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The impact of large-scale investment in agricultural land on household food security: a comparative analysis of Kenya, Madagascar and Mozambique

by

Wegayehu Bogale Fitawek

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Department of Agricultural Economics, Extension and Rural Development
Faculty of Natural and Agricultural Sciences
University of Pretoria
South Africa

Supervisor: Prof. Sheryl Hendriks

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Abstract

An increase in large-scale agricultural investments (LSAIs) in developing countries followed the 2007/8 food price crisis. The social and economic impact of increasing LSAIs is controversial among researchers, international agencies, and activists. Inadequate attention was provided to the potential effect of such investments on household food security. This study examined the impact of LSAIs on household food security in three communities in Kenya, Madagascar, and Mozambique. The study used secondary data collected from 1651 households from four distinct groups (those with employed members by an LSAI, contracted to an LSAI, non-engaged households in the same communities and counterfactual households from neighbouring communities). The data were analysed using descriptive and econometric models. According to the study findings, Kenyan households were more food-secure than those in Madagascar and Mozambique. Households in the three communities with LSAIs employees were more food-secure regarding the household dietary diversity score and the months of adequate household food provisioning than other households. This might be because households with LSAI employees received regular wages. The lack of assets to liquidate in times of stress and their adoption of more precautionary than contract farming households may indicate lower salaries than the net incomes of contract worker households. Most female-headed households in the three study areas were food-insecure except for contracted female-headed households in Kenya and counterfactual female-headed households in Mozambique. This might be because female-headed households in the study areas have limited access to LSAI employment and contract farming opportunities. Most of the employed households were migrants from the nearby districts, who may have displaced local women's job opportunities. Households with LSAIs contract agreements adopted fewer coping strategies than other households. Contract farming households seemed less inclined to slip into deeper levels of food insecurity when encountering adversity. Non-engaged households in the investment zones enjoyed a similar food security status to counterfactual households in all three countries. This indicated that living in the influence zone had deficient adverse effects on the food security of non-engaged households. Most LSAIs jobs were seasonal and low-paid. Investors and governments hosting LSAIs should set a minimum wage to prevent labour exploitation and protect people against poverty. Some households lost their land rights. Governments hosting LSAIs and investors should protect the local community from losing their land rights. Policies related to

quotas favouring female employment and preferences for contract farming are essential to improve the food security status of female-headed households. The impact of LSAIs in global literature is highly debatable. The study findings provide evidence and information for policy dialogues that LSAIs can benefit household food security through employment and contract farming. The study provides a framework for future multi-indicators assessment of food security. Further studies are needed to examine the impact of LSAIs on the surrounding communities besides food security. LSAIs may also harm the environment, land tenure, and community livelihood, further exacerbating food insecurity. A consistent project impact evaluation is essential to investigate these aspects.

Declaration 1: Originality

I declare that this thesis, hereby submitted in partial fulfilment of the Doctor of Philosophy in Agricultural Economics requirements at the University of Pretoria, is my own work and has not been submitted to any other university for a degree of an award. The research reported in this thesis is my original work. I understand plagiarism, other sources have been properly acknowledged and referenced.

Student: Wegayehu Fitawek

Signed: ----------

Date: ----------

Supervisor: Professor Sheryl Hendriks

Signed: ----------

Date: ----------

Declaration 2: Publications

These published papers are presented in this thesis as a main chapter.

Publication 1- Chapter 4 of this thesis

Fitawek, W., Hendriks, S., Reys, A., and Fossi, F. 2020. The effect of large-scale agricultural investments on household food security in Madagascar. *Food Security*, 12, 1349-1365.

Publication 2- Chapter 5 of this thesis

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Publication 3- Chapter 6 of this thesis

Fitawek, W., and Hendriks, S.L. (….). The role of contract farming on household food security in Kenya and Madagascar. Ready to submit to *Land Use Policy* journal.

Publication 4- Chapter 7 of this thesis

Fitawek, W., and Hendriks, S.L. (2022). Large-scale agricultural investments and household vulnerability to food insecurity: Evidence from Kenya, Madagascar and Mozambique. *African Journal on Land Policy and Geospatial Sciences*, 5(1),107-138.

Conference papers

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Dedication

I dedicate this thesis to all mothers in academics and sciences who passed hard times during their studies. They are superheroes.

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Acronyms and abbreviations

AFGROLAND	African Food, Agriculture, Land and Natural Resource Dynamics, in the context of global agro-food-energy system changes
ANR	*Agence Nationale de la Recherche*
ATT	Average Treatment Effect on the Treated
ATU	Average Treatment Effect of the Untreated households
AUC	African Union Commission
CAADP	Comprehensive African Agricultural Development Programme
CARI	Consolidated Approach for Reporting Indicators of Food Security
CPL	Commercial Pressures on Land
CSI	Coping Strategies Index
DID	Difference-in-Differences
DRC	Democratic Republic of the Congo
DUAT	*Direito de Uso e Aproveitamento da Terra*
ESR	endogenous switching regression
FAO	Food and Agriculture Organization of the United Nations
FCS	Food Consumption Score
FDI	Foreign Direct Investment
FIML	Full information maximum likelihood
GDP	Gross Domestic Product
GFSI	Global Food Security Index
GHI	Global Hunger Index
HDDS	Household Dietary Diversity Score
IFPRI	International Food Policy Research Institute

IMR	Inverse Mills Ratio
LMI	Land Matrix Initiative
LSAI	Large-Scale Agricultural Investment
MAHFP	Months of Adequate Household Food Provisioning
ME	Marginal Effect
NEPAD	New Partnership for Africa's Development
NLC	National Land Commission
NPCA	NEPAD Planning and Coordinating Agency
NRF	National Research Foundation
PCA	Principal Component Analysis
PLAAS	Poverty, Land and Agrarian Studies
PSM	Propensity Score Matching
SNSF	Swiss National Science Foundation
TH	Transitional Heterogeneity
TLU	Tropical Livestock Unit
VAM	Vulnerability Analysis and Mapping
WDDS	Women Dietary Diversity Score
WFP	World Food Programme
WHO	World Health Organization

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Chapter 1: Introduction

1.1 Background

Agricultural investment is an essential and effective strategy for poverty alleviation, reducing hunger in rural areas where most of the world's indigent population lives (Deininger *et al*., 2011; FAO, 2012; Liu *et al*., 2013; World Bank, 2007). Investing in agriculture increases productivity and income. Improved agricultural production increases food availability in the market and reduces prices for consumers. Lower staple food prices enable the consumers to diversify their diets, including more vegetables, fruit, eggs, and milk, improving dietary quality (Bouis *et al*., 2013).

African leaders endorsed the Comprehensive African Agricultural Development Programme (CAADP). The CAADP is committed to increasing public investment in agriculture to 10% of the National Budget, striving to achieve 6% annual agricultural growth rates between 2015 and 2025 (AUC, 2014; AUC and NEPAD NPCA, 2015). The G7 and G20 committed to supporting and increasing agricultural investment in a developing country to improve food security (Liu *et al.*, 2013). Despite prioritising agricultural growth and investment, several African countries have struggled to achieve these commitments (AUC, 2020). Foreign direct investment (FDI) is still the primary source of capital to fill the investment divergence in the agriculture sector in developing countries (Mahmoodi & Mahmoodi, 2016; Osabuohien *et al*., 2020).

The 2008 food price and fuel price crisis accelerated large-scale agricultural investments (LSAIs) in several developing countries (Chilombo, 2021; Cochrane & Andrews, 2021; Cotula *et al.*, 2014; De Schutter, 2011; Di Matteo & Schoneveld, 2016; Quansah *et al*., 2020; Scheidel & Sorman, 2012). This triggered large-scale farmland land acquisitions in Africa, Asia, and Latin America (Cotula, 2011; Nolte *et al*., 2016). Africa has been the most targeted continent in receiving large-scale land acquisitions (Anseeuw *et al*., 2012; Bluwstein *et al*., 2018; Nolte *et al*., 2016; Osabuohien *et al.*, 2013; Osabohien *et al*., 2020; Schoneveld *et al*., 2011).

Studies demonstrate LSAIs can create jobs and increase the rate of technology adoption and input use (Baumgartner *et al*., 2015; Deininger & Xia, 2016; Heuermann, 2017). LSAIs can also harm livelihoods, environment, natural resources, and conflict owing to losing land rights in host

countries (Breu *et al*., 2016; Hess *et al*., 2016; Lunstrum, 2016; Yengoh & Armah, 2015). The socio-economic impact of the growing number of LSAIs has been heavily debated in the literature (Ali *et al*., 2017; Cotula, 2013; Herrmann, 2017; Nolte & Ostermeier, 2017). Most studies of land acquisitions in Africa focused on the environment and socio-economic affects (Borras *et al*., 2011; Burnod *et al*., 2013; Duvail *et al*., 2014; Hufe & Heuermann, 2017; Kibugi, *et al*., 2016; Veldwisch, 2015; Zaehringer *et al*., 2018a).

This study aimed to analyse the impact of LSAIs on households' food security. Data were used from the African Food, Agriculture, Land and Natural Resources Dynamics in Global Agro-food-energy System Changes (AFGROLAND) project from three sub-Saharan African countries. These countries included Kenya, Madagascar, and Mozambique.

1.2 Problem statement

Large-scale land acquisitions in developing countries followed the 2007/8 food price crisis (Cotula, 2009; Cotula *et al*., 2014; Deininger *et al*., 2011). These acquisitions are purchases, long-term (99-year) leases or concessions of over 200 ha by an external actor for agricultural production (food or agrofuel production), timber extraction, carbon trading, mineral extraction, conservation, or tourism (Nolte *et al*., 2016). The Land Matrix reported a steep increase in new deals since 2000 in 2016 (Nolte *et al*., 2016). The most targeted investment destinations in Africa, including Congo, the Democratic Republic of the Congo (DRC), Ethiopia, Liberia, Madagascar, Mozambique, Sierra Leone, South Sudan, Sudan, and Zambia (Land Matrix, 2021). Several destination countries are net food importers and recipients of emergency food assistance (Daniel, 2011).

Most large-scale land acquisitions in Africa involve investors from beyond the continent mainly from developed countries (Anseeuw, 2020; Nolte *et al*., 2016). Historical ties also remained strong; for example, French investors focused on West Africa and Madagascar, whereas Portuguese investors focused on Angola and Mozambique. Belgian investors are primarily active in the DRC (Nolte *et al*., 2016). The domestic food security concerns of the investor countries are one driver of land acquisitions, especially among food-importing countries (for example, the Gulf countries, China, and Japan) with low agricultural production potential (Deininger *et al*., 2011; GRAIN, 2008). Many developing countries' governments observe these investments as an opportunity to

increase revenue and modernise their agriculture sector (Cotula, 2009). These LSAIs have been challenged by how investments contribute to rural development and poverty alleviation (De Schutter, 2011).

The land is vital to several people's livelihoods, food security, and social identity (Cotula, 2009; Cotula, 2014; Daniel, 2011). However, inadequate attention was provided to the potential effect of investments on land effect on household food security. A principal cause of hunger and poverty is inadequate and secure access to land and natural resources. Globally, half of those suffering from hunger are smallholder-farming households, one in five households is landless (Schoneveld *et al*., 2011).

Studies indicate that investment in land in underdeveloped areas may bring much-needed employment and income opportunities in the agricultural, non-farm, and services sectors (Herrmann, 2017; Müller *et al*., 2021). Such opportunities could play a role in infrastructure and food distribution to supply local consumers and stabilise prices (Von Braun & Meinzen-Dick, 2009). LSAIs could lead to losing land rights, threatening household food sovereignty (Cotula *et al*., 2014; Mechiche-Alami *et al*., 2021; Ronald, 2014). Such investments may have adverse effects on local livelihoods of the current land users. They may encounter increased commercial pressure on land. This includes those who depend on the commons for grazing, fishing, and forest access (De Schutter, 2011; Di Matteo & Schoneveld, 2017). Others in the community, particularly those who lose their land, encounter a risk of income loss, especially if employment alternatives are limited, or the investment constrains or competes with traditional livelihood activities (Anseeuw *et al*., 2012; Osabuohien *et al*., 2020).

Despite critique in academic research and popular media, little research has been done to determine the local effect of LSAIs on household food security. Many studies have been conducted in the three countries on the impact of large-scale agricultural investments on environmental, social, ecological, land right and other issues rather than food security (Aabø & Kring, 2012; Burnod *et al*., 2015; Di Matteo & Schoneveld, 2016; Garcia *et al*., 2015; Quansah *et al*., 2020; Osabuohien *et al*., 2020; Schoneveld, 2016; Zaehringer *et al*., 2018a; Zaehringer *et al*., 2018b). Therefore, objectively assessing the food security outcomes of households in the communities hosting large-scale agricultural investments developing and African countries is vital. Many studies on food

security in the three countries used one or two food security indicators to evaluate the food security status of the households (Aabø & Kring, 2012; Garcia *et al*., 2015; Matondi *et al*., 2011; Mutea *et al*., 2019; Speller *et al*., 2017). This study was used seven internationally recognised food security indicators and other econometrics models that describe food security in all dimensions (availability, access, utilization and stability), allowing for comparability of indictors and enabling a deeper understanding of the various elements of food security constructs.

1.3 Research objectives

The main objective of this study was to analyse the impact of LSAI on food security, using three countries case studies, indicating Kenya, Madagascar, and Mozambique. This study employed secondary data collected by the African Food, Agriculture, Land and Natural Resource Dynamics in the Global Agro-food-energy System Changes (AFGROLAND) project. This study includes three specific objectives to discuss the main objective.

i. The first specific research objective was to examine and compare the food security status of the households in the three countries using various food security indicators. It was hypothesised that households with employed members by LSAI and contract farming households had better food security than the non-engaged and counterfactual households.
ii. The second specific objective was to analyse the impact of LSAI on households' food security in the three countries using the endogenous switching regression model (ESR). The same hypothesis as above was asserted for this specific objective. The empirical test would confirm the findings of the non-parametric results.
iii. The third objective was to identify the most affected food-insecure households group using principal component analysis (PCA) and ordered probit model. It was assumed that not all groups of households are equally affected.

1.4 Study outline

This study comprises the following eight chapters:

- Chapter 1 provides an introduction and rationale for the study
- Chapter 2 reviews the literature

- Chapter 3 describes the study areas, the AFGROLAND project and data sources, and data analysis methods
- Chapter 4 discusses the first specific objective
- Chapters 5 and 6 discuss the findings of the second specific objective
- Chapter 7 reports the findings of the third objective
- Chapter 8 provides the summary, conclusions, and recommendations

Chapter 2: Literature review

2.1 Introduction

Chapter 2 reviews literature on LSAIs in the three countries, drivers of LSAIs, the relationship between LSAIs, food security, and literature on impact analysis.

LSAIs, large-scale land acquisition (LSIA), large-scale land investment (LSLI) or 'land grabbing' by those who observe the practice negatively, all these names used inter-changeably. The Land Matrix defines large-scale land acquisitions as:

> "land purchases, leases or concessions of lands of 200 hectares or more by domestic, diaspora, state or external actor for long periods of time for the purpose of agricultural production (food or agro-fuel production), timber extraction, carbon trading, mineral extraction, conservation and tourism" (Nolte *et al*., 2016).

Large-scale land acquisitions are often classified as large-scale plantation and contract farming (Burnod *et al*., 2015; Hall *et al*., 2017; Scoones *et al*., 2014). The plantation is a self-contained agribusiness growing a single crop on a large area of land using capital intensive devices, employed labour, and vertically integrated into processing chains (Hall *et al*., 2017). In Africa, these large-scale land acquisitions started during colonial concessions to produce cash crops, such as coffee, tea, rubber, cotton, and sugarcane (Hall *et al*., 2017). Most plantations create job opportunities and help transfer technology; however, sometimes, plantations grab smallholder land and create inadequate, low-quality jobs.

Contract farming is often an "inclusive business model" linking smallholders into commercial value chains (Hall *et al*., 2017; Tamura, 2021). Eaton and Shepherd (2001) define contract farming as an agreement between farmers and processing or marketing firms to produce and supply agricultural products under forwarding contracting agreements at predetermined prices. Contract farming models could have a positive impact on agricultural development and innovation in developing countries (Abebe *et al*., 2013; Barrett *et al*., 2012; Bellemare, 2012; Bellemare & Novak, 2016; Eaton & Shepherd, 2001; Minot & Sawyer, 2016; Singh, 2002). Contract farming

could secure existing local land rights and foster smallholder farmers commercialisation (Väth *et al*., 2019; Von Braun & Meinzen-Dick, 2009).

Studies indicated that contract farming could help achieve multiple Sustainable Development Goals (SDGs) related to food security, poverty alleviation, and biodiversity conservation (Bolwig *et al*., 2010; Deans *et al*., 2012; Vabi Vamuloh *et al*., 2019). Contract farming creates a system linking smallholder farmers with domestic and international buyers (Barrett *et al*., 2012). When contract farming is effectively designed and well managed, it increases smallholder farmer incomes and productivity through training, access to credit, and the market (Abramovich & Krause, 2014; Arouna *et al*., 2021; Bellemare, 2012; Herrmann, 2017; Herrmann *et al*., 2018; Nguyen *et al*., 2015). Contract farming models are not always win-win situations (Olounlade *et al.,* 2020). Sometimes contract farming companies profit without supporting smallholder farmers (Ruml & Qaim, 2021).

A large share of sub-Saharan Africa land was held under customary or traditional forms of land ownership (more than 60 percent). Recently, the land tenure system in Africa has been changing. Only a few households in the three countries have certified land (land-titled), although the land tenure systems are diverse in the three countries (Burnod *et al*., 2017; Delcourt, 2018; Giger *et al*., 2019). Most land in Kenya is under the customary land tenure system; the state owns only 10% of the land. In Madagascar, land can be owned by the state, individuals, or groups. Individuals can register and obtain a land title from the land administration system, but only 7% of Madagascar's land is titled. In Mozambique, land and its associated resources are the state's property, individuals may use and benefit from the land known as DUAT.

2.2 Large-scale agricultural investments in Africa

Africa's land tenure regimes are rooted in the colonial era and colonial histories. Land and resource grabbing started in Africa post-colonial before the global food and fuel crises in 2007/2008. Sub-Saharan Africa is the most attractive destination of land-scale land acquisitions for several reasons, such as land and labour being cheap, endowed with rich natural resources, including fertile soils and water, and a suitable climate for crop production. Most large-scale land acquisition leases in Africa range from 50 years up to 99 years. Governments in sub-Saharan Africa are encouraging

large-scale acquisition and changing land and investment policies to attract more investors. Africa has been the most targeted continent, with 637 concluded deals involving a total area of 26 million hectares (Land Matrix, 2021). Eastern Europe is the second target continent with 522 deals (20 million hectares), followed by Asia with 484 deals (8.6 million hectares), and Latin America 357 deals (9.7 million hectares) (Land Matrix, 2021) (Figure 2.1).

Land acquisitions in the three countries (Kenya, Madagascar, and Mozambique) have also increased following the 2007/2008 global crisis. As of June 2021, the Land Matrix database recorded concluded deals covering 343,038 ha in Kenya, 588,322 ha in Madagascar and 1,852,874 ha in Mozambique.

