modern science and technology. Furthermore, Kuznets noted that the rapid economic growth and ST, which accompany modern economic growth has social implications on urbanisation, internal migration, and employment. The conclusion was that modern economic growth is accompanied by both positive and negative effects, including surprises and puzzling consequences. Some of the effects of modern economic growth include improvement of education, a shift to urban life, increased mobility, more leisure, better health and higher life expectancy, less income inequality, as well as, at the same time increased pollution and other negative results of mass production. Moreover, Kuznets also hypothesised that there is an inverted U-shaped relationship between inequality and economic growth during the process of development (Andersson 2003). This means that as an economy develops, the level of inequality rises and then, at a certain stage of development, it naturally starts to fall again. This suggests that economic growth produces inequality and may not always be pro-poor. However, there are also studies showing that in several countries there is no inverted U-relationship between inequality and economic growth as measured by income per capita (Palma, 2011).

In the 1990s development economists were concerned with intersectoral relationships and institutions and they recognised that multiple paths of development are possible. Therefore, empirical analyses were essential in formulating alternative development strategies (Hayami and Ruttan 1985; Timmer 1988; Eicher and Staaz 1998; Mellor 1995; Tomich et al., 1995). It was also recognised that raising agricultural productivity based on favourable macroeconomic and agricultural policies were an important stimulus for economic growth and poverty reduction (Hayami and Ruttan 1985; Timmer 1988; Eicher and Staaz 1998; Mellor 1995; Tomich et al., 1995). According to Mellor (ibid.), economic development in the process of ST requires a diversification of the economy away from agriculture. However, in the early stages of development, agricultural growth is a necessary condition for ST and economic growth. But the paradox is that as agriculture grows its size relative to other sectors declines. To achieve ST, agricultural income and expenditure must increase. Rapid increase in labour productivity in agriculture then accelerates ST in other economic sectors. Technological change in agriculture increases output per unit of input boosting national income substantially and accelerating the shift to other faster growing non-agricultural sectors. Based on data from Asian countries Mellor (ibid.) found that there was a strong relationship between agricultural and non-agricultural sector growth rates. For each 1 percent of acceleration point in per capita agricultural growth, there were about a 1.5 percentage point acceleration in per capita non-agricultural growth.

According to Mellor (1995), in the early stages of development, agriculture is a slower-growing sector with large mass of output and economic inputs (land, labour and capital) and a potential source of effective demand for consumption goods. In rural areas, large populations with modest incomes favour consumption of domestically produced, labour-intensive products. Scientific and technological progress, including modern inputs such as fertilisers, machines, accelerates agricultural growth beyond the rate of population growth. Productivity is further increased by specialisation, reduction in transaction costs and expansion of trade. Increased trade and rising incomes allow for changes in the composition of output and thereby boost productivity further. These forces combined move agricultural growth forward. Mellor argues that the faster the agricultural sector grows the faster its share of GDP declines. In the early stages of development, the share of agriculture in the GDP is huge. More rapid growth in the Agricultural sector

means more for total GDP growth than a fast growth in the other sectors which are smaller. Soon however, the non-agricultural sector will overtake agriculture (agricultural growth contributes to this through the linkage effects). Hence despite agriculture growing, its relative share will decline as the non-agricultural sector can grow at a higher rate than the agricultural sector, for sustained periods. As the progress of development accelerates, the economy becomes transformed from dominated by a slower-growing agricultural sector to a faster-growing non-agricultural sector. The faster growth rate of the non-agricultural sector accelerates the growth of the entire economy. Mellor (ibid.) concludes that because ST and sectoral interactions make the process of economic development complex and dynamic, these processes and their relationships within the economy can cause ST to vary and can occur in different ways in different countries and regions.

At the level of the overall economy, Timmer (1988; 2007; 2009) highlighted the classical historical process of ST as being characterised by four main processes: a declining share of agriculture in Gross Domestic Product (GDP) and employment; urbanisation fueled by rural-urban migration; the expansion and development of industry and service sectors of the economy; and a demographic transition (Timmer, 2007; 2009). This ST involves an AT where agriculture, through higher productivity, provides food, labour and savings for the processes of urbanisation and industrialisation. At the level of the rural economy, the process involves a shift away of rural activities from traditional sectors (such as agriculture) to non-traditional/modern sectors (such as manufacturing and services) (Timmer, 2009). Diversification of the rural economy also includes agricultural diversification, which is diversification of the wider agricultural (crop and livestock) activities (Pingali and Rosegrant 1995). Diversification is an important step in the broader process of ST, which can act as the base for rural economic growth (Timmer, 2007).

As the overall economy develops, rural households invest and accumulate assets and their participation in farm activities declines while participation in nonfarm activities intensifies (Winters et al., 2010). This leads to a falling share of household income from farm activities and an increasing share from nonfarm activities (Winters et al., 2010). In the early stages of the AT, there is significant diversity at the farm level with most households producing for their own consumption. At later stages with better functioning markets, the households move towards specialisation of their production (Timmer,1997). The expansion of nonfarm activities in rural areas therefore gives rise to new income generating opportunities for rural households (Rigg, 2006). However, the resulting development process is unique to each household, region and

country due to differences in resource endowments as well as other social, political and economic factors (Losch et al., 2012).

Timmer (1988) also emphasised the government's role in fostering AT through favourable policies and investments in appropriate new technology, as well as flexible rural institutions and market orientation of agriculture. Tomich et al. (1995) argued that developing nations need to seize and exploit political and economic opportunities in order to raise productivity and reduce poverty, and priority must be given to developing the rural economy until the turning point when the absolute size of the farm population declines. Consequently, according to Tomich et al., raising agricultural productivity, expanding rural employment and growth in the non-agricultural sectors of the economy would speed up the process of ST. In addition, technological change, increased specialisation and growth in stocks of capital (human, physical and institutional), supplemented with social programs (education, health, family planning), would eventually eliminate hunger, and reduce poverty. However, Eicher and Staaz (1998), argued that sufficient domestic and international effective demand, public investments in education, research and rural infrastructure and that conducive institutional environments, are required for macroeconomic and agricultural policies to succeed in stimulating economic growth and poverty reduction.

At the same time, Haggblade et al. (2007) argue that transforming the rural nonfarm economy is the way to promote economic growth and poverty reduction, because it can reduce rural-urban migration, curb urban congestion and reduce pressure on overstretched urban service delivery systems. Furthermore, a highly dynamic rural nonfarm economy in the process of ST can drive high overall rates of economic growth. Based on empirical examples from Asia during the Green Revolution, Haggblade et al. (ibid.) argue that in prosperous rural regions, broad-based agricultural income gains led to rapid growth in rural nonfarm labour and income from increasingly high-return nonfarm processing, trading, commercial, and service activities. Haggblade at al. (ibid.) show that the rural economy has grown in importance over the last decades, with nonfarm income accounting for 35 to 50 percent of rural household incomes across the developing world. Because of their scale, nonfarm earnings can contribute significantly to aggregate economic growth. Moreover, since the poor are often confined to the low-productivity segments of the rural nonfarm economy, due to low entry barriers and skill requirements, nonfarm wage labour and labour-intensive cottage industries consistently attract the rural poor (ibid.). However, in sluggish rural regions the tradable engines of rural growth are many times found in agriculture. Therefore, in such

regions, agriculture needs to remain the focus of poverty-reducing growth strategies in order to generate rising labour productivity and wage rates and overall income growth (ibid.).

East Asian Miracle and the green revolution

The East Asian Miracle (EAM) refers to the rapid economic growth and development which occurred in eight East Asian countries (Japan, South Korea, Hong Kong, Taiwan, Singapore, Indonesia, Thailand, and Malaysia) between 1965 and 1990 (Stiglitz 1996). The countries' industrial sectors grew rapidly, life expectancy increased and absolute poverty declined. Some studies have questioned the factors responsible for the success of these economies and whether the successes could be replicated in other developing economies (World Bank 1993; Stiglitz 1996; Djurfeldt et al., 2005).

The World Bank (1993) noted that the EAM produced improvements in human welfare and income distribution, through development programs that led to fast growth. It seems that the policies which were adopted by the EAM countries such as universal primary schooling and better secondary education quickly increased the skills of the labour forces, while rapid capital accumulation made banks more reliable and encouraged high levels of domestic savings. In addition, the success of the EAM countries can be attributed to productive agricultural programs, modest tax policies, the modification of price distortions, foreign technology and investment, and the cooperation between government and private sector enterprises.

Stiglitz (1996), in an interpretive essay based on case studies, econometric data, and economic theory suggests that EAM was based on some common factors. These include capital accumulation through high rates of saving, investments in education and skills, and rural infrastructure, active government intervention in a stable, market-oriented environment, government policies that promoted higher levels of technology and higher value-added industries, as well as cooperation and competition, equality and export-led growth.

According to Jirström (2005), and Djurfeldt and Jirström (2005), based on a historical and comparative study of agricultural development in seven Asian countries (Japan, Taiwan, South Korea, Indonesia, Philippines, India and Bangladesh), they argue that five important factors contributed to the Green Revolution. Firstly, the Green Revolution in Asia was 'state-driven' - government policies and interventions in agriculture deliberately promoted the development of the food-grain commodity chains, in order to increase the national self-sufficiency in food grains. Secondly, it was 'market-mediated' -

markets for farm inputs, trade and processing of grains played a fundamental role. Thirdly, it was a strategy based on increasing productivity on 'small-sized family farms', rather than large-scale mechanised farms. Fourthly, 'technology' was an important part of the process - agricultural intensification was facilitated by scientific and industrial inputs (such as high yielding varieties of wheat and rice and chemical fertilisers), which resulted in dramatic yield improvements. Fifthly, the 'geo-political context' forced governments to act because there were threats of famine and conflict.

Another recent perspective based on a combination of experiences from East Asia, South Asia and South-East Asia offers some food for thought. Rigg (2006) argues that there must be a rethinking of the links between land, farming, rural livelihoods and poverty in the development of South Asia. Rigg thinks that development efforts should not focus too much on agricultural productivity as the solution to global poverty and driver of economic growth because this overlooks the direction and trajectory of change. Rigg argues that the assumption that farmers are attached to the land and that owning land is a necessity for poverty reduction is misplaced. Nonfarm activities are becoming more central to rural livelihoods and an increasing number of rural households are leaving farming. For instance, Rigg notes that land has lost its strategic role for some land poor and landless households (citing cases from Laos) and instead it is nonfarm activities through education, skills and networks that are important in sustaining their livelihoods. Rigg (2006) summarises the broader processes of change and ST currently underway in South Asia to include: a diminishing role of land and farming in livelihoods and poverty reduction; an increase in the importance of nonfarm activities and remittances in household income, characterised by increased occupational multiplicity, rapid diversification of rural livelihoods and a marked increase of more mobile and delocalised livelihoods; the average age of farmers is rising; cultural and social changes are resulting in livelihood modifications.

Rigg (2006) makes some thought provoking conclusions that the changes in South Asia have fundamentally changed patterns and associations regarding wealth and poverty such that one no longer needs to be land rich to be prosperous in rural areas. Rigg argues that agriculture and farming are no longer the desired or default position of rural households and neither do parents desire a settled, farming life for their children. Consequently, it should no longer be assumed that agricultural development is the best way to promote rural development, or that rural development is the best way to raise rural incomes and improve livelihoods. Moreover, in another piece of work (Rigg, 2016) the author contends that the smallholder farmer in East and South-East

Asia has become persistent in the face of ST, with neither smallholder farms being consolidated, nor people massively relocating from agriculture, as classical models of ST and development would predict.

Contextualising structural transformation using evidence from SSA

The historical and classical pathways of ST facilitated the rapid economic growth and development of countries in Europe and North America, as well as the majority of Latin America and the EAM countries in Asia. The picture in SSA is slightly different, but seems to me much closer to what is described by Rigg (2006) from the East and South-East Asia experiences. According to Losch et al. (2012), SSA is the last region of the world to undergo ST under the challenges of globalisation, a slow demographic transition and the constraints of climate change. It is projected that SSA's population will grow by 450 million people by 2030 and by this time about 52% of the population will still live in the rural areas (Losch et al., 2012). This highlights the urgent need for strategic policies to deal with employment challenges in SSA.

Similar to the broader processes of change and ST in South-East Asia, smallholder farms in SSA are becoming smaller rather than consolidated. Declining farm sizes in SSA has been attributed to high population growth, especially in land constrained areas (Andersson Djurfeldt and Jirström, 2013; Jayne et al., 2014; Headey and Jayne, 2014). Many African family farmers continue to straddle between farm and nonfarm activities (Davis et al., 2016; Winters et al., 2009, 2010). At the same time in some regions farm intensification and nonfarm diversification appear to complement each other over time (Andersson Djurfeldt and Djurfeldt, 2013).

Moreover, in SSA, despite rapid urbanisation, industrialisation in order to create much needed employment for the rapidly growing population is not taking place (Losch et al., 2012). Therefore, besides agriculture, alternative economic opportunities are limited for millions of people in SSA, as emphasised in Article 1. This contrasts the experience of Green Revolution in EAM countries where urbanisation and emerging industries gradually allowed rural people to leave agriculture and enter high return nonfarm employment (Djurfeldt et al., 2005; Haggblade et al., 2007; Stiglitz 1996). However, urbanisation in SSA is also characterised by the rapid growth of rural towns and cities offering opportunities for high income nonfarm activities (Losch et al., 2013). This suggests that development strategies in SSA will need to

stimulate growth in both agriculture and the rural nonfarm economy, rather than focussing on either one of them.

It is anticipated that the effects of population growth and urbanisation in SSA will be further accentuated by globalization which has already led to global restructuring of agri-food markets, increasing asymmetry of international competition and growing differentiation among farm, marketing, processing and distribution structures (Losch at al., 2011). However, Losch et al. (2011), finds that processes of globalisation and international competition does not seem to have had any profound macro-level impact so far on rural economies in SSA. This is because many rural smallholder households are not yet integrated into high value markets (Losch et al., 2012) and many of them are engaged in subsistence staple crop production (Djurfeldt et al., 2005; 2011).

An increase in livelihood diversification, migration and the importance of nonfarm activities in household income has also been documented for SSA (Frelat et al., 2016; Haggblade et al., 2007; Barrett et al., 2001a; Ellis 2000; 1998; Reardon 1997). In addition, although nonfarm activities are increasing in household incomes in SSA, very few smallholders have been able to leave agriculture completely (Davis et al., 2016; Frelat et al., 2016; Losch at al., 2012; Djurfeldt at al., 2005; 2011; Winters et al., 2009, 2010; Haggblade et al., 2007; Barrett et al., 2001a; Reardon 1997). However, there are also contrasting perspectives suggesting that there is a de-agrarianisation process in SSA, characterised by rapid livelihood diversification and occupational re-orientation (Bryceson, 1999; 2002). But the findings from the literature review in Article 1, and the empirical studies from SSA (Kenya and Senegal) in Articles 2 and 3 in this thesis, show that farming is still the most important source of income and livelihood.

Although agriculture is the predominant activity for most rural households in SSA, it is argued that we should not expect all smallholders to farm their way out of poverty (Staatz and Dembele, 2007). The AT in SSA is currently crippled by persistently low agricultural productivity coupled with chronic food insecurity and severe poverty (Frelat et al., 2016; Andersson Djurfeldt and Djurfeldt et al., 2013; Djurfeldt et al., 2011; 2005; Losch et al., 2012). Therefore, it seems that mixed policy strategies of supporting smallholder agriculture and diversification of the rural economy and rural smallholders into the nonfarm sector, as well as promoting the growth and development of rural towns and urban centres should all be considered in order to foster ST, economic growth and development in SSA (Frelat et al., 2016).

The classical pathways of ST that I have reviewed in this thesis do not seem to apply to every country in the world and is therefore not a universal pathway for agricultural and economic development. The historical evidence shows that the ST was driven by strong public policies in the European, American and Asian countries where it already took place. The process which was initiated by the European industrial revolution of the late 18th century progressively drove the economies to higher levels of economic efficiency in agriculture, supported by public and private investments (Bosc and Bélières, 2015). This suggests that the ST process in developing countries needs to be understood in a diversity of contexts regarding policies, population, productivity and the kind of employment opportunities available within and outside agriculture (Bosc et al., 2013). Moreover, in many developing countries, there is a diversity of farming systems, therefore a diversity ATs and STs are possible and different challenges may accompany the development process (Bosc et al., 2015).

In concluding this chapter, I challenge the normative perspectives on ST that are based on experiences from already developed economies in Europe, North and South America, and East Asia. There are questions that arose while reviewing the experiences of already developed economies. Why is a world without agriculture supposed to be the ideal world? Why must most rural people leave agriculture in order to progress and succeed? Regardless of the answers to these questions, the ideal world is beyond economics, and also depends on the society, context, culture and other social values. I agree with Rigg (2006) that people may want to hold onto farmland for many other reasons beyond its economic value, such as to pass it onto future generations or other intrinsic values. At the same time, from my qualitative fieldwork and experience in SSA I argue that many rural parents do not want their children to become farmers like themselves. This is because currently smallholder farming in SSA is hard work and generally does not seem to pay enough. The youth in SSA are also generally not interested in smallholder farming, which is viewed as inferior to other careers. I think this perception correlates the ST theories that brand agriculture as a low productivity, traditional sector that must be left behind. Hence, the mean age of farmers in SSA is also rising (Article 3), similar to what Rigg (2006) described for East and South Asia. Therefore, in my view, social and cultural views on smallholder farming in SSA will have to change so that young people can willingly choose a career in agriculture or in a non-agricultural activity or both. Moreover, as recent studies from SSA show, people living in densely populated rural areas which are well connected to small trading centres and rural towns with the necessary services do not feel the need to move to urban areas (Christiaensen et al., 2013). In

addition, it seems that agriculture in SSA is not just a rural phenomenon. Many people in urban areas of SSA are also engaged in farming, and farming in urban and peri-urban areas is important for household food security (Ayerakwa 2017). Moreover, the findings in Article 3, show that in order to increase their incomes and improve their standards of living, farmers in Kenya maintained a foothold in agriculture while also engaging in nonfarm activities by exploiting strategic complementarities between farm and nonfarm activities. In addition, there is evidence that when agro-climatic conditions are favourable, farming remains the occupation of choice for most rural households in SSA (Davis et al., 2016). The findings in Articles 2 and 3 are consistent with this interpretation. The observations above challenge the normative view that in order for SSA to develop, rural people need to move out of farming and migrate to urban areas.

3. Empirical considerations in the study of diversification at household level

In this chapter, I review the main approaches commonly used in the economic and social science literature to study household diversification behaviour. Furthermore, I describe how these theoretical approaches attempt to explain and understand household diversification behaviour. Finally, in this chapter I also look at the application and challenges of different approaches and indicators commonly used to measure household diversification.

Theoretical and Empirical methods to study household diversification

The farm household model

Most rural households in SSA derive part of their livelihoods from agriculture, utilizing mainly family labour in farm production. They often consume at least part of what they produce, integrating household production and consumption activities and decisions with partial engagement in markets that are often imperfect or incomplete (Ellis 1993; 1998). Therefore, the farm household model, in which the household is jointly engaged in production and consumption (Ellis 1993), offers an important basic theory for understanding the behaviour of rural farm households in SSA. The theory tries to explain the interactions and relationships between household production, consumption and time allocation. Accordingly, in an effort to maximise utility, rural households, subject to price and resource constraints, make a rational attempt to efficiently allocate time, income, leisure and the collection of goods and services they produce and consume. (Becker, 1965). Moreover, utility maximisation is based

on the goods and services consumed, leisure and income, which is derived from a combination of farm and nonfarm production activities and wage labour (Singh et al.,1986). The theoretical farm household model adopted by Reardon et al., (1994, p.1173), highlights several important features that are important in understanding household diversification behaviour and farm-nonfarm relationships:

> First, a given household may maximise its welfare by emphasising nonfarm or wage labour activities rather than farming. Second, income-earning activities are constrained by the household's assets, and by the physical and economic environment. Third, nonfarm and farm enterprise choices are made jointly and compete for the household's labour and capital resources. Thus, the number of nonfarm activities engaged in by the household, and the scale of each activity, depend on the relative returns to nonfarm versus farm activities, and on their relative resource requirements. Relative returns and access to resources depend on exogenous factors such as policies and markets. Fourth, the household might consume all the income, investing none, or it might reinvest the income in nonfarm activities only, in farm activities only, or in a combination of farm and nonfarm activities. Fifth, there are several factors, which are beyond household characteristics and relative returns to agriculture that determines the household's participation in nonfarm activities. These include; the physical environment (agro-ecology, climate, infrastructure, etc.); the economic and institutional environment (markets, institutions, government policies, etc.); the type of available nonfarm activities; who controls farm and nonfarm activities within the household, etc.

Push and pull theory of diversification

The most common theoretical concept in diversification research, which is implicit in the household economic models, is the *push-pull model* used to explain the causes of household diversification behaviour (Reardon et al., 2006). Neo-classical diversification theory sees AT, livelihood diversification and migration as part of the whole process of ST, in which material progress and development is a linear, gradual and universal process of continuous change from rural based traditional agriculture to urban oriented modern industry and services (Timmer, 2009). Push-pull models reflect the neoclassical economics paradigm, based on principles of utility maximisation, rational choice, factor-price differentials between regions and countries, as well as labour mobility (King, 2012). At the micro-level, neo-classical theory views farm households as individual, rational actors, who decide to diversify into nonfarm activities on the basis of a cost-benefit calculation and are expected to be able to make choices to earn the highest returns. Farm

households are production units which maximise utility by combining time and other inputs to produce output, subject to price and resource constraints (Becker, 1965). Diversification is seen as a function of returns to labour from farm activities compared to off-farm (including nonfarm activities) (Singh et al., 1986). Given an asset base, the farm household makes choices by comparing between the returns from farm labour time and time spent on off-farm income activities (Yaro, 2006). The assumption is that increases in off-farm incomes provide incentives for farm households to diversify their income generating activities.

According to this theory, combinations of push and pull factors therefore determine the type of diversification strategy pursued by a given household. Diversification may occur as a deliberate household strategy to improve standards of living or as an involuntary response to crisis (Ellis, 1998). In addition to the household's capacity to diversify, which is determined by its assets, rural households may be induced to diversify their activities by *push* and *pull* factors (Reardon et al., 2006; Ellis 2000b). *Push factors* are negative factors that may force farm households to seek additional livelihood activities within or outside the farm. They tend to dominate in high-risk and low-potential agricultural environments, subject to drought, flooding and environmental degradation (Haggblade et al., 2010). They are seen to be the cause of *push-driven or survival-led type of diversification* in SSA, whereby poorer rural farm households engage in low-return nonfarm activities to ensure survival, to reduce vulnerability or to avoid falling deeper into poverty (Lay et al., 2008). For SSA, *risk* and *seasonality* are the two most common reasons for rural farm households diversifying their activities outside agriculture as a means of dealing with agricultural risks and to smooth income and consumption (Barrett et al., 2001a; Ellis 2000b). Other push factors include land constraints driven by population pressure and fragmented land holdings, missing or incomplete factor markets and market access problems due to poor infrastructure and high transaction costs (Barrett et al., 2001a), including asset strategies and coping behaviour (Ellis 2000b). *Pull factors* are positive factors, which provide incentives for people to expand their range of income generating activities within and/or outside farming. Such factors tend to dominate in less risky, more dynamic agricultural environments (Haggblade et al., 2010). Examples include commercialization of agriculture, improved infrastructure, proximity to an urban area, improvements in market access, growth of rural towns, development of labour markets, etc. (Barrett et al., 2001a; Losch et al., 2012). Such pull factors are associated with *pull-driven or opportunity-led type of diversification*, which occurs when wealthier rural households with

accumulation objectives engage in high-return nonfarm activities in order to increase household income by maximising returns from their assets (Lay et al., 2008).

The Livelihoods approach

The livelihood approach[3] takes a more people-centered view on the study of rural livelihoods in different contexts (Scoones, 1998). This approach commonly employs the *sustainable livelihoods framework* (SLF) that is conceptualised in Table 1 as a theoretical framework to understand the livelihoods of the rural households and to link the livelihood strategies of households to assets and markets (Bosc et al., 2015a; b; Sourisseau et al., 2012). This approach offers an explanation for household diversification based on access to assets, which are used as part of the household income generating strategies (Velazco and Pinilla, 2013). A *livelihood* is defined as "the capabilities, assets (including material and social resources) and activities required for a means of living" (Scoones, 1998, p.5). Furthermore, a livelihood is said to be sustainable "when it can cope with and recover from stresses and shocks, maintain or enhance its capabilities and assets, while not undermining the natural resource base" (Scoones, 1998, p.5). The SLF shows how, in different contexts, sustainable livelihoods are achieved through access to assets or capitals, which are combined in the pursuit of different livelihood strategies in order to achieve certain outcomes. The model is based on contextualised household economic models and explains how various social relations, institutions, organizations, policies and shocks modify access to and ability to convert livelihood assets into livelihood outcomes (Vedeld et al., 2012). The SLF enables an understanding of the livelihood strategies pursued by people and the factors behind their decisions to re-enforce the positive aspects of their strategies and mitigate against constraints (Ashley and Carney, 1999). How a household copes with and withstands economic shocks depends on the options available in terms of capabilities, assets and activities and the livelihood strategy is determined by the way those options are arranged and selected (Alinovi et al., 2010).

[3] Given the interest of this thesis in livelihood diversification, the livelihood approach was essential in understanding and linking the concepts of livelihoods, livelihood strategies, livelihood assets and livelihood outcomes when applied to rural farm households. However, there were limitations in its empirical application in quantifying the spatial and dynamics patterns and determinants of household diversification, because of the largely descriptive nature of much of the empirical work using the livelihoods approaches (e.g. Smith et al., 2001; Ellis 2000b).

Table 1: The Sustainable Livelihoods Framework for analyzing rural livelihoods

(a)	(b)	(c)	(d)	(e)
Livelihood Assets (capitals)	**Access Modified by Institutions, Organizations & Policies**	**In the vulnerability Context**	**Resulting in Livelihood Strategies**	**With effects on Livelihood Outcomes**
*Human Capital *Physical Capital *Financial Capital *Social Capital *Natural Capital	**Institutions** *Markets in practice *Social relations *Community *Public/private/civic Institutions **Organizations** *Government *NGOs *Private/co-operatives **Policies** *Market liberalization (Structural adjustment programs) *regional integration *globalization	**Trends** *Population *Migration *Technological change *Relative prices *Macro policy *Economic trends (national & global) **Shocks** *Economic shocks *Diseases *Civil war *Natural hazards **Seasonality** *Production *Prices *Employment *Health	**Agriculture** (intensification/extensification) *Crop & livestock production; processing of agricultural products; hunting, fishing, forestry & gathering from natural resources) **Livelihood diversification** *rural labour market (farm and nonfarm wage labour, self-employment) *Transfers (public & private) *migration & remittances *Rents *Interest income **Migration** * Rural/local *Urban/capital *Abroad/overseas	*Increased income *Increased well-being *Improved food security *Reduced vulnerability *Sustainable use of natural resources

Source: Adapted and modified from Allison and Ellis (2001)

(a) Livelihood assets

Livelihood assets are the 'capital' stock of productive resources built up by human action and by investing current income streams, thus increasing future benefits from a given input of labour or raw material (Ahmed and Lipton et al., 1997). The value and use of an asset depends on the quantity owned, the ownership status and the fungibility of the asset (Winters et al., 2009). This implies that those with more assets are more likely to have a bigger variety of livelihood options with which to pursue their goals. In addition, the asset status of a person is highly associated with the degree of dependence from a certain resource, varying according to the local context (Kollmair and St. Gamper, 2002). There are five categories of assets/capitals, which according to Kollmair and St. Gamper (2002) are important to derive a livelihood strategy identified in the SLF: *Natural capital*, mainly natural resources (land, water, soil, mineral, plant, fisheries, animal life and environmental services) from which resource flows and services useful for livelihoods are derived; *Social capital* (networks, social claims, social relations, affiliations, associations); *Human capital* (human skills, knowledge, household size, labour resources, health of members and physical capability); *Financial* (or economic) *capital* refers to the capital base (cash, credit/debt, savings), which are essential for the pursuit of any livelihood strategy); *Physical capital* comprises producer goods and services (such as buildings, road transport, piped water, electricity, communication systems and as equipment and machinery needed to support livelihoods). Physical capital is important not only for meeting people's needs directly, but also for providing access to other capital, for instance through transport and infrastructure.