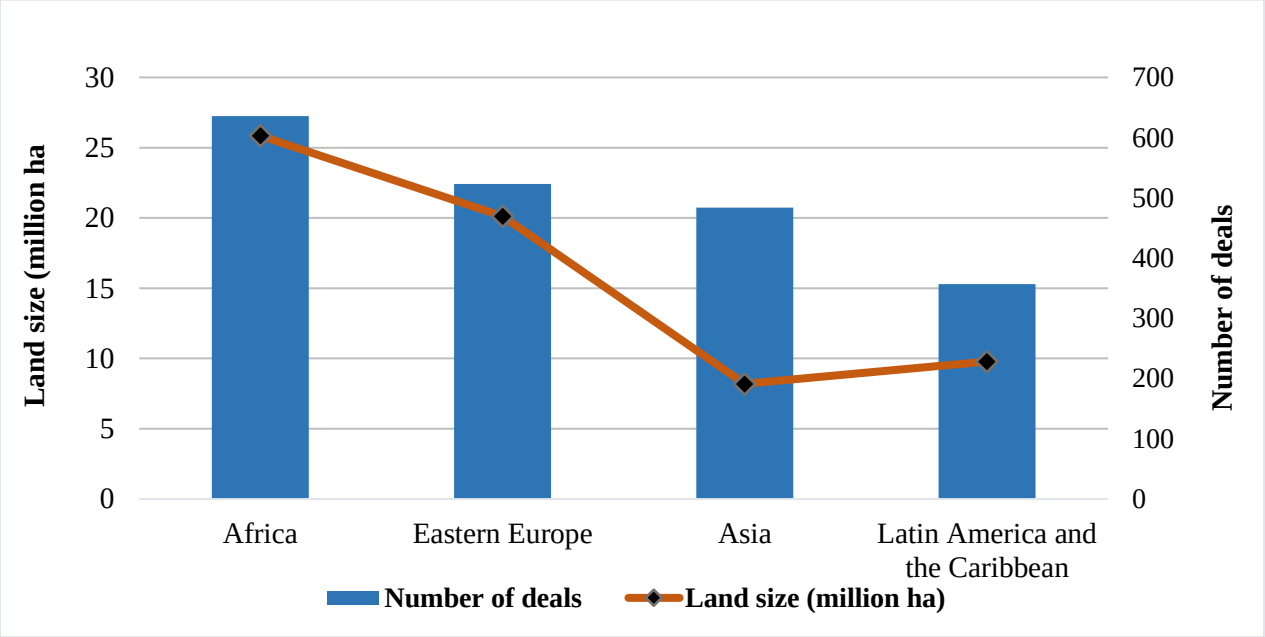


Figure 2.1: Land size and number of deals by continent

Source: Land Matrix Report (2021).

2.2.1 Large-scale agricultural investments in Kenya

In Kenya, the new National Land Policy was established in 2009, after more than a decade of civil society activism on the land issue. The National Land Policy statements were incorporated into the 2010 constitution. In 2012, National Land Commission (NLC) managed public land on behalf of the national and county governments. Potentially significant powers were provided to the new

NLC, such as control over the registration, control over the allocation and management of public land, control over resettlement, and powers to cancel illegal title certificates. The Community Land Act was endorsed and commenced in 2016 as the framework through which customary holdings were identified and registered. This law provides the recognition, protection, management, administration, and registration of community land, accounting for over 60% of Kenya's stock of land (Alden, 2018; Boone *et al*., 2019).

LSAIs have been increasing in Kenya following the 2007/2008 food and fuel crisis. According to the Land Matrix Kenya data (Land Matrix, 2021), about 343,038 hectares of land were under concluded contracts, primarily for tree production (44.4%), food crop (22.2%) and sugarcane (33.3%). Most investors were from Britain and other European countries (more than 30% of the deals), and Asia (around 20% of the deals in Kenya) (Land Matrix, 2021).

2.2.2 Large-scale agricultural investments in Madagascar

The Government of Madagascar launched the National Land Programme in 2005. Madagascar Land Observatory is to monitor the National Land Programme (Teyssier *et al.,* 2010). In Madagascar, land can be owned by the state, individuals, or groups. Individuals can register a land title through the centralised land administration system or a land certificate through a local land office. Even though land titles and land certificates convey private ownership and provide tenure, only around 7% of Madagascar's land are titled (Teyssier *et al.*, 2010). Landowners have the right to exclusive possession and use of their land, freely transferrable. Most of the land in Madagascar is under customary law, perceived as the ancestors' land and granted to a community as their sacred heritage.

Madagascar has been one of the primary targets for land-based investments in Africa (Cotula, 2009). Between 2000 and 2017, 96 companies announced their plan to develop large-scale farms; 76% of companies withdrew their investment projects owing to political instability (Andrianirina-Ratsialonana *et al*., 2011; Burnod *et al*., 2013; Reys *et al*., 2018). Most investors were from Western Europe (more than 20% of the deals) and Asia (25% of the deals) (Nolte & Ostermeier, 2017). Promoting LSAIs remains high on the political agenda (Burnod *et al*., 2017). According to the Land Matrix (Land Matrix, 2021), in Madagascar, about 588 322 ha of land were acquired with

concluded contracts, of which 71.5% for crop production (rice, corn, vegetable, and sugarcane) and 28.5% for biofuel (jatropha) production. Like other African countries, LSAIs in Madagascar led to labour migration from the surrounding areas (Burnod *et al*., 2013; Cotula, 2011).

2.2.3 Large-scale agricultural investments in Mozambique

The Mozambique 1997 Land Law mentioned that the state owns land, allocating a legal right to all land users, commonly known as a *Direito do Uso e Aproveitamento da Terra* (DUAT). A DUAT recognises the land rights of communities and individuals acquired through customary systems. Over 90% of land in Mozambique is informal and customary tenure arrangements. Land disputes are common in rural areas of Mozambique because of insufficient accounting of community land rights and uses. Concessions were granted to investors, imposing excessive costs on investor projects. In Mozambique, provincial governors can authorise land up to 1,000 hectares, the Minister of Agriculture up to 10 000 ha, and the Council of Minister grant land above 10 000 ha.

Mozambique has been one of the top LSAIs target countries from Africa. According to the Land Matrix Mozambique data (Land Matrix, 2021), 1.82 million hectares of land were under concluded contracts, mainly for crop production (63.7%), forestry (15.2%), and others unspecified (21.1%). Most investors were primarily from South Africa (around 20% of the deals), Portugal (10% of the deals), other European countries (more than 40% of the deals), Asia (10% of the deals), and the United States (around 5% of the deals) (Land Matrix, 2021).

2.3 Drivers of large-scale agricultural investments

Emerging economies primarily drive the global land acquisitions in search of alternative ways to secure the food and fuel supply of the near future (Verhoog, 2013). Several factors were proposed as drivers of LSAIs. A primary driver of LSAIs is the food price crisis of 2008, increasing competition for land and water resources (Daniel, 2011).

Developed countries, such as Europe and the United States of America, sought to acquire land in developing countries to produce cash crops and biofuels. Food-importing countries with land and water constraints, such as the capital-endowed Gulf States, also investing in developing countries.

Countries with large populations and food security concerns, such as China, South Korea, and India, also pursue opportunities to produce food abroad to balance domestic production risks and diversify food sources (Shete & Rutten, 2015). These investments focus on developing countries with lower production costs and abundant land and water (Daniel & Mittal, 2009). Population growth in developing countries will lead to increased demand for food products, expanding urbanisation, and rising incomes that need to be met by bringing more land into farming and improving productivity (Malik, 2015).

Climate change is also driving interest in green energy, including biofuel production (Deininger, 2013). Conversely, climate change recently affected agricultural production in several regions, contributing to higher food prices and rising food and energy security (Davis *et al*., 2015). In African countries like Ethiopia and Madagascar, biofuel production is the dominant purpose for land deals (Friis & Reenberg, 2010). Previously, FDI in agriculture was allocated to cash crops (coffee, tea, sugar, or bananas). The FDIs primarily focus on staples or biofuel crops, such as sugar cane, flower, castor oil plants, oil palm trees, jatropha, sweet sorghum, maize, cassava, wheat, and rice.

The extent of land tenure security is an additional driving factor for land acquisitions (Dwyer, 2013). Studies indicate a strong correlation between weak land tenure security and land acquisitions (Deininger, 2013; Anseeuw *et al.*, 2012). For instance, countries such as Cambodia, Ethiopia, Madagascar, Laos, and Ghana, have weak land tenure security and are highly targeted by LSAIs. This is more likely related to political and institutional factors. Sub-Saharan African land is considered underutilised and targeted as cheap and fertile land for acquisitions (Osabuohien *et al*., 2013).

Some African governments encourage land acquisitions by foreign companies by providing investment incentives, such as zero import duties and tax holidays, for several years. This made the country an attractive place for investment in agribusiness (Cotula, 2009). In some countries, investors producing export products are more encouraged than those who do not. This indicates that the primary purpose of the shift to LSAI is foreign exchange earnings. It is less concerned with domestic food security.

2.4 The relationship between large-scale agricultural investments and food security

Many developing countries consider FDI in the agriculture sector essential to acquire agricultural inputs, increase productivity, and achieve sustainable growth and poverty reduction (Mahmoodi & Mahmoodi, 2016; Persson, 2016). LSAIs creating many jobs for local people improve food security (Smalley, 2013). Some companies also provide meals for their employees by purchasing food from local markets, eradicating hunger and poverty (Deininger & Xia, 2016). The additional income that employed households receive improves their purchasing power and helps diversify their consumption. Studies indicated that LSAIs producing food crops for the domestic market positively affect food security by increasing food availability to the domestic market (Aabø & Kring, 2012; Kirigia *et al*., 2016).

LSAIs also harm food security; a large-scale agricultural investment can lead to losing land rights, affecting household food security (Cotula *et al*., 2014; Daniel, 2011; GRAIN, 2008). These investments may have potentially destructive effects on local livelihoods for both the current land users. They may encounter increased commercial pressure on land and those who depend on the commons for grazing and fishing grounds and forest access (De Schutter, 2011). Others in the community, particularly those who lose their land, encounter the risk of income loss, especially if employment alternatives are limited or the investment constraints or compete with traditional livelihood activities.

Most LSAIs create job opportunities for the surrounding communities. This helps the household to obtain an extra income to diversify their diets. Families engaged in contract agreements with LSAIs obtain access to input, credit, and market, helping to increase production and improve food security. Some LSAIs displace smallholder households from their area, harming food security. Figure 2.2 explains the conceptual framework of the study.

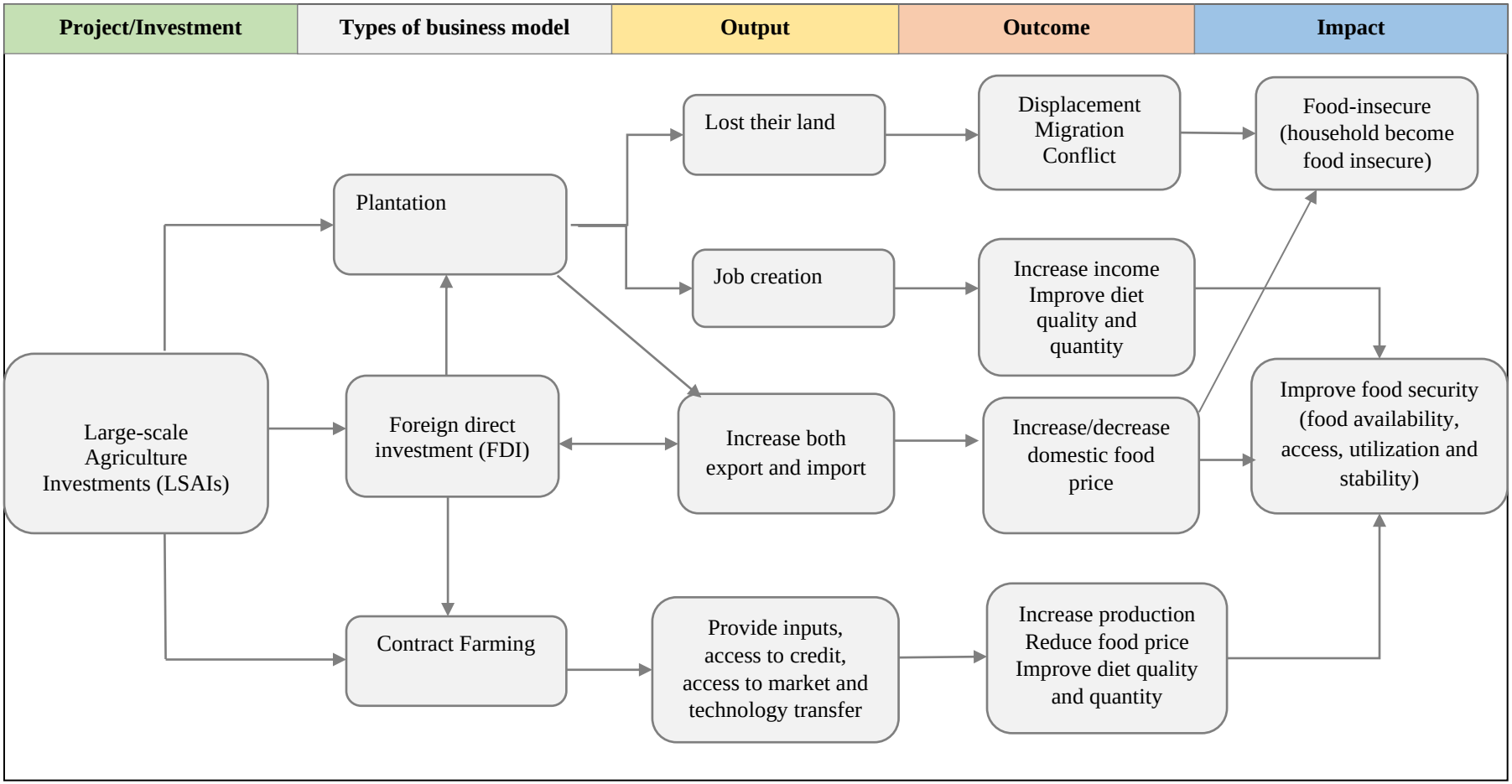


Figure 2.2: Conceptual framework on the impact of LSAIs

Source: Own work.

2.5 Impact analysis studies

The impact of LSAIs is controversial. Authors reported the adverse effects of land acquisitions on the local community; others mentioned that large-scale land acquisitions positively affect local communities.

Several econometric models can analyse the impact of a programme, project, or policy. Some methods are difference-in-difference (DID), propensity score matching (PSM), Instrumental variable, reflexive comparisons, and the ESR method. DID is a method comparing a treatment and comparison group before and after a project (Baker, 2000). Constructing panel data sets can be expensive and time-consuming. The design assumes potential selection bias (Baker, 2000; Jalan & Ravallion, 1998). PSM has been widely employed to examine the impact of a programme or project (Rosenbaum & Rubin, 1983). PSM attempts to create the observational similarity with an experiment where everyone has the same probability of participation. Concerns about remaining selection bias in estimating the propensity score remain (Ravallion *et al.*, 2005).

An instrumental variable is one of the econometric techniques that can compare programme participants and non-participants by correcting selection bias (Baker, 2000); however, it is challenging to obtain a vital instrument (Becker *et al*., 2016). Reflexive comparisons is another quasi-experimental design, needing a baseline survey of participants before project implementation and a follow-up survey after implementation (Baker, 2000). The challenge involves that reflexive comparisons may not distinguish between the programme and other external factors, therefore, affecting the reliability of results (Ravallion *et al.*, 2005).

This study used one data point for each country due to lack of baseline data. The study employed the ESR model, which is better to account for selection bias in our estimation of the impact of participation in LSAIs on food security than the above impact analysis models. The ESR model is essential to control endogeneity challenges by estimating a simultaneous equations model by complete information of maximum likelihood (Kabunga *et al*., 2012; Kassie *et al*., 2014; Malikov & Kumbhakar, 2018). The main problem with using ESR model was finding valid instrumental variables (Manda, 2016).

Most studies in the three countries focused on the impact of LSAIs on household income (Aabø & Kring, 2012; Burnod *et al*., 2015); production and productivity (Di Matteo & Schoneveld, 2016; Garcia *et al*., 2015); livelihoods of the households (Quansah *et al*., 2020; Osabuohien *et al*., 2020), land tenure and governance (Burnod *et al*., 2015; Garcia *et al*., 2015) and environmental aspects (Aabø & Kring, 2012; Di Matteo & Schoneveld, 2016; Giger *et al*., 2020; Zaehringer *et al*., 2018a), rather than food security. Studies on the impact of land acquisition on households food security in Kenya, Madagascar, and Mozambique, mainly employed descriptive analysis and single measures of food security (Aabø & Kring, 2012; Garcia *et al*., 2015; Matondi *et al*., 2011; Mutea *et al*., 2019; Speller *et al*., 2017) (Table 2.1). This study employed qualitative and quantitative approaches to analysing the impact of LSAIs on household food security in the three countries. The study findings contribute to the literature by providing empirical evidence for food security and land-related concerns.

The findings from most of the studies indicate that LSAIs created job opportunities, built infrastructure, and enabled access to farm inputs and new technologies (Hall *et al*., 2017). Additional studies indicated that LSAIs had negative socio-economic and environmental impacts on communities. These effects include conflict, migration, air and water pollution, and reduced land and water access for smallholder farmers (Aabø and Kring, 2012; Di Matteo and Schoneveld, 2016; Garcia *et al*., 2015; Zaehringer *et al*., 2018a; Zaehringer *et al*., 2018b). Table 2.1 presents a summary of case studies that examined the impact of LSAIs on household food security in these three countries.

Table 2.1: Overview of case studies on LSAIs conducted in the study areas

Source	Country	Purpose of the study	Method	Impacts
Aabø and Kring, 2012	Mozambique	The political economy of large-scale agricultural land acquisitions: Implications for food security and livelihoods in rural Mozambique	Descriptive analysis	The study stated that LSAI projects in the study areas built infrastructure and generated employment but led to significant conflict and negative social, economic and environmental degradation.
Burnod *et al*., 2015	Madagascar	Large-scale plantation and contract farming effects: qualitative and quantitative assessment in Madagascar	Qualitative and quantitative assessment methods	The authors reported that large-scale plantations worsened poverty because the company paid low wages. The employment did not contribute significantly to the resilience efforts of households that lost their land. The company benefited contract farming households by remuneration for family labour, access to farm inputs, and fewer land losses.
Di Matteo and Schoneveld, 2016	Mozambique	An analysis of investment trends, business models and social and environmental impact conduct in Mozambique	Descriptive analysis	The paper's findings indicated that most investments in Mozambique targeted domestic food markets, which increased productivity and national food security. However, social and environmental land-use conflicts rarely occurred.
Fitawek *et al*., 2020	Madagascar	The effect of LSAIs on household food security in Madagascar	Qualitative and quantitative methods	The paper presented employed households were more food-secure than other households. While contract farming households were more food-insecure than other households, but higher diet diversity than employed.
Garcia *et al*., 2015	Kenya	Food security and land governance factsheet Kenya	Review of literature	The researchers established that land rental markets were the most important means for smallholder farmers to access additional land for cultivation and improved household food security. However, LSAIs in biofuel production and leasing agricultural land for export production affected local food production.
Giger *et al*., 2020	Kenya	Large agricultural investments in Kenya Nanyuki Area: Inventory and analysis of business models	Both qualitative and quantitative approaches	The study indicated that most recent investments took place in relatively more minor land areas, unlike the large-scale land deals that often harm local communities. However, access to water is a highly relevant concern in the study area.