(b) Institutions, organisations and policies

These are the transforming structures and processes that shape livelihoods (Kollmair and St. Gamper, 2002), for example the complex social, economic and political context within which people pursue their livelihood strategies (Alinovi et al., 2010). Institutions are humanly created formal and informal mechanisms that shape social and individual expectations, interactions, and behaviour (North 1990; Agrawal 2008). They can have a great influence on access to assets in terms of creating and determining access to them and influencing rates of asset accumulation. Institutions structure and shape outcomes through the actions of individuals and decision makers associated with them. They can be classified as market, government, and community institutions (Agrawal, 2008). Specifically, access to important markets serves

as incentives for people to make choices and determine access to livelihood assets, thereby influencing the livelihood strategies chosen by households. The absence of well-functioning markets in SSA often constitutes an obstacle to sustainable development and makes simple asset creation difficult by impeding access to certain livelihood strategies (Agrawal, 2008; Barrett and Mutambatsere, 2005). Institutions can also be classified as falling into public (e.g. local agencies, local governments), private (e.g. seed banks, service organizations, private businesses) and civic (e.g. labour exchanges, collective gatherings, membership organizations & cooperatives) (Agrawal and Perrin, 2008).

(c) The vulnerability context

The vulnerability context forms the external environment in which people exist and gain importance with direct impacts upon people's asset status (Devereux, 2001). It is the context within which people pursue their livelihoods, including trends (social, economic, demographic, resource, governance trends, etc.), shocks (economic, human, livestock or crop health shocks); natural hazards (e.g. floods or earthquakes), conflicts (national or international wars etc.) and seasonality (seasonal fluctuations in prices, production, health, employment opportunities etc.). These factors can have a direct impact on people's assets and on the options available to them to pursue beneficial livelihood strategies (Alinovi et al., 2010). Not all trends and seasonality must be considered as negative, they can also move in favourable directions. For instance, trends in new technologies or seasonality of prices could be used as opportunities to secure livelihoods (Kollmair and St. Gamper, 2002). The vulnerability context represents the part of the framework that lies outside the control of the household.

(d) Livelihood strategies

Livelihood strategies are the combination of activities that people choose to undertake in order to achieve their livelihood goals, such as productive activities, investment strategies and reproductive choices (Alinovi et al., 2010). People's choice of livelihood strategies is mainly influenced by their access to assets and the policies, as well as institutions and processes that affect their ability to use these assets in order to achieve positive livelihood outcomes (Scoones, 1998). Based on its assets a household can choose between livelihood strategies consisting of combinations of only farm activities or nonfarm activities or a combination of both (Brown et al., 2006). The types of

activities within each livelihood strategy are diverse and each strategy offers different livelihood outcomes depending on the nature and types of activities (Barrett et al. 2001). The World Development Report 2008 suggests three main pathways out of poverty, namely agricultural entrepreneurship, the rural labour market and diversification of activities including migration (World Bank, 2007). These pathways out of poverty correspond to different livelihood strategies classified by Scoones (1998) into three broad clusters:

(i) *Agricultural intensification/extensification* – These are strategies based on exploitation of natural resources and those pursuing them gain most of their livelihood from agriculture (crops, livestock rearing, aquaculture, forestry etc.) through processes of intensification (more output per unit area through capital investment or increase labour input) or extensification (more land under cultivation) (Scoones, 1998). However, the decreasing farm sizes in many African countries point to serious land constraints and indicate that extensification is becoming a less viable livelihood strategy option for many rural households (Jirström et al., 2011). Intensification categories can be separated into two categories: capital-led intensification, often policy-led and supported by external inputs, or labour-led intensification, which is a more autonomous process based on own labour and social resources (Orr and Mwale, 2001).

(ii) *Livelihood diversification* – is a household strategy that involves an increasing range of farm and/or nonfarm income generating activities (Scoones, 1998). The nature, causes and consequences of income and livelihood diversification in SSA are extensively discussed in Article 1. Some of the related concepts are explained further in this chapter.

(iii) *Migration* – is to move away and seek a livelihood, either temporarily or permanently, elsewhere (Scoones, 1998). One or more family members leave the resident household for varying periods of time (Orr and Mwale, 2001). Distinctions are made between different migration causes (voluntary and involuntary movement), effects (reinvestment in agriculture, enterprise or consumption at the farm or migration site) and movement patterns (to or from different places). Ellis (1998), however, distinguishes between seasonal migration (temporary, determined by agricultural season), circular migration (temporary, but not limited to the crop season) and permanent migration (from village to town or abroad).

(e) Livelihood outcomes

Livelihood outcomes are the goals to which people aspire and the results of pursuing these livelihood strategies, such as increased income, reduced

vulnerability, increased well-being, improved food security and more sustainable use of natural resources (Alinovi et al., 2010). The ability to pursue different livelihood strategies is dependent on the basic tangible and intangible assets that people have in their possession. Such livelihood resources may be seen as the 'capital' base from which different productive streams are derived and from which livelihoods are constructed (Birago, 2006). Demographic characteristics such as age, gender, occupation, education, migration, environment (social, economic, ecological) are important determinants of livelihoods (Chambers and Conway, 1992). Moreover, causes and consequences of livelihood diversification are differentiated by location, assets, income, opportunity and social relations (Ellis, 1998).

The classification of rural activities and the components of diversification behaviour

According to Barrett et al (2001a), the components of diversification behaviour can be analysed following the production function: (i) *Assets*, are productive or non-productive factors of production that represent the household's capacity to engage in diversification; (ii) *Activities*, are ex-ante production flows of asset services, and (iii) *Incomes*, are the ex-post flows of activities. These components need to be measurable, for instance by valuing them at market or virtual prices, in order to make the analytical link between household diversification behaviour and the aggregate functioning of markets. The literature review (Article 1) reveals that rural activities and the components of household diversification are complex and are often classified based on the perspective of the household or the activity as illustrated in Article 1 (p. 1126). A three-way classification has been proposed by Barrett et al (2001a):

First, is the classification by economic sector, where *farm* (agricultural) or *nonfarm* (non-agricultural) concerns the nature of the product and the types of factors used in the production process, irrespective of the location, scale, technology or returns from the activity. *Farm income* is derived from the production or gathering of unprocessed crops, livestock, forest, fish or other products from natural resources. *Nonfarm income* is derived from all non-agricultural sources of income, including processing, transport or trading of unprocessed agricultural, forest and fish products. This secondary category

includes: nonfarm rural wage employment, nonfarm rural self-employment, property income (such as rents, interests), public or private transfers (donations, subsidies, pensions or social grants), migration remittances (urban-to-rural national remittances as well as international remittances).

Second, is the classification by function, where activities in the rural labour market are classified into *wage employment* or *self-employment*. Wage employment is where people sell their labour services to an employer in exchange for a wage or salary, while those who are self-employed typically sell their labour services to themselves (entrepreneurial activities). However, according to Barrett et al. (2001a), and as noted by Lay et al. (2008), because labour market opportunities vary, there exists a continuum from clearly wage-employment to clearly self-employment, with a grey area in the middle where an activity could be classified as either wage- or self-employment. Consequently, the distinction between wage- or self-employment is normally made during data collection and analysis (Barrett et al., 2001a).

Third, is the classification by space, depending mainly on where the activity takes place. For instance, either local or migratory. If local, the activity may be carried out at home (*on-farm*), or away from home (*off-farm*) such as in the rural or urban area, domestically or foreign. Moreover, in the literature, there is no consensus on the classification of the *off-farm* category, which can be confusing and misleading as pointed out by Barrett et al. (2001a). As pointed out by Losch et al. (2011), sometimes the off-farm category is used to refer to all activities that are not conducted on a household's farm (all nonfarm activities, including farm wage labour), whereas other times it is used to refer exclusively to agricultural wage labour.

Barrett et al (2001a) argue that the classification of rural activities and the components of diversification should conform to those used in standard practice of national accounts (sectoral classification), i.e. classifying activities into economic sectors that have standard definitions, rather than classification by space or function. Their argument is that this could avoid confusion and resolve some of the methodological questions that plague the existing literature on diversification, as well as improve comparability across studies. Moreover, standardizing the classification of rural activities would maintain a logical correspondence between micro and macro-level analyses.

Measures of household diversification and their limitations

As highlighted by Barrett et al. (2001a), in a special issue of the journal *Food Policy* on "Income Diversification and Livelihoods in Rural Africa: Cause and Consequence of Change," the empirical study of diversification meets with many practical problems including issues related to the definitions and concepts used, and to the measurement of the nature and extent of diversification. According to the authors, the lack of standard approaches has prevented effective comparative analysis and led to mistaken inference. Several methods have been employed in the empirical literature to study household diversification, some of which are presented below. Each measure of diversification has its own advantages and limitations, and in practice several measures are usually combined.

(a) Assets, activities and incomes

The *asset* or *activity* approaches use, for example, the stock of wealth in different forms of assets or the amount of each productive asset allocated to a given activity (such as hectares by crop, labour days by activity, employment share of different activities, etc.) to measure diversification (Barrett and Reardon, 2000). The asset approach is useful in studying the dynamics of income and diversification because assets are able to capture the long-term accumulated welfare of the household, since asset ownership is partially based on economic wealth (Dimova and Sen 2008). This approach is especially useful in distinguishing between high-return and low-return activities (Bezu and Barrett, 2012; Lay et al., 2008).

However, the main limitation is that the value of some assets and activities are difficult to estimate in the SSA setting because asset markets are not well-developed and non-market activities may be completely ignored (Barrett et al., 2001a). Also, the reported employment share of some activities maybe understated, for instance that of nonfarm activities, because they are widely recognised to provide supplementary work during slack periods of the agricultural cycle. Hence real working time allocated to those activities is often unintentionally added to the total account of agricultural employment (Lanjouw and Feder, 2001).

Given the weaknesses of asset and activity approaches, the common measure of diversification is often *income* because it's easy to quantify into a

single money metric measure and has a clear interpretation as a welfare outcome (Barrett and Reardon, 2000). Moreover, the objectives of diversification are closely linked to income smoothing (stability or income maximization) (Reardon et al., 2006). Income diversification is measured by the composition of household incomes at a given instant in time (Ellis, 1998). Assets and activities that are difficult to quantify can be easily valued at market or virtual prices and measured as incomes (Barrett et al., 2001a). Although income diversification measures are widely used in the literature, they are often directly linked to household assets and activities (Barrett et al., 2001a). In this thesis, all three measures - household income, activities and assets are employed in different ways in the empirical analysis of household income and livelihood diversification (Articles 2 and 3).

(b) Number of income sources

The number of income sources that a household has at a given point in time is used as a measure of income diversification (Ersado, 2006). This is the simplest measure of income diversification and is easy to communicate. However, the challenge is that it treats every income source equally and does not account for the relative contribution of each income source. For instance, a household with more economically active people, *ceteris paribas*, is likely to have more income sources - this may reflect household labour supply decisions as much as the desire for diversification (Ersado, 2006).

(c) Income shares

The shares of income from different income sources in total household income are in many cases used to measure diversification (Barrett et al., 2001a; Lay et al., 2008; Escobal, 2001; Block and Webb 2001). This method gives the number of income sources and accounts for the contribution of each income source (relative share in the portfolio). For instance, the share of nonfarm income in total household income is a measure of diversification into the nonfarm sector (Barrett et al., 2001a). The method is simple and easy to communicate, and is one of the most commonly used (ibid.). However, there are several limitations associated with this method: it works best at aggregated level of analysis when e.g. comparing farm versus nonfarm. It does not take into account the distribution of the different income sources, there is a discrepancy when comparing households receiving different shares of income from similar activities and it gives equal risk-mitigation weight to households deriving a given percentage of nonfarm income from one or more income

sources (Ersado, 2006). The last limitation is often overcome by disaggregating the income shares into several components, for instance, nonfarm income share may be disaggregated into nonfarm self-employment, nonfarm wage employment, etc. (Woldenhanna and Oskam, 2001). Since the interest in this thesis was to compare the farm versus nonfarm patterns and dynamics (Articles 2 and 3), the farm and nonfarm shares are computed, together with the shares of the different components of total household income.

(d) The Gini coefficient

The Gini coefficient, although not employed in the empirical work in this thesis, is another scalar measure used at a disaggregated level of analysis of diversification, which summarises a vector of income levels or shares into a single number (Barrett and Reardon, 2000). The Gini is commonly used to measure income distribution or income inequality. A number of studies have used the Gini coefficient and Gini decomposition measures to estimate the impact of non-farm activities on income inequality (Escobal, 2001, Lay et al., 2008; Reardon et al., 2000; De Janvry and Sadoulet, 2001). The index measures the area under the Lorenz curve as a complementary proportion of the area that would be captured if the variable (assets, activities or income) are perfectly equally distributed (Barrett and Reardon, 2000). A value of zero represents perfectly equal distribution of wealth across assets, or of productive assets across activities, or of incomes across sources, while a value of one reflects complete specialisation (Barrett and Reardon, 2000). Using the Gini coefficient and decomposition, it is possible to measure, which income source is decreasing or increasing inequality (Kaija, 2007).

The main challenges when using the Gini coefficient include: (i) computational complexity, because of the use of numerical integration techniques to approximate the true Gini coefficient; and (ii) it is not sensitive to changes in number of income sources or relative income shares, it simply measures distributional equity. For instance, if income is perfectly equally distributed across the only two income sources feasible, the Gini coefficient will be the same as when income is perfectly equally distributed across the only three income sources feasible - yet in fact the household in the second case has diversified its range of activities. Never the less, according to Barrett and Reardon (2000), the Gini coefficient illustrates well that diversification should change with adjustments to either absolute or relative shares.

(e) Diversification Indices

Diversity indices used to measure household diversification take into account the number of components (income, assets or activities) and their distribution (Barrett and Reardon 2000). Income diversification, for example, is understood as a process in which households increase not just the number of income sources, but also achieve a greater balance in terms of the relative share of the various income sources in their portfolio (Ellis, 2000). The most commonly used income diversity indices are derived from a general index of diversity of the form (Patil and Taillie, 1982):

$$D = \left[\sum_{i=1}^{n} S_j^{\alpha}\right]^{\frac{1}{(1-\alpha)}}$$

Where,

D is the diversity index,

S_j is the share of income source in total income ($S_j = \frac{Y_j}{Y}$),

where $Y = \sum_{j=1}^{n} Y_j$ is the total household income from all sources;

j = 1,2,3……..n

α is the diversity parameter[4], such that α≥0 and α≠1

The general index measures the number of income sources and the distribution of income shares, with the parameter α determining the weight of the number of sources versus evenness in the distribution of shares. The higher the α value, the greater the emphasis on the distribution. A parameter value of α = 0 simply counts the number of income sources (*S*). The upper limit value of the index for any α value is the number of income sources and the lowest limit is 1. The lower value occurs when a given household has only one source of income and the upper value occurs only when the shares are equal (the distribution is even across all income sources).

The index values are constrained to values between zero and unity, but their weighted arithmetic mean, and hence D, can never be smaller than 1/*S*, which is reached when all types are equally common. A value of one indicates

[4] α represents the order of diversity which is limited to non-negative values, because negative values would give less important income sources more weight than abundant ones (Patil and Taillie, 1982).

complete dependence on a single income source while a value of 1/k represents perfectly equal earnings across income sources, where there are k different income source categories analysed (Barrett et al. 2001a). The index measures not only the number of income sources, but also the evenness of income shares, with the parameter α determining the weight of the number of sources versus evenness in the distribution of shares. This index measures the degree of concentration (scatteredness) of household income into various sources, it thus measures the level of income diversification.

Since the mean proportional number of income sources increases with decreasing number of income sources and increasing abundance of the most common income source, D obtains low values in datasets of big diversity and high values in datasets of low diversity, i.e. the value of D increases with increasing concentration. This is counterintuitive behaviour for a diversity index, so often such transformations of D that increase with increasing diversity have been used instead.

Examples of diversity indices commonly used include the Herfindahl-Hirschman index or Herfindahl index (similar to the Simpson index in ecology), and the Entropy index (equivalent to the Shannon index in ecology and finance literature) (Patil and Taillie, 1982). In economic studies the Herfindahl index is the most commonly used (Baird and Gray, 2014; Anderson and Deshingkar, 2005; Barrett & Reardon, 2000; Bradshaw et al., 2004; Zhao and Barry, 2013). Barrett and Reardon (2000), after reviewing several diversification measures, find that it is more advantageous to use the Herfindahl index because it allows for disaggregation of diversification data since it is sensitive to the range of components available (assets, activities or income sources) and hence provides a multidimensional perspective on diversification behaviour. The most common transformations are the Gini-Herfindahl index (1 - D) (Losch et al., 2012) and the inverse Herfindahl index (1/D) (Baird & Gray, 2014; Ersado, 2006).

However, diversification indices are criticised because they are two dimensional and not able to reveal the type of diversification pursued by different households that have the same value of the indices or within a single household at different points in time. Hence they may be an inappropriate measure for understanding diversification into given income sources because they provide limited information concerning the overall structure of household diversification (Zhao and Barry, 2013).

4. Methodology

The Study Areas

The empirical studies on diversification in this thesis (Articles 2 and 3) are based on rural household data collected from different regions in two countries in SSA (Kenya and Senegal). In this chapter, I first give an overview of the context of rural diversification and livelihoods in the two countries. Thereafter, I describe the conceptual framework for the study, followed by a description of the methodological strategy, data and sources, and finally the analytical methods.

Economic diversification and rural livelihoods in Kenya and Senegal

In this thesis, I selected Kenya and Senegal as the study areas to investigate the empirical patterns, determinants and dynamics of household diversification. Both countries are at the initial stage of ST with smallholder agriculture playing an important role in growth, employment and poverty reduction (Losch et al., 2012). Both countries have implemented SAPs since the 90s with partial integration and liberalization policies, characterised by withdrawal of the state from agricultural marketing and input provision (Losch et al., 2012). The exit option for rural smallholders due to declining agricultural performance and depressed conditions of traditional agricultural exports (mainly coffee for Kenya and groundnuts for Senegal) over the period after SAPs, seems to be the informal sector through diversification or migration to urban areas (Kirimi et al., 2010; Ba et al., 2009). However, economic liberalization has also opened up new income generating opportunities for smallholders in both countries, especially through production of non-traditional export crops (especially horticulture) and contract farming with agro-industry (Losch et al., 2012).

The development of value added sectors in agriculture, and the expansion of non-traditional marketing channels show somewhat different patterns in the

two countries. In Senegal, the importance of the major agricultural export product (groundnuts) has declined over time. Government policy and investment is now focused on development of capital-intensive systems with non-traditional production directed towards export, especially horticulture, in the irrigated zone of the Saint-Louis/Senegal River region (Maertens, 2009; Maertens and Swinnen, 2009). However, the bulk of the smallholder farmers are engaged in rain-fed crop production, mostly cereal grains, and livestock rearing (Ba et al., 2009). Moreover, the existing investment policy concerning infrastructure gives priority to urban areas in the capital. The horticultural sector is an important foreign exchange earner and plays a central role in Senegal's export diversification strategy towards high-value export commodities (Ba et al., 2009). While in Kenya, horticulture is one of the strategic sectors of the economy, and considered one of the elements of its success story, with horticultural exports expanding rapidly since the beginning of the 1990s (Minot and Ngigi, 2004).

Both countries are faced with adverse weather conditions especially due to frequent droughts. However, there are large differences in terms of agro-ecological conditions both between and within the two countries (Losch et al., 2011). This difference in agricultural potential is reflected in their different development strategies, with Senegal investing less in agriculture as an engine for growth. As a consequence, cereal import dependency ratios of the two countries are very different: the level in Senegal was on average 56.1% over the period 2006-2008 and 24.8% in Kenya (FAOSTAT, 2015).

Both countries have over 70% of the population engaged in agriculture. Poverty rates are high in both countries, although there are differences in poverty depth, with a higher level of the Senegalese population affected by severe poverty (Appendix A). In Senegal, high rural poverty, increasing population growth leading to pressure on natural resources, frequent droughts, and limited access to rural infrastructure such as irrigation (especially in the southern part of the country), have fueled migration to the capital and other urban areas, as well as to rural areas with more economic opportunities facilitated by irrigation systems (Ba et al., 2009). In addition, diversification of livelihoods outside agriculture (migrations, wage labour, tourism, crafts, etc.) provides rural households with opportunities to generate incomes during the dry seasons, in order to supplement household income (Ba et al., 2009).

In Kenya, the poverty situation is worsened by continuing population growth, climate change, and degradation of natural resources (IFAD, 2011). Farm sizes are declining gradually (Muyanga and Jayne, 2014; Djurfeldt and Jirström, 2013) and this development and growing landlessness are by default

pushing unskilled farm labour into the mainly low-return rural nonfarm sectors (Headey and Jayne, 2014). Rural farm households across different regions of Kenya are continuing to diversify their broader livelihoods by adding off-farm activities, while maintaining most of their agricultural activities (Kimenju and Tschirley, 2008). Moreover, it seems that the rural poor depend principally on food-crop agriculture and seasonal wage income for their livelihoods, while the relatively better-off tend to combine food-crop agriculture with livestock production and widespread engagement in non-farm self-employment activities (Freeman et al., 2004).

Conceptual and analytical framework

Household diversification behaviour is too complex to be explained by a single theory. Therefore, in this thesis a combination of different methodological theories and concepts (described in chapter 3) are applied by integrating different dimensions in the empirical study of income and livelihood diversification (Articles 2 and 3). Household diversification is conceptualised beyond just the number of household economic activities. It is also a process that can potentially lead to positive change and ST when in response to pull factors, which can enable rural households to increase their incomes, build assets and improve their standards of living. In this section, I describe in detail how I conceptualise household income and livelihood diversification behaviour in the thesis, and the methods I have used to capture the spatial and temporal patterns, the determinants and the gender disparities (Articles 2 and 3). I use a mixed methodology (Bryman, 2008) to answer the empirical questions, combining different types of quantitative data with qualitative fieldwork, in order to triangulate different information on diversification at household level.

Classifying the components of household diversification

Assets, activities and incomes make up the components of household diversification behaviour which are necessary to generate a livelihood (Barrett et al., 2001a). Following the livelihood approach, a livelihood therefore relates to different assets and activities required to make a living. Assets, activities and incomes are used as complementary measures of diversification in the empirical work (Articles 2 and 3).

The sectoral classification of *farm* (agricultural) versus *nonfarm* (non-agricultural) is applied to the components of household diversification behaviour according to the standard practice in national accounting. The *farm* category includes the production or gathering of unprocessed crops or livestock or forest or fish products from natural resources. This category is disaggregated into sub-categories such as crops (food staples, other food crops, cash crops, etc.), livestock (including livestock products such as milk, meat, hides, etc.), hunting, fishing, gathering from natural resources (for instance collecting firewood) and working on other farms (farm wage labour).

The *nonfarm* category refers to all activities other than the production of primary agricultural commodities. Nonfarm incomes accrue from such activities, for instance mining, manufacturing, utilities, construction, commerce, transport and other services. The secondary sub-categories include nonfarm wage employment, nonfarm self-employment, remittances from migrant household members, transfers (pensions, donations, subsidies or social grants) and property income from rents. In Article 3 the categories of nonfarm employment are further disaggregated into micro-business and large-scale business.

Estimating household income and livelihood diversification

For many reasons, I mainly use income as the primary measure of diversification behaviour in the empirical work. First, income has a clear interpretation as a welfare outcome (Barrett and Reardon, 2000). Second, it is the most common measure employed in the previous studies on diversification reviewed (Article 1). Third, income stabilisation or income maximisation is one of the main motives of household income diversification (Barrett et al., 2001a; Ellis, 2000a, 2000b). Fourth, the objective no. two of the thesis is to analyse the spatial and geographical patterns and determinants of rural household income diversification (Article 2). Fifth, the quantitative data, which will be described in the next section, contain detailed information on the income sources of rural smallholder households that facilitated the understanding of household diversification behaviour.

I conceptualise *income diversification* and *livelihood diversification* in many ways that are reflected in the measures chosen for the empirical work, as described in what follows:

(a) According to Ellis (1998), income diversification is the increase in the number of household economic activities at a given point in time. It is analysed

empirically by examining the composition of household incomes at the point in time (Article 2).

(b) Following the livelihood approach and the sustainable livelihoods framework described in chapter 2, I conceptualise livelihood diversification as a household livelihood strategy that involves increasing the range of farm and/or nonfarm income generating activities (Scoones, 1998). It is an active social process of household diversification, involving the maintenance and continuous adaptation of a highly diverse portfolio of activities (farm and/or nonfarm) over time in order to secure survival and improve standards of living (Ellis, 2000). In the empirical work, I use the changes in the composition of household incomes over time as an indicator of the process of livelihood diversification (Article 3).

(c) Income diversification is defined as a process in which rural households increase their income from nonfarm activities (Lay et al., 2008; Reardon et al., 2006; Barrett et al., 2001a; Escobal 2001; Barrett and Reardon, 2000; Ellis, 2000a; 2000b). I also use the share of total income from nonfarm activities as an indicator to highlight the importance of nonfarm income in a household's livelihood. Then I measure diversification by estimating the income shares from different household income generating activities with special interest in the nonfarm income share. I examine the spatial differences in terms of household income diversification based on differences in the nonfarm income share (Article 2). In addition, I use the changes in the nonfarm income share over time, as a proxy to measure the changes in livelihood diversification (Article 3).

(d) The increasing share of nonfarm incomes in rural household incomes over time is an indicator of diversification in terms of the classical processes of change, which are linked to the broader ST (Winters et al., 2010). The way it is conceptualised is that as the rural economy grows, household participation in farm activities declines and gradually replaced by more intense involvement in nonfarm activities (Winters et al., 2010). Accordingly, on average the share of income derived from farm activities declines and that from nonfarm activities increases substantially over time. Hence, the increase in overall household incomes and increasing nonfarm income share in total household incomes over time is consistent with the concept of household diversification as part of the classical processes of change and overall ST.

(e) I also conceptualise household diversification behaviour as a process in which rural households increase their number of income sources and achieve a greater balance in terms of the relative share of the various income sources in their portfolio (Ellis, 2000a; b). Accordingly, I measure household income

diversification using an index that takes into account the number of income sources and their distribution (Zhao and Barry, 2013; Barrett and Reardon, 2000). In the empirical work in Article 2, I use the inverse Herfindahl index, which estimates the number of household income sources and the contribution of each income source to total household income (Baird and Gray, 2014; Ersado, 2006; Zhao and Barry, 2013), at a given point in time, as a proxy measure of the level of household income diversification.