Source	Country	Purpose of the study	Method	Impacts
Hakizimana *et al.*, 2017	Kenya	Land and agricultural commercialisation in Meru County, Kenya: evidence from three models	Mixed-methods approach	They found both winners and losers in the three models. This was because the agrarian setting was undergoing change and influenced by local and external factors; attributable to government policies and international export commodity prices.
Mutea *et al.*, 2019	Kenya	Livelihoods and food security among rural households in the North-Western Mount Kenya Region	Qualitative and quantitative assessment methods	They established that participation in LSAIs (as wage workers or sub-contract farmers) were not influencing food security.
Porsani *et al.*, 2019	Mozambique	The impact of large-scale land acquisitions on poverty: findings from a case study in Mozambique	Descriptive analysis	The finding of the study indicated that large-scale land acquisitions worsen farming conditions and aggravate poverty.
Porsani *et al.*, 2017	Mozambique	The divergence between anticipated and real benefits of Chinese investment in the Limpopo Valley	Qualitative and quantitative assessment methods	The authors established that the investment in the study area created job opportunities and contract farming agreements for the surrounding communities. However, the community suffered from a lack of proper compensation and single-headed households encounter aggravated risk because of the absence of insurance.
Zaehringer *et al.*, 2018a	Kenya	How do LSAIs affect land use and the environment on the western slopes of Mount Kenya? empirical evidence based on small-scale farmers' perceptions and remote sensing	Qualitative and quantitative assessment methods	This study established that LSAIs had both positive and negative impacts. Positive spillovers from LSAIs onto small-scale farmers' land in agricultural technologies and job opportunities. However, LSAIs have other environmental impacts, such as air and water pollution and decreased water availability for smallholder farmers.
Zaehringer *et al.*, 2018b	Mozambique	LSAIs trigger direct and indirect land-use change: new evidence from the Nacala corridor, Mozambique	Qualitative and quantitative assessment methods	The authors stated that LSAIs had both positive and negative effects. However, the positive spillover effects could not compensate for the negative impacts.
Zaehringer *et al.*, 2021	Kenya, Mozambique and Madagascar.	LSAIs in Eastern Africa: consequences for small-scale farmers and the environment	A remote-sensing-based analysis	The study established that LSAIs affected the surroundings negatively. LSAIs have only some benefits on employment opportunities and infrastructure improvement. The impacts of LSAIs are harmful, by reduced access to land and water, pollution, health issues, and unsatisfactory working conditions.

Chapter 3: Methodology

3.1 Introduction

This chapter discusses the methodology employed in this study. This chapter is divided into five sections. The first section summarises the three countries, followed by a description of the study areas in the second section. The third section provides information about the AFGROLAND project. The fourth section data collection methods and sample size. The concluding section explains the data analysis methods employed in this study.

The agriculture sector in these three countries is dominated by smallholder production; 78% of the total agricultural production comes from the smallholder sector in Kenya; 70% in Madagascar; 95% in Mozambique (Suit & Choudhary, 2015). Agriculture in Kenya contributes to 25% of gross domestic product (GDP); 65% of exports and employs 60% of the total labour force (Birch, 2018). In Madagascar, agriculture contributes to 17% of GDP, 40% of export earnings and 60% of the entire labour force and in Mozambique, 24% of GDP and 80% of the entire labour force (World Bank, 2019). Females accomplish 80% of Kenya's farming activities compared to 35% in Mozambique and few in Madagascar (Onyalo, 2019). According to the World Bank 2019 report, Kenya has the higher GDP per capita, USD 1816, followed by Madagascar USD 523, and Mozambique USD 503.

Kenya has a well-integrated economy with a comparatively mature commercial agriculture sector than Madagascar and Mozambique (Giger *et al*., 2019). Agricultural from the total land was 48% in Kenya, 63% in Mozambique and 71% in the island in Madagascar (World Bank, 2019). Since 2009, Mozambique hosted more LSAIs than Kenya and Madagascar (Land Matrix, 2021; Nolte *et al*., 2016).

Crops and livestock production vary across the three countries. Maize, potatoes, and wheat are the main crops cultivated in Kenya; rice and cassava are the most common crops in Madagascar; maize, sorghum, and beans are the most common in Mozambique (Giger *et al*., 2019). Cattle production is more dominant among smallholder farmers in Kenya and Madagascar, whereas poultry is more common in Mozambique. According to the Global Hunger Index (GHI) 2020 report, the three countries have low GHI scores (Von Grebmer *et al*., 2020). Kenya had a better GHI (ranked 86th out of 117 countries) than Madagascar and Mozambique (ranked 114th and 96th, respectively) (Von Grebmer *et al*., 2020).

3.2 Description of the study areas

This section illustrates detailed descriptions of the study areas in the three countries (Kenya, Madagascar, and Mozambique). The AFGROLAND project selected the three countries for two reasons. The main reason was these three countries were among the top destination of LSAIs in Africa. Studies on the impact of a land acquisition on households' food security in Kenya, Madagascar, and Mozambique mainly used descriptive analysis and single measures of food security compared to other targeted African countries, such as Ethiopia.

In each country, LSAI projects were purposively selected in the Nanyuki area from Kenya; Satrokala and Ambatofinandrahana from Madagascar and the Nacala Corridor of Mozambique (Monapo and Gurué districts) as shown in the figures below (Figures 3.1-3.3) (Reys, 2016; Reys & Burnod, 2017; Reys & Mutea, 2017).

Nanyuki is a district in central Kenya where commercial farming is common. The land acquisition plantations within the Nanyuki district experienced various transitional changes. Companies in Buuri (located about 45 km North-East of Nanyuki), Kangaita (located about 10 km East of Nanyuki), and Nyariginu (located about 6 km North-East of Nanyuki) engage in flower farming, whereas farms in Naibor (located about 22 km North of Nanyuki) and Tigithi (located about 16 km South of Nanyuki) grow vegetables, Mutarakwa- Kiambogo (located about 27 km North-East of Nanyuki) farmers produce vegetables on a contract basis (Table 3.1). Barrie (located about 60 km North-East of Nanyuki) is a counterfactual area without LSAIs (Figure 3.1). The principal farming activity practised by households in the surrounding area is growing food crops (Reys & Mutea, 2017).

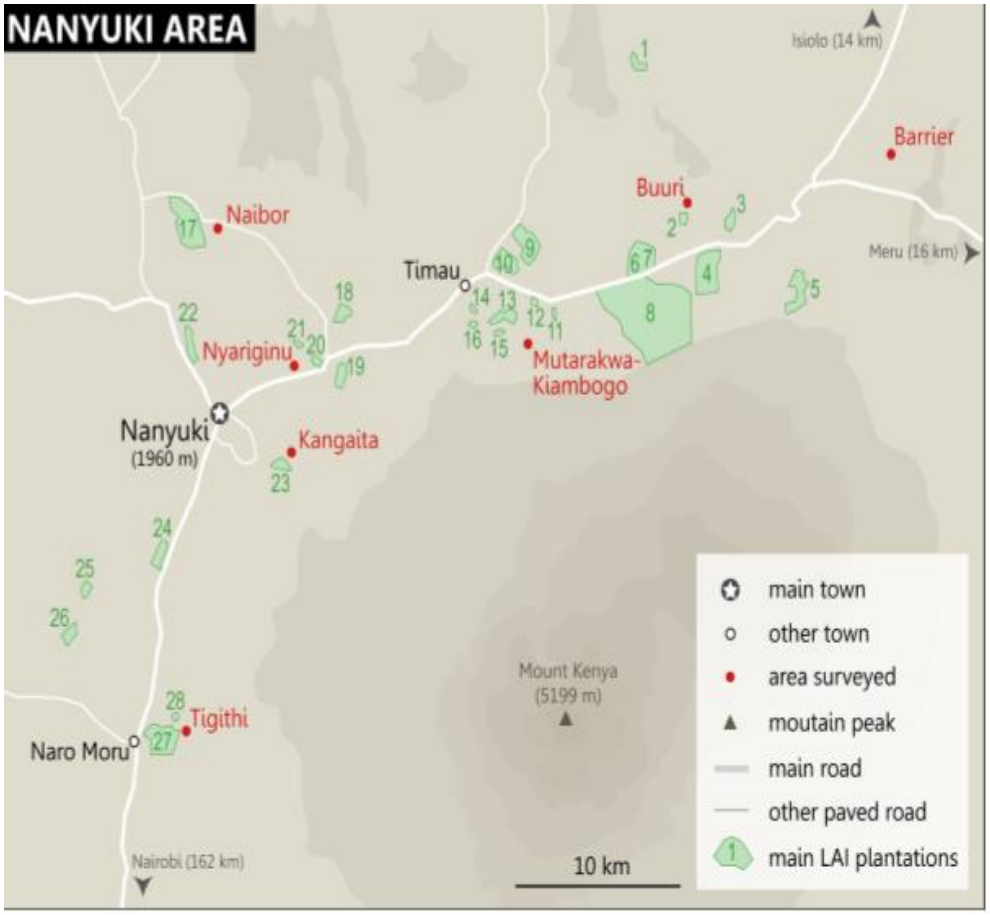


Figure 3.1: Nanyuki surveyed areas in Kenya

Source: Reys and Mutea (2017).

With Madagascar, the project selected two companies in the Satrokala and Ambatofinandrahana municipalities (labelled Company X and Y) (Table 3.1). X is a 10-year-old Italian company, mainly producing maize and geranium on about 3500 ha in Satrokala (Reys and Burnod, 2017). Company Y is a 20-year-old Malagasy out-grower scheme, operating in Ambatofinandrahana. It contracts 2000 households to produce barley.

Company X farms 3500 hectares split into several plots surrounding the small town of Satrokala on a plateau (Figure 3.2). Satrokala town's population has been thriving since the establishment of the company in 2009. Most households in the town were migrants. The plateau is a highland grassland terrain suitable for extensive grazing of livestock. Most households were cattle breeders and farmers (Reys & Burnod, 2017).

Table 3.1: List of companies in the study areas

Country	Name of Company	Type of crop produce	Investor country	Types of farms
Kenya	AAA Growers	Vegetables	Vietnam	Plantation and contract farming
	Kariki LM	Flowers	Domestic	Plantation
	KHE	Vegetables	Domestic	Plantation
	VP Food Produce	Vegetables	Domestic	Contract farming
	Sunripe	Fresh Vegetables	Norwegian	Plantation
	Bloomingdale Roses	Flowers	Domestic	Plantation
	Kisima Flower	Flowers	Domestic	Plantation
	Equinox Farm	Flowers	USA	Plantation
	HM Cluase Kenya LM	Vegetables	France	Plantation
Madagascar	Company X	Jatropha	Italy	Plantation
	Company Y	Barley, corn and sugar	France	Contract farming
	Company Z	Artemisia	Malagasy company	Contract farming
Mozambique	ATFC	Eucalyptus	United Kingdom	Plantation
	Agro Moz	Soybeans, rice	Portuguese	Plantation
	Cha Magoma	Tea plantation	South African	Plantation
	Hoyo Hoyo	Maize, soybeans	Portuguese	Plantation
	Rei Do Agro	Soybeans	Domestic	Plantation
	RDC	Vegetables	Mauritius	Plantation
	Murrimo Macadamia	Macadamia nuts, maize, bens	South African	Plantation
	SDZ	Tea plantation	Domestic	Plantation
	GF Macadamia	Nuts	Netherlands	Plantation

Company Y engages 7200 farmers in three regions, indicating Vakinankaratra, Amoron'Imania and HauteMatsiatra. Ambatofinandrahana is one commune in the Amoron'Imania region. At the time of sampling, 2636 farmers were involved and cultivated in 256 ha. A few households were contracted to Company Z to produce *artemisinin* or wormwood, an antimalarial agent

(Reys & Burnod, 2017). Ifasina commune was selected as a counterfactual zone, 25km in the West of Ambatofinandrahana-town (Figure 3.2).

Figure 3.2: Map the study sites of Madagascar

Source: Reys and Burnod (2017).

The project selected two districts from Mozambique in the Nacala Corridor (Northern Mozambique); Monapo in the Nampula province and Gurué in the Zambezia province (Reys, 2016); three factual zones (Manlé and Ruacé from Gurué and Ramiena from Monapo); two counterfactual zones (Muela in Gurué (located about 30 km South-East of Gurué-town) and Canacué in Monapo (located about 33 km South of Monapo-town) were selected from the two districts (Figure 3.3).

Manlé (located about 26 km East of Gurué-town) is a rural Gurué district near a tea plantation, "Cha Magoma" (Table 3.1). The other investment area in the Gurué district is Ruacé, a town near a soya plantation, "Hoyo Hoyo"; another soya plantation, Rei Do Agro, is 11 km away. In the Monapo district, Ramiena was selected as an investment area located adjacent to sisal plantation "Ramiena" (Figure 3.3) (Reys, 2016).

Figure 3.3: Map showing the study sites in Mozambique

Source: Reys (2016).

3.3 AFGROLAND project

This study employed secondary data collected by the AFGROLAND project. The project was funded by the Belmont Forum and the Joint Programming Initiative on Agriculture, food security and climate change (FACCE-JPI) African Food, Agriculture, Land and Natural Resource Dynamics (AFGROLAND) project through the *Agence Nationale de la Recherche* (ANR), France, the Swiss National Science Foundation (SNSF), Switzerland, and the National Research Foundation (NRF), South Africa.

The objective of the AFGROLAND project was to analyse how the global agro-food-energy system changes affect the countries in the global South (Africa). The project planned extensive empirical research and spatial multidimensional and multi-scale approaches. The project had five work packages (WPs) to attempt these objectives:

- Work package one (WP1): to identify the drivers of change within the global agro-food-energy systems, how they impact on and in return are shaped by governance changes at the regional, national, and local levels.
- Work package two (WP2): to better qualify the rush for land by assessing and defining the production and land-based investment models being developed.
- Work package three (WP3): to quantify and analyse these changes concerning land and natural resource use and governance (land, water, and soil) and assess the effects on sustainable soil ecosystem service provision.
- Work package four (WP4): to evaluate how such changes impact food security (with a focus on the large enterprises and smallholders) and on food access (employment creation, sustainable livelihoods) at the local/national level.
- Work package five (WP5): to ensure cooperation across the key disciplines/WPs involved and proactive dissemination strategies and continuous exchange with stakeholders in the policy, civil society and business communities.

This study used WP4 data to analyse and compare the impact of LSAIs on food security in Kenya, Madagascar, and Mozambique.

3.4 Methods of data collection and sample size

The study employed secondary data (qualitative and quantitative) from the three countries, collected by the AFGROLAND project through formal survey techniques, using semi-structured questionnaires. The data were collected from January to March 2017 from Kenya; March to April 2017 from Madagascar; September to October 2016 from Mozambique. The lean season in Kenya is from May to September, in Madagascar from January to March, and in Mozambique from September to February (FAO, 2021).

The project employed a three-stage stratified random sampling procedure to select sample households. In the first stage, seven sub-locations were purposively selected from the Nanyuki area in Kenya, two municipalities from Madagascar (Ambatofinandrahana & Statrokala) and Mozambique (Gurué & Monapo) based on the availability of LSAI. In the second stage, companies were purposively selected based on the development level (most were established before 10 to 20 years), area of cultivated (i.e., greater than 200 ha, only two LSAI companies in Kenya were less than 200 ha) and the number of households potentially affected (through

contracts, jobs, or land grab). Finally, 1651 representative households were randomly selected for interviews from the three countries (Table 3.2).

Table 3.2: Countries survey details

Country	Number of households interviewed	Factual			Counterfactual
		Employed	Contract farming	Non-engaged	
Kenya	546	46	58	282	160
Madagascar	601	61	124	230	186
Mozambique	504	121		155	228
Total sample	1651	**228**	**182**	**667**	**574**

Source: Reys and Burnod (2017).

Households were classified into four categories based on their participation in LSAIs and their location (factual or counterfactual). These categories include:

- Households where at least one member was employed by an LSAI company (termed employed households)
- Households where at least one member engaged with a contract agreement with an LSAI company
- Households lived in the same areas as the two companies but were neither employed nor contracted by the companies (non-engaged)
- Counterfactual households residing on average 25 km away from the influence zone of the particular companies.

This study defines the influence zone as areas within a 25 km radius of LSAIs.

3.5 Methods of data analysis

This study employed descriptive and econometrics models to analyse the data. Descriptive statistical devices like mean, percentage, chi-square, t-test, PCA, and the seven food security indicators were used to analyse the first specific objective; the findings are presented in Chapter 4 of this thesis. Econometric models, such as probit and ESR model, were used to analyse the second objective; the results are shown in Chapters 5 and 6 of the study. PCA and ordered probit model were used to analyse Objective 3 of the study; the results are presented in Chapter 7.

3.5.1 Measuring food security

Food security is multidimensional and has no single globally recognised measure (Hendriks *et al*., 2016). Therefore, this study used seven internationally recognised food security indicators to estimate the dimensions of food security. These indicators included:

- The household dietary diversity score
- Women's dietary diversity score (WDDS)
- Food consumption score
- The month of adequate household food provision
- Coping strategy index
- Asset
- Consolidated Approach for Reporting Indicators of Food Security (CARI) (Table 3.3)

The food consumption score, months of adequate household food provision, and CARI measured food availability. The household dietary diversity score and WDDS measured the adequacy of nutrient intakes. The coping strategy index measures food accessibility, and the asset index was a proxy of stability.

The categorised FCS results were converted to CARI (acceptable group in FCS to food-secure in CARI, borderline in FCS to moderately food-insecure in CARI and poor in FCS to severely food-insecure in CARI). The food expenditure share was calculated by dividing the total food expenditure by the entire household expenditure:

$$food\ expenditure\ share = \frac{food\_monthly}{Total\ expenditure\ (food_{monthly} + nonfood_{monthly})}$$

The higher the food expenditure share indicates the less food-secure the household.

Table 3.3: Food security indicators

Indicator	Recall period	Descriptions
Household dietary diversity score (HDDS)	24-hours	HDDS measures diet quality by capturing the total consumed (12 food groups). (Hendriks *et al.* 2016; Hirvonen *et al.,* 2016; IFPRI, 2006; Mekonnen & Gerber, 2017; Swindale & Bilinsky, 2006). Then households were categorised into three groups as lowest dietary diversity (HDDS ≤ 3), medium dietary diversity (HDDS 4 and 5) and high dietary diversity (HDDS ≥ 6) (FAO, 2006)
Women's dietary diversity dcore (WDDS)	24-hours	WDDS assessed the micronutrient adequacy of the diets of women of reproductive age (15-49 years of age) (Chagomoka *et al*., 2017; Chagomoka *et al*., 2016; Kennedy *et al*., 2010; Leroy *et al.,* 2015)
Food consumption score (FCS)	7-days	FCS measures the frequency of consumption of the last seven days and is then weighted by a coefficient. (Hendriks *et al*., 2016; Leroy *et al.,* 2015; WFP, 2006). The results were classified as 0-21 or poor food consumption, 21.5-35 or borderline food consumption and above 35 for acceptable food consumption (WFP, 2008). FCS = (days of staple consumption) *2 + (days of pulses cons.) *3 + (days of vegetables and leaves cons.)*1+ (days of fruit cons.)*1 + (days of meat/fish/eggs cons.)*4 + (days of dairy cons.)*4 + (days of sugar/honey cons.) * ½ + (days of oils and fats cons.)*1/2+ (condiments)*0
Months of adequate household food provisioning (MAHFP)	12-months	MAHFP measures household food access over a year. Sum of the months of adequate provision (Bilinsky & Swindale, 2010; Konda *et al*., 2008)
Coping strategy index (CSI)	7-days	CSI is an indirect measure of food security. It measures the severity of behaviours that households engage in to mitigate food shortages (Hendriks *et al*., 2016; Leroy *et al.,* 2015; Maxwell & Caldwell, 2008) $\text{CSI} = (\text{frequency CS1} * \text{severity CS1}) + (\text{frequency CS2} * \text{severity CS2}) + \cdots + (\text{frequency CS12} * \text{severity CS12}$
Asset	Current	Total of assets that the household owns (both house and farm equipment) that shows the ability to cope with shocks (Chambers, 2006; Maxwell & Smith, 1992; Swift, 2006)
Consolidated Approach for Reporting Indicators of Food Security (CARI)	7-days and 12 months	It combines food security indicators (status and coping capacity) into a summary called the Global Food Security Index (GFSI), representing the food security status (Butaumocho & Chitiyo, 2017). A combination of three food security indicators: FCS, CSI and the food expenditure share (WFP, 2014)

The following table shows the summary of converting food security indicators to CARI console (Table 3.4).

Table 3.4: Food security indicator for CARI console

Domain		Indicator	Food-secure (1)	Marginally Food-secure (2)	Moderately food-insecure (3)	Severely food-insecure (4)
Current Status (CS)	Food consumption	Food consumption score	Acceptable (> 35)		Borderline (21.5-35)	Poor (0-21)
Coping Capacity (CC)	Economic Vulnerability	Food expenditure share	share < 50%	50% - 65%	65% - 75%	share > 75%
	Asset Depletion	Livelihood coping strategy	None (1)	Stress (2)	Crisis (3)	Emergency (4)
Food Security Index (CARI)			Able to meet essential food and non-food item (1)	Has minimally adequate food consumption (2)	Has significant food consumption gaps (3)	Has extreme food consumption gaps (4)

3.5.2 Endogenous switching regression (ESR) model

This study employed an ESR model to estimate the impact of LSAIs on food security. Lee (1982) developed the ESR model to generalise Heckman's selection correction approach (Lokshin & Sajaia, 2004). An ESR model accounts for the selection bias that may have occurred attributable to the self-selection of participation (employed or contracted) households (Dutoit, 2007; Heckman, 1979).

An ESR comprises two stages (Kabunga *et al*., 2012; Kassie, 2014; Malikov & Sun, 2018). In the first stage, a probit model identified the socio-economic factors determining household participation in LSAI. The study estimated the selection equation as follows (Di Falco *et al*., 2011):

$$Z_i^* = a + \gamma Q_i + \varepsilon_i \qquad \text{Equation 1}$$

Where Z_i^* was a binary variable takes the value 1 if the household participated in LSAI (employed or contract to farm) and 0 otherwise; *a* was an intercept; Q_i was a vector of exogenous variables influencing the participation decision; γ was a vector of coefficient and ε_i was the disturbance term with zero mean and a constant variance.

A full information maximum likelihood (FIML) model was used in the second stage of the ESR model to account for potential selection bias. The binary outcomes (the food security

status of the households) conditional on being engaged in LSAIs were represented as switching regimes:

Regime 1: $Y_{1i} = X_{1i}\beta_1 + \sigma_{1\varepsilon}\lambda_{1i} + u_{1i}$ If Ai = 1 for engaged households Equation 2

Regime 2: $Y_{2i} = X_{2i}\beta_2 + \sigma_{2\varepsilon}\lambda_{2i} + u_{2i}$ If Ai = 0 for non-engaged households Equation 3

Where Y_i represented the outcomes variables (food security indicators) of household i for each regime (1 = for engaged (employed or contracted) and 0 = non-engaged); X_i was a vector of determinant variables that affect household food security status. The variables in vectors X in equations (2) and (3) may overlap with Q in equation (1). It is required that at least one variable in Q that does not appear in X. β and σwere parameters to be estimated, and u_{1i} and u_{2i} were an independently and identically distributed error term of the food security estimation equation. The inverse Mills ratio (IMR) of participation is computed from the selection Equation (1) by included in Equations (2) and (3) to correct for selection bias in a two-step estimation procedure (i.e., ESR) as $\lambda_{1i} = \frac{\phi(Z_i\alpha)}{\Phi(Z_i\alpha)}$ and $\lambda_{2i} = \frac{\phi(Z_i\alpha)}{1-\Phi(Z_i\alpha)}$. Non-zero covariance between the error terms of the selection equation and the outcome equation indicated selection bias, and the null hypothesis of the absence of a selection bias would be rejected.

The three error terms ε_i, u_{1i} and u_{2i} are assumed to follow a trivariate normal distribution with zero mean vector and covariance matrix defined as (Lokshin & Sajaia, 2004):

$$\Omega = \begin{bmatrix} \sigma_1^2 & \sigma_1\sigma_2 & \rho_{1e}\sigma_1 \\ \sigma_1\sigma_2 & \sigma_2^2 & \rho_{2e}\sigma_1 \\ \rho_{1e}\sigma_1 & \rho_{2e}\sigma_2 & \sigma_\varepsilon^2 \end{bmatrix}$$

Equation 4

The covariance between the error terms of the selection equation and outcome equation was denoted by (cov (ε, u) = ρ). Where ρ_{1e} and ρ_{2e} were the correlation coefficients between u_{1i} and ε_i and between u_{2i} and ε_i, respectively. If either ρ_{1e} or ρ_{2e} were statistically different from zero, the existence of selection bias would be confirmed. If ρ>0, then there was a negative selection bias, indicating that households with below average HDDS, FCS, MAHFP and the food expenditure share were more inclined to be engaged in LSAIs. If ρ<0, a positive selection bias would indicate that households with above average HDDS, FCS, MAHFP and the food expenditure share would more likely be engaged in LSAIs.

The selection model is used to access innovative technology and the land tenure system as instrumental variables to discuss the endogeneity problem (Abdulai & Huffman, 2014; Di Falco *et al*., 2011). These affected household participation in LASIs but did not directly affect the food security status of the households. This study selected innovative technology as an instrument. Some households may have engaged in an LSAI to gain access to a job and new technologies, such as improved seeds, storage facilities, marketing facilities, pesticides, and various types of machinery.

The land tenure system may have affected the household decision to engage in an LSAI. Land-titled households have a better chance of engaging in contract farming (Ton *et al*., 2017; Väth & Kirk, 2013). Customary landholding lacked the security of tenure to ensure agricultural investment and the right to use their land. The probability of households losing their land rights and employment participation may have been higher under the customary tenure system than land-titled households.

This study estimated the average treatment effects (the change in the outcomes owing to engagement in an LSAI) calculated as the difference between the food security indicators of engaged and non-engaged households. The average treatment effect was represented by Y_i (HDD, FCS, MAHFP and the food expenditure share) as shown in Equations (5) – (8). The equations for the expected conditional and average treatment effects of engaged and non-engaged groups were provided as:

The equation for engaged (employed or contract farming) in an LSAI:

$$E[Y_{1i}/X,\ A_i = 1] = \alpha_1 + X_{1i}\beta_1 + \rho_{1i}\sigma_{1\varepsilon}\lambda_{1i} \qquad \text{Equation 5}$$

The equation for engaged, they decided not to engage in an LSAI:

$$E[Y_{2i}/X,\ A_i = 1] = \alpha_2 + X_{2i}\beta_2 + \rho_{2i}\sigma_{2\varepsilon}\lambda_{2i} \qquad \text{Equation 6}$$

The equation for non-engaged, they engaged in an LSAI:

$$E[Y_{1i}/X,\ A_i = 0] = \alpha_1 + X_{1i}\beta_1 + \rho_{1i}\sigma_{1\varepsilon}\lambda_{1i} \qquad \text{Equation 7}$$

The equation for non-engaged, which did not engage in LSAI:

$$E[Y_{2i}/X,\ A_i = 0] = \alpha_2 + X_{2i}\beta_2 + \rho_{2i}\sigma_{2\varepsilon}\lambda_{2i} \qquad \text{Equation 8}$$

Where Ai = 1, if households engaged by LSAI; Ai = 0, if households non-engaged with LSAI; Y1i and Y2i: food security indicators (HDDS, FCS, MAHFP and food expenditure share) of engaged and non-engaged. The study calculated the heterogeneity effects using the expected outcomes described in Equations (5) to (8). The base heterogeneity for involved households (BH_1) was calculated as the difference between Equations (5) and (7), while base heterogeneity for non-engaged households (BH_2) was calculated as the difference between Equations (6) and (8). Finally, the study estimated the transitional heterogeneity (TH) to understand if the impact of participation in LSAIs was larger or smaller for households engaged in an LSAI (Table 3.5).

Table 3.5: Conditional expectations, treatment, and heterogeneous effect

Sub-samples	**Decision stage**		**Treatment effects**
	To employed	Not to employed (non-engaged)	
Employed households	[a]$E(Y_{1i}/A_i = 1)$	[b]$E(Y_{2i}/A_i = 1)$	ATT
Non-engaged households	[c]$E(Y_{1i}/A_i = 0)$	[d]$E(Y_{2i}/A_i = 0)$	ATU
Heterogeneous effects	BH_1	BH_2	TH

Note: (a) and (d) are observed outcomes; (b) and (c) are the hypothetical unobserved outcomes

BHi: is the effect of base heterogeneity for households that engaged (A =1) and non-engaged (A = 0)

TH: Transitional heterogeneity = ATT – ATU.

The expected change in the level of food security for engaged households (the average treatment effect of treated households or ATT was provided as:

$$ATT = (a) - (b)$$

$$= E[Y_{1i}/X, A_i = 1] - E[Y_{2i}/X, A_i = 1] \quad \text{Equation 9}$$

$$= X_{1i}(\beta_1 - \beta_2) + \lambda_{1i}(\sigma_{1\varepsilon} - \sigma_{2\varepsilon}) \quad \text{Equation 10}$$

Similarly, the study estimated the expected change on non-engaged households as the average treatment effect on the untreated households (ATU) provided as:

$$ATU = (c) - (d)$$

$$= E[Y_{1i}/X, A_i = 0] - E[Y_{2i}/X, A_i = 0] \quad \text{Equation 11}$$

$$= X_{2i}(\beta_1 - \beta_2) + \lambda_{2i}(\sigma_{1\varepsilon} - \sigma_{2\varepsilon}) \quad \text{Equation 12}$$

Where ATT: is the average treatment effect on treated; ATU: is average treatment effect on untreated (engaged and non-engaged group).

3.5.3 Principal component analysis (PCA)

The principal component analysis (PCA) is a multivariate analysis technique that describes the underlying relationships among the variables by creating new indicators (factors or principal components) (Conte, 2005). The first factor in PCA captures the maximum variation between the elements. The subsequent components capture new but lower levels of variation (Field, 2009). Many scholars recently used PCA to measure food security, poverty, and vulnerability (Assefa, 2015; Hjelm *et al*., 2016; Odhiambo *et al*., 2021; Wineman, 2016). In this study, PCA was used to analyse objective one, identifying the more frequently consumed food groups and the most commonly practised coping strategies in each household category.

Principal component analysis needs a minimum ratio of cases variables to be five, requiring a modest correlation among the variables, a minimum correlation size of 0.3 between variables (Field, 2009).

The factor mathematically model:

$$Y_i = b_1 X_{1i} + b_2 X_{2i} + \cdots . + b_n X_{ni} \quad \text{Equation 13}$$

Where Y_i represents factors or a linear combination of variables (food security indicators); X_{ni} represents indicators from 1 to n, and b denoted factor loading. The relation (correlation) of indicators was checked using Bartlett's sphericity test, which tests the appropriateness of a principal component (Assefa, 2015). After reviewing the suitability of a principal component, the indicators were extracted. Finally, a principal component with an Eigenvalue greater than 1.0 was selected (Field, 2009).

3.5.4 Ordered probit model

This study employed an ordered probit model to analyse Objective 3, identifying the most vulnerable food-insecure households in the three countries. The food security indicators measures are categorical. Ordinal ordered probit or logit models are the most appropriate for analysis. The ordered probit is the most widely used model for requesting response data in

applied econometric work. The CSI was an outcome food security indicator to identify the more vulnerable food-insecure households.

An ordered probit model was employed to identify the determinant factors of household coping ability during food shortages, based on the results of the CSI scores. The CSI was taken as an outcome variable (Y_i) and ranked into four ordered values (j = 1, 2, 3, 4) based on Maxwell *et al.* (2014) cut-off points, where CSI <=2 categorised under food-secure; CSI >= 3 and <=12 categorised as mildly food-insecure; CSI >=13 and <=40 categorised as moderately food-insecure and CSI >40 categorised as severely food-insecure. The ordered probit was derived from a latent (unobservable) random variable Y_i^*, expressed in the following equation:

$$Y_i^* = X_i\beta + \varepsilon_i \qquad \text{Equation 14}$$

Where Y_i^*: is the latent outcome variable (CSI); X_i: is a vector of explanatory variables (predictors) that describe the adaptive capacity of the households (employed, contract, and non-engaged), sex of the household head, education status, marital status, household size, livestock holding, land size, migration status, and households that had lost their land rights; β: is a vector of a parameter to be estimated and ε_i: is the error term assumed to be normally distributed. The observed CSI (Y_i) is coded into four discrete categories: -

$$Y_i = 1 \text{ if } 0 <= Y_i^* <= 2 \text{ (Food-secure)}$$

$$Y_i = 2 \text{ if } 3 <= Y_i^* <= 12 \text{ (Mildly food-insecure)}$$

$$Y_i = 3 \text{ if } 13 <= Y_i^* <= 40 \text{ (Moderately food-insecure)}$$

$$Yi = 4 \text{ if } Yi^* > 40 \text{ (Severely food-insecure)}$$

The coefficients β_1, β_2, β_3, …., β_k were estimated with cut-off points μ_1, μ_2, …. μ_{k-1}. The estimated cut-off points followed the order $\mu_1 < \mu_2 < \mu_3$ following (Greene, 2000). The marginal effects indicated the probabilities that the CSI in the four food security status groups (food-secure, mildly food-insecure, moderately food-insecure, and severely food-insecure) would change attributable to a unit change in a particular variable (Gloy *et al.*, 2000; Ibrahim *et al.*, 2016).

Chapter 4: The effect of large-scale agricultural investments on household food security in Madagascar

4.1 Introduction

This chapter evaluates and discusses the effect of LSAIs on household food security in Madagascar and compare the findings with Kenya and Mozambique. The chapter discusses the first objective, which tests the hypothesis that households with employed members and contract farming were more food-secure than non-engaged and counterfactual households. The study findings were published in the journal of *Food Security* in 2020 (Fitawek *et al*., 2020). This chapter comprises four sections. The first section emphasises the chapter and then describes the data sources and data analysis methods used in the paper in Section 2. The third section discusses the descriptive and food security indicators results. Finally, the fourth section estimates and compares the effect of LSAIs on household food security in the three countries (Kenya, Madagascar, and Mozambique).

4.2 Data source and methods of data analysis

The chapter primarily used Madagascar data collected by the AFGROLAND project in 2017. Kenya and Mozambique data were used for comparison, discussed in section four. As discussed in the methodology chapter, the AFGROLAND project selected two companies in the Satrokala (Location A) and Ambatofinandrahana (Location B) municipalities (Company X and Y). Six hundred and one households were randomly selected for interviews (304 from Location A and 297 from Location B). The sampled households were classified into four categories, indicating employed, contract farming, non-engaged, and counterfactual households. Table 4.1 presents the sample distribution of the households.

Table 4.1: Sample size distribution in Madagascar

Location	The total number of households interviewed	Factual			Counterfactual households
		Employed households	Contract farming households	Non-engaged households	
Location A	304	61	-	141	102
Location B	297	-	110	89	98
Total sample	**601**	**61**	**110**	**230**	**200**

Source: Reys and Burnod (2017).

This study employed seven internationally recognised food security indicators for a comparative analysis of the dimensions of food security, indicating the HHDS, WDDS, FCS, MAHFP, CPI, asset, and CARI. PCA was used to examine household food consumption patterns and coping strategies.

4.3 Results

The result section is presented in three sub-sections. The first subsection describes the demographic and socioeconomic characteristics of sampled households. The second subsection presents the results of the food security indicators analysis. The last subsection presents the PCA results.

4.3.1 Description of the sample

Over 75% of the sampled household heads in Madagascar were male. Proportionately more non-engaged households in Location B were female-headed (22%) compared to contract farming households (12%), counterfactual households in Location A (12%) and households with employed members (13%). Most household heads were married (over 70%). More divorced household heads were among the non-engaged group than other households in Location B samples (Table 4.2).

Only 8% of non-engaged households in Location B had a large household (over eight members). This could relate to the high proportion of divorced (22% of households) in this group (Table 4.2). Most households with employed members in Location A (73.8%) were migrants from nearby districts. Less than 10% of household heads in the counterfactual zone in Location A were migrants. Most household heads in Location B were non-migrants (Table 4.2).

Most household heads had completed primary school. Households with employed members and non-engaged household heads in Location A were more educated (over 30% of the household heads completed secondary school) than counterfactual household heads in Location A and Location B. This indicates that educated household heads were more likely to have a member employed by an LSAI (Table 4.2).

Only a few households reported losing land rights in Location A (4% of members employed and 8% of non-engaged households). The land size was larger in Location A than Location B. Particularly, counterfactual households in Location A had larger farms. Over 60% of households with employed members in Location A and all groups of households in Location B had held less than one hectare of land. Non-engaged households in Location B had landholdings slightly smaller than other groups (Table 4.2). This may have been attributable to the proportionally higher number of female-headed households in this group.

Table 4.2: Demographic characteristics results of Madagascar, 2017

Demographic variable	Variable descriptions	Location A				Location B			
		Employed (%)	Non-engaged (%)	Counter factual (%)	Chi-square ($\chi 2$) p-value	Contract (%)	Non-engaged (%)	Counter factual (%)	Chi-square ($\chi 2$) p-value
Sex	Male	86.5	84.1	87.9	0.128	88.2	77.5	82.7	0.000
	Female	13.5	15.9	12.1		11.8	22.5	17.3	
Age	Age < 30	18.0	26.7	23.9	0.000	16.6	20.8	16.3	0.016
	Age 30-39	37.8	24.6	30.7		23.4	21.7	20.4	
	Age 40-49	20.7	22.1	25.7		24.0	23.9	33.7	
	Age 50-59	11.7	12.8	10.8		21.5	18.0	16.3	
	Age >60	11.7	13.8	8.9		14.4	15.5	13.3	
Marital Status	Single	5.4	3.1	3.4	0.000	1.0	0.0	2.0	0.000
	Married	74.8	79.5	87.1		81.3	73.2	83.7	
	divorce	11.7	13.3	7.5		8.5	16.6	8.2	
	Others	8.1	4.1	2.0		9.2	10.2	6.1	
Family Size	Small (1-4)	55.9	42.6	33.5	0.000	35.2	53.5	33.7	0.000
	Medium (5-8)	30.6	43.6	53.5		52.9	38.9	47.9	
	Large (>8)	13.5	13.8	13.0		11.9	7.6	18.4	
Migrant	Non-Migrant	19.8	48.2	90.7	0.000	67.7	67.9	60.2	0.017
	Migrant nearby	6.3	11.8	4.7		30.3	30.7	35.7	
	Migrant far	73.9	40	4.6		2.0	1.4	4.1	
Education Status	No school	13.5	12.8	13.3	0.000	12.7	7.0	13.3	0.012
	Primary	56.8	55.4	67.3		67.9	74.4	65.3	
	Secondary	26.1	31.3	17.3		18.3	17.7	20.4	
	College/University	3.6	0.5	2.1		1.0	0.8	1.0	
Land size	Very small (< 1 ha)	66.7	44.1	15.0	0.000	63.8	76.6	59.2	0.013
	Small (1-3 ha)	25.2	26.7	35.8		28.1	17.2	31.6	
	Medium (3-15 ha)	4.5	23.6	37.9		8.1	6.2	9.2	
	Large (>15 ha)	3.6	5.6	11.3		0.0	0.0	0.0	
Livestock ownership	Small (< 10)	93.7	75.9	50.7	0.000	99.4	100.0	93.9	0.000
	Medium (10-30)	5.4	13.8	25.6		0.6	0.0	6.1	
	Large (>30)	0.9	10.3	23.7		0.0	0.0	0.0	
Land grab	Yes	3.6	7.7	0.0	0.000	0.0	0.0	0.0	0.000
	No	96.4	92.3	100.0		100.0	100.0	100.0	
Observations		61	141	102		110	89	98	

Source: Author's own computations, based on the AFGROLAND 2017 survey data.