Determinants of household diversification

I have already extensively discussed the motives or determinants of diversification in Article 1 and also in chapter 2. I calculate the empirical models (Article 2 and 3), using the farm household model as the underlying theory. The determinants of household income and livelihood diversification, and the types of diversification based on motives of survival/distress (push factors) or accumulation/opportunity (pull factors) used in the empirical work (Article 2 and 3), are identified following the push and pull theory. Examples of push factors include seasonality, climatic uncertainty, land constraints, missing or incomplete factor markets, market access problems, poor infrastructure, asset strategies and coping behaviour. Pull factors include commercialisation of agriculture, improved infrastructure, proximity to an urban area, improvements in market access, growth of rural towns and development of labour markets.

Furthermore, adding the perspective of the livelihoods approach, there are capacity factors such as household assets that underpin household livelihood strategies by determining the livelihood options available to them (Reardon et al., 2006). Household income and livelihood diversification depend on asset wealth and the diversity of those assets (Martin and Lorenzen, 2016). I identify and classify household assets in the empirical work (Article 2 and 3) according to the livelihoods approach, which categorises them as capitals such as natural, physical, human, financial, and social capital, as described in chapter 3.

Methodological strategy, data and sources

In order to examine diversification in the empirical work (Article 2 and 3) I use a mixed methods approach combining different types of data (Bryman, 2008) on rural smallholder households. I use quantitative cross-sectional

survey data in Article 2 and panel data in Article 3. The quantitative data used in Article 2 comes from a cross-sectional rural household survey on Senegal and Kenya carried out by the *RuralStruc* (CIRAD/World Bank) project, while the quantitative data used in Article 3 is a panel data collected by the Swedish-African *Afrint* (Lund University, Sweden) project. Both datasets were collected from smallholder households in regions with variation and with contrasting rural situations. This makes the data ideal for trying to understand household diversification, ST and development patterns. I carried out qualitative fieldwork collecting qualitative data from purposively selected households and key informants using in-depth interviews. I collected the qualitative data also from contrasting regions in both countries. In both articles, I complement the quantitative data with qualitative fieldwork. The data and the specific regions where it was collected are extensively described in Articles 2 and 3. In the next section, I give a brief description of the different datasets.

The RuralStruc data and description of specific regions

The RuralStruc program and its main objectives

The *RuralStruc* program (2007-2010) was a joint initiative of the World Bank, the French Cooperation (French Development Agency, Ministry of Agriculture and Fisheries, Ministry of Foreign and European Affairs, Agricultural Research Centre for International Development - CIRAD) and the International Fund for Agricultural Development (IFAD). The main objective of the project was to provide new perspectives on agriculture and its role for development by including issues related to trade liberalization, rural transformation and the evolution of rural economies within a rapidly globalizing world (see Losch et al., 2011; 2012). The program collected data with three specific objectives: to contribute to the analytical knowledge base about structural change and its impacts on agriculture and the rural economy in developing countries; to feed and improve international and national debates by promoting and reconnecting these issues; and to provide perspectives for policy making (Losch et al., 2012, p.30).

Sampling strategy and data

The data was collected from about 8,000 households in 26 regions in seven countries[5] at different stages in the process of liberalization and economic integration. The data collection took place between November 2007 and May 2008, based on a common methodology and asking similar questions. The surveys collected information on household characteristics, assets and production factors, farm and nonfarm incomes and activities, food and household expenditures and trajectories and projects of participating rural households in several regions. The data was collected from different regions based on criteria related to market access (infrastructures and proximity to cities), the presence of integrated value chains, the level of public investments and public goods and the situation regarding natural resources. The regions where data was collected were stratified into three types, with reference to existing trends: "*winning regions*" (WR), where the on-going dynamics of market integration (whether related to specific value chains, the proximity of urban centers or good infrastructure) provide opportunities and are strong drivers of change; "*losing regions*" (LR), characterised by trends toward marginalization due to local constraints (low factors endowment, lack of public goods), poor connection to markets, high poverty rates, and where household sustainability appears to be increasingly difficult; and "*intermediary regions*" (IR), where the trends are more imprecise and broadly depend on the evolution of the local economic and institutional context, which either provide or reduce new opportunities and reduce or increase existing constraints (Losch et al., 2012).

Within each type of region (winning, intermediary or losing) specific localities (villages or rural communities) were purposively selected based on regional characteristics[6] such as market access, agro-ecology and level of public investments. Thereafter, sampling was done based on existing census lists or specific village/locality household lists prepared especially for the RuralStruc program. The surveyed households were randomly selected from these lists. A sufficient number of households per village/locality were selected to allow representativeness at local level. For Senegal, the RuralStruc survey collected data from rural households in three main regions (Senegal River

[5] Mexico, Nicaragua, Morocco, Mali, Senegal, Kenya and Madagascar.

[6] The detailed description of the context and regional characteristics, can be found in the RuralStruc country reports; Kirimi et al. (2010) for Kenya, and Ba et al. (2009) for Senegal.

delta, Groundnut basin and Casamance), resulting in a total of 1,039 interviewed households. In Kenya, the survey was also carried out in three regions (Nakuru North, Bungoma and Nyando), interviewing a total of 902 rural households. However, in this thesis (Article 2), after dropping outliers and households not involved in farming, we focus on a total of 1,770 rural farm households for the analysis (871 from Kenya and 876 from Senegal). The regions and specific villages/localities where data was collected are described in the following.

Senegal regions in the RuralStruc data

The first region selected was the ***Senegal River Delta***, which a priori was stratified as the *winning region*. This region is located in the Northern part of the country, and was in this project sub-divided into two main sub-regions of Haut Delta and Bas Delta. Rural households in the RuralStruc survey from the Senegal River Delta region were selected from six villages in the department of Dagana (Table 2). The physical environment of Dagana is characterised by the diversity of the river system flowing through it. Because of the potential of water and land, the Dagana is a strong agricultural area. The Delta region has a semi-arid climate (200 to 400 mm of rain) and alluvial humid and clay soils in depressions (which favour irrigated rice production) as well as sandy soils in rain-fed areas. This region has received massive public investments aimed at developing commercially oriented agriculture through irrigation. The region has a good level of market integration, with proximity to the major cities of St. Louis and Dakar. The Senegal River Delta region has three major agricultural settings: the Delta and around Lake Guiers, the middle valley and the upper valley. Households are involved in a diverse set of farm and nonfarm activities depending on their location relative to the Senegal River and Lake Guiers. The region as a whole has a mixture of different types of farms ranging from flood recession farming to irrigated farming and rain-fed farming. The farming system is generally characterised by pumped water irrigation and mechanised cultivation, which allows double cropping of rice over extensive areas (Ba et al., 2009). Major agricultural activities include rice, horticulture (mainly industrial tomato and onion) in the irrigation scheme of the SAED[7], sugar cane, cattle (for meat and draft force), small ruminants (sheep, goats) and fisheries.

[7] Société d'aménagement et d'exploitation des terres du delta.

Family farms coexist with large commercial farms or agribusinesses[8]. Several agribusinesses are integrating local producers mainly into contract production of tomato and sugarcane. Many nonfarm job opportunities are found in trade, services and agro-industries due to good accessibility to major cities and other smaller rural towns.

Table 2. Characteristics of the surveyed areas from the Senegal River Delta

Department	Rural Community	Villages	Sub-region	Principal characteristics
Dagana	Ross-Béthio	Mboundoum	Bas delta	Large developments and small land areas per household, rice monoculture
		Gnith	Diéri	coexistence of rain-fed and irrigated farming with Lake Guiers, production of sweet potato
	Ronkh	Ronkh	Bas delta	Proximity to the river, diversification (rice, tomato); contract production of rice and tomato; micro enterprises, micro credit institutions
		Thiagar	Bas delta	
	Mbane	Mbane	Haut delta	Rain-fed farming is dominant, sweet potato production (Lake Guiers)
	Gaé	Bokhol	Haut delta	Self-consumption of rice, high production of tomato on contracts

Source: Ba et al. (2009)

The second region selected was ***the Groundnut Basin***, which a priori was stratified as the *intermediary region*. It is located in the central part of country and was sub-divided into the sub-regions Mékhe 1, Mékhe 2 and Nioro. Data was collected from rural households in several villages in each sub-region as shown in Table 3. Mékhe has very good accessibility to the cities of St - Louis, Thiès, and Dakar, while Nioro has a good to medium accessibility to the city of Kaolack and the Gambia border. The groundnut basin has areas with semi-

[8] Examples include SOCAS (tomato processing), Compagnie Sucrière Sénégalaise, CSS (sugarcane) and Grands Moulins (horticulture).

arid and north-sudanian climate, with rainfall ranging between 300 and 900 mm concentrated from June to September. It is densely populated, with the majority of family farms semi-subsistence and mainly rain-fed, with limited irrigation (Ba et al., 2009). Agricultural activities include crop production (cassava, cereals such as cowpeas, millet, sorghum, rice and maize), livestock and fishing. In Nioro, there is a high concentration of the rural population and in the past the sub-region attracted vital public infrastructure investments. There is dynamic segmentation of the groundnut sector and there are parallel initiatives in strengthening producer organizations and in marketing channels for seeds and groundnut production.

Generally, the groundnut basin region is the major area of groundnut production, which is Senegal's main export crop (Ba et al 2009). In the groundnut basin, the farming systems combine production of groundnuts and short cycle cereals (mainly millet and sorghum) and raising small ruminants and cattle. However, since the 1970s there has been a crisis in the groundnut sector due to falling world prices for groundnuts and its related products, poor weather conditions, emergence of substitutes, as well as domestic and international economic shocks, which have significantly reduced production and exports (Badiane, 2001; Oya, 2001; Ba et al., 2009; Faye et al., 2007). Groundnut production has also led to degradation of an already fragile ecosystem, thereby impeding the production of other major food crops (Badiane, 2001).

Table 3. Characteristics of the surveyed areas in the Groundnut Basin region

Region	Department	Zone	Villages	Principal characteristics
North-Central Groundnut Basin	Tivaouane: (Mérina, Dakhar, Koul)	Zone Céréales	Koul	International migration; Easy access to market
			Khandane	Easy access to market
			Ndiakhalane	Migration to Dakar, vendors of sand with their carts; Difficult access to market
			Taby	Organised migration of entire families to Touba; Difficult access to market
			Fass Diaksao	Extensive livestock breeding, Agricultural activities conducted on protected areas, Crops of millet, groundnuts, cowpeas and gardening in the shallow areas, Village marabout; Easy access to market
"	"	Zone Intermédiare	Kelle	Cereals, watermelon and cassava; Easy access to market
"	Tivaouane : (Méouane)	Zone Manioc	Diamathiène	Development tree cultivation, fruit growing and basketry; Difficult access to market
			Meouane	Development tree cultivation and basketry; Difficult access to market
			Mekhe village	Development of basketry, embroidery, sewing and fishing migration; Difficult access to market
			Mborine	Development of basketry,

				Difficult access to market
			Ndeukou Ndiagne	Development of basketry, Difficult access to market
South-Eastern Groundnut Basin	Nioro	M. Sabakh/ M. Sabakh	Médina Sabakh	Very close to Gambia, strong density of commercial network, village market, physical access is easy
		Paos Koto/ Porokhane	Porokhane	Very close to Gambia, strong density of commercial network, village market, physical access is easy
		M. Sabakh/ M. Sabakh	Ndiba Ndiayène	Close to Gambia, moderate density of commercial network, village market, physical access is easy
		M. Sabakh/ Ngayene	Ngayène	Close to Gambia, moderate density of commercial network, village market, physical access is difficult
		M. Sabakh/ Ngayene	Djiguimar	Close to Gambia, poor density of commercial network, no village market, physical access is difficult
		Paos Koto/ Paos Koto	Paoskoto	Close to Gambia, strong density of commercial network, no village market, physical access is easy

Source: Adapted from Ba et al. (2009).

The third region was ***Casamance***, which was characterised as the *losing region*. It is located in the Southern part of the country, bordering the Gambia. The data was collected from several villages in the sub-regions of Kolda and Sédhiou (Table 4). Casamance is remote, with difficult access to the rest of the country because of poor infrastructure. It has sudano-guinean climate, with about 1 000 mm of rain and clay to sandy or silty tropical soils, offering a high potential for agriculture. Farming is mostly rain-fed and rural households mainly produce staples (maize, sorghum, millet), as well as rice, cotton, groundnut, cattle and fisheries. Nonfarm job opportunities are very limited. Ba et al. (2009) indicate that despite the region's good natural potential it has not benefitted from much public investment. The area remains secluded in comparison to the rest of the country, weakly connected to the markets, under-equipped with socio-economic infrastructures and a victim of permanent insecurity stemming from civil conflicts. Consequently, it is one of the poorest regions with two households out of three below the poverty line (Ba et al., 2009). The farming systems are traditionally based on mangrove rice farming and long cycle cereal crops. However, the invasion of rice fields by salty water has led to a sharp decline in rice production in the mangrove areas, but it has benefitted exposed crops such as groundnuts, millet/sorghum and maize. In addition, horticulture and fruit growing is developing strongly and farmers, who traditionally were limited to mangrove farming have also become fishermen.

Table 4. Characteristics of the surveyed areas in the Casamance region

Sub-region	Department	Zone	Village	Principal characteristics
Kolda	Dioulacolon Saré Bidji Saré Gagna Saré Demba Ansata	Haute Casamance	Saré S Tchika	Physical access is easy No village market
	Dabo Salikégné		Guiro Yéro Bocar	Physical access is easy There is a village market
	Médina Yoro Foulah		Kanel Abécouta	Physical access is difficult No village market
Sédhiou	Dianah Malary	Moyenne Casamance	Karcia Dianah Bah	Physical access is easy No village market
	Diattacounda		Ntérembas Thiar	

Source: Adapted from Ba et al (2009)

Kenya regions in the RuralStruc data

For Kenya, rural households were randomly selected from different locations and sub-locations in three principal regions, shown in Table 5. The first region ***Nakuru North***, was a priori characterised as the *winning region*. Nakuru North is located along the main transportation corridor between Mombasa (Kenya) and Kampala (Uganda). It has good access to Nakuru town, which is the fourth largest town in Kenya, and many classified roads, half of them being tarmac. Nakuru North has a high potential for agriculture and livestock, with annual rainfall between 950 and 1,500 mm. The big attractions of the region are Lake Nakuru and its national park. Some households make and sell crafts to tourists visiting these attractions. Households cultivate a large variety of crops including wheat, maize, millet, beans, pyrethrum, tea, coffee, potatoes and vegetables. Cattle ranching, poultry and bee-keeping are also well developed. There are several agribusinesses integrating local producers on contract for tea and coffee production. Several nonfarm opportunities exist in the nearby towns of Nakuru, Gilgil and Nyahururu with many businesses and industries.

The second region selected was ***Bungoma***, which was characterised as an *intermediary region*. Bungoma is among the fastest growing regions in Western Kenya with the highest population growth rate and population density. The region has close proximity to the Uganda border, which is important for cross-border trade. It has a poor road network, largely impassable during the rainy season, partly due to the lack of river crossings and proper bridges. At the same time, the region has good soils and well distributed rainfall, making it agriculturally productive. It has several large rivers used for small-scale irrigation. Households mainly produce food-staples (maize, beans, potatoes, sorghum) for subsistence, and sugarcane, tobacco and coffee as cash crops. There is production of horticultural and fruit crops (passion fruits, tomatoes, onions, citrus and capsicum) in some districts. There are several agribusinesses integrating local producers on contract for sugar, cotton, tobacco and milk. Some agro-industries in the region are providing employment opportunities in paper milling and other small-scale manufacturing.

The third region, ***Nyando***, was characterised as the *losing region*. Nyando is located 30 km from Kisumu (the third largest city in Kenya) on the large plains of Awach and Nyando rivers and it faces perennial flooding and erosion. It has series of hills and scarps to the South and in the North West the fertile Kano Plains extending down to Lake Victoria. Households produce food-staples (maize, groundnuts, beans, sorghum, cassava, sweet potatoes) mainly for subsistence. The main cash crop is sugarcane, produced by individual

households and estates, while dairy farming and coffee production dominates on the higher altitudes. Factories for milling sugarcane and cotton ginneries have closed down in some areas. Nonfarm job opportunities are very limited due to the extremely poor state of value chains, insufficient provision of public goods and low level of incomes.

Table 5. Characteristics of the areas surveyed by RuralStruc in Kenya

Province	Region	Division	Location*	Principal characteristics of the region
Rift Valley	Nakuru North	Bahati	Bahati Dundori Solai Bahati Kabazi	Good accessibility and proximity to major cities and markets because of good road network, high agricultural potential region in the rift valley; cash-crop region (tea, coffee, pyrethrum); cattle ranching; Tea and coffee agribusinesses integrate smallholders
		Mbogoini	Subukia	
Western	Bungoma	Sirisia Kanduyi Chwele Kimilili Bamula	Sirisia Bukembe East Bukusu Mukuyuni Namwela Maeni Kibingei Napara	Borders Uganda, high population density region, fast growing urban areas, poor road network with some roads impassable during the rainy season; good agricultural potential region; sugarcane, coffee & tobacco main cash crops, maize and beans for subsistence; Sugarcane and tobacco agribusinesses intergrate smallholders
Nyanza	Nyando	Miwani	Nyangoma North East Kano Ombeyi	Located on large plains (Awach and Nyando rivers), but faces perennial flooding and erosion; Better soils are Found in the series of hills and scarps in the South, and the Kano Plains going down to Lake Victoria in the Northwest; main cashcrop is sugarcane; Maize, groundnuts, beans, sorghum, Cassava, sweet potatoes are mainly forsubsistence. Milling sugar cane factories in Muhoroni in difficulty and closed in Miwani.
		Nyando	North East Kano East Kano Kakola Onjiko Kakmie	
		Upper Nyakach	Thur Dibuoro	
			West Nyakach	
			South Nyakach	
	Muhoroni	Muhoroni	North East Kano	

Note: *sub-locations are not shown. Source: Adapted from Kirimi et al (2010) and Losch et al (2011)

The Afrint data, the regions and specific contexts

Afrint project and its main objectives

The *Afrint* project is a collaborative research project involving researchers from Sweden (Lund University and Linköping University) and nine African countries in the maize and cassava belt of SSA[9]. 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 (Djurfeldt et al., 2011). Household level production and village level data have been collected through surveys in 2002, 2008 and 2013. The 2002 round was part of a comparative project taking the Asian Green Revolution as its starting point (Djurfeldt et al., 2005), while the 2008 round was aimed at analyzing the drivers of smallholder crop production in the study areas (Djurfeldt et al., 2011). The 2013 round included components on gender issues, farm/nonfarm interactions and household diversification. Household level panel data and village level data from Kenya were collected through surveys in 2002, 2008 and 2013. However, the empirical work in this thesis (Article 3) focuses on the 2008 and 2013 Afrint panel data, mainly because the 2002 data lacks information on the cash incomes generated by the different activities of rural households.

The data and sampling methods

Sampling followed a multi-stage purposive design (Djurfeldt et al., 2011). Regions in each country were purposively selected from areas that were deemed above average in terms of agro-ecological potential and market access (infrastructure), but excluding the most dynamic and productive areas, which were considered to be extreme cases or outliers. Sites within countries were sampled to provide a variety in terms of agricultural and economic dynamism. Regions considered dynamic and less dynamic were purposively sampled from each country and a number of villages were purposively sampled in each region based on size and agronomic variations. In each village households were sampled randomly, the sample therefore is representative at the village level. Data was collected using quantitative surveys at household and village level with the aid of questionnaires. The household, as defined by residence, was used as the data collection unit, with interviews carried out with the household

[9] Ghana, Kenya, Malawi, Nigeria, Tanzania, Ethiopia, Mozambique, Uganda and Zambia.

head or farm manager. The household questionnaire was developed to study differences in production performance over time, levels of intensification and resource access for different types of households.

For Kenya, data were collected in 2002, 2008 and 2013 from 300 households, in a total of 10 villages, in two districts (Nyeri and Kakamega). The two districts were purposively sampled, with Nyeri representing the relatively dynamic region in terms of agro-ecological potential and market access, while Kakamega was the less dynamic in these terms. Thereafter, data were collected from rural farm households in five villages in each region (Table 6), primarily on the basis of differences in agro-ecological potential and market access (Karugia, 2008; 2003). At the village level, enumerators with the help of location chiefs, sub-location assistant chiefs and village elders compiled lists of households, 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. In 2008, the attrition rate, i.e. households who had disappeared from the sample population, either by passing away or by emigrating from the area was 11.3% (Djurfeldt et al., 2011). The problem of attrition was dealt with by including in the sample randomly selected descendant households who were traced in case of partition, with one descendant household sampled to replace the original one. 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 global 2013 data contain the following categories of households: (a) *Afrint II* sample re-interviewed (unpartitioned households with the same head as in 2008, the majority) (b) Descendant households (unpartitioned households with new head or newly sampled offspring households) (c) Replacement for attrition (in-migrated households sampled from list of in-migrants and out-migrated households). In Article 3, the interest was in analysing the regional and gender dimensions of livelihood diversification, hence the focus of the analysis was on a panel of 239 rural households who were interviewed in both 2008 and 2013. The specific districts and villages where the data was collected are described in what follows.

Table 6. Characteristics of Afrint villages in Kenya in 2002

Region (district)	Village	Distance to all weather road (km)	Population density	Relative farm sizes	General soil fertility	Average annual rainfall	Land under irrigation (%)	Market access	Major crops grown
Nyeri	Thegenge/ Gatondo	4	494	Small	Good	1400	19.22	Good	Tea & horticultural products
	Ichuga/ Gathumbi	2	512	Small	Medium	1000	6.11	Good	Coffee, maize
	Kiambii	0	510	Small	Medium	900	0.69	medium	Maize
	Gatagati	1	128	Medium	Good	1000	67.52	Poor	Horticultural products
	Irigithathi	0	126	Large	Poor	800	60.22	medium	maize
Kakamega	Shikomoli	6	848	Small	Poor	2000	0.00	medium	Coffee, tea, maize
	Ekero	2	617	Medium	Good	1800	9.87	Good	Sugarcane, maize
	Chegulo	4	287	Very large	Medium	1600	0.26	Poor	Sugarcane, sweet potatoes
	Munyuki	4	436	Very large	Good	1400	0.16	Good	Maize
	Mukuyu	20	373	Small	Good	1200	0.61	Poor	Maize

Source: Karugia (2003)

Description of Kakamega region and the Afrint villages

Kakamega district is located in the Western Province and is an area with a very high population density. The villages in Kakamega were selected on the basis of different agro-ecological potential, market access and population density. The region has a rich and varied ecological base (high temperatures, reliable rainfall, fairly fertile soils), which have been significant drivers of human settlement, farming and other activities (Karugia, 2003). 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 an uneven distribution of the road network with a concentration in the Southern and Central parts.

Each village in Kakamega was selected from a different administrative division. Shikomoli village (Tirika West division) has average market access and a very high population density and hence small farm sizes. This village has relatively poor agro-ecological potential characterised by rocky and hilly terrain with poorly developed soils. At the same time, Ekero village (Mumias division) has relatively good market access due to good gravel roads maintained by Mumias Sugar Company. Ekero village is an example of an outgrower scheme in sugarcane, where farmers grow maize for subsistence. Chegulo village (Kabras division), on the other hand, is an interior hard to access village, with medium agricultural potential and some small-scale irrigation. Lastly, Munyuki and Mukuyu villages have relatively low population densities and are areas of maize monoculture with high agro-ecological potential. Munyuki has a fairly good market access in terms of proximity to the markets of Lumakhanda and Kipkarren River, while Mukuyu has very poor market access.

Description of Nyeri region and the Afrint villages

Nyeri district located in the Central Province has considerable variability in agro-ecological potential and market access. The district has a high road density and good access to markets in the regional towns of Nyeri, Karatina, Nanyuki and the capital, 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 and also on the dryer 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). Currently, most of the districts in Kenya with mean population density greater than 650

persons per km^2 are located in the Nyanza and Western Provinces, with most districts in the Central Province approaching this threshold (Jayne and Muyanga, 2012).

The villages selected from Nyeri district have marked differences in market access. They show increased levels of agricultural production through intensification and grow most of the common food and cash crops in Kenya. They have better market access (compared to Kakamega) owing to high road density and proximity to a major market (Karatina), which is well linked to other important urban markets. The agro-ecological conditions of villages in the Mathira division are better than in Kieni East. In the Mathira division: Thegenge/Gatondo village has high agro-ecological potential and good market access; Ichuga/Gathumbi village has medium potential and good market access; and Kiambii village has poor agro-ecological potential and average market access. In Kieni East the Gatagati village has good agro-ecological potential and some irrigation, but poor market access. Irigithathi village has relatively large farm sizes, but poor agro-ecological potential and average market access.

Data from qualitative fieldwork

To enrich the analysis for a better understanding of the livelihoods of the rural households, I carried out fieldwork and collected qualitative data, in order to supplement the quantitative datasets. I collected the data from contrasting regions and villages purposively selected in the two countries. The fieldwork was carried out between November 2012 and October 2013. For Senegal, I did fieldwork in the Groundnut basin/Basin Arachidier (Mekhe and Fass Diaksao villages in Mekhe region) between November and December 2012, and in the Delta region (Mboundoum and Bokhol villages in the upper and lower Delta) between September and October 2013. The villages for the data collection were selected on the basis differences in agro-ecological potential and market access. In Kenya, I did the fieldwork in January and February 2013 in the districts of Kakamega and Nyeri where four villages were purposively selected (Ekero and Mukuyu villages in Kakamega district; and Ichuga and Gatagati villages in Nyeri district) based on differences in agro-ecological potential and market access.

I collected the qualitative data using a variety of qualitative methods in order to achieve triangulation and get a deeper understanding of the research objectives and to increase the validity of results (Teddlie and Tashakkori, 2009; Bryman, 2008). The data was gathered using in-depth interviews with

rural farm household heads and some of their spouses, as well as with key informants (government officials, extension agents, leaders of farmer groups and village chiefs). I drew the list of farm households for the qualitative interviews together with the village chief, in consultation with the area extension agent. The list of households was based on four main criteria: firstly, all the households selected were involved in farming; secondly, their geographical location was considered; thirdly, a mix of female and male household heads were selected; lastly, rich and poor households were included in the sample, in order to capture households with different asset wealth endowments. These criteria enabled the interviews to capture the diversity in the types of rural households and their activities.

I conducted the key informant and in-depth interviews much like a dialogue between the respondent and I, with the support of an interpreter who spoke the local language. I always began the interviews with an informal introduction of the objectives of the study. The interview questions were open-ended and based on a checklist of semi-structured questions (Appendix B) that I prepared in advance to capture issues on rural livelihoods, household activities, incomes and assets, gender, and general changes in the social, economic and political context. I explored the relevant questions in-depth as the respondent brought them up during the interview. I also personally observed the respondent and the things around the environment in order to supplement the information on interactions and actual behaviour of households, their physical, social and economic environments.

Since the wealth status of the household is closely linked to the asset endowments, I expected richer households to have relatively more assets. I assumed that richer households with relatively more assets are also more likely to access attractive livelihood opportunities compared to poorer households (Barrett et al., 2002; Asmah, 2011). Land endowments are an important determinant of wealth (Winters et al., 2009) and of household strategies (Van den Berg, 2010), including diversification behaviour (Barrett et al., 2001a). Thus, I judged the wealth status of a household subjectively based on access to farmland. I assumed that households with access to more farmland are relatively richer, and vice versa. The limitation is that the subjective judgement of wealth may not tally with actual endowments. However, this aspect is taken care of by the quantitative data that also includes data on land endowments.