4.3.2 Food security outcomes

A universally accepted indicator of food security does not exist. Indicators measure distinct aspects of food security. Seven globally recognised indicators were used to measure food security.

Based on the HDDS, all groups of households consumed over five food groups within 24 hours. On average, LSAI employees in households in Location A and contract farming households in Location B consumed more food than other groups (6.4 and 6.1 respectively) (Table 4.3).

Households in the counterfactual zone of Location A had FCSs higher than other groups. The diets of most households in all groups were classified as acceptable except for the non-engaged households in Location B. Households in Location A were more food-secure than their counterparts in Location B.

As with the above dietary diversity indicators, female-headed households with LSAI employees consumed more diverse foods than others. Female-headed households in Location A consumed more varied diets than their counterparts in Location B. A higher proportion of non-engaged and counterfactual female-headed households in Location B diets had inadequate dietary diversity, consuming only two to three food groups (Table 4.3). This may be owing to divorced female-headed households losing their land rights, finding it difficult to secure contracts (Daley *et al*., 2013).

Table 4.3: Descriptive results of food security indicators

Indicators	Location A						Location B					
	Employed		Non-engaged		Counterfactual		Contract		Non-engaged		Counterfactual	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
HDDS	6.4	1.69	5.92	1.65	5.6	1.68	6.1	1.49	5.8	1.41	6.0	1.36
FCS	48.2	14.95	49.9	18.22	58.6	19.48	38.9	12.17	37.1	9.82	40.3	11.72
WDDS	3.8	1.72	3.6	1.09	2.9	1.25	3.6	1.78	2.6	0.79	2.9	1.05
MAHFP	9.5	1.72	9.6	1.83	9.3	1.29	7.2	2.19	7.58	2.28	8.1	1.98
CSI	10.7	14.99	5.8	11.70	6.0	2..27	6.8	12.84	8.3	13.17	10.2	13.83
Asset	6.78	2.62	7.2	2.28	8.1	2.67	6.9	2.84	5.7	2.35	5.5	2.35
CARI	1.8	0.78	2.1	0.62	2.0	0.51	2.3	0.69	2.4	0.59	2.2	0.62
Observations	61		141		102		110		89		98	

Source: Author's own computations, based on the AFGROLAND 2017 survey data.

Households typically had adequate food access for over seven months of the year. More households with employed and non-engaged households in Location A reported access to adequate food for ten months of the previous year than reported by households in other groups (Table 4.3).

Contract households had less adequate food access (able to access food for seven months) (Table 4.3). The households adopted a few coping strategies. This may have been because the data were collected during the harvesting season when food was plentiful. The most practised strategies included: consuming less expensive foods, limiting portion sizes, restricting the consumption for adults and reducing the number of meals.

Contrary to the findings of the other indicators, demonstrating that households with LSAI employees were comparatively more food-secure, households with these members adopted more coping strategies than other groups (Table 4.3).

Counterfactual households in Location A owned more assets than other groups, including beds and mattresses, sofa sets, tables, and mobile phones. More households in Location B owned farm equipment (Table 4.3). On average, 90% of Location A households and over 60% of Location B households owned beds. More families own sofa sets and tables in Location A; however, over 50% of the households in Location B owned radios.

Over 45% of households were classified as marginally food-secure by the CARI. They met the minimum adequate food consumption requirement without engaging in erosive coping strategies. They could still not afford some essential non-food items, such as pay for medicine, transport, education, and coal or gas. More households with employed members (36%) were classified as food-secure than in other groups. In Location B, 44% of contract and 48% of non-engaged households (48%) were classified as moderately food-insecure (Table 4.4).

Table 4.4: CARI console

Domain	Indicator	Household Group	Food-secure (1) (%)	Marginally food-secure (2) (%)	Moderately food-insecure (3) (%)	Severely food-insecure (4) (%)
Current Status (CS)	Food Consumption Score (FCS)	Employed in Location A	80.1		17.1	1.8
		Non-engaged for Location A	72.3		27.2	0.5
		Counterfactual for Location A	88.5		10.2	1.3
		Contract in Location B	53.3		44.7	2.0
		Non-engaged for Location B	45.9		51.3	2.8
		Counterfactual for Location B	64.3		35.7	0.0
Coping Capacity (CC)	Food Expenditure Share	Employed in Location A	15.3	28.8	23.4	32.4
		Non-engaged for Location A	20.2	10.4	16.1	53.4
		Counterfactual for Location A	16.7	5.5	20.5	57.3
		Contract in Location B	4.3	10.8	12.2	72.8
		Non-engaged for Location B	3.1	6.3	16.6	74.0
		Counterfactual for Location B	10.2	13.2	14.3	62.2
	Livelihood Coping Strategy	Employed in Location A	92.7	1.8	5.5	0.0
		Non-engaged for Location A	96.9	2.1	1.0	0.0
		Counterfactual for Location A	95.2	2.8	2.1	0.0
		Contract in Location B	77.2	8.7	14.1	0.0
		Non-engaged for Location B	73.2	11.5	15.2	0.0
		Counterfactual for Location B	87.8	5.1	7.1	0.0
Food Security Index (FSI)		Employed in Location A	36.4	47.5	16.1	0.0
		Non-engaged for Location A	20.4	58.0	21.5	0.0
		Counterfactual for Location A	12.4	75.4	12.2	0.0
		Contract in Location B	10.1	44.5	44.3	1.1
		Non-engaged for Location B	2.6	47.8	48.1	1.5
		Counterfactual for Location B	11.6	58.9	29.5	0.0

Source: Author's own computations, based on the AFGROLAND 2017 survey data.

4.3.3 Principal component analysis (PCA)

Table 4.5 illustrates the consumption patterns of households. Two of the 12 food groups (cereal and condiments) were dropped from the analysis to conduct the PCA because of a lack of variance in the data. Grains were the staple diets in these households.

Households with members as LSAI employees were more likely to consume vegetables, eggs, legumes, nuts and seeds, milk products, and oil and fats, followed by meat, fish, and seafood. Households with employed members were less likely to consume white tubers and roots, fruit, and sugar and sweets. The consumption patterns of non-engaged and counterfactual in Location A were similar, except that non-engaged households were more likely to consume white tubers and roots besides cereal, milk, and oil and fats. Counterfactual households were more likely to consume fish, cereal, milk, oil, and fats. Both groups were less likely to consume meat, fruits, and eggs. Non-engaged and counterfactual households were less likely to consume vegetables, legumes, sugars, and sweets (Table 4.5).

Table 4.5: Food consumption patterns of principal components in Location A, Madagascar

Food type	**Employed**			**Food type**	**Non-engaged**			**Food type**	**Counterfactual**		
	PC1	PC2	PC3		PC1	PC2	PC3		PC1	PC2	PC3
Vegetable	0.456			White tub	0.449			Milk	0.526		
Eggs	0.300			Milk	0.448			Oil & fat	0.518		
Legumes	0.408			Oil & fat	0.602			Fish	0.444		
Milk	0.471			Meat		0.618		Fruits		0.615	
Oil & fat	0.485			Fruits		0.479		Meat		0.402	
Meat		0.512		Egg		0.456		Egg		0.348	
Fish		0.626		Vegetable			0.555	White tub			0.429
White tub			0.565	Fish			0.300	Vegetable			0.438
Fruits			0.258	Legumes			0.435	Legumes			0.486
Sweets			0.403	Sweets			0.545	Sweets			0.362
Eigenvalue	2.05	1.56	1.45	Eigenvalue	1.77	1.61	1.42	Eigenvalue	2.06	1.57	1.30
Percentage variability	18.7	14.2	13.2	Percentage variability	16.1	14.6	13.0	Percentage variability	18.8	14.3	11.8

Source: Author's own computations, based on the AFGROLAND 2017 survey data.

Contract households seemed more likely to consume cereals, daily meat, white tubers roots, vegetables, eggs, fish, seafood, and milk products regularly. Contract households were less likely to consume legumes, nuts and seeds, fruit, oils, fats, sugars, and sweets (Table 4.6). Non-engaged households in Location B were more likely to consume cereals, milk, meat, legumes, nuts, and seeds, followed by vegetables, white tubers, and eggs. Non-engaged households in Location B were less likely to consume fruit, oils, fats, sugars, and sweets. Contract and counterfactual households in Location B had less diversified diets than non-engaged households.

Table 4.6: **Food consumption patterns of principal components in Location B, Madagascar**

Food type	**Contract**			**Food type**	**Non-engaged**			**Food type**	**Counterfactual**		
	PC1	PC2	PC3		PC1	PC2	PC3		PC1	PC2	PC3
Meat	0.429			Milk	0.533			Milk	0.481		
White tub		0.283		Meat	0.572			Meat	0.493		
Vegetable		0.392		Legumes	0.497			Legumes		0.542	
Eggs		0.470		White tub		0.555		Fish		0.682	
Fish		0.438		Vegetable		0.471		Egg		0.525	
Milk		0.406		Egg		0.312		Vegetable			0.388
Legumes			0.437	Oil& fat			0.336	White tub			0.376
Fruits			0.402	Fruits			0.352	Fruits			0.456
Oils & fat			0.530	Fish			0.507	Oil & fat			0.600
Sweets			0.460	Sweet			0.427	Sweets			0.369
Eigenvalue	2.18	1.34	1.25	Eigenvalue	2.05	1.52	1.33	Eigenvalue	2.05	1.42	1.28
Percentage variability	21.8	13.4	12.5	Percentage variability	18.6	13.9	12.1	Percentage variability	20.1	14.2	12.8

Source: Author's own computations, based on the AFGROLAND 2017 survey data.

The PCA was also run to explore the food consumption related coping strategies adopted by households. Following Maxwell and Caldwell (2008), preventive strategies were classified into four categories. The first category included strategies, such as eating less preferred and expensive foods, cutting meal sizes, and reducing the number of daily meals. The second category contained households adopting strategies that sought to increase the short-term food availability, including buying food on credit, borrowing food from relatives or friends, only feeding working members of the households, and sending household members to eat elsewhere.

Table 4.7: Patterns of principal components of coping strategies in Location A, Madagascar

Coping Strategy	Employed			Coping Strategy	Non-engaged			Coping Strategy	Counterfactual		
	PC1	PC2	PC3		PC1	PC2	PC3		PC1	PC2	PC3
Con. less expensive	0.374			Con. less expensive	0.329			Con. less expensive	0.432		
Borrow food	0.389			Borrow food	0.367			Limit port. food	0.393		
Limit port. food	0.399			Begging	0.386			Restrict cons. adult	0.498		
Restrict cons. adult	0.375			Gather wild food	0.300			Purchase food credit	0.444		
Purchase food credit		0.353		Reduce no. of meals	0.356			Borrow food		0.541	
Gather wild food		0.398		Skip days	0.300			Eat elsewhere		0.495	
Begging		0.484		Purchase food credit		0.463		Reduce no. of meals			0.507
Feed working		0.535		Restrict cons. adult		0.348		Gather wild food			0.588
Eat elsewhere			0.686	Limit port. food		0.356		Consume seed stock			0.325
Consume seed stock			0.237	Consume seed stock			0.747	Feed working			0.368
Reduce no. of meals			0.469	Feed working			0.499	Skip days			0.425
Eigenvalue	4.28	1.70	1.38	Eigenvalue	4.73	1.44	1.31	Eigenvalue	3.19	1.39	1.05
Percentage variability	38.9	15.5	12.6	Percentage variability	39.4	12.0	10.9	Percentage variability	39.9	17.5	13.1

Source: Author's own computations, based on the AFGROLAND 2017 survey data.

Table 4.8: Patterns of principal components of coping strategies in Location B, Madagascar

Coping Strategy	Contract			Coping Strategy	Non-engaged			Coping Strategy	Counterfactual		
	PC1	PC2	PC3		PC1	PC2	PC3		PC1	PC2	PC3
Limit port. food	0.385			Borrow food	0.377			Borrow food	0.341		
Restrict cons. adult	0.391			Purchase food credit	0.379			Purchase food credit	0.304		
Reduce no. of meals	0.415			Gather wild food	0.328			Gather wild food	0.329		
Purchase food on credit	0.385			Consume seed stock	0.356			Limit port. Food	0.411		
Consume seed stock		0.482		Reduce no. of meals	0.404			Restrict cons. adult	0.382		
Feed working members		0.704		Restrict cons. adult	0.339			Reduce no. of meals	0.409		
Cons. less expensive			0.426	Con. less expensive		0.522		Feed working		0.714	
Borrow food			0.433	Limit port. food		0.421		Eat elsewhere		0.605	
Gather wild food			0.398	Eat elsewhere			0.290	Con. less expensive			0.566
Skip days			0.614	Feed working			0.468	Consume seed stock			0.418
Eat elsewhere			0.321	Skip days			0.292	Skip days			0.356
Eigenvalue	3.88	1.33	1.21	Eigenvalue	3.32	1.62	1.13	Eigenvalue	3.44	1.48	1.31
Percentage variability	35.3	12.1	11.0	Percentage variability	33.2	16.2	11.3	Percentage variability	34.3	14.8	13.1

Source: Author's own computations, based on the AFGROLAND 2017 survey data.

The third category included practices, such as restricting the consumption of adults and eating seed stocks. The final category included rationing strategies, such as sending household members to beg, going days without meals, and collecting and eating wild fruit or immature crops.

Counterfactual households in Location A and contract farming households in Location B were more food-secure than others, implementing fewer severe coping strategies. The more severe coping strategies, such as collecting wild food, consuming seed stock for food, begging for food, and skipping days without food, were rarely adopted by counterfactuals in Location A and contract farming households (Table 4.7 and Table 4.8).

Non-engaged households in both locations and counterfactual households in Location B adopted more coping strategies than other households. Households with LSAI-employed members occasionally adopted more severe coping strategies, such as begging for food and collecting wild food, but rarely.

4.4 Comparison of Kenya, Madagascar, and Mozambique

This section compares the findings of the three countries (Table 4.9 to Table 4.11). Most households' diets in the three countries were classified as adequately diversified. Conversely, all households in Kenya (over 90%) consumed more diversified food than Madagascar and Mozambique (Table 4.9 to Table 4.11).

Over 95% of the households in Kenya and 90% of the households in Mozambique were grouped as acceptable food consumers; however, households in Location B in Madagascar were less food-secure (lower FCS) than Location A households in Madagascar and all households in Kenya and Mozambique (Table 4.9 to Table 4.11).

According to WDDS, 80% of female-headed contract farming households in Kenya and 58% of female-headed non-engaged households in Mozambique had adequately diversified diets. Most female-headed households in Kenya and Mozambique and female-headed households with employed members in Madagascar had moderately diversified diets. Most female-headed households in Madagascar had inadequate diets compared to other households; this might be

because female-headed households in the study may be disadvantaged concerning access to employment, affecting their food security and dietary quality. The findings indicated that even if more households in the study areas had acceptable food consumption, the diets of most female-headed households in all regions were insufficiently diverse (Table 4.9 to Table 4.11).

The findings of the MAHFP indicated that most households in all three countries accessed food for over ten months (categorised as least food-insecure). Most non-engaged and counterfactual households in Kenya and Location B households in Madagascar were moderately food-insecure (able to access food for six to 10 months) (Table 4.9 to Table 4.11).

According to the asset ownership index, most households in Kenya and Location A households in Madagascar were moderately resilient. Most households in Mozambique and households in Location B in Madagascar were the least resilient (Table 4.10 to Table 4.11).

The CSI measures the household behavioural change or coping ability during food shortages. Unlike other food security indicators, the finding of CSI indicated that only fewer households in the three countries were categorised as food-secure. Most households fell into mildly and moderately food-insecure groups, except for 59% of contract farming households and 80% counterfactual households in Location A in Madagascar, categorised as food-secure.

CARI was calculated using a combination of three food security indicators, such as FCS, CSI, and the food expenditure share. The findings indicated that most households in Madagascar and Mozambique were categorised as marginally food-insecure. Most households in Kenya were classified as food-secure. According to CARI results, no household was classified as severely food-insecure, except less than 2% in contract farming and non-engaged households in Location B in Madagascar.

Table 4.9: Summary of food security outcomes Kenya, 2017

Indicator	Category no.	Category description	Range	Employed (%)	Contract (%)	Non-engaged (%)	Counterfactual (%)
Household dietary diversity Score (HDDS)	1	Adequate dietary diversity	≥ 6	91	96.43	92.37	95.86
	2	Moderate dietary diversity	4-5	9	3.57	7.63	4.14
	3	Inadequate dietary diversity	≤ 3	0	0.00	0.00	0.00
Food consumption score (FCS)	1	Acceptable	> 35	97.59	98.15	97.84	98.81
	2	Borderline	21.5- 35	2.41	1.85	1.45	1.19
	3	Poor	0-21	0.00	0.00	0.71	0.00
Women's dietary diversity score (WDDS)	1	Adequate dietary diversity	≥ 6	46.88	80.00	28.46	45.95
	2	Moderate dietary diversity	4- 5	53.13	20.00	67.10	51.35
	3	Inadequate dietary diversity	≤ 3	0.00	0.00	4.44	2.70
Month of adequate household food provision (MAHFP)	1	Least food-insecure	≥ 10	57.85	60.71	46.17	41.76
	2	Moderate food-insecure	6- 10	39.75	35.71	51.10	54.12
	3	Most food-insecure	≤ 6	2.41	3.57	2.72	4.12
Coping strategy index (CSI)	1	Food-secure	0-2	37.30	48.15	33.46	23.67
	2	Mildly food-insecure	3-12	31.81	35.19	36.04	32.54
	3	Moderately food-insecure	13-40	22.29	14.81	25.12	38.46
	4	Severely food-insecure	>40	8.57	1.85	5.38	5.33
Asset indicator	1	Most resilient	≥ 10	8.05	21.43	8.90	10.06
	2	Moderately resilient	6-10	85.17	76.79	75.33	74.56
	3	Least resilient	3-6	6.78	1.79	15.77	15.38
CARI (Food Security Index)	1	Food-secure		55.78	77.78	54.29	41.67
	2	Marginally food-secure		42.22	20.37	45.24	57.74
	3	Moderately food-insecure		0.00	1.85	0.47	0.60
	4	Severely food-insecure		0.00	0.00	0.00	0.00
Observations				48	57	270	170

Source: Author's own computation from AFGROLAND (2017).