The qualitative data was collected without aiming to be statistically representative, but in order to get additional information beyond the quantitative data to enrich the analysis and to support the interpretation of the results. This kind of mixed methods approach is used to find out whether

different types of data might reveal different facets of the phenomenon or suggest new variables, concepts and propositions (Teddlie and Tashakkori, 2009). Such an approach is also useful when evaluating and qualifying different types of information (Bryman, 2008).

Analytical methods

I analyze the empirical data in this thesis using a mixture of qualitative and quantitative methods. The quantitative methods are mainly descriptive statistics and econometrics. The descriptive statistics are used to examine how the patterns of income and livelihood diversification vary across households, over space and time and the econometric models to estimate the determinants of income diversification across space based on geographical regions (Article 2), as well as to estimate the determinants of changes in livelihood diversification (Article 3). I analyse the spatial and geographical patterns of diversification and its determinants at regional and household levels for both, Senegal and Kenya (Article 2). I also investigate the geographical and gender patterns and determinants of change at regional and household level, but focusing on Kenya (Article 3). Furthermore, I disaggregate rural households in each geographical region based on the gender of the household head, for the analysis in Article 3.

The qualitative data from the fieldwork is used to supplement and explain the quantitative data. I used content analysis and synthesis, through coding (highlighting main ideas/themes), memoing (noting hypotheses that arise about potential themes or relationships), sorting (compiling and arranging themes, codes and illustrative quotes into an outline of a narrative that explains situations) and interpretation.

Limitations of the thesis

There are many limitations of this thesis in trying to empirically understand rural household income and livelihood diversification in SSA. As discussed in what follows, they mainly relate to the reliability and validity of data.

Firstly, household income and livelihood diversification, its nature, causes and consequences are obviously complex and vary spatially and temporally across different households, regions and countries. Moreover, the concept is

not just about households increasing their income generating activities in response to certain push or pull factors, but also relates to overall processes of agrarian change, rural transformation and economic development. Therefore, even with the best empirical data, it is complex and challenging to capture this process.

Secondly, the data were collected from rural smallholder households in only a few regions in the countries selected and hence it is not representative of the whole country situations.

Thirdly, I mainly conceptualise household diversification, its geographical patterns and the dynamics, in terms of household incomes (Article 2 and 3). However, the income data is based on household cash incomes and it excludes the value of output retained by the household for own consumption. In addition, the cash incomes are based on self-reported estimates by households, which are liable to recall bias. Also, since I focus on household incomes to build proxy measures of diversification, it was not possible to use the 2002 wave of the Afrint panel in Article 3 because it lacks detailed information on household cash incomes and sources. Moreover, for the 2002 wave, data on production, price, and marketing were only collected for the grain staple crops and not for tubers.

Fourthly, my use of the asset index as a proxy for household wealth (Article 3) can be criticised. I estimated the asset wealth index using the statistical technique of PCA, following some previous studies. However, this method is criticised because it lacks an underlying theory, suggesting that the assignment of asset weights might be arbitrary. Hence the validity of the asset wealth index in estimating household wealth may be unreliable as it might over- or underestimate the household's long-term wealth situation. However, as a validity check, I compared the asset wealth with the self-reported incomes and the results were consistent, showing that households with a higher asset wealth index actually had relatively higher incomes.

Lastly, the empirical results (Article 2 and 3) illustrate the limitations of using household models in investigating the determinants of economic behavior such as income and livelihood diversification in rural Africa, since the determinants of decisions made within the household context vary according to an individual's place in the family structure. Therefore, the household model which focusses on the household head, inevitably leaves out other possible determinants and motivations for diversification such as structural, social or cultural constraints on other adult members in the household who are not household heads.

5. Synthesis of the findings, contributions, policy and recommendations

Synthesis of the findings

Patterns of structural transformation and rural livelihood diversification in SSA

Article 1 in this thesis is a review article examining the nature and evolution of rural livelihood diversification in SSA and the situation regarding smallholders, who make up the majority of agricultural producers. At the beginning of the article, I discuss recent literature related to the progress and constraints to the overall process of structural transformation (ST) and Agricultural transformation (AT) in the context of SSA. In addition, I examine previous literature on the patterns, determinants and welfare impacts of income and livelihood diversification in SSA. The review article provided the motivation and foundation for the empirical work in Articles 2 and 3. The literature review resulted in three main findings:

First, SSA is clearly not yet following the classical path of ST and AT that took place in the developed economies in Europe, America and Asia, where urbanisation and industrialisation accompanied rural transformation and development. The progress of ST and AT based on the classical theories seem to be moving very slowly in SSA. This situation has been mainly attributed to a persistent low agricultural productivity, coupled with chronic food insecurity and severe poverty. Moreover, in many regions farm sizes are declining rapidly, fuelled by high population growth. At the same time the literature indicates that in the high density areas of SSA increasing population pressure has already encouraged agricultural intensification. However, smallholders are not making significant use of modern inputs (fertiliser or irrigation), which

makes agricultural intensification unsustainable. Food production in SSA has been increasing mainly due to agricultural extensification, which is no longer sustainable due to declining farm sizes and rapid urbanisation. Moreover, declining farm sizes and growing landlessness are by default pushing unskilled farm labour into mainly low-return nonfarm sectors.

Second, rural livelihood diversification into farm and nonfarm activities has grown in importance in SSA and there are high expectations that promoting it can offer solutions to development goals such as poverty reduction, food security and economic growth. The literature shows that livelihood diversification has positive effects on welfare indicators such as income, wealth, consumption, nutrition, agricultural productivity and food security. However, the process of livelihood diversification is biased in favour of relatively wealthier smallholders with sufficient assets, while the poor tend to be mostly hindered by asset-related entry barriers. These entry barriers limit access to high-return rural nonfarm sectors to relatively wealthier households, while the poor are mainly confined to low-return nonfarm activities. The relatively wealthier smallholders tend to engage in successful livelihood diversification by combining farm and nonfarm activities. They are able to benefit from livelihood diversification to expand their incomes and accumulate wealth, mainly by exploiting the opportunities and synergies between farm and nonfarm activities. However, even the low-return nonfarm sectors provide a safety net for the rural poor, and sometimes offer a means for upward mobility. On the other hand, some low-return activities provide other benefits such as flexibility, home-working and cultural acceptability.

Third, given the wide heterogeneity of the rural economy, understanding the medium- to long-term impacts of livelihood diversification on smallholders and their environments, and the role in the broader process of ST and AT in SSA, has been severely hampered by lack of data. Most of the studies on livelihood diversification have so far been based on cross-sectional data rather than longitudinal or panel data. Hence more has been revealed about rural livelihood diversity in different contexts and at different points in time than about livelihood diversification as a dynamic process.

Patterns and determinants of income diversification in rural Senegal and Kenya

The main objective of Article 2 was to examine the spatial and geographical patterns and determinants of rural household income diversification based on cross-sectional rural household data from different types of regions in Senegal and Kenya. As already mentioned, the regions in each country were a priori classified by the RuralStruc program into the categories of winning (WR), intermediary (IR) and losing (LR) based on different criteria related to market access and agro-ecological potential. The income patterns showed that rural households in the WR in both countries obtained significantly higher total incomes compared to those in the IR and LR. Only households in the WR of both countries had incomes above the $2 per day relative poverty line, while incomes in the LR of Senegal fell below the $1.25 per day absolute poverty line. In general, very low nonfarm incomes in the latter contributed a large share of total household income, reflecting the high levels of risk and poverty.

Nonfarm income shares of total household income for rural households in Senegal ranged from 29.9% in the LR to 54.1% in the IR, whereas in Kenya, it ranged from 34% in the IR to 51.7% in the WR. In general, the results corroborate the literature that nonfarm incomes are increasing in importance among African rural households, in terms of their contribution to household incomes (Haggblade et al., 2007). However, about 15% of the rural households in our study, in both countries, did not have any nonfarm incomes, suggesting that they concentrated on farming for reasons such as good access to land and labour, or alternatively, maybe they were confined to farming because they lacked access to nonfarm opportunities. Thus, despite the importance of nonfarm incomes, farming remains the major source of livelihood in certain regions, especially the LR of Senegal and the IR of Kenya.

In general, the richest households in all regions, and the households located in the relatively more dynamic WR, had more diversified income sources and accessed more nonfarm incomes. In both countries, the poorest households were mostly dependent on farm income, with significantly less diversified income sources, and significantly less nonfarm incomes, when compared to other groups of households. Hence the results are consistent with other studies such as Barrett et al. (2001a) (see Article 1) indicating that opportunities for income diversification are more accessible to richer households with more assets, and to households in well-endowed regions in terms of agro-ecological potential and market access.

The empirical investigation into the determinants of income diversification revealed that sometimes push and pull factors act concurrently within the same geographical location. The specific determinants differ spatially by region and country. Moreover, some of the regions did not conform to the classifications that were assigned a priori. Although geographical location matters for income diversification in both countries, the context of the region (in terms of infrastructure, the level of public investments and public goods, the presence of integrated value chains and the situation regarding the use of natural resources) matters even more, and it influences the kind of diversification households can engage in.

In Senegal, households in the IR, compared to households in the LR, had significantly more diversified income sources. However, the levels of income in both regions were low and not significantly different from each other, suggesting the prevalence of a more survival-led diversification in both regions. The qualitative fieldwork showed that households in the IR and LR of Senegal are faced with long recurrent periods of droughts, and lacked irrigation possibilities. Hence, they mainly use income diversification as a survival or coping strategy.

In Kenya, households in the WR, compared to households in the LR, had significantly more diversified and higher incomes, suggesting a more positive opportunity-led diversification in the WR. There is no significant difference between the IR and LR in Kenya in terms of income diversification, despite the ex-ante regional classification. The qualitative fieldwork revealed that rural households in the IR and LR of Kenya in addition to sugarcane farming are mainly engaged in subsistence production of staple crops. Moreover, farm and nonfarm opportunities in the two regions are constrained by climatic factors and poor road infrastructure.

The findings also show that the role of migration differed depending on the region in each country. In general, and unlike the regions in Kenya, migration opportunities were important for income diversification in all the regions of Senegal. Migration abroad and to the capital and main cities, compared to rural-rural migration, was positively and significantly correlated with income diversification across all three types of regions. The qualitative fieldwork revealed that for Senegal, lack of access to irrigation was a major push factor into income diversification in the IR and LR. In these regions mentioned, rural households were pushed to diversify their income sources through migration and remittances to ensure survival during the long drought season. Because of the crisis in the groundnut sector and recurrent droughts in the absence of irrigation opportunities, rural households in IR and LR have developed various

strategies of coping and adaptation. Some strategies revealed by the qualitative fieldwork included local and international migration (or relying on remittances) and labour intensive nonfarm activities including basketry, crafts, hides and skins, sewing and embroidery, making leather products such as shoes and bags. On the other hand, in Kenya, migration to the capital or main cities was only significant in the LR, suggesting that farm households in the least dynamic agricultural region of Kenya were pushed to seek nonfarm opportunities for survival.

We find that in both countries, ownership and access to certain productive or non-productive assets are important for income diversification. Specifically, livestock ownership is a positive and significant determinant of income diversification in certain less dynamic agricultural regions in both countries (IR and LR for Kenya, and in the IR for Senegal). This indicates livestock incomes may be used as a source of capital in such regions. Therefore rural households with livestock incomes are more able to access other income generating opportunities, compared to those who lack livestock incomes. For Kenya, having productive facilities such as water and electricity were negatively associated with income diversification in the IR region. Such basic facilities can be viewed as important productive assets for engaging in farm and nonfarm activities, and a lack of them may act as entry barriers to income diversification.

In the LR of Senegal, having more active members in the household was positively and significantly associated with income diversification. In this region, according to the qualitative fieldwork, diversification is used more as a permanent strategy to deal with seasonality and risks, and household activities are involved in multiple production and consumption strategies for risk management and coping. At the same time, *housing quality index* (type of roof, floor and walls) was significant and negatively correlated with diversification in the WR of Senegal and LR of Kenya. This suggests that the relatively better-off households in these regions are more likely to specialise in farming, rather than diversifying out of farming.

Farm size per adult equivalent had mixed effects on income diversification in the IR and LR in Kenya. In the IR, the larger the farm size per adult equivalent, the more intensive the specialisation in agriculture, indicating that there is no push factor of land scarcity in this region. However, in the LR, the larger the farm size per adult equivalent, the more households engaged in diversified activities. We attributed this to poor agro-ecological conditions that lead to low revenues from agriculture, hence better-off households with more land seek better opportunities by diversifying away from farming. Also,

probably due to low physical capital assets other than land, some households may fail to engage efficiently in farming.

In Senegal, lack of credit was a significant constraint for income diversification in the IR. It was reported during the qualitative fieldwork by some respondents in this region that lack of credit to buy farm inputs and pay hired labour was a major problem. Hence, several households tend to rely on family or exchange labour, while others rely on remittances and other nonfarm incomes in order to hire labour for farm activities. Some households borrow money (mainly from friends and family) in order to engage in income generating activities. Furthermore, *social networks of the household head* was positive and significant in the IR of Senegal, indicating the importance of social capital in this region. Moreover, social capital through groups and networks are known to relax credit constraints of their members, provide a form of social insurance and may also provide a source of capital for purchasing inputs and engaging in various farm and nonfarm activities.

Finally, we tested the importance of food security for income diversification and found that it was significant in certain agricultural regions. The variable *food security situation of the household* was negative and significant in the IR of Senegal. In contrast, was positive and significant in the WR of Kenya. Hence, in the WR of Kenya perceptions of improvement in food security over the last decade seem to have promoted income diversification, while in the IR of Senegal, food security concerns over the last decade appear to be a constraint for income diversification.

Geographical and gender dimensions of household livelihood diversification based on panel data evidence from rural Kenya

This Article 3 shows that generally, the livelihoods of rural farm households in the districts of Kakamega and Nyeri are were highly diverse. The households do not rely only on farm incomes to sustain their livelihoods, but by various motives they diversify their income sources into the nonfarm sector. 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. However, farm incomes dropped over the study period because of a drought shock. By 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. 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 (mainly crop sales) were the most important source of livelihood. However, the share of nonfarm incomes, mainly from microbusiness activities, increased significantly as part of total household cash incomes.

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 head of the household, whether male-headed (MHH) or female-headed (FHH). The overall *farm income share in total household income* (FIS) dropped significantly, driven by changes in Nyeri. Compared to MHH, the FHH in Nyeri became more vulnerable as they were more affected by farm cash incomes declined. Moreover, the total cash incomes of FHH fell below the international poverty line in the 2008 to 2013 period, while that of MHH did not change much. In contrast, the overall *nonfarm income share in total household income* (NFS) increased significantly over the study period, driven by significant changes in Kakamega. However, the dynamism in nonfarm livelihood diversification in Kakamega was mainly driven by 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 or distress-push motives and accumulation or opportunity-pull motives. Many previous studies on diversification have concentrated on risk minimization as the major factors explaining the observed patterns of livelihood diversification in SSA (Dercon, 2002; 2004; Block and Webb, 2001). This study, however, shows that, for the panel of rural farm households surveyed in Kenya between 2008 and 2013, some households in certain regions diversified their livelihoods over time in response to attractive opportunities in the nonfarm sector. At the regional level the econometric work shows 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.

In both regions, farm households who significantly increased their asset wealth over the study period (except MHH in Nyeri) also significantly

increased their level of livelihood diversification in the nonfarm sector. Therefore, in certain regions, livelihood diversification was used as an accumulation strategy by both FHH and MHH, as opposed to just being a risk management strategy. However, this means that it is mainly pro-active households with the necessary asset wealth who increased their levels of livelihood diversification over the study period. This is consistent with previous longitudinal studies in SSA (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). Moreover, the qualitative fieldwork interviews showed that relatively richer households tend to diversify their livelihoods into the nonfarm sector, but at the same time remain engaged in farming. They are able to increase their incomes and wealth over time by exploiting the synergies and strategic complementarities between farm and nonfarm activities.

In addition to asset wealth, other important determinants of changes in livelihood diversification 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 Kakamega) were positively and significantly associated with increased 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 in farmer groups was surprisingly not significant in driving changes in livelihood diversification. At the same time, overall, hiring labour (most especially for MHH in Kakamega) had a positive and significant effect on the change in livelihood diversification. Increased access to agricultural input credit (overall), and having more secure land rights (for MHH in Nyeri) promoted specialisation in farming rather than diversification out of farming. Finally, food security was important for increasing livelihood diversification, especially in the less dynamic region (Kakamega), where it is relatively food secure FHH households who increased their livelihood diversification over the study period. On the other hand, the poverty indicator shows that poorer households in Kakamega that borrowed to meet their subsistence needs over the study period significantly reduced their livelihood diversification. This was for instance the case of FHH in Kakamega, who significantly reduced the number of meals eaten in the lean season and borrowed to cover their subsistence needs over the study period.

Contributions of the thesis

In this study on livelihood diversification in SSA, I have gone beyond looking at the multiple income sources of rural farm households for survival, coping or accumulation, by incorporating aspects of structural transformation, in order to understand the implication of income and livelihood diversification on development. I argue that household income and livelihood diversification also include change and transition in response to various opportunities and constraints faced by rural households, and relates to the current structural and economic transformations taking place in SSA. With this thesis, I want to contribute to the debates on the implications of smallholder livelihood diversification in SSA, particularly on the implications for ST, economic growth and development. Through a combination of literature reviews and empirical work, I aim at a deeper understanding of the patterns of household diversification in SSA and its implications for development strategies of poverty reduction, food security and economic growth. The analysis of the different spatial and temporal patterns and determinants of livelihood diversification in different geographical contexts and among different types of households have shed light on the opportunities and constraints faced by farm households in different types of agricultural regions. The challenge for policy makers and development practitioners in SSA is therefore to develop strategies to mitigate the negative outcomes of diversification on rural households, while harnessing the positive outcomes and opportunities to achieve the different development goals. Recognizing and understanding diversity among smallholder farm households in SSA is important for designing proper policies for poverty reduction, food security and economic growth. By recognizing the diversity livelihood strategies among farm households, policies can better target the relatively poorer households that need support. In addition, understanding the main determinants of household diversification is important for policy makers in order to formulate proper development strategies that target the different constraints to household livelihoods.

This thesis, adds in various ways to the body of knowledge on the important subject of rural household income and livelihood diversification in SSA. The review of previous literature (Article 1) draws attention to the nature and evolution of livelihood diversification in SSA, and its impact on rural smallholders. It shows that the role of livelihood diversification in the broader process of ST and AT in SSA cannot be ignored, given the challenges to the agricultural sector and in the overall development of SSA. Furthermore, it pointed out important research gaps that need to be filled in order to create a

better understanding of the dynamic process of livelihood diversification in SSA and the medium to long-term progress of the process of ST. Moreover, the review enumerates the variety of situations in terms of constraints and opportunities facing different types of rural households in different environments in SSA, as well as the kinds of choices available to them and the impacts on their welfare.

This thesis, also contributes empirical findings on the spatial and temporal patterns of livelihood diversification based on studies from different regional contexts in two SSA countries (Article 2 and 3). The articles provide insights into both the spatial and temporal patterns and the determinants of livelihood diversification change across heterogeneous rural household situations. In essence, they reveal the constraints and opportunities faced by SSA smallholders in the context of the broader process of development. This subject had not yet been thoroughly examined in these specific regions before. The empirical findings thus contribute to the body of literature on rural livelihoods, livelihood diversification and ST from the perspective of diverse geographical and rural situations in SSA.

In this thesis, I make use of different types of data in order to understand the patterns, determinants and geographical and gender dimensions of household diversification – a review of previous studies, two types of quantitative data from different types of regions collected by different projects, and data from qualitative fieldwork. All the different types of data confirm that in rural SSA there is generally a positive relationship between diversification and household income or assets. This implies that it is the relatively wealthier rural households who are able to successfully diversify and achieve progressive success, while poorer households are limited by asset entry barriers. However, the wealthier rural households who diversify successfully into the nonfarm sector do not exit farming. Moreover, in relatively dynamic agricultural regions, farming remained the occupation of choice for most rural households in the study.

Finally, although the literature review highlighted an important research gap in the better understanding of the dynamic process of livelihood diversification in SSA, and the medium to long-term progress of the process of ST; the extent of my contribution in this respect was limited by data availability. The panel data from Kenya that I used to study the dynamics of livelihood diversification was only from two points in time (2008 and 2013), hence through the empirical work I could not contribute much insights into the long-term trends and the extent of progress of livelihood diversification as relates to the processes of ST. However, I showed that at the household level, based on the surveyed areas in Kenya for the two-time periods, some patterns of change in diversification

of farm-nonfarm activities do conform with the classical model of ST – showing declining share of farm income in household incomes and increasing share of nonfarm income in household incomes.

Policy implications of the findings

A number of policy implications emerge from the review article (Article 1), as well as the empirical work (Articles 2 and 3) in this thesis:

Firstly, given persistent low agricultural productivity in SSA and the situation of declining farm sizes coupled with rising population, because of which SSA's ST and AT appears to move very slowly, suggests that SSA might take a different path from the classical historical process. Therefore, SSA policy makers need to invest in more data collection, research and data analysis in order to get a better understanding of the ongoing processes in different regions and what development policy mechanisms to adopt.

Secondly, given that farming seems to remain the main employment option for the majority in SSA, especially for rural households in dynamic agricultural regions, strategies to increase agricultural productivity should obviously be continually strengthened. However, the important role for the nonfarm sector in providing employment for those smallholders that are forced to straddle between farm and nonfarm activities or to completely exit farming should not be ignored. Investment in education, infrastructure and other public goods are important in fueling the development of nonfarm sectors and other service sectors linked to agriculture to provide employment. In addition, the growth and development of rural towns and trading centers, as well as rural industries should be promoted by providing necessary infrastructure (roads, water, electricity, etc.) in order to create new rural employment opportunities.

Thirdly, livelihood diversification and growth in the rural nonfarm economy in SSA currently seems to benefit mainly wealthier rural households, while the poor are constrained by lack of necessary assets. The recommendation would be for governments, policy makers and development partners who already have high expectations in livelihood diversification as a poverty reduction tool to make it more inclusive through policies and programs that lower entry barriers for the poor and increase their access to economic assets.

Lastly, panel and longitudinal research initiatives looking, at change and transformations within farm and nonfarm sectors in rural SSA should, get more

technical and financial support in order to contribute to a better understanding of the micro-level processes over time and the direction of the process of ST and AT in SSA, in the context of globalization and climate change.

From the empirical work, the following policy implications emerge:

In general, the results from Article 2 and 3 highlight 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, food security and economic growth.

The findings in Article 2 and 3 show that households' motives for diversification, as well as the opportunities available to them, differ significantly across geographical regions and between FHH and MHH. Therefore, it is important for policymakers to understand the nature and patterns of household income diversification and its major determinants, in order to distinguish the factors that drive households into nonfarm diversification due to survival/distress or opportunity/accumulation motives. This would inform programs and policies in the rural nonfarm sector and would be useful for targeting vulnerable households or vulnerable regions.

The study results in Article 2 also show that rural households in dynamic agricultural regions prefer to engage in agriculture, while those in less dynamic agricultural regions tend to migrate to other areas or engage in low return activities. This suggests that different policies may be required to promote development in different contexts. Therefore, in dynamic agricultural regions, smallholder agriculture needs to be strengthened, while in less dynamic agricultural regions other alternative employment opportunities in the nonfarm sector should be promoted.

Furthermore, the findings of Article 2 show that the specific patterns and determinants of diversification differ significantly in between regions, with push and pull factors sometimes acting concurrently. This implies that policies need to be tailored to meet the development needs in specific regional contexts in order to have beneficial impacts.

In Article 2, it was also revealed that, although regional location matters for income diversification, the context of the region seems to matter even more, as it influences the type of diversification households are able to engage in. The policy implication is that policy initiatives to provide or improve access to all types of infrastructure would make regions more attractive also for different kinds of investments that would promote development of income and employment, generating rural activities to the benefit of rural households.

The results in Article 3 show that asset wealth is an important driver of changes in livelihood diversification at the regional level, while the qualitative results illustrate the importance 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 on poorer rural households especially their limited access to 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 and lower other entry barriers into rural nonfarm sectors. 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 due to social, economic and cultural factors.

The results from Article 3 show that it is also important for policy makers to pay attention to the motives for increased rural household livelihood diversification. This is 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 knowledge can be used as a way to identify and 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. They must also take into account the differences between regions and between types of households (MHH or FHH) and their specific needs. For instance, in order to reduce absolute poverty, the poorer and more vulnerable FHH may need continued support through relief, social safety nets, development aid, and other support programs.

The results in Article 3 indicate that although farming continues to be 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.

Lastly, the econometric results in Article 3 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 input credit provision and improving land tenure security and rights should be supported in order to increase smallholder agricultural performance. Finally, the result that it is relatively food secure FHH in Kakamega who were able to invest in nonfarm activities, suggests that policy initiatives to improve food security are likely to impact positively on livelihood diversification among FHH.

Recommendations for future research

First, given the limitations already outlined in trying to empirically understand rural household income and livelihood diversification in SSA, I would recommend more panel studies for future research in order to better understand the dynamic process of livelihood diversification and the medium to long-term progress of the process of ST, economic growth and development in SSA.

Second, I find that based on the empirical work in Kenya, there is a positive and significant relationship between nonfarm income diversification and rural household asset wealth, and it is households with the necessary asset wealth who increase their level of diversification over time. This finding is consistent with previous studies on rural Africa cited in Barrett et al (2001a). However, the question remains - does diversification into nonfarm income sources cause greater improvement in household asset wealth over time? This is an important question for policy and for future research in order to know whether nonfarm income diversification indeed improves welfare and offers a pathway out of poverty.

Third, previous studies show that linkages between farm and nonfarm sectors through backward and forward production linkages, can create multiplier effects, which lead to growth and development (Haggblade et al., 1989; 2007). However, there is still much debate on the effects of diversification into nonfarm income sources on agricultural production, and whether nonfarm incomes are indeed invested back into farming. This thesis did not investigate this issue, but it is a very important subject to recommend for future research in SSA, especially given the challenges in the agricultural sector that are discussed in the introduction to the thesis.

Fourth, as shown by the literature review (Article 1), the debate on the overall effect of nonfarm activities on rural income distribution in different

contexts in SSA remains open. In some cases, diversification into nonfarm income sources increases inequality, while in other cases it reduces inequality. This was not the subject of interest in this thesis, but is recommended for future research, being an important issue of considerable policy interest in SSA.

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Appendix A. Selected macro-economic indicators for Senegal and Kenya

Indicator	Senegal	Kenya
Surface area (sq. km)	196,710	580,370
Population 2008, total (millions)	12	39
Population density 2008 (people per sq. km of land area)	64	68
GDP 2008 (current US$ Billion)	13	36
Agriculture, value added 2008 (% of GDP)	16	25
Industry, value added 2008 (% of GDP)	23	21
Services, value added 2008 (% of GDP)	61	54
% Rural population, 2005	58	79
% Economically Active Persons in Agriculture, 2005	72	73
Poverty headcount ratio at national poverty lines, 2005 (% of population)	46	48
Poverty headcount ratio at $1.25 a day (PPP), 2005 (% of population)	43	34
$2 a day poverty, 2005 (PPP) (% of population)	60	67

Source: World Bank, World Development Indicators, 2005-2008

Appendix B. Checklist of interview questions for the qualitative fieldwork

(a) Key Informant interviews

1. Village name, name and position of key informant.

2. What are the **general characteristics** of the region/village?
   - Population, **gender**, ethnicity, household sizes,
   - Land uses & tenure, rainfall patterns, natural resources (forests, water bodies, etc.)
   - Markets & access, infrastructure & public services (roads & transport, water, electricity, health services, mobile communication, etc.)

3. What are the **main activities** (or income sources) of people (farm & nonfarm)? How do people manage their activities? What are the relationships between activities? What farm activities are **women** involved in?

- What types of **farm activities**? (please specify e.g. crop types, livestock types, fishing, forestry, hunting & gathering, etc.);

- What types of farming (rain-fed, irrigated, flood recession, contract farming/outgrowers, etc); types of farm inputs (seed, fertilizer, labour, machines, equipment, etc.);

- How do people generally use farm income (please specify e.g. family needs (food, clothing, school fees, etc), savings, investments in ….., etc.)? **What about the women?**

- What type of **farm inputs** do people use and their sources? (Labor resources (family/mutual/hired), seed, fertilizer, ploughs, machinery & equipment, etc.). How do people access these inputs? What are the constraints & opportunities for access?

- What types of **non-farm activities**? (actual activities e.g. teaching, trade, crafts, rent, remittances, etc.) Where? How? Why? Are the activities seasonal, temporary or permanent? Rural-urban linkages? What non-farm activities are **women** involved in?

- How do people generally use non-farm income (please specify e.g. family needs (food, clothing, school fees, etc.), savings, investments in ….., etc.)? **What about women?**

- Are there **migrants** who come to this village or people who migrate away? From/to where? For how long? What do they do? Do they normally send money to their families? How often and how much? Do they have land in their villages?

- What are the average incomes? Poverty levels? National Poverty line?

- Are they **market based or non-market activities**? How far is the market?

- What are the marketing arrangements? What commodities are commonly sold? How do people transport the products to the market? What are the constraints & opportunities?

- Where do people get **credit** in this village? Are people able to **save**? What are the requirements? Do they require collateral? What kind of collateral?

- What is the status of **education**? How many schools (public & private)? What levels (primary, secondary, tertiary)? How is school fees paid (free/public, co-shared with government or fully private)? What are the forms of payment (cash/grain, etc.)?

- What is the **food security** situation in this village? What are the common diets? How many meals do people eat on average? Do people send/receive food to/from other villages? Have there been any food shortages recently? If so, where did people get food? How did they cope?

4. What are the Institutions, organizations, policies, legislations in the area?

- What public (government) & private institutions and organizations operate in the region?

-What main **public programs** are being targeted at people in this village?

-(e.g. **NGOs, CBOs**, credit institutions, etc.) are operating in the region? (what are their activities? what are the relationships with households? how do their activities affect the households? Do they work with all households? Do they provide any support (inputs, credit, extension & training, marketing, land management/conservation, etc.)

- Are there **farmer groups**? What are the activities? membership terms? Benefits & constraints? Do they get any support from public or private agencies?

-What recent **public policies** directly affect the households & their livelihoods?

-Are there any **public support** systems (credit, extension, inputs, etc.)

5. What are the environment factors?

- Have there been any **shocks, trends, seasonality effects, natural disasters** (especially those that have occurred between 2008 & 2013 in the region or the country)?

- How did people respond to these factors (positive/negative factors) in the environment? What were their effects on people in the region/village? How did people cope?

-What **changes** have occurred as a result of these factors (policy/programs/initiatives)?

(b) Household interviews

1. What are the **general household characteristics? (**estimate the wealth level of the household**)**

- name of family head/family chief, age, gender, marital status, ethinicity, education
- occupation of head, family size, occupation of family members and their location, education of members (how do you pay school fees?), access health services, water?
- Assets (Housing, Land (size & tenure), livestock, equipment & machinery, etc.)
- Consumer durables (TV, radio, phone, bicycle, furniture, piped water, etc.)

2. What are the main income sources (or activities) of the household (head & members**)?**

- Do you have any household members who live away from home (**migrants**)? Where? What did they go to do? For how long? Do they normally send money/other items to you? How often and how much? What do you use it for? Do they have land in this village? Is it farmed? By who? Do you send them food/grain? What kind of food/grain?

-What types of **farm activities**? (please specify actual activities e.g. crop types, livestock types, fishing, forestry, hunting & gathering, etc.). When & how did you start the activity? What type of farming (rain-fed, irrigated, flood recession, contract farming/outgrower, etc.); Where does the money come from for each farm activity? What is the average income from each farm activity? How do you use the income from each farm activity? What are the links between the farm & nonfarm activities? How are the activities managed (strategies)? How do activities contribute to each other? How do you use the farm income (please specify e.g. family needs (food, clothing, school fees, etc.), savings, investments in ….., etc.)? Were you doing the same farm activities in 2008? If not, what activities were you doing then? Why did you change?

- What type of **farm inputs** do you use and their sources? (Labour resources-family/mutual/hired), seed, fertilizer, manures, pesticide, ploughs, machinery & equipment, etc.). How do you access these inputs? What are the constraints & opportunities for access?

- What types of **non-farm activities**? (please specify actual activities e.g. teaching, trade, crafts, rent, remittances, etc.) By which family member? Where? How? Why? When & how did you start the activity? Are the activities seasonal, temporary or permanent? Where does the money come from for each non-farm activity? What is the average income from each activity? How do you use the income from each non-farm activity? What are the links between the farm & nonfarm activities? How are the activities managed (strategies)? How do activities contribute to each other? How do you use the non-farm income (please specify e.g. family needs (food, clothing, school fees, etc.), savings, investments in …, etc.)? Were you doing the same non-farm activities in 2008? If not, what activities were you doing then? Why did you change?

- Are they **market based or non-market activities**? How far is the market? What commodities do you sell? If so, to whom? where? How do you transport them to the market? What constraints & opportunities do you face in the marketing?

- Are you a member of a farmer group? Why or why not? Benefits? Constraints?

- Have you borrowed money before? From where/whom? What are the requirements? Do they need collateral? What kind of collateral? What did you use it for? Are you able to **save** some money? About how much? What do you plan to use it for? Do you have any **investment** (building, land, **etc.)** in this village? Where did you get the money?

- What is the **food security** situation in this village? What are the common diets? How many meals do people eat on average? Have there been any food shortages recently? If so, where did people get food? How did the household cope?

- Have there been any shocks (drought, flood, etc.) or other natural disasters in this village since 2008? What was it & how did the household cope?

Article 1

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Rural Livelihood Diversification in Sub-Saharan Africa: A Literature Review

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ABSTRACT *This article provides a comprehensive review of the literature on the nature and evolution of rural livelihood diversification in sub-Saharan Africa, and the situation regarding smallholders. It reveals mixed findings about the causes and consequences of livelihood diversification on rural smallholders adopting this strategy. A lot of evidence from the literature suggests that it is relatively better-off smallholders with sufficient assets who achieve successful livelihood diversification, mainly by exploiting opportunities and synergies between farm and nonfarm activities. Because of asset constraints, increase in incomes and wealth based on livelihood diversification has not yet benefitted the large majority of smallholders.*

1. Introduction

Livelihood diversification has received much attention from researchers and policy-makers in the past decades, with high hopes that promoting it can offer a pathway for poverty reduction and economic growth in sub-Saharan Africa (SSA) (World Bank, 2007). The term 'diversification' refers to processes taking place at different levels of the economy, which are usually, but not always directly linked (Start, 2001). Firstly, 'diversification of the rural economy' refers to a sectoral shift of rural activities away from farm to non-farm activities, associated with the expansion of the rural non-farm economy (Start, 2001); normally as part of a broader process of structural transformation (Timmer, 2009). Secondly, 'individual or household diversification' refers to income strategies of rural individuals or households in which they increase their number of activities, regardless of the sector or location. Livelihood diversification is an active social process of individual or household diversification, involving the maintenance and continuous adaptation of a highly diverse portfolio of activities over time in order to secure survival and improve standards of living (Ellis, 2000b). The components of rural livelihood diversification are commonly classified by sector (farm or non-farm), by function (wage employment or self-employment) or by location (on-farm or off-farm) as summarised in Table 1.

In SSA, many rural smallholder farmers have increasingly diversified their livelihoods through nonfarm activities and migration (Barrett, Reardon, & Webb, 2001; Losch, Freguin-Gresh, & White, 2012; Reardon, 1997). These diversified livelihoods are facilitated by infrastructural development, emergence of rural towns and improving accessibility to urban areas (Losch, Magrin, & Imbernon, 2013). Whether diversification will provide impetus for improving standards of living in SSA is still a subject of much debate, however. A contrasting perspective views livelihood diversification in rural SSA as a long-term deagrarianisation process of adjustment and reorientation of livelihoods in distress;

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Table 1. Classification of the components of rural livelihood diversification

Classification	Category	Definition
By sector	Farm (agricultural)	Production of unprocessed crops, livestock, forest, or fish products from natural resources. This category also includes farm wage labour, sale of farm output and consumption-in-kind of own farm output.
	Nonfarm (non-agricultural)	Includes all income-generating activities other than the production of primary agricultural commodities. Examples include mining, manufacturing, utilities, construction, commerce, transport, government services, among others. It also includes agro-processing, transport or trading of unprocessed crop, livestock, forest and fish products.
By function	Wage employment	Involves an employer–employee relationship, where the employee sells labour services to the employer in exchange for a wage or salary.
	Self-employment	Involves the sale of labour services to oneself, rather than working for an employer that pays a wage or salary. Income is earned through activities operated directly by the owner.
By location	On-farm	Income activity takes place on the farm, for example, crop and livestock production, hunting, fishing or gathering from natural resources.
	Off-farm	Income activity takes place away from the farm (rural or urban, local or foreign). Typically includes all in the nonfarm category. Also refers to wage or exchange labour on other farms, and labour payments in kind such as harvest sharing and other non-wage labour contracts.

Notes: The classification by sector follows standard national accounting systems. Classification by function depends on how labour is compensated, while that by location depends on where the activity takes place.
Source: Adapted from Barrett et al. (2001); Ellis (1998); Haggblade et al. (2010); Losch et al. (2012).

one in which smallholders are invariably moving away from farming (Bryceson, 1999, 2002). Since most empirical studies on this subject in SSA have been based on cross-sectional data, the medium- to long-term impacts of livelihood diversification on smallholders and its links to the process of structural transformation have not yet been well understood.

This review article broadly examines recent empirical studies on SSA relating to the nature and evolution of rural livelihood diversification, its causes and consequences for rural smallholders, and the overall process of structural transformation. The aim is not to be exhaustive, but to point at some issues for reflection and for further research. The next five sections examine various literature on the subject and conclude with a discussion of main issues arising from the review.

2. Diversification of the Smallholder Rural Economy in Sub-Saharan Africa

Historical lessons from structural transformation in Europe and North America indicate that rising agricultural productivity, together with industrialisation and urbanisation, has been the stimuli for economic development (Timmer, 2009). In Asia, agricultural transformation occurred through the Green Revolution in which productivity was raised by growing high-yielding grain varieties – a process which was driven by the state, mediated by markets and based on smallholders (Djurfeldt, Holmen, Jirstrom, & Larsson, 2005). The structural transformation process at the macro level was characterised by a declining share of agriculture in GDP and employment, rural–urban migration leading to urbanisation, the development of a modern industrial and service economy, and a demographic transition (Winters, Essam, Zezza, Davis, & Carletto, 2010). Although agriculture became less important relative to other sectors, it continued to grow in absolute terms (Timmer, 2009). At the micro level, rural household participation in farm activities declined relative to nonfarm activities (Winters et al., 2010). In the early stages of the process, most rural households were subsistence farmers who

produced most of the farm and nonfarm goods and services they required (Timmer, 2009). Because agriculture was mainly for subsistence, trade and commerce remained marginal. With better functioning markets and improved transport and communications infrastructure in rural areas, farm households diversified to include nonfarm activities as a way to increase their incomes. In the later stages, with rising incomes and higher standards of living, they either specialised in farming on larger consolidated farms or moved into high-return nonfarm sectors (Timmer, 2009).

Evidence suggests that SSA deviates in many ways from this expected path of structural transformation and economic development. Firstly, instead of farms becoming consolidated as it happened in Europe and North America, farm sizes in SSA are generally becoming smaller (Andersson Djurfeldt & Jirström, 2013; Jayne et al., 2003; Jirström, Andersson, & Djurfeldt, 2010). Recent studies on land issues in SSA (Headey & Jayne, 2014; Jayne, Chamberlin, & Headey, 2014; Muyanga & Jayne, 2014) have mainly attributed the declining farm sizes especially in land constrained areas in SSA to high population growth resulting from high fertility rates. According to these studies, while rural populations in Asia and Latin America are expected to decline by 2050, in SSA they are expected to increase further. The already declining farm sizes coupled with the high population growth could have a potentially negative impact on rural welfare and food security in SSA. The increasing population density has already encouraged more intensive use of land in high density areas of SSA, albeit in the absence of modern input use (fertiliser or irrigation), indicating unsustainable intensification. Increase in food production in SSA has so far been mainly based on the expansion of cultivated areas (Jirström et al., 2010; World Bank, 2013), which is now limited by declining farm sizes and the expansion of urban areas (Andersson Djurfeldt, 2015; Losch et al., 2012). Shrinking farm sizes and growing landlessness are by default pushing unskilled farm labour into mainly low-return nonfarm sectors (Haggblade, Hazell, & Reardon, 2007; Headey & Jayne, 2014).

Secondly, urbanisation in SSA is taking place without industrialisation (Andersson Djurfeldt, 2015; Losch et al., 2012), in contrast to green revolution Asia where urbanisation and emerging industries gradually allowed rural people to leave agriculture and enter nonfarm employment (Haggblade et al., 2007), and rewarded investments in education and migration (Jayne et al., 2014). In the absence of manufacturing industries and high-return service sectors to provide skilled nonfarm opportunities, prospects for increased employment and rising incomes in urban areas of SSA remain limited. This leaves smallholder farming as the primary option for gainful employment for SSA's growing young labour force (Losch et al., 2012). However, rapid growth in nonfarm sectors fuelled by improvements in education and infrastructure can potentially alter this situation (Haggblade, Hazell, & Reardon, 2010).

Thirdly, persistent low agricultural productivity coupled with chronic food insecurity and severe poverty characterises the smallholder rural economy in SSA (Reardon & Timmer, 2007). As opposed to green-revolution Asia where modern inputs such as fertiliser and irrigation were important in raising agricultural productivity (Djurfeldt et al., 2005), in SSA low agricultural productivity is mainly linked to low fertiliser use, low responsiveness to fertiliser use due to overexploitation of land leading to nutrient mining and loss of organic matter, low use of irrigation, insecure land tenure, environmental degradation and underinvestment in crop research (Dethier & Effenberger, 2012; Headey & Jayne, 2014; Tittonell & Giller, 2013). Therefore, poverty gaps are increasing, with yield gaps resulting from such factors, particularly in regions with low agricultural potential (Dzanku, Jirström, & Marstorp, 2015). As a consequence of poverty and food insecurity, a large proportion of smallholders remain deeply engaged in subsistence staple crop production, but at the same time seasonally rely on the market for their staple food needs (Jirström et al., 2010; Losch et al., 2012). However, panel studies following agricultural transformation in nine SSA countries between 2002 and 2010 (Djurfeldt, Aryeetey, & Isinika, 2011; Djurfeldt et al., 2005; Djurfeldt, Larsson, Holmquist, Jirström, & Andersson, 2008), attribute increased agricultural productivity among smallholders in some regions to participation in agricultural markets and the nonfarm sector, and to the use of modern inputs and technology. Amidst the new opportunities and threats for smallholders linked to market liberalisation and globalisation (Reardon & Timmer, 2007), there is hope that with more public expenditure on

infrastructure, modern technologies, promoting agricultural marketing and agribusiness, and pro-poor nonfarm growth, smallholder agriculture in SSA might be transformed (Haggblade et al., 2007).

3. Smallholder Livelihood Diversification in Sub-Saharan Africa

Recent studies indicate that asset, activity and income diversification characterise the livelihood strategies of rural smallholders in SSA (Barrett et al., 2001; Ellis, 2000b). Incomes from nonfarm sources have grown in importance; accounting for about 35 per cent of rural household incomes in SSA and 50 per cent in Asia and Latin America (Haggblade et al., 2010). Diversification at household level is viewed as an outcome of dynamic livelihood adaptation to various constraints and opportunities faced by smallholders (Ellis, 2000b). Diversification is therefore associated with both livelihood survival and distress under deteriorating conditions, as well as with livelihood security under improving economic conditions (Niehof, 2004). It is aimed at securing better living standards by reducing risk, vulnerability and poverty, increasing income, enhancing security and increasing wealth (Yaro, 2006). In order to use livelihood diversification to secure better living standards, rural households have to be able to generate cash, build assets and diversify across farm and nonfarm activities (Ellis & Freeman, 2004). It is a cumulative process that requires investment in improved farm practices or in nonfarm assets, or a combination of both, according to the options available for risk reduction and income generation. Where there are no feasible opportunities to diversify income activities, migration and remittances between rural and urban areas may be important in sustaining rural livelihoods (World Bank, 2007). There is substantial evidence showing that some rural households are sustained by multi-spatial livelihood activities (Andersson Djurfeldt, 2014; Ellis, 2000a; Losch et al., 2012) or food transfers (Andersson, 2011; Andersson Djurfeldt, 2012; Andersson Djurfeldt & Wambugu, 2011). Agricultural entrepreneurship, a vitalised rural labour market and migration are thus often complementary (World Bank, 2007). While farm income may provide capital for rural nonfarm employment and migration, nonfarm income plays a key role in strengthening the potential of smallholder farming as a pathway out of poverty.

Given the prevalence of risk in the rural SSA smallholder context, diversification may often be a strategy for survival or coping with risk, especially where agriculture fails to offer sufficient means of livelihood (Bryceson, 2002; Larsson, 2005; Reardon, 1997). In situations of high-risk agriculture and poverty, poorer smallholders without the necessary assets may be pushed to seek alternative incomes by engaging in low-return and sometimes risky nonfarm activities (Barrett, Bezuneh, Clay, & Reardon, 2001). However, it is mainly among richer households or in regions with favourable agricultural conditions that livelihood diversification driven by motives to raise incomes or accumulate wealth prevails (Haggblade et al., 2007). Although diversification is a common livelihood strategy, not all households enjoy equal access to high-return opportunities (Barrett et al., 2001; Lay, Mahmoud, & M'Mukaria, 2008), and for many rural households there are limited possibilities for remunerative nonfarm work (Jayne, Mather, & Mghenyi, 2010; Jirström et al., 2010; Otsuka & Yamano, 2006). The constraints and opportunities are unevenly distributed socially and geographically, and households with better asset endowments are more likely to access better opportunities for diversification (Barrett, Bezuneh, & Aboud, 2001; Barrett et al., 2001). The usual pattern is for the range of activities that can lead to increase in incomes and wealth to rise with income level (Ellis, 1999; Oya, 2007), and for such activities to be more common in areas with favourable agro-ecology and good market access (Losch et al., 2012; Reardon, 1997). Even in rural areas with favourable endowments or opportunities, some households are better off in terms of welfare, while others remain trapped in structural poverty (Losch et al., 2012).

4. Empirical Approaches to Studying Livelihood Diversification

Two main approaches are commonly used in the economic literature to study livelihood diversification behaviour: 'the household economic model' (Singh, Squire, & Strauss, 1986; Taylor & Adelman,

2003) and 'the livelihood approach' (Ashley & Carney, 1999; Chambers & Conway, 1992; Scoones, 2009). The household economic model considers farm households as production units that maximise utility by combining time and other inputs to produce output, subject to price and resource constraints (Becker, 1965). Diversification is seen as a function of returns to labour from farm activities compared to off-farm activities (Singh et al., 1986). Given an asset base, the farm household makes choices by comparing the returns from farm labour time and time spent on off-farm activities (Yaro, 2006). The assumption is that increases in off-farm incomes provide incentives for farm households to diversify their activities. In the SSA context, the household model has been used to investigate household production and off-farm labour allocation decisions (Barrett et al., 2001; Reardon, 1997; Reardon, Delgado, & Matlon, 1992), farm/nonfarm interactions (Davis, Winters, Reardon, & Stamoulis, 2009; Haggblade, Hazell, & Brown, 1989), participation, patterns and drivers of diversification at household level (Abdulai & CroleRees, 2001; Barrett et al., 2001, 2001; Bezu & Barrett, 2012; Bezu, Barrett, & Holden, 2012; Canagarajah, Newman, & Bhattamishra, 2001; Lay et al., 2008; Lay, Narloch, & Mahmoud, 2009; Winters et al., 2009, 2010).

The household models have been criticised for not taking the inter-temporal dimensions of livelihoods into account and for failing to capture survival strategies of livelihoods under stress (Ellis, 2000a, 2000b). They are also criticised for not considering the social relationships between household members, which in many cases have strong influence on household choices (Ellis, 1998). Furthermore they simplify reality by assuming that incomes and preferences are shared between household members (Taylor & Adelman, 2003). In reality, division of responsibilities and tasks between men and women in the household affects their production decisions and income distribution (Ellis, 1993). The models further assume that markets are perfectly functioning; whereas in developing countries, households are frequently exposed to incomplete or imperfect markets that limit their choices and thus affect their behaviour (De Janvry & Sadoulet, 2006; Ellis, 1993).

The livelihood approach, on the other hand, takes a more people-centred view on the study of rural livelihoods in different contexts, even under stress. The approach has been widely used in empirical studies of livelihood strategies and adaptation (Ellis, 2000a; Orr & Mwale, 2001; Yaro, 2006), livelihoods, risk and poverty (Ansoms & McKay, 2010; Bebbington, 1999; Bird & Shepherd, 2003; Ellis & Bahiigwa, 2003), and livelihood diversification (Ellis, 2000a, 2000b; Smith, Gordon, Meadows, & Zwick, 2001). The livelihood approach has also been adopted by many development and non-government organisations (NGOs) as a tool for monitoring livelihoods and their transformation (Ashley & Carney, 1999). The approach commonly employs the 'sustainable livelihoods framework' (SLF) to assess people's livelihood assets and how the external environment of social relations, institutions, organisations, policies, seasonality, trends and shocks modify access to and ability to convert livelihood assets into livelihood outcomes (Ansoms & McKay, 2010; Vedeld, Jumane, Wapalila, & Songorwa, 2012). The approach has its strength in recognising the multiple and diverse character of livelihoods (Ellis, 1998, 2000a; Ellis & Biggs, 2001) and has proved useful in examining the diversity of farming systems (Sourisseau et al., 2012). Furthermore it accounts for the influence of institutions on livelihoods (Ellis & Freeman, 2004) and the social and economic character of livelihood strategies (Ellis, 2000b). The SLF has also been used to understand the costs and benefits of different livelihood decisions and strategies (Ashley & Carney, 1999). At the same time, it has been criticised because many of its components are difficult to measure and often require the use of proxy indicators, which are sometimes difficult to find. The approach also fails to account for prices and wages, which is necessary when comparing the costs and benefits of different livelihood outcomes (Barrett & Reardon, 2000).

Most of the studies on livelihood diversification in SSA using the above analytical approaches have been based on cross-sectional data from individual countries or from sample regions within countries. In some cases, studies compare two or more country or regional situations (Barrett et al., 2001; Canagarajah et al., 2001; Dercon & Krishnan, 1996; Losch et al., 2012; Winters et al., 2009, 2010), and few studies have used panel data from one or more countries to add a time dimension to their analyses (Abdulai & CroleRees, 2001; Bezu & Barrett, 2012; Bezu et al., 2012; Block & Webb, 2001; Dercon, 2004; Djurfeldt et al., 2011; Kijima, Matsumoto, & Yamano, 2006; Lay et al., 2009; Porter,

2012). Despite the need for empirical evidence from panel data to capture changes over time, there is a lack of financial and skilled human resources in SSA to collect and analyse data of sufficient quality and scope to inform policy. Where panel surveys depend on irregular financing by donors, it becomes difficult to plan ahead, with negative repercussions for the collection of panel data (Carletto, Jolliffe, & Banerjee, 2013). Hence, the wide heterogeneity of the rural economy and funding constraints have limited most empirical studies to one-time shots, with limited scope for making comparisons and generalisations.

5. Patterns and Determinants of Diversification in Sub-Saharan Africa

Individuals and households may diversify their assets, incomes and activities in response to incentives that may be classified as push and pull factors (Ellis, 2000b; Reardon, Berdegué, Barrett, & Stamoulis, 2006). However, the processes and outcomes of push and pull factors are different in dynamic and in marginalised or stagnant regions (Haggblade et al., 2007).

5.1 Push Factors

Push factors are negative factors that may force farm households to seek additional livelihood activities within or outside the farm. Push factors tend to dominate in high-risk and low-potential agricultural environments, subject to drought, flooding and environmental degradation (Haggblade et al., 2007). When agricultural activities are seasonal and environments are full of uncertainty, like in many parts of SSA, rural households tend to reduce risk by diversifying into activities with lower covariate risk in order to make consumption and incomes less volatile (Barrett et al., 2001; Dercon, 2002; Ellis, 2000b; Matlon, 1991). The most common push factors are related to different forms of risk, such as seasonality and climatic uncertainty (Ellis, 1998, 2000b). Others include land constraints driven by population pressure and fragmented land holdings, missing or incomplete factor markets, and market access problems due to poor infrastructure and high transaction costs (Barrett et al., 2001).

Diversification may be used as a strategy for coping or risk management (Dercon, 2002; Ellis, 1998; Matlon, 1991; Start & Johnson, 2004). Risk management is an ex-ante deliberate strategy where a household anticipates failures in their income streams and thereby maintain a range of income activities to safeguard against it, while coping is a response to disaster or unanticipated failure in major sources of survival. In SSA, the general lack of social insurance or safety nets from government transfers, NGOs, community or family members may push households into diversification for risk management (Barrett et al., 2001).

Regarding seasonality, many nonfarm income activities tend to peak during the dry seasons when there is a decline in farm activities (Reardon, 1997). During the dry season, especially in semi-arid regions, some rural households depend on incomes from selling farm products and from nonfarm activities, including migration remittances (Ellis, 1998; Losch et al., 2012; Reardon, 1997). This is the case in the Sahelian agricultural systems, where farmers turn to nonfarm sources to supplement farm incomes when harvests fail (Bryceson, 2002; Grawert, 1998). Diversification is also driven by differences in relative returns in different agro-climatic zones (Reardon, 1997).

Social factors such as social positions, networks, associations, religion and culture are important drivers of diversification (Ellis, 1998). Labour market opportunities may be restricted by gender, class or social inequalities (Oya, 2007; Start & Johnson, 2004). In terms of gender, rural women are often constrained in accessing land and other productive assets (Gladwin, Thomson, Peterson, & Anderson, 2001). Therefore, they often adopt multiple livelihood strategies (Andersson Djurfeldt, Djurfeldt, & Lodin, 2013). However, nonfarm income may contribute more to inequality among female-headed households, where self-employment is important and nonfarm opportunities more constrained (Canagarajah et al., 2001). Institutional factors also play a significant role in creating opportunities or constraints to the improvement of

rural livelihoods. In some regions, institutional factors such as regressive tax systems at local level tend to discourage rather than foster livelihood diversification (Ellis & Freeman, 2004).