Table 4.10: Summary of food security indicators Madagascar, 2017

Indicator	Category	Category description	Range	Location A			Location B		
				Employed (%)	Non-engaged (%)	Counter factual (%)	Contract (%)	Non-engaged (%)	Counter factual (%)
Household dietary diversity score (HDDS)	1	Adequate dietary diversity	≥ 6	58	66	62	62	56	70
	2	Moderate dietary diversity	4-5	42	30	30	36	39	30
	3	Inadequate dietary diversity	≤ 3	0	4	8	2	5	0
Food consumption score (FCS)	1	Acceptable	>35	80	72	89	53	46	64
	2	Borderline	21.5-	18	27	10	45	51	36
	3	Poor	0-21	2	1	1	2	3	0
Women's dietary diversity (WDDS)	1	Adequate dietary diversity	≥ 6	11	6	0	7	6	0
	2	Moderate dietary diversity	4-5	67	29	40	13	41	20
	3	Inadequate dietary diversity	≤ 3	22	65	60	80	53	80
Months of adequate household food provision (MAHFP)	1	Least food-insecure	≥ 10	54	54	35	26	18	21
	2	Moderately food-insecure	6-10	44	44	65	65	71	73
	3	Most food-insecure	3-6	2	2	0	9	11	6
Coping strategy index (CSI)	1	Food-secure	0-2	45	49	80	59	49	48
	2	Mildly food-insecure	3-12	20	25	13	14	23	13
	3	Moderately food-insecure	13-40	30	14	4	19	16	28
	4	Severely food-insecure	>40	5	12	3	8	12	11
Asset indicator	1	Most resilient	≥ 10	14	18	21	16	10	9
	2	Moderately resilient	6-10	65	59	63	40	25	29
	3	Least resilient	3-6	21	23	16	44	65	62
CARI (Food Security Index)	1	Food-secure		36	20	12	10	3	12
	2	Marginally food-secure		48	58	75	45	48	59
	3	Moderately food-insecure		16	22	12	44	48	29
	4	Severely food-insecure		0	0	0	1	1	0
Observations				61	141	102	110	89	98

Source: Author's own computation from AFGROLAND (2017).

The study findings indicate that the food security status of the households in Kenya was better than in Madagascar and Mozambique. Households with LSAI-employed members in Madagascar and Mozambique were more food-secure than other households in the two countries. In Kenya, contract farming households enjoyed diets with higher dietary diversity and were more food-secure than others (Table 4.9). Households with employed members held better dietary quality, food security, and resilience in Madagascar and Mozambique (Table 4.10 and Table 4.11). Their steady income smoothed consumption. Households with employed members in Madagascar and Kenya with low asset bases made them moderately resilient to food security shocks. Contract farming households in Madagascar owned more assets. These assets could provide liquidity in times of food stress. The periodic contract payments seem to favour purchasing assets.

Non-engaged households in the land investment zones enjoyed similar dietary diversity to the counterfactual homes in the three countries. Living in the influence zone did not have significant adverse effects on the food security of non-engaged households. This might be because the data were collected immediately after the harvesting season.

Table 4.11: Summary of food security outcomes for Mozambique, 2016

Indicator	Category	Category description	Range	Employed (%)	Non-engaged (%)	Counterfactual (%)
Household dietary diversity score (HDDS)	1	Adequate dietary diversity	≥ 6	64	62	56
	2	Moderate dietary diversity	4-5	28	29	34
	3	Inadequate dietary diversity	≤ 3	8	9	10
Food consumption score (FCS)	1	Acceptable	> 35	94	94	88
	2	Borderline	21.5- 35	5	6	9
	3	Poor	0-21	1	0	3
Women's dietary diversity score (WDDS)	1	Adequate dietary diversity	≥ 6	25	58	49
	2	Moderate dietary diversity	4- 5	58	27	37
	3	Inadequate dietary diversity	≤ 3	17	15	14
Month of adequate household food Provision (MAHFP)	1	Least food-insecure	≥ 10	59	61	73
	2	Moderate food-insecure	6- 10	37	37	26
	3	Most food-insecure	≤ 6	4	2	1
Coping Strategy index (CSI)	1	Food-secure	0-2	28	24	34
	2	Mildly food-insecure	3-12	47	41	37
	3	Moderately food-insecure	13-40	21	33	25
	4	Severely food-insecure	>40	4	2	4
Asset indicator	1	Most resilient	≥ 10	0	2	0
	2	Moderately resilient	6-10	23	20	9
	3	Least resilient	3-6	77	78	91
CARI (Food Security Index)	1	Food-secure		22	27	29
	2	Marginally food-secure		72	65	65
	3	Moderately food-insecure		6	8	6
	4	Severely food-insecure		0	0	0
Observations				121	155	228

Source: Author's own computation from AFGROLAND (2016).

4.5 Summary

According to the study findings, Kenyan households were more food-secure than those in Madagascar and Mozambique. The variation among countries and indicators might be because of the countries' economic contexts. Kenya has a higher economic status than Madagascar and Mozambique. Households with LSAIs-employed members in the three countries were more food-

secure than other households. This might be because households with LSAI employees received regular wages. Living in the zone of influence did not seem to have significant adverse effects on the food security of non-engaged households. However, it was impossible to investigate the long-lasting impact of LSAIs on household food security using cross-sectional data. This chapter forms the foundation for the empirical analyses presented in the next three chapters (Chapter 5, 6 and 7).

Chapter 5: Evaluating the impact of large-scale agricultural investments on household food security using an endogenous switching regression model

5.1 Introduction

The literature on the impact of LSAIs on household food security is contentious. A few empirical studies of the effect on food security inform these discussions exist. This study estimated employment affects by LSAIs on household food security in Kenya, Madagascar, and Mozambique. The chapter discusses the second objective of the thesis, assessing the hypothesis that households with employed members were more food-secure than non-engaged and counterfactual households using an ESR model. The study's findings were published in the journal of *Land* in 2021 (Fitawek & Sheryl, 2021). The chapter comprises three sections; the first section provides information about the chapter. The second section describes the data sources and types of data analysis. Finally, the third section discusses and compares the three countries descriptive and food security indicators results.

5.2 Data source and methods of data analysis

This chapter used data collected by the AFGROLAND project from Kenya, Madagascar, and Mozambique. The chapter focuses on the data of the household with an LSAI employed member and non-engaged households. The analysis was conducted from a total sample of 1296 households (i.e., three countries), as stated in Table 5.1 below. Households were classified into two categories, indicating employed where at least one member was an LSAI employee and non-engaged, where the companies did not employ members. A binary variable (1 for employed and 0 for non-engaged) was used for this classification.

Table 5.1: Sample size

Country	Number of households interviewed	Employed households	Non-engaged households
Kenya	488	46	442
Madagascar	304	61	243
Mozambique	504	121	383
Total sample	**1296**	**228**	**1068**

Source: Reys and Burnod (2017).

Table 5.2 presents variable names, descriptions, and expected signs. In this chapter, the study used four internationally recognised food security indicators:

- The HDDS
- FCS
- The MAHFP
- The household food expenditure share

An ESR model examined the impact of LSAIs on household food security and control for a possible selection bias.

Table 5.2: Variable names, definitions, and expected sign

Variable	Description	Expected Sign
Sex of the household head	If the sex of the household head is male = 1, 0 for female	+
Age of the respondent	Age of the respondent (years)	−
Household size	Family size of the household	+
Education status of the household head	If the household head no schooling = 0, primary = 1, secondary = 2 & college/univ. = 3)	+
Marital status of the household head	Coded 1 if the household head married, 0 otherwise	−
Livestock holding	Livestock holdings in tropical livestock unit (TLU)	−
Land size	Land size (hectares)	−
Distance to market	Coded 1 if <30 min; 2 if the distance 30 min-1hr and 3 if the distance > 1 hr	+/−
Distance to road	Coded 1 if <30 min; 2 if the distance 30 min-1 hr and 3 if the distance > 1 hr	+/−
Migration status of the household head	Coded 1 if the household is non-migrant and 0 if migrant	−
Access to irrigation	Coded 1 if the household had access to irrigation, 0 otherwise	+/−
Households that lost their land rights	Coded 1 if the household lost their land rights, 0 otherwise	+
Access to other sources of revenue	Coded 1 if the household has access to other sources of revenue, 0 otherwise	−
Access to new technology	Coded 1 if the household has access to new technology, 0 otherwise	+
Land tenure system	Coded 1 if it is customary; 2 informal and 3 for others	+/−
Location dummy	Coded 1 if the household in factual areas, 0 otherwise	+
Outcome variables		
Household dietary diversity scores (HDDS)	Household dietary diversity scores	
Food consumption scores (FCS)	Food consumption scores	
Months of adequate household food provisioning (MAHFP)	Months of adequate household food provisioning	
Household food expenditure share	Food expenditure share	

5.3 Results and discussion

This section presents and discusses the study findings in two sub-sections. The descriptive results are shown in the first subsection, followed by the ESR, causing the second subsection.

5.3.1 Descriptive results

The descriptive statistics of the surveyed households and the explanatory variables that determined household participation in LSAIs are presented in Table 5.3. The mean comparison test summarised the food security status of employed and non-engaged households. The mean values of HDDS, FCS, MAHFP, and the household food expenditure share of employed members in Kenya were higher than households in Madagascar and Mozambique.

In all three countries, households with employed members were male headed. In Kenya and Mozambique, household size among families with employed members was more significant than in Madagascar. In Madagascar, households that did not engage members in LSAIs owned more livestock and had larger plot sizes than households with employed members and non-engaged households in Kenya and Mozambique. The Kenyan households were, on average, further from a market than households in Madagascar and Mozambique.

Table 5.3: Descriptive statistics of the samples

Variable	Kenya			Madagascar			Mozambique		
	Employed	Non-Engaged	Diff.	Employed	Non-Engaged	Diff.	Employed	Non-Engaged	Diff.
Outcome variables									
HDDS	8.27 (0.22)	7.28 (0.06)	0.98 ***	4.95 (0.34)	5.54 (0.17)	-0.59	6.20 (0.21)	5.99 (0.10)	0.21
FCS	82.29 (2.57)	75.42 (0.79)	6.87 ***	48.19 (1.91)	53.59 (123)	-5.41 **	55.00 (1.15)	53.13 (0.72)	1.87
MAHFP	10.35 (0.37)	9.93 (0.10)	-0.41	9.54 (0.22)	9.47 (0.10)	0.07	10.31 (0.08)	9.98 (0.18)	0.34 **
Food exp. share	34.84 (2.76)	42.39 (1.13)	-7.54 *	66.05 (2.73)	72.69 (1.49)	-6.64 **	77.85 (2.08)	83.41 (0.86)	-5.56 ***
Explanatory variables									
Sex of the household head	1.78 (0.06)	1.58 (0.02)	0.19 ***	0.99 (0.05)	0.85 (0.15)	0.14	1.94 (0.02)	1.87 (0.02)	0.08 **
Age of the household head	36.37 (2.11)	44.77 (0.94)	-8.40 ***	39.13 (1.76)	41.37 (1.94)	-1.94	40.12(1.21)	39.99 (0.75)	0.11
Household size	4.51 (0.21)	4.07 (0.09)	0.44	4.84 (0.35)	6.12 (0.21)	-1.28 ***	4.81 (0.18)	4.80 (0.10)	0.01
Education status of the household	2.01 (0.03)	2.12 (0.09)	-0.02	1.52 (0.15)	1.26 (0.06)	0.26 *	2.25 (0.07)	2.26 (0.04)	-0.01
Marital status of the hh head	1.26 (0.06)	1.35 (0.02)	-0.08	1.26 (0.09)	1.16 (0.04)	0.11	1.08 (0.02)	1.15 (0.02)	-0.07 **
Livestock holdings	4.96 (1.34)	2.57 (0.12)	2.39 ***	2.15 (1.36)	14.29 (3.16)	-12.13 **	0.09 (0.05)	0.10 (0.02)	-0.02
Land size	1.03 (0.14)	1.29 (0.07)	-0.27	2.19 (0.91)	7.94 (1.63)	-5.74 *	2.22 (0.44)	2.17 (0.11)	0.05
Distance from a market	2.86 (0.07)	1.82 (0.04)	1.04 ***	1.18 (0.05)	2.04 (0.06)	-0.87 ***	1.69 (0.06)	2.08 (0.04)	-0.38 ***
Distance from a road	2.39 (0.12)	1.66 (0.03)	0.72 ***	2.93 (0.05)	2.91 (0.02)	0.02	2.62 (0.07)	2.61(0.06)	0.01
Migration status of the household	1.16 (0.05)	1.15 (0.02)	0.87	1.24 (0.06)	1.68 (0.03)	-0.44 ***	1.45 (0.05)	1.53 (0.03)	-0.07 *
Access to irrigation	2.00 (0.00)	1.34 (0.02)	0.67 ***	0.36 (0.06)	0.41 (0.03)	-0.05	1.02 (0.02)	1.03 (0.01)	-0.03
Households that lost their land rights	1.06 (0.03)	1.04 (0.01)	0.02	0.05 (0.03)	0.07 (0.02)	-0.02	1.25 (0.04)	1.18 (0.02)	0.08 *
Access to other sources of revenue	1.12 (0.05)	1.19 (0.02)	-0.07	0.00 (0.00)	0.00 (0.00)	0.00	1.21 (0.04)	1.69 (0.02)	-0.48 ***
Observations	46	442		61	243		121	383	

Note: Standard errors appear in parentheses; * $p < 0.1$, ** $p < 0.05$ and *** $p < 0.01$.

Kenyan households with LSAIs employees had better access to irrigation than non-engaged households in the same area. In Madagascar, households with employed members were typically migrants from other villages. Non-engaged households in Mozambique had greater access to other revenue sources than households with employed members and non-engaged households in the Kenyan and Madagascar sites. Mozambican households with LSAIs employees had lost their land rights than households with employed and non-engaged households in Kenya and Madagascar (Table 5.3).

5.3.2 Endogenous switching regression results

The first stage of the ESR analysis (the selection model) estimated the household determinants with an employed member in an LSAI. Each country had various determinant factors; however, the distance from a market was a common determinant factor in the three countries. For instance, there were seven determinant factors for employment in an LSAI in Kenya (sex, age, and marital status of the household head, livestock ownership, land size, distance from a market and distance from a road). In Madagascar, four determinant factors for employment in an LSAI were livestock ownership, distance from a market, migration status of the household head, and the location dummy. In Mozambique, five variables (education status of the household head, distance from a market, households that lost their land rights, access to other sources of revenue, and location dummy) were determinant factors for employment in an LSAI (Table 5.4).

The positive coefficient for the sex of the household head indicated that the probability of employment of a household member in an LSAI was higher for male-headed households. The negative coefficients for the age of the household head, livestock holdings, and land size indicated that older household heads with more livestock and larger land sizes were less likely to have a member employed in an LSAI. The negative coefficient for the education status of the household head in Mozambique indicated that a more educated the household head was less likely to have a member employed in an LSAI. Households with larger land sizes may have continued farming rather than seek employment in an LSAI. Distance from a market was another determinant of employment in an LSAI. Households further away from a market were less likely to have a member employed by an LSAI (Table 5.4).

Table 5.4: Determinants of participation in LSAIs

Variables	Kenya	Madagascar	Mozambique
	Coefficient (Std Err)	Coefficient (Std Err)	Coefficient (Std Err)
Sex of the household head	0.469 **	0.385	0.446
	(0.232)	(0.334)	0.289
Age of the head	-0.022 ***	-0.002	0.003
	(0.008)	(0.008)	(0.005)
Family size	0.028	-0.041	0.017
	(0.071)	(0.039)	(0.037)
Education status of the head	0.139	0.002	-0.212 **
	(0.161)	(0.097)	(0.098)
Marital status of the head	-0.571 **	0.316	-0.139
	(0.295)	(0.323)	(0.189)
Livestock owned (TLU)	-0.075 **	-0.043 **	0.131
	(0.034)	(0.037)	(0.146)
Land size	-0.239 **	-0.004	0.005
	(0.127)	(0.008)	(0.021)
Distance to market	-0.811 ***	-0.669 ***	-0.295 **
	(0.158)	(0.161)	(0.116)
Distance to road	0.419 ***	0.146	0.199 *
	(0.129)	(0.289)	(0.113)
Migration status	-0.129	-0.467 **	0.048
	(0.282)	(0.223)	(0.159)
Households that lost their land rights	0.145	0.282	-0.188 **
	(0.495)	(0.433)	(0.178)
Access to other source of revenue	-0.098	0.005	-1.271 ***
	(0.319)	(0.021)	(0.167)
Location_Dum	-0.310	0.931 ***	1.532 ***
	(0.224)	(0.306)	(0.208)
Access to new technology	0.889 ***	-0.427 ***	0.543 **
	(0.205)	(0.983)	(0.226)
Land tenure system	-0.186 **	-0.186 **	0.023
	(0.095)	(0.095)	(0.093)
Constant	-4.333	-0.586	0.300
	(1.412)	(1.118)	(1.062)
Likelihood	-101.00	-107.71	-177.05
Observations (N)	488	304	504

Source: Own calculation from AFGROLAND data; Standard errors appear in parentheses.

* $p < 0.10$, ** $p < 0.05$ and *** $p < 0.01$.

Having other sources of revenue other than farming was another critical determinant of employment in an LSAI in Mozambique. Having lost land rights was also one of the positive determinants of employment in an LSAI in Mozambique. If the household lost their land rights because of establishing an LSAI, the probability of engagement in off-farm activities or employment was high (Table 5.4). Only a few numbers of households lost their land rights in Kenya and Madagascar.

The estimated results of the three countries' ESR model are presented in Tables 5.5 to 5.7. A selection bias was detected and represented by the significant correlation coefficients of the selection equations in Table 5.5, Table 5.6 and Table 5.7. Instrumental variables, such as access to new technology and land tenure system, were added to the selection model for more robust estimation. The statistically significant coefficients for access to innovative technology and land tenure system indicated that the selected instruments were relevant and affected household participation decisions.

The significant results of the likelihood ratio test (χ^2), the sigma (σ_i) and correlation coefficients (ρ_i) indicated the existence of self-selection problems. They suggested that the three equations are jointly dependent—the model specification controlled for this inferred endogeneity (Lokshin & Sajaia, 2004). The findings revealed that employment might not have had the same impact if non-engaged households engaged in employment with the LSAI. The positive and statistically significant coefficients of ρ_{ie} (HDDS and MAHFP) in Mozambique, indicating a negative selection bias (Table 5.7). Households with a below-average food security status (HDDS and MAHFP) were more likely to have a member employed in an LSAI. A possible negative selection bias was also established for one food security indicators (FCS) in Madagascar (Table 5.6). The negative and statistically significant coefficients of ρ_{ie} (MAHFP and food expenditure share) in Kenya show that the existence of a positive selection bias, indicating more food-secure households were more likely to have members employed by an LSAI (Tables 5.5 to 5.7).