5.2 Pull Factors

Pull factors are positive and these may attract farm households to pursue additional livelihood activities to improve their living standards. These factors provide incentives for people to expand their range of income activities outside farming by increasing the returns from nonfarm activities. Such factors tend to dominate in less risky, more dynamic agricultural environments (Haggblade et al., 2007). Diversification becomes a deliberate strategy for an individual or household in order to generate assets for accumulation and reinvestment (Ellis, 1998, 2000b). Pull factors include the commercialisation of agriculture and the emergence of improved nonfarm labour market opportunities linked to better market access, improved infrastructure, and proximity to urban areas (Losch et al., 2012; Reardon et al., 2006; Winters et al., 2009). Other pull drivers of diversification are supply factors, such as improved technology, expansion of education, increased demand for non-food goods and services driven by higher per capita incomes (Reardon, 1997).

5.3 Survival-led or Opportunity-led Diversification

Diversification resulting from push or pull factors have been categorised as either 'survival-led' or 'opportunity-led' respectively (Ellis, 2000b; Lay et al., 2008; Reardon et al., 2006). Survival-led diversification, mainly driven by push factors, occurs when poorer rural households engage in low-return nonfarm activities by necessity to ensure survival, to reduce vulnerability or to avoid falling deeper into poverty. They are pushed towards diversifying their income sources to manage risks or cope with shocks, such as declines or stagnation in agriculture, differentiated labour markets, credit market imperfections, demographic pressures and land constraints (Barrett et al., 2001; Lay et al., 2008; Reardon et al., 2006). They are pushed into low-return nonfarm activities because they have low endowments of assets such as land, capital, livestock and credit, making them more vulnerable to seasonal and other risk factors (Barrett et al., 2001; Ellis, 1998; Lay et al., 2008; Reardon & Taylor, 1996). Many poor households also tend to lack formal education and skills, which act as entry barriers preventing them from engaging into high-return activities like nonfarm waged and skilled employment (Abdulai & CroleRees, 2001; Barrett et al., 2001; Ellis, 1998; Reardon, 1997). The poor are confined to low-income, labour-intensive nonfarm activities that leave them trapped in structural poverty, while richer households tend to specialise in high-return farm or nonfarm activities (Haggblade, Hazell, & Reardon, 2005; Losch et al., 2012). The poor tend to be food insecure all year round, and depend on selling their labour or on safety net supports (Ellis & Freeman, 2004). Sometimes they are unable to sustain their subsistence needs and may be forced to engage in activities with returns below those in the agricultural sector (Lay et al., 2008).

Opportunity-led diversification is mainly driven by pull factors. It occurs when wealthier rural households engage in high-return nonfarm activities, with accumulation objectives, in order to increase household income by maximising returns from their assets. They are able to diversify their income activities in more favourable labour markets or take advantage of off-farm opportunities created by technological advances, new market possibilities, proximity to urban centres or improved infrastructure (Lay et al., 2008; Losch et al., 2012). High returns to nonfarm activities may emerge from increased demand for nonfarm goods and services or off-farm opportunities created by growth motors in different rural sectors such as agriculture, mining or tourism (Reardon et al., 2006). Better-off households are those with high endowments of assets such as land, livestock and buildings (Ellis & Freeman, 2004), and are more likely to engage in diverse high-return nonfarm activities, some of which have similar or higher returns than farming (Barrett et al., 2001; Lay et al., 2008). In this way some better-off households are

capable of accumulating capital by combining commercial farming and nonfarm activities while still relying more on commercial agriculture (Andersson Djurfeldt, 2013; Barrett et al., 2001; Ellis & Freeman, 2004; Oya, 2007).

6. The Welfare Impacts of Diversification in Sub-Saharan Africa

The literature on diversification in rural Africa generally shows a positive relationship between nonfarm income and household welfare indicators such as income, wealth (estimated through size of land holdings or livestock), consumption and nutrition (Barrett et al., 2001; Ellis, 1998, 2005; FAO, 1998; Reardon, 1997). Panel and longitudinal data evidence from Ethiopia suggest that bigger nonfarm income results in a more rapid growth in income and consumption, especially among wealthier farm households (Bezu et al., 2012; Block & Webb, 2001). A reason for this is that substantial entry barriers (Abdulai & CroleRees, 2001; Barrett et al., 2001; Davis et al., 2009) limit access to high-return rural nonfarm income to relatively better-off households, while the poor are mainly confined to low-return activities (Barrett et al., 2001; Bezu et al., 2012). High-return nonfarm opportunities are often found in formal sector employment and activities which are skilled, capitalised or protected from competition, while the low-return opportunities generally have little requirement for skill or capital, for example, unskilled factory or porter jobs, traditional cottage activities, and micro-enterprise like petty-trade, handicrafts, sand mining, brick making, burning charcoal or collecting firewood (Start & Johnson, 2004).

A number of studies also find that nonfarm income diversification has a positive impact on farm productivity and food security. For instance, in Burkina Faso, some households that lacked credit used nonfarm incomes to invest in farm assets such as animal traction (Savadogo, Reardon, & Pietola, 1998). In Senegal, nonfarm incomes enabled some households to access farm inputs like groundnut seeds, fertilisers and livestock (Kelley, Diagana, Reardon, Gaye, & Crawford, 1996). In Tanzania and Ethiopia, Dercon and Krishnan (1996) found that households engaged in off-farm activities with high entry barriers such as trade or business, had higher levels of assets, income and consumption. Ellis and Mdoe (2003) found that in Tanzania richer households tended to diversify into high-return nonfarm activities and had higher agricultural productivity compared to the poor households. Whilst in Ethiopia, farm households with more diversified income sources had higher agricultural productivity and that off-farm income was complementary to farm income when farm households lacked credit (Woldehanna, 2000). Evidence from Kenya shows that involvement in high-return nonfarm activities such as salaried employment has positive effects on agricultural productivity (Lay et al., 2008; Marenya, Oluoch-Kosura, Place, & Barrett, 2003). In Western Kenya, Andersson Djurfeldt (2012) finds that wealthier farm households with access to nonfarm incomes were able to profit from seasonality of agricultural markets through trade-based or barter exchanges for agricultural produce. In contrast, poorer farm households that lacked nonfarm incomes were more vulnerable and their food security was worsened by seasonal changes in food prices and in the agricultural production cycle.

The overall effect of nonfarm activities on rural income distribution in SSA generally remains mixed (Barrett et al., 2001; FAO, 1998, Haggblade et al., 2005; Reardon, 1997; Reardon & Taylor, 1996; Reardon, Taylor, Stamoulis, Lanjouw, & Balisacan, 2000). In some cases, nonfarm activities reduce overall income inequality (Adams, 2002; Van Den Berg & Kumbi, 2006), while in others they tend to increase inequality (Block & Webb, 2001; Canagarajah et al., 2001; Reardon & Taylor, 1996). When relatively poor households are able to engage in nonfarm activities, it reduces total income inequality, if incomes are large enough and accessible to the poor (Reardon & Taylor, 1996; Van Den Berg & Kumbi, 2006). Where high-return nonfarm activities are unequally distributed in favour of relatively richer households, it tends to reinforce total income inequality, even when incomes are generally increasing across income strata (Canagarajah et al., 2001; FAO, 1998; Reardon & Taylor, 1996). There are differences in the nature and returns to labour in different nonfarm activities undertaken by rural SSA households according to their income strata, due to the presence of asset entry barriers (Lay et al., 2009; Reardon & Taylor, 1996; Woldenhanna & Oskam, 2001). However, it seems

that households with less diversified income sources struggle hard to diversify more over time (Barrett et al., 2001). In Ethiopia, panel evidence (Bezu & Barrett, 2012; Bezu et al., 2012) shows that poor households who were able to accumulate capital through low-return nonfarm activities could subsequently access high-return nonfarm activities. In other words, participation in the rural nonfarm economy provided a pathway for upward mobility. This suggests that even if opportunity-led diversification in SSA is biased in favour of the wealthier households, survival-led diversification has more potential than just being an important safety net for poorer households.

The effect of nonfarm activities on income inequality is commonly analysed by considering the relationship between diversification (share of nonfarm income in total household income or absolute level of nonfarm income), and total household income (or the size of landholdings). There is generally conflicting empirical evidence on the patterns and on whether nonfarm income contributes more to the income of the relatively poor or richer rural households; with an apparent contradiction in which several patterns of the relationships emerge in different regions (FAO, 1998; Losch et al., 2012; Reardon, 1997; Reardon & Taylor, 1996; Reardon et al., 2000). Roughly five main patterns of the relationship between diversification and total household income emerge from this literature: strongly negative and linear; strongly positive and linear; the U-shaped pattern; the inverted U-shaped pattern; or otherwise with no clear relationship. The patterns depend on whether diversification is measured using the share of nonfarm income in total household income or absolute level of nonfarm income. There is evidence in many cases, that the ratio of the absolute levels of nonfarm incomes between the highest and lowest income strata is much higher than the ratio of the shares (FAO, 1998). In many cases there is also a high correlation between total household income and the size of landholdings (Reardon et al., 2000).

In *the strongly negative and linear pattern*, the share of nonfarm income declines sharply as total household income increases, following the conventional wisdom. This means that the relatively poor households are highly diversified compared to the relatively rich households. For *the strongly positive and linear pattern*, the share of nonfarm income increases sharply as total household income increases, contradicting the conventional wisdom. The relatively rich households are highly diversified as opposed to the relatively poor households. In general, a positive pattern of the relationship between diversification and total household income or size of landholdings is reported in much of Africa, while the negative pattern is reported mostly in Latin America, and mixed patterns found in Asia (FAO, 1998; Reardon, 1997; Reardon et al., 2000). This pattern in SSA is attributed to high entry barriers to nonfarm opportunities for the poor, because farming is mainly subsistence, land distribution is relatively equal, and infrastructure, rural town economies and capital markets are relatively undeveloped; hence, the scarcity of labour intensive activities with low entry barriers and prevalence of high entry barriers in capital intensive activities (FAO, 1998; Reardon & Taylor, 1996; Reardon et al., 2000).

While *the U-shaped pattern* means that both the relatively poor and the relatively rich households have a higher share of nonfarm income (highly diversified), while the middle-income households are less diversified. Although the poorest households have higher shares of nonfarm income compared to the middle-income households, their absolute level of nonfarm income is considerably lower. Asset-poor households may spend a large share of their time on nonfarm activities but receive low returns, while richer households with more assets may spend the same or less time on nonfarm activities and get higher returns (FAO, 1998). The U-shaped pattern has been found most frequently in Asia and Latin America (less in Africa) because there is greater availability of labour intensive activities with low entry barriers for the poor, and richer households with more assets are able to diversify into capital intensive activities (FAO, 1998; Reardon & Taylor, 1996; Reardon et al., 2000).

In *the inverted U-shaped pattern*, the middle-income households have a higher share of nonfarm income compared to the relatively poor and the relatively rich households with a lower share of nonfarm income (FAO, 1998; Losch et al., 2012; Reardon et al., 2000). A comparison of diversification and rural change at household level was done across seven countries in Africa and Latin America at different stages of structural change (Losch et al., 2012): The findings show a strong positive

relationship between income and the process of structural change towards a more diversified rural economy in these countries, which include four from SSA (Kenya, Senegal, Mali and Madagascar). At very low income levels rural households focused on survival strategies, while as incomes grew they began to diversify their activities in order to cope with risk and find additional incomes. At higher income levels households started to specialise into farm or off-farm activities. In the SSA countries, most households seemed to be trapped in structural poverty and were neither able to earn sufficient income through diversification to become secure in their livelihoods nor able to reach the point of specialisation. This inverted U-shaped pattern was mainly attributed to poverty and prevalence of high entry barriers in the nonfarm sector.

7. Conclusion

This article discusses some recent studies on structural and agricultural transformation, and rural livelihood diversification in SSA, with a special focus on the situation of smallholders. The literature review reveals some important issues for reflection and further research: Firstly, because of persistent low agricultural productivity and declining farm sizes coupled with rising population, SSA's structural and agricultural transformation appears to move very slowly. In addition, the transformation path clearly differs from the one taken by developed economies in Europe, America or Asia, where urbanisation and industrialisation accompanied the rural transformations. Although this leaves farming as the main employment option for the majority, there is an important role for the nonfarm sector in providing employment for those smallholders that are forced to straddle between farm and nonfarm activities or to completely exit farming.

Secondly, it is clear that rural farm and nonfarm livelihood diversification is of increasing importance for economic growth, poverty reduction, food security and creation of employment. Evidence from studies in rural SSA indicates their positive welfare impacts on income, wealth, consumption, nutrition, agricultural productivity and food security. However, increases of income and accumulation of wealth as a result of livelihood diversification is not yet happening on a large enough scale to affect a majority of smallholders in rural SSA. The process is biased in favour of relatively better-off farmers with sufficient assets, while the poor tend to be hindered by entry barriers. The relatively better-off smallholders who exploit opportunities and synergies between farm and nonfarm activities are able to use livelihood diversification to expand their incomes and accumulate wealth. Thus, growth in the rural nonfarm economy in SSA is currently neither inclusive nor redistributive. Although the benefits of livelihood diversification mainly favour the better-off, it still provides a safety net for the rural poor and sometimes offers a means for upward mobility. There is therefore good reason for governments and development partners to promote livelihood diversification among smallholders in SSA, and to make it more inclusive through policies and programmes that lower entry barriers for the poor.

Thirdly, because of wide heterogeneity in the rural economy and of data limitations, the medium- to long-term impact of livelihood diversification on smallholders and their environments, and its role in the broader process of structural and agricultural transformation in SSA, remain to be fully understood. Most studies have so far been based on cross-sectional data rather than panel or longitudinal data. This suggests that more is revealed about rural diversity in different contexts and at different points in time than about livelihood diversification as a dynamic process. Thus, there is urgent need for more longitudinal research projects focusing on livelihood diversification and transformation in SSA, and for existing panel studies to get the financial support needed to continue. Panel studies in SSA can be encouraged by providing consistent funding to such survey efforts and technical support to build their analytical capacity.

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Article 2

Patterns and Determinants of Household Income Diversification in Rural Senegal and Kenya*

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Abstract: Income diversification is considered one of the important household strategies for securing rural livelihoods. We investigate its patterns and determinants using data on 1,747 farm households collected in 2007-2008 from six regions in rural Senegal and

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Kenya. The empirical investigation shows that the regional variation in income diversification does not follow any clear patterns, with push and pull determinants acting concurrently within and between regions. Therefore, policies on income diversification need to be tailored to meet the development needs of specific regions. More generally, income diversification is significantly associated with household asset endowments, demographic factors, accessibility to rural towns, migration opportunities, and perceptions on food security.

Keywords: Rural livelihoods, Income diversification, Push and pull determinants, Senegal, Kenya

Rural households in Sub-Saharan Africa (SSA) generally construct their livelihoods from multiple income sources, contrasting the traditional image that they are mainly peasants who obtain their income only from farming. Income diversification is a strategy whereby households allocate their productive assets among different income generating activities (Abdulai & CroleRees 2001). Households may diversify their farm activities by growing different crops, rearing different kinds of livestock, working on other farms or engaging in natural resource related activities (Losch, Freguin-Gresh, & White 2012). They may also diversify into nonfarm activities by engaging in waged labor, self-employment or labor migration (Haggblade, Hazell, & Reardon 2007). Some households may even straddle between farm and nonfarm activities over time depending on the opportunities and constraints they face (Djurfeldt & Djurfeldt 2013). Income diversification may be a deliberate household strategy to secure survival, minimize risk, finance farm inputs, reduce income variability, or simply an involuntary response to cope with crises or shocks (Ellis, 2000b; Reardon, Berdegué, Barrett & Stamoulis 2006). Diversification is becoming an increasingly important livelihood strategy among rural households in SSA (Barrett, Reardon, & Webb 2001; Haggblade et al.

2007; World Bank 2007). Empirical studies from SSA show that diversification has positive impacts on household incomes, wealth, consumption and nutrition (Barrett, Reardon, et al. 2001). Therefore, household diversification is of interest to policy makers because of its potential to contribute to poverty reduction and economic growth.

There is a wide empirical literature on rural livelihood diversification in SSA as reviewed in Alobo Loison (2015). However, most of the literature is based on cross-sectional data, and only a few studies use longitudinal or panel data to study the dynamics. Moreover, the cross-sectional patterns and determinants are mixed, depending on the specific geographical region, country, or rural context. In the absence of longitudinal or panel data, some studies have simultaneously analyzed different rural contexts based on cross-sectional data, and this provided a powerful tool to identify key determinants, patterns, similarities and differences between situations, in terms of household diversification (Barrett, Bezuneh, & Aboud 2001; Dercon & Krishnan 1996; Losch et al. 2012).

This paper analyses household income diversification in six regions of rural Senegal and Kenya. Specifically, what are the geographical patterns and determinants of income diversification among rural farm households? How do the patterns and determinants differ between dynamic and less dynamic agricultural regions? Senegal and Kenya are selected for the study as examples of growth in SSA economies, with the selected regions reflecting the diversity of rural situations, and at the same time capturing different patterns and levels of regional development (Losch et al. 2012). Access to such household level data from rural SSA is very rare. Hence, it is interesting use this type of data to study the regional variations in access to high income diversification opportunities in different parts of SSA. We are aware of the big differences between Senegal and Kenya; however, the regional dynamics captured by the data offer interesting perspectives to enhance our understanding of the different contexts in which diversification takes place. Nevertheless, there is need for better methodological approaches

to improve the understanding of what factors can be of a more general character in determining income diversification, and how they interplay with local/regional contexts. Our econometric results derived by using the household model approach indicate that the regional variation in income diversification does not seem to follow any clear patterns, with push and pull determinants acting concurrently within and between regions. The results illustrate the limitations of using household models in investigating the determinants of economic behavior such as income diversification in rural Africa, since the determinants of decisions made within the household context vary according to an individual's place in the family structure. Therefore, the household model which focusses on the household head, inevitably leaves out other possible determinants and motivations for diversification such as the structural, social or cultural constraints on other adult members in the household who are not household heads.

The rest of the paper is organized as follows: the next section explains the conceptual and analytical framework. This is followed by a detailed methodological section. Thereafter, the results are presented and discussed, and conclusions given in the final section.

Conceptual and analytical framework

Income diversification generally refers to income strategies of rural households involving an increase in their number of economic activities, regardless of the sector or location (Start 2001). The income strategies may involve diversification of farm activities only, combining both farm and nonfarm activities, or completely diversifying out of farming. Rural households generally diversify their activities based on their capacity, as determined by access to different types of assets (Reardon et al. 2006). The incentives for diversification are categorized into "push" and "pull" determinants (Barrett, Reardon et al. 2001; Haggblade et al. 2007). The push-pull theory of diversification is based on principles of neoclassical economics of utility maximization, rational choice, factor-price

differentials between regions and countries, and labor mobility (Singh, Squire, & Strauss 1986; Taylor & Adelman 2003). Given an asset base, the farm household makes choices by comparing between the returns from farm labor time and time spent on nonfarm income generating activities (Singh et al. 1986). The assumption is that increases in nonfarm incomes provide incentives for farm households to diversify their income sources (Reardon et al. 2006).

Push determinants are negative factors that may force farm households to seek additional livelihood activities within and/or outside farming. They include factors such as risk, seasonality, land constraints driven by population pressure and fragmented land holdings, missing or incomplete factor markets (land, capital, labor), and market access problems due to poor infrastructure and high transaction costs, asset strategies and coping behavior (Barrett, Reardon et al. 2001; Ellis 2000b). Such factors tend to dominate in high-risk and low-potential agricultural environments, subject to drought, flooding and environmental degradation (Haggblade, Hazell & Reardon 2010). They are associated with survival-led type of diversification, whereby poorer rural farm households are pushed to engage in low-return nonfarm activities to ensure survival, to reduce vulnerability or to avoid falling deeper into poverty (Haggblade et al. 2007).

On the other hand, pull determinants are positive factors which provide incentives for people to expand their livelihood activities within and/or outside farming. Examples include commercialization of agriculture, improved infrastructure, proximity to an urban area, improvements in market access, growth of rural towns, development of labor markets, improvements in education and technology (Barrett, Reardon et al. 2001; Haggblade et al. 2007; Losch et al. 2012). Such pull factors tend to dominate in less risky, more dynamic agricultural environments (Haggblade et al. 2010). They are associated with opportunity-led type of diversification which occurs when wealthier rural households engage in high-return nonfarm activities, with accumulation objectives, in order to increase their incomes and

maximize returns from their assets (Haggblade et al. 2007). Moreover, securing better living standards through diversification is a cumulative process that requires the ability to generate cash, invest in assets and diversify across activities (Ellis & Freeman 2004).

Following the push-pull theory, we hypothesize that the observed levels of income diversification among farm households in a given region are mainly associated with push or pull factors. We expect farm households in relatively stagnant agricultural regions where push factors are more prevalent (such as poor market access, difficult farming conditions and lack of nonfarm opportunities) (Haggblade et al. 2007, 2010), to engage in low income diversification activities as a means of survival. In contrast, in relatively dynamic agricultural regions, pull factors are more prevalent (such as better infrastructure and market access, productive agriculture, more nonfarm opportunities), therefore households have opportunities to engage in attractive high income diversification activities (Haggblade et al. 2007; 2010).

Diversification is commonly measured using income because of its clear interpretation as a welfare outcome (Barrett & Reardon 2000). Income diversification is analyzed by examining the composition of household incomes in terms of different income generating activities (Abdulai & CroleRees 2001). It is also analyzed using the vector of income shares associated with different income sources (Davis et al. 2010; Escobal 2001; Lay, Mahmoud & M'Mukaria 2008), most especially nonfarm income (Barrett, Reardon et al. 2001; Barrett & Reardon 2000; Ellis 2000a, 2000b; Escobal 2001; Lay et al. 2008; Reardon et al. 2006). The share of household income from nonfarm activities is used to highlight the importance of nonfarm income in a household's livelihood. There are also alternative measures of diversification based on a wide range of indices as measures of diversity (Patil & Taillie 1982). The most common in finance, economics, and social science literature is the Herfindahl–Hirshman index, which is equal to the sum of squared shares across each possible income source (Anderson & Deshingkar 2005; Barrett & Reardon 2000; Bradshaw,

Dolan & Smit 2004; Zhao & Barry 2013). The Herfindahl index is useful for disaggregating diversification data because it is sensitive to the range of income sources available and hence provides a multidimensional perspective on diversification behavior (Barrett & Reardon 2000). The index estimates the increasing mix of activities used to generate household income, taking into account the number and distribution of income sources (Zhao & Barry 2013).

In this paper, to measure income diversification, we use the nonfarm income share in total household income, together with a transformation of the Herfindahl index referred to as the Inverse Herfindahl Index (IHI). The IHI has the advantage of estimating both the number of household income sources and the contribution of each income source to total household income (Aihonsu, Olubanjo & Shittu 2011; Ersado 2006; Patil & Taillie 1982; Zhao & Barry 2013). The IHI ranges from one (where a household is highly specialized with complete dependence on a single income source) to the maximum possible diversity of income sources (highly diversified). It rises with increasing number of income sources and its value is maximized for a given number of income sources when all income sources are equally distributed. The index measures income diversification as an increasing mix of income sources away from complete dependence on a single source (own crop farming). The index is given by the formula below:

$$\text{IHI} = \frac{1}{Hefindahl\ index} = \frac{1}{\sum_{i=1}^{n} S_i^2}$$

where S_i represents the share of income source *i* in total income, while n is the total number of income sources. We disaggregate household income into 10 categories: (1) crops, (2) livestock, (3) HFG (hunting, fishing and gathering), (4) onfarm processing, (5) farm wage, (6) nonfarm wage, (7) nonfarm self-employment, (8) remittances, (9) transfers and (10) rents. These components of household income may be further classified into the farm or nonfarm categories (Barrett, Reardon et al. 2001). Farm income is obtained from the production or gathering of

unprocessed crops or livestock or forest or fish products from natural resources (categories 1 through 5). Nonfarm income is derived from all non-agricultural sources (categories 6 through 10). Nonfarm wage refers to wages or salaries obtained in exchange for labor services to an employer. While nonfarm self-employment refers to income earned through activities operated directly by the owner. We classify onfarm processing as farm income because, in our data, it mainly consists of small-scale transformation of raw products to add value to farm outputs, mainly groundnuts into oil. The category remittances are incomes received from household members, relatives or friends living elsewhere, while transfers are incomes received from other households (donations), or from public (pensions) or non-governmental bodies (subsidies or social grants). Rents are incomes generated by rental revenues from physical assets or securities.

Data and Sources

Quantitative survey

The data for this study come from a cross-sectional survey of rural households collected between November 2007 and May 2008 by the RuralStruc program (2007-2010), which was a joint initiative of the World Bank, the French Cooperation (French Development Agency, Ministry of Agriculture and Fisheries, Ministry of Foreign and European Affairs, Agricultural Research Centre for International Development (CIRAD), and the International Fund for Agricultural Development (Losch et al. 2012). It was aimed at understanding the dynamics and the processes of rural change in countries at different stages of structural transformation. The data was collected from rural households in different types of regions in seven countries, including Senegal and Kenya, using a common methodology (Losch et al. 2012).

The regions were purposively selected based on criteria related to

market access (infrastructures and proximity to cities), the presence of integrated value chains, the level of public investments and public goods, and the situation regarding natural resources. Three types of regions were a priori identified: (i) *winning regions* (WR) are relatively more dynamic agricultural regions where the on-going dynamics of integration to markets (whether related to specific value chains, the proximity of urban centers or good infrastructure) provide market-related opportunities and are strong drivers of change; (ii) *losing regions* (LR) are relatively more stagnant agricultural regions that are characterized by trends toward marginalization due to local constraints (low factors endowment, lack of public goods, poor connection to markets); (iii) *intermediary regions* (IR) are agricultural regions where the trends appear to be more imprecise (Losch et al., 2012). The final sample of surveyed rural households was stratified at the country level according to the regional categories. Within each type of region (WR, IR and LR), specific villages were purposively selected based on regional characteristics (Losch et al., 2012). Thereafter the surveyed households were randomly selected from census lists to allow representativeness at the local level. The total sample from Senegal and Kenya consists of 1,747 rural households, after excluding 23 non-farming households.

In Senegal, the WR is located in the *Senegal River Delta* in the North. The region has a semi-arid climate (200 to 400 mm of rain), alluvial humid and clay soils in depressions which favor irrigated rice production, and sandy soils in rain-fed areas. The region has a good level of market integration, with proximity to the major cities of St. Louis and Dakar. Major agricultural activities include production of rice, sugarcane, horticulture (mainly industrial tomato and onion), livestock (cattle, sheep, goats) and fisheries. Family farms coexist with large commercial farms or agribusinesses involved in tomato processing, sugarcane and horticulture. Several agribusinesses are integrating local producers mainly into contract production of tomato and sugarcane. Many nonfarm job opportunities are found in trade, services and agro-industries due to good accessibility to major cities and other smaller

rural towns. The IR is located in the central *groundnut basin* (Mékhe and Nioro). Mékhe has very good accessibility to the cities of St Louis, Thiès, and Dakar, while Nioro has good to medium accessibility to the city of Kaolack and the Gambia border (Losch et al. 2012). The groundnut basin has areas with semi-arid and North-Sudanian climate, with rainfall ranging between 300-900 mm, concentrated from June to September. The region is the major area of production of groundnuts, which is one of Senegal's main exports (Maertens 2009). It is densely populated, the majority of family farms are semi-subsistence, with limited irrigation possibilities (Ba, Diagana, Dièye, Hathie & Niang 2009). The main agricultural activities include crop production (cassava, cowpeas, millet, sorghum, rice and maize), livestock and fishing. Nonfarm job opportunities consist of mainly low-return self-employment activities. The LR is *Casamance*, which is located in the South (bordering Gambia). The region has difficult connection to the rest of the country because of poor infrastructure. It has Sudano-Guinean climate, receiving about 1000 mm of rain, with clay to sandy or silty tropical soils, offering a high potential for agriculture. Farming is mostly rain fed and households mainly produce staples (maize, sorghum, millet), as well as rice, cotton, groundnut, cattle and fish. Nonfarm job opportunities are very limited.

In Kenya, the WR is *Nakuru North*, which is located along the main transportation corridor between Mombasa and Kampala (Uganda). There is good access to Nakuru town, which is the fourth largest town in Kenya. The region has a high potential for agriculture and livestock, with annual rainfall between 950 and 1500 mm. Households cultivate a large variety of crops including wheat, maize, millet, beans, pyrethrum, tea, coffee, potatoes and vegetables. Cattle ranching, poultry farming and bee-keeping are also well developed. There are several agribusinesses integrating local producers on contract for tea and coffee production. Several nonfarm opportunities especially businesses and industries exist in nearby towns, and tourism is very active in the region. The IR is *Bungoma*, which is among the fastest growing densely populated regions in western Kenya. The region has a poor road network which is largely

impassable during the rainy season. However, the region has good soils and well distributed rainfall, making it agriculturally productive. Households mainly produce staples (maize, beans, potatoes, sorghum) for subsistence, and sugarcane, tobacco, cotton and coffee as cash crops, in addition to livestock. Some agro-industries are providing employment opportunities in paper milling and other small-scale manufacturing. The LR is *Nyando*, which is located on the large plains of Awach and Nyando rivers, and faces perennial flooding and erosion. It has series of hills and scarps to the South, and the fertile Kano Plains going down to Lake Victoria in the Northwest. Households produce staples (maize, groundnuts, beans, sorghum, cassava, sweet potatoes) mainly for subsistence. The main cash crop is sugarcane, produced by individual households and estates. Dairy farming and coffee production are suitable in the higher altitudes. Sugarcane mills and cotton ginneries in some areas have closed down. Nonfarm job opportunities are very limited.

Qualitative fieldwork

Given the limitations of our quantitative data which were collected to facilitate analysis using a household model, the first author collected qualitative data from rural Senegal and Kenya during fieldwork periods between November 2012 and October 2013. This was used to enrich the quantitative analysis in order to give a deeper qualitative understanding of the rural contexts and the patterns of household diversification.

The regions, villages and respondents for the qualitative work were all purposively selected, with characteristics similar to those of the quantitative data, but without the aim of being statistically representative. The regions and villages were selected based on differences in agro-ecological potential and market access. While respondents were selected based on certain criteria (such as location, gender, wealth) to ensure variety and to obtain detailed information. The qualitative data were collected using in-depth interviews with 150 household heads and key informants (government officials, extension

agents, leaders of farmer groups and village chiefs), complemented with personal observation.

For Kenya, qualitative data was collected in January and February 2013 from the central (Nyeri district) and western (Kakamega district) part of the country. A total of four villages were chosen (Ichuga and Gatagati villages from Nyeri district; Ekero and Mukuyu villages from Kakamega district). For Senegal, fieldwork was carried out in the groundnut basin (Mekhe and Fass Diaksao villages in Mekhe region) between November and December 2012, and in the Delta region (Mboundoum and Bokhol villages in the upper and lower Senegal Delta, respectively) between September and October 2013. The qualitative data collected was analyzed using content analysis, synthesis and interpretation, in order to complement and explain the quantitative results.

Results and Discussion

Regional patterns of household income diversification

Household income patterns

The annual total household incomes (in $PPP[1] per capita) from different farm and nonfarm activities of rural households in the study are shown in Table 1. The income patterns show that households in the WR in both countries obtain significantly higher total incomes compared to those in the IR and LR. They have significantly higher incomes from both farm and nonfarm sources. Only households in the WR of both

[1] PPP (purchasing power parity) exchange rates allow for comparison of relative price levels across countries. We convert household incomes per capita aggregated at the regional level from local currency units into $PPPs (international dollars) for the year 2007, which is the year of reference of the RuralStruc survey. We use conversion rates of 1 Senegal CFA Franc= $258.6 PPP and 1 Kenya Shilling = $34 PPP, following Losch et al. (2012).

countries have incomes above the relative poverty line ($2 per day per capita). In contrast, total household incomes in the LR and IR of Senegal fall significantly below the absolute poverty line[2] ($1.25 per day per

Table 1.
Composition of Household Incomes (Per Capita $PPP)

Income source	Senegal			Kenya		
	LR	IR	WR	LR	IR	WR
1. Crops	163.4	160.2	306.5	208.2	213.7	365.5
	(235)	(428)	(163)	(272)	(288)	(268)
2. Livestock	89.7	22.1	84.2	29.5	57.1	328
	(116)	(202)	(43)	(112)	(168)	(235)
3. HFG	5	2.8	7.6	19.5	3.8	0
	(14)	(21)	(6)	(24)	(17)	(0)
4. Onfarm processing	0	2.8	0.2	0	0	0
	(0)	(17)	(1)	(0)	(0)	(0)
5. Farm wage	0.3	2.9	9.9	25.4	11.7	18.1
	(1)	(8)	(9)	(49)	(24)	(28)
6. Nonfarm wage	10.6	31.8	93.5	183.3	143.3	306.1
	(5)	(74)	(37)	(160)	(101)	(98)
7. Self-employment	69.5	183.5	261.8	115.4	101.2	929.5
	(128)	(393)	(128)	(77)	(114)	(219)
8. Public transfers	0	0	0	0.1	0.2	0.9
	(0)	(0)	(0)	(2)	(2)	(3)
9. Remittances	20	38.1	17.5	3	2.2	11.6
	(55)	(167)	(30)	(70)	(44)	(95)
10. Rents	2	1.1	50	12.4	6.6	25.3
	(33)	(35)	(39)	(144)	(76)	(122)
Farm income (1-5)	258.4	190.8	408.4	282.6	286.3	711.6
	(238)	(449)	(171)	(276)	(295)	(284)
Nonfarm income (6-10)	102.1	254.5	422.8	314.2	253.5	1,273.4
	(171)	(422)	(153)	(260)	(205)	(273)
Total income (1-10)*	360.5b	445.3b	831.2a	596.8b	539.8b	1,985.0a
N (households)	239	461	176	283	299	289

Notes: Figures in parentheses are the number of households receiving income from a given source. *a, b show the differences in means for total income between regions in each country, using Tukey-Kramer pairwise comparison tests at 1% level of significance. Similar letters indicate no significant difference between regions.

[2] $1.25 per day was the international poverty line in 2005, but has been raised to $1.90 in 2015 (World Bank, 2015).

capita). This indicates the prevalence of high levels of poverty among rural households in the IR and LR of both countries.

Nonfarm income diversification

Nonfarm income shares as a per cent of total household incomes range between 29.9 in the LR of Senegal (lowest) and 54.1 in the IR of Senegal (highest), indicating significant regional differences (Table 2). The figures are consistent with the literature (Haggblade et al. 2010; Reardon 1997), indicating that nonfarm income shares among rural African households are ranging between 35-50 per cent of total household incomes. However, at the same time, about 15 per cent of the rural households in our study for each country do not have any nonfarm

Table 2.
Share of Farm and Nonfarm Income Sources (Per Cent of Total Household Income)

Income source	Senegal			Kenya		
	LR	IR	WR	LR	IR	WR
1. Crops	51.4	38.4	44.1	34.3	50.9	24.3
2. Livestock	16.2	5.7	6.8	8.2	10.3	21.0
3. HFG	2.4	0.9	1.3	2.6	1.5	0.0
4. Onfarm processing	0.0	0.5	0.1	0.0	0.0	0.0
5. Farm wage	0.1	0.4	0.9	7.1	3.2	3.0
6. Nonfarm wage	1.3	5.4	8.9	30.2	17.3	15.3
7. Self-employment	22.7	40.4	30.4	11.4	14.8	33.6
8. Public transfers	0.0	0.0	0.0	0.01	0.04	0.02
9. Remittances	5.1	8.0	3.6	1.6	0.7	1.6
10. Rents	0.7	0.3	3.9	4.6	1.3	1.1
Farm income share (1-5)	70.1	45.9	53.2	52.2	65.9	48.3
Nonfarm income share (6-10)*	29.9 b	54.1 a	46.8 a	47.8 a	34.1 b	51.7 a
N (households)	239	461	176	283	299	289

Notes: * a, b show the differences in means for nonfarm income between regions in each country, using Tukey-Kramer pairwise comparison tests at 1% level of significance. Similar letters indicate no significant difference between regions.

incomes. This indicates that some farm households are unable to diversify into nonfarm income sources, and therefore rely only on farming to sustain their livelihoods. As shown by other studies in rural SSA (Jirström, Andersson, & Djurfeldt 2011; Jirström, Archila, & Alobo Loison 2018), there is a considerable share of such rural households that are not engaged in any nonfarm income diversification, simply because such opportunities do not exist.

In discussing the regional differences, it is important to note that the specific context of each region matters, because it influences the type of diversification pursued by different farm households. Moreover, household income levels may reflect the type of diversification pursued. For Kenya, our results show, as expected, that rural households in the WR have significantly more nonfarm incomes than those in the IR (Table 2). As already shown, households in the WR had significantly higher total incomes than those in the IR and LR. At the same time, households in the WR have more access to relatively high-return nonfarm opportunities (mainly self-employment and nonfarm wage). This supports our hypothesis that in the WR of Kenya, diversification could be mainly associated with pull factors. The pull factors prevalent in the WR of Kenya include regional endowment of natural resources such as the rift valley and Nakuru national park which offer opportunities for diversification linked to tourism, plus better market access opportunities due to good road network, and good connections to major cities (Losch et al. 2012).

However, surprisingly, there is no significant difference in nonfarm income share between households in the WR and LR of Kenya. And yet as already shown, farm households in the LR had significantly lower total incomes than those in the WR. Therefore, the low incomes albeit with high levels of diversification, gives credit to our hypothesis that in the LR of Kenya, diversification could be mainly associated with push factors. In this region, such push factors include poor agricultural conditions because of perennial flooding and erosion, coupled with poor road infrastructure and poor market access opportunities (Losch et al.

2012).

For Senegal, as expected, the households in the LR have significantly lower nonfarm income share (compared to the IR and WR). Moreover, as already shown, households in the LR had significantly lower total incomes (compared to the IR and WR). This supports our hypothesis that the observed levels of income diversification among the farm households in the LR of Senegal is mainly associated with push factors. Such push factors prevalent in the LR of Senegal include poor road infrastructure and difficult market access, because the region is very remote and cut off from the rest of the country by the Gambia (Losch et al. 2012).

Contrary to what we expected, there is no significant difference in nonfarm income share between the IR and WR of Senegal. And yet, as already shown, households in the IR earn significantly lower total incomes than those in the WR. In the IR, households have high levels of nonfarm income share yet significantly low total incomes, indicating that diversification is mainly a means of survival. This can be attributed to prevalence of push factors such as long and recurrent drought seasons. The qualitative fieldwork in the IR (Mekhe region) supports this interpretation, because it revealed a common pattern where farm households participate mainly in low-return nonfarm activities (especially basketry and crafts), and there is predominantly the migration of youthful family members (to the capital, the Delta, and other urban areas) in order to manage long drought seasons annually, when crop farming is not possible because of lack of irrigation.

On the other hand, high income diversification in the WR of Senegal could be attributed to pull factors such as availability of commercialized farming opportunities, better market access due to good road infrastructure, good accessibility to the capital Dakar and other major towns, which facilitate high-return nonfarm opportunities. In addition, the farming system in the WR of Senegal has benefitted from heavy government and private investment in irrigation infrastructure and mechanized cultivation, as well as development of contract farming

through large agribusinesses (Ba et al. 2009).

Determinants of income diversification

We now turn to econometric regression techniques to estimate the determinants of income diversification (Table 4). Income diversification is proxied by the *Inverse Herfindahl Index* (IHI), which is used as the dependent variable. The explanatory variables include household assets and push/pull variables, which are described and summarized in Appendix 1 and 2, respectively. We noted that a major weakness of the IHI is that it is two dimensional and provides limited information concerning the overall structure of household diversification. However, Zhao and Barry (2013) showed that using two-dimensional indices in empirical analyzes of rural income diversification produces strong consistency of quantile patterns between income and diversification, compared to one-dimensional indices (such as the nonfarm income share).

Our data has a large number of observations with values of one for the IHI, because some households rely on only one income source. Estimating such censored variables using OLS would yield biased and inconsistent estimates (Long 1997). Therefore, we use a Tobit model (Wooldridge 2010), which is a censored regression model to provide a more accurate estimation given the nature of our dependent variable. The Tobit technique assumes that the dependent variable has a number of its values clustered at a limiting value. Hence it estimates a regression line using all observations, both those at the limit and those above it (McDonald & Moffitt 1980). Other studies on income diversification have also used Tobit models to overcome such limitations (Babatunde & Qaim 2009; Janvry & Sadoulet 2001; Woldenhanna & Oskam 2001).

The results of the IHI (Table 3) are somewhat consistent with our results from the nonfarm income share, in estimating the regional differences in household income diversification. The IHI is significantly higher in certain regions (the IR in Senegal, and the WR in Kenya—when

compared to the LR in each respective country). This indicates that household income diversification has significant importance in these regions. However, the push/pull incentives for diversification seem to be associated with the specific regional contexts.

Table 3.
Income Diversification by Region

Country	Region	IHI	SD	Min	Max	N
Senegal	LR	1.80 b	0.56	1.00	3.85	239
	IR	1.96 a	0.65	1.00	4.00	461
	WR	1.85 ab	0.63	1.00	4.12	176
Kenya	LR	1.91 b	0.69	1.00	4.53	283
	IR	1.83 b	0.73	1.00	4.25	299
	WR	2.25 a	0.70	1.00	4.45	289

Notes: a, b show the differences in means for IHI between regions in each country, using Tukey-Kramer pairwise comparison tests at 1% level of significance. Similar letters indicate no significant difference between regions.

Accessibility to rural towns

In each context, accessibility to rural towns or urban centers (proxied by the variable *distance to nearest big town*) has different effects on household income diversification (Table 4). The variable is negatively correlated with IHI in the LR of Senegal, indicating that households further from the nearest big town are relatively less diversified, as expected. In contrast, the variable is positively correlated with IHI in the WR of both countries, suggesting that even households who are located relatively far away from the big town in the WR are able to diversify their income sources. This indicates that accessibility to rural towns is a pull factor in the WR which enables households to easily exploit the services, opportunities and other advantages of rural towns to increase their farm and nonfarm incomes.

Household asset endowments

The number of *tropical livestock units*[3] owned by the household is strongly positive and significantly correlated with the IHI in the IR and LR for Kenya, and in the IR for Senegal. This suggests that livestock is an important financial and productive asset used for engaging in multiple activities. Our qualitative fieldwork found that in IR of Senegal, livestock is mainly used for building savings, purchasing food, providing capital for migration, hiring labor for farming and engaging in nonfarm activities (mainly petty trade). In the drought prone IR of Senegal, livestock income in addition to crop income is a very important safety net when there is crop failure (Reardon 1997). Whereas, our qualitative fieldwork in Kenya found that dairy livestock is used as collateral to obtain credit from formal lenders, hence it is an important financial asset. It was reported that credit is mainly obtained from co-operatives and farmer groups through which farmers sell milk on contract to large processors. Livestock incomes are also used for accumulating savings in table banking groups, purchasing food, farm inputs, paying school fees, solving pressing cash needs and engaging in nonfarm activities. In western Kenya, oxen are used for draught power in farming and sometimes leased out to earn extra income. In addition, livestock are an important part of cultural ceremonies like circumcision.

Credit availability is negative and significantly associated with IHI in the IR of Senegal. This suggests that households who received credit[4]

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[3] Having livestock does not necessarily translate into revenues. Moreover, the number of households with livestock but with no livestock revenue is large in Senegal (about 46 per cent) compared to Kenya (6.5 per cent). Hence for Kenya, the effect of livestock on income diversification may be overestimated, because the livestock variable—through sales of milk or animals—may influence the livestock revenues and hence the results of the IHI.

[4] Only 36 per cent of the households in the study from Senegal received credit, mainly from informal sources.

had relatively less diversified income sources, implying that they concentrate on farming. Credit is important for purchasing farm inputs and assets, mobilizing savings, and may provide the necessary working capital to set up farm enterprises (Reardon 1997; Schwarze et al. 2005). Furthermore, it was reported during the qualitative fieldwork in Mekhe region, that credit is used to buy farm inputs and hire farm labor. However, many respondents indicated that they mainly access credit for farming informally from friends or family members, rather than formally from banks or micro-finance institutions. This is probably because formal land market transactions in Senegal are limited, as land cannot be used as collateral for formal credit (Ba et al. 2009). However, from the qualitative findings in rural Senegal, it seems that an active informal market for selling and leasing land exists.

Table 4.
Tobit Estimates of the Determinants of Income Diversification in Rural Senegal and Kenya

Dependent variable: IHI	Senegal			Kenya		
Explanatory variables	LR	IR	WR	LR	IR	WR
Distance to nearest big town (km)	-0.003** (0.001)	-0.003 (0.004)	0.008* (0.003)	0.000 (0.003)	0.006 (0.003)	0.012* (0.006)
Farm equipment index	0.205** (0.067)	0.126** (0.047)	-0.031 (0.073)	0.144 (0.077)	0.127 (0.106)	-0.020 0.074)
Facility index	-0.238 (0.133)	-0.037 (0.069)	0.212 (0.118)	0.065 (0.117)	-0.373** (0.117)	-0.130 (0.067)
Housing quality index	-0.022 (0.086)	0.073 (0.064)	-0.444*** (0.136)	-0.287* (0.136)	0.066 (0.163)	0.039 (0.065)
Age of household head	-0.032 (0.018)	0.010 (0.013)	0.052 (0.034)	0.002 (0.033)	-0.030 (0.021)	-0.006 (0.020)
Age of household head squared	0.000 (0.000)	0.000 (0.000)	-0.001 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Gender of household head	-0.313 (0.191)	-0.253 (0.237)	-0.214 (0.286)	-0.099 (0.122)	-0.197 (0.150)	-0.157 (0.131)
Education level of household head	0.18 (0.098)	-0.129 (0.081)	-0.131 (0.112)	-0.144 (0.157)	0.088 (0.118)	-0.096 (0.112)
Number of potentially active members in the household	0.023* (0.011)	-0.011 (0.009)	0.011 (0.013)	0.023 (0.025)	0.056 (0.029)	0.019 (0.020)

Credit availability	-0.132	-0.138*	-0.079	0.161	0.087	0.111
	(0.087)	(0.067)	(0.102)	(0.120)	(0.129)	(0.121)
Tropical livestock units	0.002	0.023***	-0.006	0.014	0.137***	0.044**
	(0.002)	(0.006)	(0.004)	(0.011)	(0.030)	(0.015)
Farm size per adult equivalent (hectares)	0.021	-0.022	0.042	0.213*	-0.453*	0.043
	(0.043)	(0.040)	(0.055)	(0.094)	(0.200)	(0.110)
Social networks of household head	-0.041	0.142*	-0.016	0.002	0.028	0.150
	(0.067)	(0.066)	(0.099)	(0.112)	(0.095)	(0.087)
Household has migrant(s) abroad	0.276**	0.222**	0.426*	0.070	0.154	-0.264
	(0.090)	(0.080)	(0.175)	(0.239)	(0.460)	(0.233)
Household has migrant(s) in capital/main cities	0.378***	0.411***	0.094	0.294*	0.317	0.000
	(0.114)	(0.079)	(0.139)	(0.138)	(0.189)	(0.102)
Food security situation of the household	0.081	-0.120*	0.140	-0.251	0.046	0.221*
	(0.077)	(0.060)	(0.098)	(0.182)	(0.163)	(0.111)
Constant	3.231***	1.603***	1.166	1.650*	2.129***	2.005**
	(0.622)	(0.455)	(1.052)	(0.719)	(0.517)	(0.575)
N (households)	230	422	170	281	295	285
uncensored households	215	403	156	269	261	280
left censored households at IHI<=1	15	19	14	12	34	5
Akaike's information criteria (AIC)	387			623		

Notes: ***, **, * indicate statistical significance at 0.1%, 1% and 5% levels, respectively. Figures in parentheses are robust standard errors using Huber/White estimators to control for heteroskedasticity

Access to facilities (facility index) such as running water, electricity in the house, and private toilet was negatively and significantly correlated with IHI in the IR of Kenya. Such basic facilities can be viewed as important productive and non-productive assets for engaging in farm and nonfarm activities, a lack of which may act as entry barriers to income diversification. Whereas, *access to farm equipment (farm equipment index)* is significantly and positively correlated with IHI in the LR and IR of Senegal. This implies that rural households who accessed farm equipment (such as animal traction, mechanical/motorized traction, sprayer, micro-irrigation system, irrigation pump, silo, tractor) were able to diversify their income sources. Some farm equipment, especially for animal traction, are important assets for exploiting farmland in rural

Senegal, and for generating additional income, thereby relaxing constraints on other income sources. During the fieldwork, it was reported that animal ploughs drawn by horses or donkeys, and tractors are used to generate extra cash by leasing them to other farm households during agricultural seasons. On the other hand, *housing quality index* (type of roof, floor and walls) is significant and negatively correlated with diversification in the WR of Senegal and LR of Kenya. This suggests that the relatively better-off households in these regions are more likely to specialize in farming, rather than diversifying out of farming.

For Kenya, *farm size per adult equivalent* was significant with mixed effects: in the IR, the larger the farm size per adult equivalent, the more intensive the specialization in agriculture. This suggests that there is no push factor of land scarcity in this region. However, in the LR, the larger the farm size per adult equivalent, the more households engaged in diversified activities. This can be attributed to poor agro-ecological conditions that lead to low revenues from agriculture, hence better-off households with more land seek better opportunities by diversifying away from farming. Also, probably due to low endowment of physical capital assets other than land, some households may fail to engage efficiently in farming. Land assets seem to play a key role in explaining both survival-led and opportunity-led diversification strategies in Kenya (Lay et al. 2008).

The variable on *social networks of the household head* was positive and significant in the IR of Senegal. The variable was constructed as a composite indicator of the number of groups and associations the head belongs to, in order to show the importance of social capital. Social groups and networks are known to relax credit constraints of their members, provide a form of social insurance, and are a source of capital for engaging in various activities. Bernard, Collion, de Janvry, Rondot and Sadoulet (2008) find that community organizations are important for risk sharing, especially in the IR of Senegal, which is more vulnerable to environmental risks because of relatively poor soils, low rainfall, and almost non-existent irrigation facilities. It was reported during our

qualitative fieldwork that farmer groups are very important for accessing mutual farm labor and accessing subsidized fertilizers from government. While most female respondents reported being members of tontines (mutual groups) where funds generated are mainly used to cover expenditures on food, household items and religious or family ceremonies.

Demographic factors

In Senegal, the *number of potentially active members in the household* is positively correlated with IHI in the LR. In this region, diversification is used as a more permanent strategy to deal with seasonality and risks, and household activities are characterized by multiple production and consumption strategies (Ba et al. 2009). Households are engaged in a mix of ex ante risk management and coping strategies. Household consumption is organized within the family in such a way as to regulate consumption over the year between the short rainy season and the long dry season. Different household members are engaged in different livelihood strategies—some are seasonal, others temporary and others more permanent (Losch et al. 2012). According to our qualitative fieldwork, consumption is regulated between productive and non-productive members of the family. In many households, during the dry season some productive family members migrate to other areas to look for work. Some migrants send remittances to support the family left behind. Migration remittances are used by the remaining household members to buy food and farm inputs. Household members who migrate seasonally usually return to the village during the rainy season to provide additional labor for farm activities.

Other demographic variables such as *age, gender and level of education of the household head*, whilst found important as determinants of income diversification in other African studies (Abdulai & CroleRees 2001; Lay et al. 2008; Woldenhanna & Oskam 2001), are not significant at regional level, for both countries.

The role of migration

The variables *households with migrants in the capital or main cities, and households with migrants abroad* (both compared to *households with migrants in other rural areas*) have a strongly positive and significant correlation with IHI in every region of Senegal. For Senegal, migration abroad is a significant income diversification strategy in every region, while migration to the capital/main cities is significant only in the IR and LR. For Kenya, migration to the capital is significant in the LR. The variables concerning migrants in the household were included in the regression analysis as proxies for the level of social capital of the household, in the view that it promotes income diversification. Moreover, having migrants in the household does not imply having remittances. Households with migrants but no revenues from migration are quite numerous in our sample, making up about 71 per cent in Senegal and 76 per cent in Kenya. This confirms our interpretation of the presence of migrants in the household as mainly social assets for networks and co-operation.

Migration abroad or to the capital/main cities is mainly in search of better economic opportunities, the pull factor being higher wages in the migration destination, which gives households incentives to diversify their income sources. However, households in risky areas may be pushed to migrate for risk reduction and to minimize income variability (Barrett, Reardon et al. 2001). The importance of migration greatly depends on the destination of the migrant (Wouterse & Taylor 2008). Migrants abroad or to capital/main cities are more likely to engage in nonfarm activities because the returns are higher (Reardon et al. 2006), but may also engage in farm activities (Wouterse & Taylor 2008). Migration abroad is an accumulation strategy only accessible for households that have a certain level of wealth at their disposal (Sakho-Jimbira & Bignebat 2007). However, migration transfers can also stimulate nonfarm activities by reducing liquidity constraints, to increase capital needed for migration (Bignebat & Sakho-Jimbira 2013). Income diversification and migration

in the Sahelian regions are mainly used to compensate for shortfalls in cropping income, since households are constrained by the single and short cropping season, low rainfall, poor soils and general lack of irrigation (Reardon, Delgado & Matlon 1992).

An important perception from our qualitative fieldwork in Senegal is that migration to different destinations is a strategy to increase household income sources outside the farming season, especially in the drought prone LR and IR where access to irrigation facilities is very limited. While in the WR where irrigation is more prevalent, migration abroad seems to be an important strategy for high income diversification. In the drought prone regions, crop farming is mainly carried out during one rainy season between June to September, with a long dry period afterwards where many rural households are unable to farm. As a result, many are pushed to supplement farm income with mainly low income nonfarm activities during the year, including seasonal migration of productive household members. It was reported that seasonal migrants travel especially to coastal areas for fishing in order to get incomes to support their families in the rural areas. Some of the migrants who find better job opportunities tend to migrate more permanently mainly to the capital Dakar, and a few to neighboring countries or abroad. Migrants to the capital Dakar tend to engage in nonfarm activities such as petty trade, commerce, transport, masonry, tailoring, and carpentry. As Reardon (1997) indicates, households with migrants usually maintain social ties with the resident household and remittances are an important safety net especially in areas where agricultural incomes are insufficient due to low agricultural potential. Some households are pushed to depend on income from migration because nonfarm activities are covariant with farming (Reardon et al. 2006).

In Kenya, on the other hand, the qualitative fieldwork revealed that migrants to the capital (Nairobi) and other major towns are mainly young people below 40 years old, for education purposes (university or other tertiary institutions) or in search of employment opportunities. The young people who migrate to urban areas for education purposes tend to

stay temporarily, some with relatives in the urban areas, while others return to the village during school holidays. Those who find jobs in the capital or other cities tend to settle more permanently and only return to the village during festive seasons or religious holidays. Some migrants occasionally send remittances to their families in the villages using MPESA (mobile money transfer services).