Table 5.5: Kenya endogenous switching regression estimation of outcomes variables

Variables	HDDS		FCS		MAHFP		Food expenditure share	
	Employed	Non-engaged	Employed	Non-engaged	Employed	Non-engaged	Employed	Non-engaged
Sex of the household head	-0.263 (0.564)	-0.058 (0.129)	-1.329* (6.076)	-1.621 (1.601)	0.409* (0.213)	0.080 (0.249)	1.258 (1.041)	-0.570 (2.227)
Age of the head	-0.021 (0.022)	-0.001 (0.003)	0.749***(0.232)	-0.075* (0.044)	-0.010**(0.006)	0.007 (0.007)	-0.050(0.228)	0.039 (0.063)
Household size	-0175 (0.156)	0.019***(0.034)	-2.129 (1.699)	0.282 (0.427)	0.061 (0.064)	0.068 (0.065)	4.827***(1.568)	-3.657***(0.605)
Education status of the head	-0.295 (0.339)	0.303***(0.088)	0.372 (3.668)	2.905***(1.088)	0.149 (0.123)	-0.303**(0.143)	1.735 (3.630)	-6.624***(1.543)
Marital status of the head	-0.385 (0.722)	-0.162 (0.144)	-1.546**(0.764)	-1.669**(1.789)	-0.202 (0.186)	0.323* (0.179)	-1.621 (1.796)	-1.494 (2.534)
Livestock owned (TLU)	-0.028 (0.038)	0.096***(0.027)	-0.291 (0.410)	1.521***(0.333)	0.086 (0.033)	-0.189**(0.047)	0.412 (0.395)	-0.268 (0.473)
Land size	0.583** (0.339)	0.042 (0.042)	8.591** (3.607)	1.139***(0.522)	-0.207* (0.111)	-0.022 (0.079)	-2.318 (3.601)	-0.473 (0.768)
Distance to market	0.801 (0.506)	0.081 (0.068)	4.755 (5.522)	-0.510 (0.843)	0.544***(0.164)	0.053 (0.085)	-2.657 (5.228)	2.127* (1.195)
Distance to road	-0.212 (0.245)	-0.101 (0.088)	0.719 (2.611)	2.625** (1.079)	0.535***(0.128)	-0131 (0.161)	1.617***(2.555)	0.852 (1.530)
Households lost their land rights	-0.229 (0.931)	-0.443 (0.293)	3.397 (1.094)	-2.565 (3.641)	0.704** (0.309)	0.389 (0.522)	2.233 (1.669)	11.112**(5.156)
Access to other sources of rev.	0.210 (0.670)	-0.033 (0.159)	5.481 (1.217)	-0.589 (1.967)	0.543** (0.226)	0.012 (0.013)	-0.109 (7.288)	-4.501 (2.784)
Migration status	1.196* (0.648)	0.048 (0.167)	-3.748 (0.035)	3.368 (2.069)	-0.257 (0.247)	0.072 (0.279)	3.545 (6.928)	-3.843 (2.926)
Location dummy	-0.115 (0.529)	0.108 (0.126)	1.008 (5.752)	1.111 (1.566)	0.098 (0.186)	0.719 (2.611)	9.865* (5.817)	2.867 (2.221)
Constant	6.237 (3.189)	6.631 (0.646)	11.528 (34.544)	7.810 (7.976)	0.028 (0.162)	1.204 (0.045)	2.969 (3.351)	6.540 (11.295)
σ_i	0.471***(0.223)	0.241***(0.049)	2.831 (0.211)	2.738 (0.038)	0.954***(0.147)	0.797***(0.039)	3.106***(0.205)	3.079*** (0.037)
ρ_i	0.705 (0.456)	-0.548(0.333)	0.664 (0.444)	-0.321 (0.228)	-0.638**(0.321)	-1.279**(0.319)	-1.281**(0.399)	0.221 (0.268)
Log likelihood	-934.12		-2143.62		-1077.11		-2289.28	
Wald $\chi 2$	60.14***		75.87***		32.78***		84.17***	
LR test of indep. equa $\chi 2$	4.01		3.37		15.51***		8.20**	
Observation	46	442	46	442	46	442	46	442

Source: Own calculation from AFGROLAND data; Standard errors appear in parentheses; * $p < 0.10$, ** $p < 0.05$ and *** $p < 0.01$.

Table 5.6: Madagascar endogenous switching regression estimation of outcomes variables

Variables	HDDS		FCS		MAHFP		Food expenditure share	
	Employed	Non-engaged	Employed	Non-engaged	Employed	Non-engaged	Employed	Non-engaged
Sex of the household head	1.502 (1.007)	0.440 (0.593)	0.173 (0.261)	1.974**(0.772)	-0.820(0.760)	0.152 (0.379)	0.694** (0.321)	-0.855 (0.392)
Age of the head	-0.039* (0.023)	0.006 (0.012)	-0.016 (0.173)	-0.043 (0.093)	0.003 (0.017)	-0.003 (0.008)	0.004 (0.005)	0.173 (0.107)
Household size	0.011 (0.120)	0.084 (0.058)	-1.828**(0.788)	0.464 (0.434)	-0.235(0.090)	-0.036 (0.037)	-0.002 (0.034)	0.627***(0.616)
Education status of the head	0.054 (0.255)	0.227 (0.181)	3.827 (1.804)	0.005 (1.334)	0.146 (0.196)	0.072 (0.116)	0.053 (0.085)	0.210***(0.505)
Marital status of the head	1.609 (0.931)	0.133 (0.596)	1.547 (3.268)	-1.142 (2.805)	-0.571 (0.680)	0.101** (0.383)	0.269 (0.193)	0.211 (0.761)
Livestock owned (TLU)	0.043 (0.028)	0.005 (0.003)	0.198* (0.118)	0.044 (0.027)	-0.008 (0.021)	0.001 (0.002)	0.048 (0.034)	0.461 (0.682)
Land size	0.019 (0.042)	-0.008(0.007)	-0.073 (0.277)	0.057 (0.054)	-0.003 (0.030)	0.013***(0.004)	-0.019 (0.057)	-0.266 (0.955)
Distance to market	-2.637**(1.224)	0.157** (0.224)	6.257 (5.501)	4.754***(1.796)	-1.026 (0.755)	-0.096 (0.166)	-0.075 (0.153)	0.011 (0.209)
Distance to road	-1.104 (0.862)	-0.358 (0.524)	0.719 (2.611)	-0.235 (0.456)	-0.713 (0.618)	-0.284 (0.341)	-1.627 (0.628)	0.997 (1.043)
Households lost their land rights	-0.439 (1.373)	0.289 (0.762)	0.881 (1.821)	-2.779 (5.765)	0.259 (1.019)	0.135 (0.479)	0.213** (0.979)	0.013 (0.104)
Access to other sources of rev.	0.242 (0.124)	-0.233 (0.156)	0.456 (0.217)	-0.234 (0.452)	0.945 (0.549)	0.045 (0.233)	0.562 (0.069)	-0.897 (0.354)
Migration status	-1.546** (0.764)	0.235 (0.256)	-1.748 (0.035)	0.562 (0.069)	-0.897 (0.354)	-0.365 (0.279)	0.026 (0.089)	0.195 (0.795
Location dummy	-1.566 (1.599)	0.163 (0.358)	1.008** (0.752)	1.042***(2.930)	0.997 (1.043)	0.257 (2.611)	0.026 (0.089)	0.195 (0.795
Constant	-1.301 (1.067)	2.932 (1.928)	-5.678 (12.071)	3.879 (7.527)	12.939 (2.543)	10.139 (1.224)	3.879 (7.527)	0.031 (0.082)
Access to new technology	0.427***(0.983)		0.564 (0.312)		-0.363 (0.714)		0.131 (0.115)	
Land tenure system	-0.186** (0.095)		-0.008 (0.048)		0.044 (0.123)		1.042***(2.930)	
σ_i	0.718***(0.102)	0.947***(0.058)	2.997***(0.229)	2.972***(0.068)	0.528**(0.217)	0.454***(0.046)	2.679***(0.097)	2.882***(0.052)
ρ_i	-0.102 (0.652)	-0.961 (0.282)	2.279** (1.180)	-0.878**(0.402)	0.068 (0.552)	0.029 (0.306)	-0.021 (0.642)	0.189 (0.531)
Log likelihood	-786.88		-1382.57		-669.33		-1439.36	
Wald $\chi 2$	30.77***		32.53***		17.48		17.30**	
LR test of indep. equa $\chi 2$	6.69**		3.91		1.00		0.08	
Observation	61	243	61	243	61	243	61	243

Source: Own calculation from AFGROLAND data; Standard errors appear in parentheses; * $p < 0.10$, ** $p < 0.05$ and *** $p < 0.01$.

Table 5.7: Mozambique endogenous switching regression estimation of outcomes variables

Variables	HDDS		FCS		MAHFP		Food expenditure share	
	Employed	Non-engaged	Employed	Non-engaged	Employed	Non-engaged	Employed	Non-engaged
Sex of the household head	1.433***(0.952)	0.111*(0.316)	1.579(0.509)	-0.292(0.336)	3.827(1.804)	0.005(1.334)	1.546**(0.764)	-1.669***(1.789)
Age of the head	0.049(0.018)	-0.013(0.008)	0.047(0.092)	0.048(0.051)	1.547(3.268)	-1.142(2.805)	-0.291(0.410)	1.521***(0.333)
Household size	-0.289**(0122)	-0.055(0.051)	0.530(0.599)	0.541(0.344)	0.198*(0.118)	0.044(0.027)	8.591**(3.607)	1.139***(0.522)
Education status of head	-0.205(0.304)	0.056(0.132)	3.203(1.579)	3.246(0.899)	-0.073(0.277)	0.057(0.054)	4.755(5.522)	-0.510(0.843)
Marital status of the head	0.859(0.604)	-0.386**(0.202)	-5.996(3.125)	-1.964(1.356)	6.257(5.501)	4.754***(1.796)	0.719(2.611)	2.625**(1.079)
Livestock owned (TLU)	0.145(0.427)	0.023(0.255)	-0.878(2.128)	-1.827(1.712)	0.719(2.611)	-0.235(0.456)	3.397(1.094)	-2.565(3.641)
Land size	0.039(0.054)	0.127*(0.049)	0.277(0.247)	-0.292(0.336)	0.881(1.821)	-2.779(5.765)	5.481(1.217)	-0.589(1.967)
Distance to market	-0.234(0.360)	0.127(0.148)	-0.028(0.036)	0.144(0.143)	0.456(0.217)	-0.234(0.452)	-3.748(0.035)	3.368(2.069)
Distance to road	0.407(0.349)	0.379***(0.142)	0.849(1.665)	3.776(0.938)	-1.748(0.035)	0.562(0.069)	1.008(5.752)	1.111(1.566)
Households lost land rights	0.518(0.552)	1.206***(0.304)	-5.403(2.766)	2.177(2.049)	0.043(0.028)	0.005(0.003)	-0.101(0.088)	0.719(2.611)
Access to other sources of rev.	2.551***(0.642)	-0.809***(0.305)	-4.335(5.837)	1.585(1.834)	-2.637**(1.224)	-0.008(0.007)	-0.443(0.293)	3.397(1.094)
Migration status	0.183(0.490)	0.292(0.213)	-0.321(2.302)	-7.791(1.409)	0.019(0.042)	0.157**(0.224)	-0.033(0.159)	5.481(1.217)
Location dummy	1.685*(0.939)	0.614*(0.320)	1.599(7.530)	-2.762(1.980)	-1.104(0.862)	-0.358(0.524)	0.048(0.167)	-3.748(0.035)
Constant	-0.717(2.948)	5.190(1.299)	33.206(16.383)	14.974(8.272)	-0.439(1.373)	0.289(0.762)	3.879(7.527)	1.939(2.543)
Access to new technology	0.130(0.155)		0.197(0.111)		0.543**(0.226)		0.157**(0.224)	
Land tenure system	-0.053(0.122)		-0.136(0.136)		0.023(0.093)		0.289(0.762)	
σ_i	1.070***(0.101)	0.674***(0.052)	2.538**(0.165)	2.578***(0.043)	1.133***(0.103)	0.800***(0.052)	-0.665*(0.073)	0.453***(0.022)
ρ_i	1.350***(0.242)	0.554*(0.312)	0.622 (0.529)	-0.466**(0.219)	1.434***(0.219)	-1.392**(0.274)	0.039(1.202)	-0.023*(0.652)
Log likelihood	-1187.18		-2088.89		-1262.08		-670.89	
Wald $\chi 2$	53.82***		66.59***		42.99***		12.03	
LR test of indep. equa $\chi 2$	8.85**		4.11		5.23**		7.42**	
Observation	121	383	121	383	121	383	121	383

Source: Own calculation from AFGROLAND data; Standard errors appear in parentheses; * $p < 0.10$, ** $p < 0.05$ and *** $p < 0.01$.

Table 5.8 presents the expected value of the food security indicators under observed and unobserved scenarios. The endogenous switching model for HDDS indicated that, on average, being an LSAI employed member increased the HDDS (number of food items consumed) from 6.41 to 8.27 in Kenya, from 2.37 to 5.41 in Madagascar and from 2.16 to 4.09 in Mozambique. If households in an LSAI decide not to be employed, the number of food items consumed decreased by 1.86 points in Kenya, 3.04 points in Madagascar and 2.16 points in Mozambique. With non-engaged households, the HDDS were 5.98 in Kenya, 4.93 in Madagascar and 5.97 in Mozambique. When non-engaged families decided to be employed in an LSAI, the HDDS of households increased from 5.98 to 7.26 in Kenya, from 4.93 to 10.01 in Madagascar and decreased from 5.97 to 5.23 in Mozambique (Table 5.8).

The results for the FCS in both observed and unobserved scenarios are also presented in Table 5.8. Being employed by an LSAI increased the FCS from 72.34 to 82.42 in Kenya, from 38.93 to 47.76 in Madagascar and from 45.49 to 55.00 in Mozambique indicated that if households were employed by LSAIs, the FCS would have increased by 10.08, 8.83 and 9.51 points in Kenya, Madagascar, and Mozambique, respectively. When non-engaged households decided to be employed by an LSAI, the FCS would have increased from 57.55 to 75.40 in Kenya, from 38.78 to 43.34 in Madagascar, whereas it decreased from 53.08 to 43.18 in Mozambique (Table 5.8). The result of both FCS and HDDS of non-engaged households in Mozambique would not seem to improve when they decided to be employed by LSAI. This may be because households in Mozambique have small landholdings and livestock compared to Kenya and Madagascar. The salary paid by an LSAI may not be enough to improve the food security status of non-engaged in Mozambique significantly.

Table 5.8: Endogenous switching regression treatment effects

Outcome variables	Household and employment effects	Kenya			Madagascar			Mozambique		
		Decision Stage		ATE	Decision Stage		ATE	Decision Stage		ATE
		To Employ	Not to Employ		To Employ	Not to Employ		To Employ	Not to Employ	
HDDS	Employed (ATT)	8.27	6.41	1.86***	5.41	2.37	3.04***	6.24	4.09	2.16***
	Non-engaged (ATU)	7.26	5.98	1.28***	10.01	4.93	5.08***	5.23	5.97	-0.74
	Heterogeneous effects	1.01	0.43	0.58	−4.60	-2.56	-2.04	1.01	-1.88	2.89
FCS	Employed (ATT)	82.42	72.34	10.08 ***	47.76	38.93	8.83***	55.00	45.49	9.51***
	Non-engaged (ATU)	75.40	57.55	17.86 ***	43.34	38.78	4.56***	43.18	53.08	-9.90 ***
	Heterogeneous effects	7.02	14.79	-7.78	4.42	0.15	4.27	11.82	-7.59	19.42
MAHFP	Employed (ATT)	10.56	8.67	1.90***	9.57	9.49	0.08	10.98	8.23	2.75***
	Non-engaged (ATU)	9.89	9.82	0.07	9.47	6.72	2.75***	10.89	10.31	0.58
	Heterogeneous effects	0.74	-1.22	1.97	−1.06	0.33	-1.39	−0.91	-2.08	2.17
Food expenditure share	Employed (ATT)	34.39	51.37	-16.98 ***	80.52	76.25	4.27***	77.85	84.56	-6.71***
	Non-engaged (ATU)	64.83	42.25	22.58 ***	77.38	76.33	1.05**	83.23	80.41	-3.18**
	Heterogeneous effects	-30.44	9.12	-39.56	3.14	-0.08	3.22	-2.38	1.15	-3.53

Note: ATE- average treatment effect; ATT- average treatment effect for treated. ATU-average treatment effect for untreated; ** $p < 0.05$, *** $p < 0.01$.

On average, households had access to food for over eight months before the surveys for all three countries. Households with LSAI-employed members enjoyed adequate access to food for 10.5, 9.6 and 10.9 months in Kenya, Madagascar, and Mozambique, respectively. If employed households decided not to be employed by an LSAI, the household's access to food would decrease from 10.6 to 8.7 months in Kenya, from 9.6 to 9.5 months in Madagascar and 10.9 to 8.2 months in Mozambique. Whereas non-engaged households decided to be employed in an LSAI, the MAHFP of non-engaged households would have increased from 9.8 to 9.9 months in Kenya, from 6.7 to 9.5 months in Madagascar 10.3 to 10.9 months in Mozambique (Table 5.8).

The food expenditure share results of sampled households in the three countries are presented in Table 5.8. Most sampled households in Kenya had lower food expenditure shares than households in Madagascar and Mozambique. The food expenditure shares for households with employed members were 34.39 in Kenya, 80.52 in Madagascar, and 77.85 in Mozambique. In comparison, the food expenditure share of non-engaged households was 42.25, 76.33 and 80.41 in Kenya, Madagascar, and Mozambique, respectively. If employed households were no longer employed, the food expenditure share increased by 16.98 points in Kenya and 6.71 points in Mozambique. This result validates Engel's law that has stated that the expenditure on food falls as the household income increases (Mujenja & Wonani, 2012). In Madagascar, the food expenditure share decreased by 4.27 points, indicating employed households were less food-secure than non-engaged in Madagascar based on the food expenditure share indicator results.

If an LSAI employed a member of a non-engaged household, the food expenditure share would increase by 22.58, 1.05 and 3.07 points in Kenya, Madagascar, and Mozambique, respectively (Table 5.8). The three countries' food expenditure share results indicated that if an LSAI employed a member of non-engaged households, the food security status of the households would not improve. These results contradicted Engel's law. This might be because most LSAIs jobs were seasonal and low-paid. The household members employed by LSAIs maintained low living standards; therefore, the rise in income might fill the food consumption divergence (Herrmann, 2017).

Some signs of the base heterogeneity effects were positive, and others were negative, signalling that households with employed members, the food security level may have been influenced by the unobservable impacts of participation in employment (Di Falco *et al*., 2011). A positive base heterogeneity effect implied that households with employed members were more food-secure than non-engaged households; however, sometimes, the sign of TH effects was negative. For example, the TH effects were -7.78 for FCS in Kenya, -2.04 for HDDS and -1.39 for the MAHFP in Madagascar, whereas there was no negative transitional in Mozambique heterogeneity effect. This indicated that employment impact on household food security (FCS, HDDS, and MAHFP) would be higher for non-engaged households if an LSAI employed a member.

Finally, Table 5.9 summarises the average treatment effects (ATT), which show the impact of LSAIs on the food security status of households with members employed. The positive sign of the ATT for the three food security indicators (HDDS, FCS, and MAHFP) implied that households with employed members had higher food security than non-engaged households. The HDDS, FCS, and MAHFP indicators were consistently higher among households with LSAIs-employed members in the three countries. This finding confirms other studies' results that employment creation had an income and food security benefit (Baumgartner *et al*., 2015; Speller *et al*., 2017). The food expenditure shares also confirmed this among households with employed members in Kenya and Mozambique.

Conversely, the negative sign of the ATT for food expenditure shares in Kenya and Mozambique indicated that households with employed members had lower food expenditure shares (more food-secure) than non-engaged households. This result validates Engel's laws and concurs with other literature confirming that the lower household food expenditure is, the more food-secure a household is (Carletto *et al*., 2013; Mujenja & Wonani, 2012; Smith & Ali, 2007; Umeh & Asogwa, 2012). However, this was not the case in Madagascar, where the food expenditure share had positive ATT implying that non-engaged households were more food-secure than households with employed members (Table 5.9).

Table 5.9: Comparing the results of the average treatment effects for treated (ATT)

Outcome variables	Country ATT		
	Kenya	Madagascar	Mozambique
Household dietary diversity score	1.86 ***	3.04 ***	2.16 ***
Food consumption score	10.08 *	8.83 ***	9.51 ***
Month of adequate household food provision	1.90 ***	0.08	2.75 ***
Food expenditure share	-16.98 ***	4.27 ***	-6.71 ***

Note: ATT average treatment effects for treated (ATT); * $p < 0.10$, *** $p < 0.01$.