Perceptions on food security

The variable *food security situation of the household* is negative and significant in the IR of Senegal. In contrast, it is positive and significant in the WR of Kenya. It is a qualitative and subjective variable which was self-reported to reflect the evolution of household food security, and therefore should be interpreted cautiously. In the questionnaire, respondents were asked how their food security has changed in the last ten years from 2008 (whether it got better or remained unchanged or worsened). In the WR of Kenya, perceived improvement in household food security in the last decade is positively correlated with income diversification. While on the contrary, in the IR of Senegal, perceived food security concerns seem to have been an entry barrier against income diversification. From the qualitative fieldwork in the IR of Senegal (Mekhe), it was reported that most households do not farm during the dry season because of lack of irrigation facilities. However, in some villages where soils are suitable, cassava is an important source of income and food security during the dry season, as it can be harvested from 6 months up to one year, depending on the food and cash needs of the family. A common opinion was that relatively poor households with limited incomes tend to harvest their cassava quicker, thereby reducing their food security, and are forced into precarious alternative sources of income.

Whereas for Kenya, the WR was reported to be relatively food secure. Crop production is mainly conducted during two rainy seasons in the year. In general households are involved in production of high value

horticultural crops (fruits and vegetables), plantation crops (tea, coffee), trees, in addition to food crops, and zero-grazed dairy cattle for milk (with cultivation of grasses and fodder crops). Farmers have good connections to markets for their produce due to good road infrastructure and proximity to large cities.

Conclusions

Household income patterns from our study show that it is rural farm households in the WR in both countries that obtain significantly higher total incomes compared to those in the IR and LR. Moreover, an analysis of household income composition shows significant regional differences in terms of income diversification, but no clear patterns. In Senegal, there is no significant difference in the level of income diversification between the IR and WR, unexpectedly, —yet households in the IR earn significantly lower total incomes than those in the WR. While in Kenya, there is no significant difference in the level of income diversification between the WR and LR, surprisingly —although farm households in the LR earn significantly lower total incomes than those in the WR. These patterns rendered support to our hypothesis that the observed levels of income diversification among farm households in a given region are mainly associated with push or pull factors. We noted however that although geographical location of the region matters, the specific context of each region (such as the type of infrastructure, the level of public investments and public goods, and the situation regarding the use of natural resources) matters even more, because it influences the type of diversification pursued by different farm households.

The empirical investigation into the regional determinants of income diversification in rural Senegal and Kenya reveals that push and pull factors tend to act concurrently within and between regions, although with no clear patterns. This implies that policies on income diversification need to be tailored to meet the development needs of specific regional contexts in order to have beneficial impacts. In general,

the significant determinants of income diversification include accessibility to rural towns, household assets, demographic factors, migration opportunities, as well as perceptions on food security. At the regional level, accessibility to rural towns is significant in the WR of both countries. While assets such as livestock are significant in certain regions (the IR of Senegal, and the WR and IR of Kenya). Migration is an important diversification strategy across all regions of Senegal, while credit and social networks are mainly important in the IR of Senegal. Finally, perceptions on food security emerge as important determinants in certain regions (the WR of Kenya and IR of Senegal).

In conclusion, our econometric results have highlighted the limitations of using the household economic approach in modelling the determinants of economic behavior in rural Africa, because of its inherent focus on the household head as the decision maker. As a result, analyzing the determinants of decisions made by the household head may fail to capture other factors that may influence behavior of the household, since data from other adult members who are not household heads is excluded. Therefore, there is a need for better methodological approaches that go beyond the commonly used household models, in order to improve the understanding of income diversification, its determinants, and how they interplay with local/regional contexts.

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Appendix A

Description of Variables Used in the Econometric Models

Variables	Description
Dependent variables	
Inverse Herfindahl Index (IHI)	Sum of squared shares of each source of household income per capita ($PPP).
Nonfarm income share (NFS)	Share of non-farm income in total household income per capita ($PPP)
Explanatory variables	
Physical assets	
Winning region (WR)	(1=winning region, 0=losing region)
Intermediary region (IR)	(1= Intermediary region, 0=losing region)
Distance to nearest big town (km)	The big towns include Nakuru, Bungoma and Kisumu towns for Kenya; Dakar, Tivaouone, St. Louis, Dagana, Nioro, Kolda and Sedhiou for Senegal
Farm equipment index (EQh)	EQh = sum of EQih (1-Pi), where Pi=ni/n and where EQih=1 if thehousehold h can access agricultural equipment i (animal traction, mechanical/motorized traction, sprayer, micro-irrigation system, irrigation pump, silo, tractor), Pi = the probability of accessing the agricultural equipment i, ni=number of households which access agricultural equipment i, n= total number of households
Facility index (Fh)	Fh = sum of Fih (1-Pi) with Pi=ni/n and where Fih=1 if the household h has access to facility i (piped/running water, electricity in the house and private toilets in the house), Pi is the probability of accessing the facility I, ni= number of households which can access facility i, n= total number of households
Housing quality index (Qh)	Qh = sum of Qih (1-Pi) with Pi=ni/n and where Qih=1 if the quality of the housing i of the household h is (cement or concrete floor, roof made of Iron or tile, wall made of stones or wood), Pi is the probability of having housing quality i, ni= number of households which have housing quality i, n= total number of households
Farm size per adult equivalent	Measured in hectares
Human assets	
Age	Age of the household (HH) head (years)
Gender	Sex of the household head (1=male, 0=female)
Active household members	Number of potentially active members in the household aged between 15 and 64 years
Education dummy	Level of education of the household head (1=Some formal education (primary, secondary or tertiary), 0= No formal education)
Financial assets	
Credit availability dummy	(1= Household has credit, 0= Household has no credit)
Tropical livestock units (TLU)	Calculated based on the energy needs of a 250kg ruminant. [camel (1), cattle (0.7), sheep (0.1), goats (0.1), horses (0.8), donkeys (0.5), pigs (0.2) chicken (0.01)] (see Makeham and Malcolm 1986)
Social capital	
Index of networks of household head	Is the sum of memberships to groups & associations, including agricultural mutual aid groups for Senegal. While for Kenya it is a dummy for membership to groups, associations or organisations (1=yes, 0=no)
Migration abroad	1= HH has migrant(s) abroad, 0= HH has migrant(s) in other rural areas
Migration to the capital or main cities	1=HH has migrant(s) in capital/main cities 0=HH has migrant(s) in other rural areas
Food security situation of the household	Evolution of household food security in the last 10 years from 2008 (1=improved/better, 0= remained unchanged or worsened)

Appendix B

Descriptive Statistics for Variables Used in the Econometric Models

Variables	Senegal (N= 822)				Kenya (N=861)			
	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
Nonfarm income share	0.45	0.31	0	1.0	0.44	0.34	0	1.0
Inverse Herfindahl Index (IHI)	1.91	0.63	1	4.1	2.00	0.73	1	4.5
Winning region	0.21	0.41	0	1	0.33	0.47	0	1
Intermediary region	0.51	0.50	0	1	0.34	0.47	0	1
Losing region	0.28	0.45	0	1	0.33	0.47	0	1
Distance to nearest big town (km)	31.72	29.30	6.0	125.0	30.39	13.43	8.9	60.3
Farm equipment index	1.34	0.77	0	4.1	0.60	0.57	0	3.7
Facility index	2.24	0.49	1	3.0	0.27	0.52	0	2.7
Housing quality index	2.28	0.57	0.5	3.0	0.41	0.59	0	1.7
Age of household head (years)	51.78	13.01	18	98	49.13	13.79	17	90
Age of head squared	2,850	1,394	324	9,604	2,604	1,443	289	8,100
Gender of head	0.97	0.17	0	1	0.81	0.39	0	1
Education level of head	0.212	0.41	0	1	0.995	0.07	0	1
Number of potentially active members in the household	6.80	3.88	1	30	3.69	2.16	0	12
Credit availability	0.36	0.48	0	1	0.11	0.32	0	1
Tropical livestock units	5.72	13.06	0	117.8	2.44	3.06	0	27.1
Farm size per adult equivalent (hectares)	0.97	0.87	0	6.4	0.29	0.35	0	3.6
Social networks of head	1.41	0.55	1	3	0.50	0.50	0	1
HH has migrant(s) in capital or main cities	0.20	0.40	0	1	0.14	0.35	0	1
HH has migrant(s) abroad	0.18	0.38	0	1	0.02	0.15	0	1
HH has migrant(s) in other rural areas	0.23	0.42	0	1	0.37	0.48	0	1
Food security situation of the household	0.47	0.50	0	1	0.10	0.30	0	1

Source: RuralStruc Quantitative Survey, data analysis by authors.

Article 3

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 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. More specifically, farm incomes declined significantly, pushing female headed households into absolute poverty. Whereas nonfarm income share in total household cash incomes increased significantly, especially in Kakamega. Overall, the econometric results show that whether or not household fixed effects are included, there is a positive and significant relationship between changes in household asset wealth and changes in livelihood diversification, implying that diversification is mainly an accumulation strategy for wealthier farm households. Increase in livelihood diversification was also determined by the initial level of diversification, household demographic characteristics such as age, gender (being female), education level and hiring labour. In contrast, increased access to agricultural input credit and more secure land rights seemed to promote specialisation in farming rather than diversification. Finally, food security indicators had a positive 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). Some 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 contributed some 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 labor-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

[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).

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; 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 provides 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, in some regions, women's ability to engage in nonfarm activities is constrained by child-rearing obligations which 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 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 behavior 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 in the Central province of Kenya, and from Kakamega district in the Western province (see map in Appendix A). The two regions are diverse in terms of geographical location, agro-ecological potential, market access, household activity and demographic structure as shown in Appendix B. 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, 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 (Appendix C) 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

[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).

market 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 is 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. Four villages (Ekero and Mukuyu in Kakamega district, and Ichuga and Gatagati in Nyeri 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 analyzed 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 D.

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 household effect or heterogeneity (considered to be constant over time).

e_{it} represents the idiosyncratic errors that change across t and i.

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, for example gender, religion, culture, education. 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 Appendix E and F) 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. Following Andersson Djurfeldt and Hillbom (2016), the number of *meals eaten during the lean season*[5] is used to capture the effect of food insecurity on diversification, and hence capture risk coping or distress diversification behaviour. One of the coping strategies of food-insecure households is reducing the number of meals and diversifying their income sources (Giesbert and Schindler, 2012). Indeed, recent studies have found a strong positive relationship between diversification and food security in SSA (Frelat et al., 2016). 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 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 many significant differences between regions, while there are surprisingly very few significant differences between MHH and FHH in both regions. Overall, the average age of the farm household head 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.

[5] The lean season is the season between harvests, with dry spells in many regions of Kenya. Hence in the lean season, the risk of food insecurity increases, with many rural farm households becoming vulnerable to hunger (Andersson Djurfeldt and Hillbom, 2016). Food prices increase, and yet many smallholders tend to depend on the market for their food needs during this period (Andersson Djurfeldt, 2012; Oluoch-Kosura and Karugia, 2005).

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[6] 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. Overall, farm incomes remained significantly higher than nonfarm incomes, in both periods.

[6] 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).

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). At the village level in Kakamega, the patterns of significant increase in nonfarm activities over the study period was consistent only in two villages – Ekero and Chegulo (Appendix G). 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 produce. 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 can be attributed to climatic shocks (shifting rainfall patterns and droughts) and

poor road conditions in some regions. For instance, qualitative fieldwork in Gatagati village in Nyeri in 2013 revealed that farm production was badly affected by climatic conditions and difficult market access. Some of the respondents reported that they left horticultural produce to rot on the farms, because the roads became impassable during the rainy season and traders cannot 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 7.2% (from 82% in 2008 to 75% in 2013). 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 among 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 livestock (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 7.2% (from 18% in 2008 to 25% in 2013). 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% 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 that they were mostly low-return nonfarm activities.

More specifically, the increase in NFS in Kakamega was much more for FHH (42.1%) compared to MHH (9.1%). Moreover, reliance on nonfarm income sources in Kakamega was higher among FHH (NFS of 53% in 2013), compared to MHH (NFS of 27% in 2013). 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 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% increase in nonfarm income among

[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.

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 60–80% of household incomes. Because of this the study claimed that *de-agrarianization* 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. In contrast, the results on cash incomes here are consistent with findings from 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 H. Model 1 estimates the determinants for the entire panel of 239 households. Models 2 and 5 estimate the determinants only for the panel of households from 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 in the respective regions.

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 all the regional and gender-based models (except model 6), the *asset wealth index* was positively and significantly associated with increase in the NFS over the study time period, *ceteris paribus*. This confirms that increase in asset wealth is significantly associated with an increase in livelihood diversification at the

regional level. The implication is that "accumulation" is the primary motive for diversification, 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, which 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 recent findings of Jirström et al. (2018) showing 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 'boda boda' transport microbusiness

Mary (not real name) is a second wife with five children. Three of them migrated to Nairobi after completing senior four in Ekero. Two of them found jobs in Nairobi – one in a hotel & another in a factory. The third one in Nairobi is still looking for a job. She is engaged in a 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 transport business with one motorcycle *bodaboda* 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 & 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 *bodabodas*. She uses the money from the *bodabodas* to educate her children and to buy farm inputs (maize seed & fertiliser). She plans to invest in dairy cattle using the money from the *bodabodas*. 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 in Nairobi.

Source: qualitative fieldwork interviews in Kenya, Ekero village, 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 and 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, find 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 shop microbusiness

Linda (not real name) is a single mother who owns a shop in Kiawarigi town in Icuga. She started the business in 1997 using her savings from previous wage employment. She dropped out of secondary school in form 4, 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 and she has 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 laborers 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 when she needs it. 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, Icuga village, Nyeri, Jan-Feb 2013.

A higher *initial level of nonfarm income* is positively and significantly associated with the subsequent increases in the level of nonfarm income in both regions, especially among MHH. This suggests that MHH are able to increase their level of livelihood diversification because they can build on previous nonfarm incomes and wealth. 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 Mukuyu trading centre. He is married with six children, out of which four 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, among others. 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 Vihiga 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. He is not a member of any farmer group or organization.

Source: Qualitative fieldwork interviews in Kenya, Mukuyu village, 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 all the models, older age was associated with increase in NFS, although not significant in all. It is relatively older farmers in Kakamega (Model 2), FHH in Kakamega (Model 5), and MHH in Nyeri (Model 6), who were able to significantly increase their 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, in contrast, the perception from the qualitative fieldwork was that older farmers were more involved in farm activities. For instance, in the villages of Gatagati and Icuga in Nyeri where the qualitative interviews were done, relatively older farmers reported their main activities as traditional cash crop production (coffee and tea) and keeping zero-grazed dairy livestock. Dairy milk was sold to processors through co-operatives and farmers received their pay through the bank. While in Kakamega (especially in Ekero village), most older farmers reported that they were sugarcane outgrowers. The qualitative results are consistent with Lay et al. (2008) who found that in Kakamega, as the age of the household head increased, the share of nonfarm income dropped significantly.

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	0.024	0.079***	0.157***	0.148**	0.043**	0.047	0.079**
	(0.015)	(0.026)	(0.052)	(0.069)	(0.022)	(0.033)	(0.039)
Initial level of NFS (2008)	0.786***	0.856***	0.789***	-0.036	0.824***	0.732***	0.378*
	(0.029)	(0.054)	(0.130)	(0.366)	(0.037)	(0.086)	(0.207)
Age of head (years)	0.001	0.003**	0.002	0.030***	-0.0001	0.005	0.001
	(0.001)	(0.001)	(0.003)	(0.011)	(0.001)	(0.003)	(0.004)
Gender of head (male), dummy	-0.069**	-0.130**			-0.031		
	(0.032)	(0.054)			(0.032)		
Education level of head (years)	0.001	-0.003	0.006	0.062***	0.003	-0.007	-0.007
	(0.003)	(0.005)	(0.012)	(0.017)	(0.004)	(0.008)	(0.012)
Household size	-0.005	-0.008	0.0004	-0.016	-0.006**	-0.010	0.001
	(0.004)	(0.007)	(0.010)	(0.021)	(0.003)	(0.007)	(0.009)
Membership of group, dummy	-0.019	0.063	0.076	0.010	-0.033	0.042	0.087
	(0.031)	(0.059)	(0.087)	(0.121)	(0.030)	(0.044)	(0.115)
Use of hired labor, dummy	0.060**	0.129***	0.211***	0.149	0.013	0.074	-0.017
	(0.027)	(0.041)	(0.060)	(0.125)	(0.030)	(0.059)	(0.066)
Agricultural input credit, dummy	-0.129***	-0.129**	-0.230**	-0.554	-0.089***	-0.080	-0.071
	(0.030)	(0.060)	(0.093)	(0.364)	(0.032)	(0.050)	(0.046)
Land title, dummy	-0.015	0.032	0.006	0.009	-0.058	-0.237***	0.137
	(0.029)	(0.037)	(0.059)	(0.233)	(0.040)	(0.068)	(0.104)
Number of meals eaten in lean season	0.005	-0.007	-0.013	0.251***	-0.003	-0.015	-0.053
	(0.022)	(0.028)	(0.048)	(0.092)	(0.030)	(0.050)	(0.080)
Borrow to cover needs, dummy	-0.015	-0.097**	-0.037	-0.272***	0.029	-0.009	-0.082
	(0.027)	(0.041)	(0.053)	(0.078)	(0.031)	(0.047)	(0.083)
Constant	0.195**	0.244*	0.016	-1.986	0.209	0.103	0.129
	(0.090)	(0.138)	(0.236)	(0.633)	(0.113)	(0.238)	(0.336)
No. of observations	455	221	170	51	234	182	52
No. of groups	238	120	92	28	118	92	26
R-squared (overall)	0.389	0.377	0.352	0.113	0.560	0.405	0.165

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 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, and is consistent with the findings of Lay et al. (2008) for Kakamega. The results also corroborate Andersson Djurfeldt et al. (2013) based on the 2002 and 2008 AFRINT data, which show that both farm and nonfarm cash incomes for members of FHH for Kenya were higher than that of members of MHH, although

the difference was not significant. The gender differences in livelihood diversification in Kakamega can probably be explained by differences in agricultural productive resources. Cultural factors in Kakamega are important in limiting women's ownership or control over certain productive resources, especially agricultural land (Lay et al., 2008). During the qualitative fieldwork in Western Kenya it was reported that many farm laborers tend to be women because they do not own land for farming. Women can access farmland when allocated through their husbands after marriage or through other family members. However, women with wage or self-employment are 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). The qualitative interviews with some women farmers that had some formal education indicated that they 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. For Nyeri (Model 5), *larger household size* was negatively and significantly associated with change in NFS. This is as expected, implying that households with relatively more family members were more likely to concentrate on farming, rather than diversifying out of farming.

Membership in farmer groups was expected to be important in increasing NFS, but surprisingly it was not significant in any of the models. This is probably because most of the farm households that are members of farmer groups participate and obtain their incomes mainly from farm activities, rather than nonfarm activities. The qualitative fieldwork indicated that a number of households were involved in farmer groups[8] which access capital and start-up skills from government, donors, NGOs or banking institutions (Box 1). Some households were able to access land, capital and inputs for farming through such farmer groups. The farmers were mainly involved in livestock production, horticulture and other high value farm and sometimes nonfarm 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 high value enterprises included production of ornamental Arabica flowers (Icuga village, Nyeri), silkworm and mulberry farming (Gatagati village, Nyeri), building energy stoves (Ekero village, 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 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 were excluded from becoming outgrowers because they lack control and ownership of land based on *Abaluya* cultural norms, however they were mostly involved 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 generally 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

Change in *agricultural input credit* was negatively and significantly associated with change in NFS, when considering all households (Model 1), and the specific regions separately (Models 2 and 5). It was also the case for MHH in Kakamega. This suggests that in both regions increased agricultural input credit has generally promoted the intensification over the study period, rather than diversification out of farming. 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 in Kenya seem to be declining rapidly (Andersson Djurfeldt and Jirström, 2013), intensification especially in grain production has been happening already in Kenya, 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. The qualitative interviews generally showed widespread use of chemical fertilisers especially on hybrid maize. It was reported that fertiliser prices are subsidized 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 among MHH in Nyeri (Model 6). Again this result indicates that land in Nyeri is mostly controlled by MHH. 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 contrast, 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.

Food security is important for increasing livelihood diversification

In Kakamega, it is FHH households who consumed more *meals during the lean season* who significantly increased their NFS (Model 4). This indicates that in Kakamega, it is relatively food secure FHH households who invested in nonfarm activities. Conversely, FHH in Kakamega who were less food secure were constrained from engaging in nonfarm activities. This result is consistent with the findings of Frelat et al. (2016) showing that off-farm income is one of the drivers of variations in food availability. They found that the off-farm income contribution to food availability is higher for households with sufficient food available. Furthermore, the results show that over the study period, livelihood diversification in parts of Kakamega were probably driven by distress motives and characterised by survival strategies. For instance, there was a negative and significant association between FHH households in Kakamega who *borrowed to cover their subsistence needs* and the change in NFS.

The food security patterns above can be explained by the qualitative fieldwork especially in Mukuyu village (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. Therefore, households that invest in petty trade shops selling maize are able to reap from the seasonality in such a way that they generate even more income during the lean maize season from other households in search of food, mainly maize (Box 3). In Mukuyu village this pattern is probably linked to a common practice of remitting maize to relatives in neighboring Vihiga village after the harvest (Box 3). For poorer households, after remitting maize to relatives they often do not have enough for the lean season. These food transfer patterns are described in much detail by Andersson Djurfeldt (2012), Andersson Djurfeldt and Wambugu (2011) and Djurfeldt et al. (2011). Moreover, Andersson Djurfeldt (2012), found that in Western Kenya, nonfarm income sources were important for coping with seasonality and food insecurity. The 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.

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. However, nonfarm incomes increased significantly in total household cash incomes, 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. 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 below the international poverty line in the 2013 period, while that of MHH did not change much. In contrast, the overall NFS increased significantly over the study period, driven by significant changes in Kakamega. However, the dynamism in nonfarm livelihood diversification in Kakamega was mainly driven by 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 both regions, farm households who significantly increased their asset wealth over the study period (except MHH in Nyeri), also significantly increased their level of livelihood diversification in 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 Kakamega) were positively and significantly associated with increased 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. Whereas, overall, hiring labour (most especially for MHH in Kakamega) had a positive and significant effect on the change in livelihood diversification. Increased access to agricultural input credit (overall), and having more secure land rights (for MHH in Nyeri) promoted specialization in farming

rather than diversification out of farming. Finally, food security was important for increasing livelihood diversification, especially in the less dynamic region (Kakamega) – where it is relatively food secure FHH households who increased their livelihood diversification over the study period. Whereas, poorer households in Kakamega that borrowed to meet their subsistence needs over the study period significantly reduced their livelihood diversification. This was the case for FHH in Kakamega, who significantly reduced the number of meals eaten in the lean season and borrowed to cover their subsistence needs over the study period.

The results have several implications for development policy in rural Kenya and SSA in general – highlighting the importance of recognizing 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, however, 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 input credit provision and improving land tenure security and rights should be supported in order to increase smallholder agricultural performance. Finally, the result that it is relatively food secure FHH in Kakamega who were able to invest in nonfarm activities, suggests that policy initiatives that improve food security are likely to impact positively on livelihood diversification among FHH.

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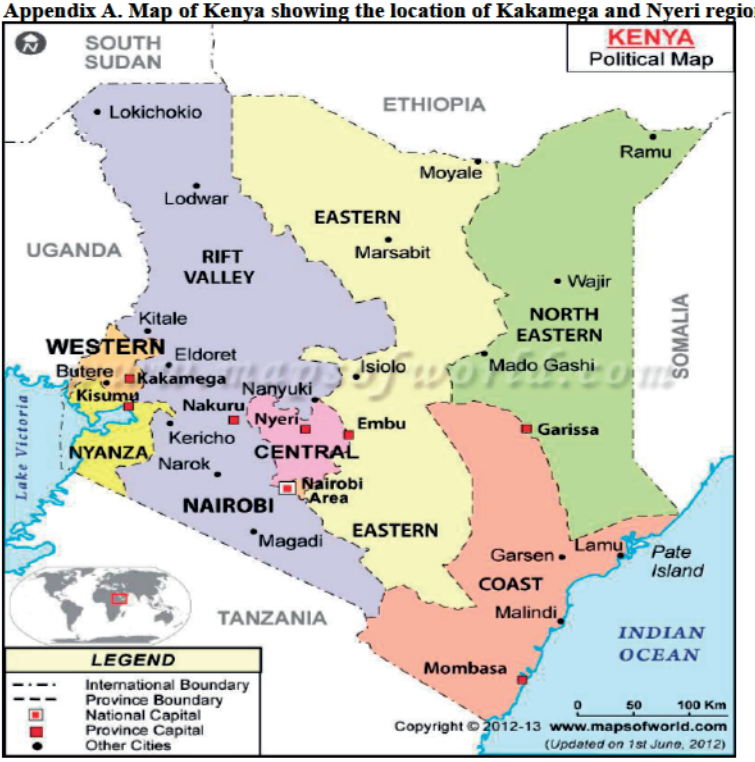
Appendix A. Map of Kenya showing the location of Kakamega and Nyeri regions



Appendix B. 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 C. Characteristics of villages in the AFRINT Kenya study regions, 2002

Region (district)	Village	Distance to all weather road (km)	Population density	Relative farm sizes	General soil fertility	Average annual rainfall	Land under irrigation (%)	Market access	Major crops grown
Nyeri	Thegenge/ Gatondo	4	494	Small	Good	1400	19.22	Good	Tea & horticultural products
	Ichuga/ Gathumbi	2	512	Small	Medium	1000	6.11	Good	Coffee, maize
	Kiambii	0	510	Small	Medium	900	0.69	medium	Maize
	Gatagati	1	128	Medium	Good	1000	67.52	Poor	Horticultural products
	Irigithathi	0	126	Large	Poor	800	60.22	medium	Maize
Kakamega	Shikomoli	6	848	Small	Poor	2000	0.00	medium	Coffee, tea, maize
	Ekero	2	617	Medium	Good	1800	9.87	Good	Sugarcane, maize
	Chegulo	4	287	Very large	Medium	1600	0.26	Poor	Sugarcane, sweet potatoes
	Munyuki	4	436	Very large	Good	1400	0.16	Good	Maize
	Mukuyu	20	373	Small	Good	1200	0.61	Poor	Maize

Source: Karugia (2003)

Appendix D. 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 E. 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 F. 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 G. Village level patterns of change in farm and nonfarm cash incomes

Region	Village	Change in farm income (US$ per adult equivalent, 2013-2008)	Change in nonfarm income (US$ per adult equivalent, 2013-2008)	Change in total household income (US$ per adult equivalent, 2013-2008)	Change in farm income share (2013-2008) %	Change in nonfarm income share (2013-2008)%
Nyeri	Gatagati	-899***	ns	-954***	ns	ns
	Gatondo/Thegenge	ns	ns	ns	ns	ns
	Icuga/Gathumbi	ns	-117**	ns	13*	-13*
	Irigithathi	-245*	ns	ns	ns	ns
	Kiambi	ns	-357**	-420**	18*	-18*
Kakamega	Ekero	ns	75**	ns	-20**	20**
	Chegulo	ns	465**	573**	-30***	30***
	Mukuyu	91*	ns	ns	ns	ns
	Munyuki	ns	ns	ns	ns	ns
	Shikomoli	ns	ns	ns	ns	ns

Notes: ***, **, * indicate statistical significance at 1%, 5% and 10% levels, respectively.
ns indicates no statistical significance.

Appendix H. 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
Number of meals in lean season	2.58	0.59	2.40	0.64	2.39	0.64	2.43	0.62	2.75	0.48	2.78	0.46	2.65	0.52
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	

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