The three food security indicator results (for HDDS, FCS, and MAHFP) in Kenya and Madagascar indicated that LSAIs affected household food security in a household where an LSAI employed a member. In Mozambique, only the MAHFP results indicated an impact on both household groups. The HDDS and FCS results indicated that LSAIs had only an effect on households with a member employed by an LSAI. Food expenditure share results contradicted other food security indicators in Kenya and Mozambique, where the result indicated that LSAI affected households with a member employed by an LSAI; however, if an LSAI employed a member of a non-engaged household, the household's food security status would not improve in all three countries. The variation among indicators might be because of the dissimilar economic status of the countries and attributable to many jobs being seasonal and low-paid.

5.4 Summary

The findings of the study showed that different determinant factors for the participation of household members in LSAI employment were evident in each country. LSAI seemed to improve food security in the three communities. Employment appeared to smooth consumption, although employment may be seasonal. To capture the seasonality nature of food security, we recommend further studies using panel data to study the impact of large-scale agricultural investments on household food security. This chapter only focused on the employment impact of LSAI on household food security; the findings confirmed the result of the non-parametric analysis in chapter 4. The next chapter focuses on the impact of contract farming on household food security (in Chapter 6).

Chapter 6: The role of contract farming on household food security in Kenya and Madagascar

6.1 Introduction

Two models for LSAIs were widely discussed in the literature, indicating plantation farm and contract farming (out-grower scheme[1]) models (Burnod *et al*., 2015; Hall *et al*., 2017; Scoones *et al*., 2014). Many articles have pointed to the negative impact of large-scale land acquisitions on surrounding communities (Bottazzi *et al*., 2018; Cotula, 2009; Hall, 2011; Matenga & Hichaambwa, 2017; Vermeulen & Cotula, 2010). Contract farming has been promoted as a more 'inclusive business model' where local smallholder farmers can participate in and benefit from such investment in rural areas, sometimes known as win-win situations (Cotula, 2009; Deininger *et al*., 2011; Hall *et al*., 2017).

Most studies on the impact of contract farming in the two countries (Kenya and Madagascar) focused on income (Bellemare, 2010; Bellemare, 2012; Burnod *et al*., 2015; Mwambi *et al*., 2016; Wainaina *et al*., 2012); determinant factors affecting participation in contract farming (Dindi, 2013; Kagwiria & Gichuki, 2017; Kokeyo, 2013) and other socio-economic affects rather than food security (Tamura, 2021; Väth *et al*., 2019; Wainaina *et al*., 2014). Ton *et al*. (2017) reviewed a meta-analysis of 22 case studies. Most studies analysed the impact of contract farming on household income, except one study that investigated the effects of contract farming on household food security.

This chapter analyses the function of contract farming on household food security in Kenya and Madagascar. The findings contribute to discussing disputed outcomes of the impact of LSAIs through contract farming on food security by providing empirical evidence for the literature. The chapter discusses the results of the second objective of the research. The study findings are prepared to be submitted for publication in the journal of *Land Use Policy*.

[1] We use the term ‘outgrower’ synonymously with ‘contract farming’

The chapter has three sections. The first section introduces the chapter. The second section describes the data sources and methods of data analysis. Finally, the third section discusses the study findings.

6.2 Data and analytical framework

Seven hundred ninety-seven households were interviewed by the AFGROLAND project in the two countries; 500 from Kenya (58 households were engaged with contract and 442 were non-engaged) and 297 from Madagascar (110 contracted and 187 non-engaged households). Household detail demographic characteristics and food security data were collected using a survey questionnaire from both countries in 2017.

Households were classified into contract farming and non-engaged households. Contract farming households were households engaging in a contract agreement with an LSAI company. Non-engaged households were households that did not engage in a contract agreement with an LSAI company. Household participation in contract agreements with LSAIs was a dependent variable and defined as a binary variable, using a Value 1 for engaged and 0 for non-engaged.

Table 6.1 presents the sampled household characteristics. More households engaged in contract agreement were male-headed than non-engaged households in Kenya and Madagascar, whereas the number of female-headed households in Kenya was higher than in Madagascar. More households in Madagascar were married than in Kenyan. Most of the sampled households in both countries were attended primary school.

More contract farming households in Kenya were migrated from the nearby districts than other households. Most of the non-engaged households in Kenya were closer to the market and road than others (less than one hour distance). Most contract farming households in Kenya had access to irrigation compared with other households. Kenyan households had greater access to other sources of revenue than Madagascar households. Only a few households in both countries accessed innovative technologies. Most households (over 70%) in Madagascar had an informal land tenure system compared with less than 10% in Kenya. On average, contract farming households in Kenya

were younger and owned more livestock than other households. Contract farming households in Madagascar were larger households than in Kenya (Table 6.1).

Table 6.1: Descriptive statistics

Variable	Category	Kenya			Madagascar		
		Engaged in contract	Non-engaged	Difference	Engaged in contract	Non-engaged	Difference
Sex of the household head (Dummy)	Male	75.44	58.18	0.17**	89.09	81.28	0.09
	Female	24.56	41.82		10.91	18.72	
Marital status of the household head (Dummy)	Married	73.68	64.77	0.09	81.82	80.21	0.02
	Single	26.31	35.23		18.18	19.79	
Education status of the household head (Years)	No school	21.05	21.30	0.05	8.18	9.63	0.07
	Primary	52.63	50.00		69.09	70.05	
	Secondary	26.32	27.32		22.73	19.79	
	College	0.00	1.39		0.00	0.53	
Migration status (Dummy)	Migrant	86.06	16.59	0.03	31.82	36.90	0.05
	Non-migrant	14.04	83.41		68.18	63.10	
Distance from market (minute/hour)	<=30 minute	8.77	15.49	0.61***	0.91	17.65	0.22
	30 min. to 1hr	3.51	51.71		41.82	30.48	
	>= 1 hour	87.72	32.80		57.27	51.87	
Distance from road (minute/hour)	<=30 minute	22.81	48.97	0.76***	26.36	25.53	0.16
	30 min. to 1hr	12.28	36.45		32.73	19.79	
	>= 1 hour	64.91	14.58		40.91	54.55	
Access to irrigation (Dummy)	Yes	100.00	32.65	0.68***	31.82	25.13	0.07
	No	0.00	67.35		68.18	74.87	
Other source of revenue (Dummy)	Yes	87.72	60.87	0.05	0.00	0.53	
	No	12.28	39.13		100.00	99.47	
Access to new technology (Dummy)	Yes	14.29	20.69	0.27***	19.09	5.35	0.14
	No	85.71	79.31		80.91	94.65	
Land tenure system (Dummy)	Informal	7.02	8.40	0.20*	70.91	77.54	0.26
	Customary	26.32	17.04		20.91	18.05	
	Titled	66.67	74.55		8.18	3.21	
Continuous variables		Mean	Mean		Mean	Mean	
Age of the household		37.59	44.82	7.22***	44.89	42.79	2.10
Family size		4.49	4.07	0.42	5.75	5.61	0.14
Livestock ownership		4.76	2.54	2.21***	1.42	1.04	0.07
Land size (Hectares)		1.03	1.29	0.26	1.07	0.98	0.08
Observations		58	442		110	187	

Note: *p<0.10, ** p<0.05, ***p<0.01.

In this chapter, three internationally recognised food security indicators were employed to analyse the food security status of the households:

- HDDS
- FCS
- MAHFP

The study employed an ESR model to estimate the impact of contract farming on household food security. An ESR model accounts for the selection bias that may have occurred because of the self-selection of contracted households (Dutoit, 2007; Heckman, 1979).

The selection model was employed to access innovative technology; the land tenure system was employed as instrumental variables to discuss the endogeneity problem (Abdulai & Huffman, 2014; Di Falco *et al*., 2011). These affected household participation in contract farming but did not directly affect the food security status of the households. The study selected innovative technology as an instrument because some households may have engaged with a contract agreement in an LSAI to access new technologies, such as improved seeds, storage facilities, marketing facilities, pesticides, and various types of machinery. The land tenure system may have affected the household decision to engage in contract farming. Land-titled households have a better chance to engage in contract farming (Ton *et al*., 2017; Väth and Kirk, 2013). Customary landholding lacked the security of tenure to ensure agricultural investment and the right to use their land. Therefore, the probability of being engaged in contract farming has been lower for households under the customary tenure system than land-titled households.

6.3 Result and discussion

This section presents and discusses the study findings in two sub-sections. The first subsection presents the determinant factors of contract farming and illustrates the ESR model causing the second subsection.

6.3.1 Determinants of participation in contract farming

The first stage ESR results (the selection model results) presents in the second column of Table 6.2 and Table 6.3. The selection model estimated the household determinant factors to engage in a contract with an LSAI. From 14 explanatory variables, the sex of the household head, distance from a road and distance from a market were the common determinant factors in the two countries. Besides this, there were four additional determinant factors of contract farming in an LSAI in Kenya (age and marital status of the household head, livestock ownership, and access to new technology). In Madagascar, three additional determinant factors include land size, access to new technology, and a land tenure system (Table 6.2).

The positive coefficient of the sex of the household head indicated that the probability of engaging in a contract agreement with an LSAI was higher for male-headed households. The negative coefficient for the age of the household head, marital status of the household head and land size indicated that older married household heads with larger land sizes were less likely to engage in contract agreement with an LSAI. Whereas livestock holding was a positive coefficient, the more livestock the household had, the higher the probability of contract employment with an LSAI. Distance from a market and a road were other determinant factors. The positive coefficient indicated that the probability of engaging in a contract agreement with an LSAI was higher for households further away from a market and road (Table 6.2).

The estimated results of Kenya and Madagascar's second stage ESR model results are also presented in Table 6.2 and Table 6.3 from columns three to eight. The statistically significant coefficients for access to innovative technology and land tenure system in the selection equation indicated that the selected instruments were relevant and affected household participation decisions.

Table 6.2: Kenya endogenous switching regression estimation results

Variables		HDDS		FCS		MAHFP	
	Selection	Contract	Non-engaged	Contract	Non-engaged	Contract	Non-engaged
Sex of the household head	0.326*	-0.498	0.091	-7.251	-2.219	-0.284	-0.412**
	(0.193)	(0.465)	(0.143)	(5.229)	(1.611)	(0.842)	(0.217)
Age of the household head	-0.019***	-0.038**	-0.004	-0.584***	-0.071	-0.049	-0.003
	(0.006)	(0.015)	(0.004)	(0.172)	(0.043)	(0.031)	(0.006)
Household size	0.040	-0.175	0.091***	-3.091	0.201	-0.261	-0.082
	(0.058)	(0.155)	(0.034)	(1.812)	(0.417)	(0.260)	(0.056)
Education status of the head	-0.008	0.317	0.317***	0.164	2.751**	0.223	0.321**
	(0.135)	(0.269)	(0.089)	(3.272)	(1.089)	(0.503)	(0.146)
Marital status of the head	-0.489**	-1.033**	-0.125	-1.934**	-5.206***	-2.269	-0.615**
	(0.232)	(0.478)	(0.145)	(5.411)	(1.782)	(1.055)	(0.269)
Livestock owned (TLU)	0.065**	-0.029	0.094***	-0.241	1.489***	-0.004	0.175***
	(0.031)	(0.035)	(0.027)	(0.399)	(0.352)	(0.061)	(0.045)
Land size	-0.1555	0.577*	0.045	0.057**	1.238**	0.766	0.077
	(0.105)	(0.305)	(0.042)	(3.439)	(0.517)	(0.537)	(0.069)
Distance to market	0.652***	1.039**	-0.102	6.372	-3.478***	-0.693	-0.199
	(0.152)	(0.439)	(0.096)	(4.937)	(1.176)	(0.618)	(0.149)
Distance to road	0.526***	-0.231	-0.062	-2.268	3.521***	-0.123	-0.261
	(0.115)	(0.279)	(0.092)	(3.128)	(1.121)	(0.201)	(0.026)
Other source of revenue	0.217	0.116	0.031	6.847	-0.839	0.477	0.031
	(0.252)	(0.526)	(0.162)	(5.925)	(1.973)	(1.038)	(0.264)
Migration status	-0.178	0.954**	0.084	0.729	4.154**	-0.513	0.105
	(0.244)	(0.415)	(0.164)	(4.673)	(1.548)	(1.050)	(0.269)
Location dummy	0.069	-0.161	0.064	1.798	0.455	-0.476	0.127
	(0.187)	(0.454)	(0.126)	(5.297)	(1.542)	(0.749)	(0.207)
Access to new technology	0.800***						
	(0.185)						
Land tenure system	-0.096*						
	(0.047)						
σ_i		0.393*	0.267***	2.805***	2.766***	2.439***	2.062***
		(0.220)	(0.054)	(0.214)	(0.043)	(0.354)	(0.073)
ρ_i		0.680**	-0.567*	0.659***	-0.324	0.309	-0.076**
		(0.470)	(0.329)	(0.469)	(0.262)	(0.407)	(0.468)
Log likelihood		-897.09		-2027.64		-1237.23	
Wald $\chi 2$		43.08***		52.93***		38.40***	
LR test of independent equations $\chi 2$		3.75		2.95		0.41	
Observations	500	58	442	58	442	58	442

Note: σ_i- sigma; ρ_i - correlation coefficients (rho); *p<0.10, ** p<0.05, ***p<0.01.

Table 6.3: Madagascar endogenous switching regression estimation results

Variables		HDDS		FCS		MAHFP	
	Selection	Contract	Non-engaged	Contract	Non-engaged	Contract	Non-engaged
Sex of the household head	0.613*	-1.997***	0.598	0.936	-1.336	-0.929	-0.215
	(0.327)	(0.705)	(0.432)	(4.637)	(2.704)	(0.744)	(0.557)
Age of the household head	0.002	0.002	0.008	0.188**	0.041	-0.008	0.013
	(0.006)	(0.013)	(0.009)	(0.087)	(0.054)	(0.014)	(0.011)
Household size	0.009	0.058	-0.061	0.132	-0.713**	0.076	-0.102
	(0.035)	(0.066)	(0.053)	(0.447)	(0.334)	(0.069)	(0.069)
Education status of the head	0.041	0.064	-0.009	1.677	0.958	-0.447	0.246
	(0.090)	(0.172)	(0.129)	(1.186)	(0.812)	(0.195)	(0.169)
Marital status of the head	0.152	-0.798**	-0.214	0.624	-0.055	0.325	-0.352
	(0.194)	(0.360)	(0.292)	(2.402)	(1.834)	(0.410)	(0.375)
Livestock owned (TLU)	0.042	0.065	0.048	0.618	1.404***	0.142	0.157
	(0.037)	(0.084)	(0.053)	(0.568)	(0.334)	(0.094)	(0.067)
Land size	-0.034**	0.424***	0.291***	2.184**	1.973***	0.412	0.069
	(0.059)	(0.149)	(0.089)	(0.973)	(0.515)	(0.156)	(0.106)
Distance to market	0.436***	0.161	-0.472***	-1.576	-2.201**	-0.209	-0.222
	(0.132)	(0.352)	(0.149)	(2.482)	(0.951)	(0.400)	(0.197)
Distance to road	-0.199*	-0.033	0.297*	0.071	-0.044	-0.694	0.271
	(0.114)	(0.248)	(0.155)	(1.743)	(0.990)	(0.287)	(0.205)
Other source of revenue	-0.901	-0.303	0.659**	2.248	4.144**	0.262	1.401
	(0.263)	(0.418)	(0.309)	(2.887)	(1.971)	(0.488)	(0.409)
Migration status	-0.059	0.268	0.423*	3.471	1.680	0.586	0.452
	(0.154)	(0.309)	(0.225)	(2.117)	(1.364)	(0.364)	(0.283)
Location dummy	0.170	-0.345	0.063	-2.031	0.589	0.053	-0.016
	(0.168)	(0.334)	(0.242)	(2.323)	(1.501)	(0.378)	(0.310)
Access to new technology	0.588***						
	(0.189)						
Land tenure system	0.143*						
	(0.076)						
σ_i		0.805***	0.727***	2.427***	2.249***	1.043***	0.699***
		(0.125)	(0.075)	(0.099)	(0.054)	(0.131)	(0.074)
ρ_i		-1.301	1.418***	-0.473*	-0.078	-1.666***	-0.304
		(0.286)	(0.231)	(0.253)	(0.404)	(0.402)	(0.334)
Log likelihood		-738.84		-1288.29		-799.57	
Wald $\chi 2$		47.56***		60.30***		32.27***	
LR test of independent		19.32***		2.75		9.62***	
Observations	297	110	187	110	187	110	187

Note: σ_i- sigma; ρ_i - correlation coefficients (rho); * p<0.10, ** p<0.05, ***p<0.01.

The significant results of the likelihood ratio test ($\chi 2$), the sigma (σ_i) and correlation coefficients (ρ_i) implied self-selection problems and the model specification controlled for this inferred endogeneity. The finding suggested that contract farming might not have had the same impact if non-engaged households engaged in a contract agreement with an LSAI. The positive and statistically significant correlation coefficient of contract farming households (ρie) of HDDS and FCS in Kenya indicated the existence of adverse selection bias (Table 6.2). This revealed that less food-secure households were more likely to engage in a contract with an LSAI. While in Madagascar, the negative and statistically significant correlation coefficient of contract farming households (ρ_{ie}) of FCS and MAHFP indicated a positive selection bias (Table 6.3). This indicated that more food-secure households were more likely engaged in a contract with an LSAI.

6.3.2 Impact of contract farming on household food security

Table 6.4 presents the expected value of the observed and unobserved scenarios of the three food security indicators. The endogenous switching results of the three food security indicators (HDDS, FCS, and MAHFP) in Kenya were statistically dissimilar from zero. On average, the HDDS of contract farming households increased from 6.23 to 8.16 in Kenya, whereas it decreased from 8.72 to 5.96 in Madagascar. If the household contracted in an LSAI decided not to be contracted, the HDDS decreased by 1.93 points in Kenya and increased by 2.76 points in Madagascar. In the non-engaged scenario, the HDDS were 7.29 in Kenya and 5.87 in Madagascar. If non-engaged households engaged in a contract agreement with LSAI, the HDDS of the household would decrease from 7.29 to 6.72 in Kenya and increase from 5.87 to 9.06 in Madagascar (Table 6.4). The variation in the two countries might be attributable to selection bias; for instance, less food-secure households were more likely to engage in a contract with an LSAI in Kenya, and the contract farming improved HDDS.

The FCS result indicated that a contract agreement with an LSAI increased FCS from 69.86 to 82.28 in Kenya. However, a contract agreement with an LSAI was not statistically significantly different in Madagascar's FCS of households. If non-engaged households engaged in a contract agreement with an LSAI, the FCS decreased by 4.52 points in Kenya (Table 6.4).

On average, households had access to food for almost ten months in Kenya and over six months in Madagascar. This indicated that Kenyan households were better food access than Madagascar. Contract farming households enjoyed adequate food for 10.33 months in Kenya and 8.18 months in Madagascar. If contract farming households decided not to be agreeing with an LSAI, the households' food access decreased by 0.49 points in Kenya and 1.21 points in Madagascar. While non-engaged households chose to be engaged in contract agreement with an LSAI, the households' food access decreased from 9.93 to 9.24 in Kenya and increased from 7.85 to 12.29 in Madagascar (Table 6.4).

The signs of base heterogeneity and TH for all food security indicators (HDDS, FCS, and MAHFP) in Kenya were positive, indicating that households engaged in contract farming with an LSAI were more food-secure than non-engaged households. Whereas in Madagascar, the base heterogeneity and TH for all food security indicators were negative, implying that the impact of contract farming on household food security would be higher for non-engaged households if they decided to be engaged in contract farming with an LSAI (Table 6.4).

Table 6.4: Endogenous switching regression treatment effects

Outcome variables	**Household type and contract farming effects**	**Kenya**			**Madagascar**		
		Decision s0tage		ATE	Decision stage		ATE
		To engage	Not to engage		To engage	Not to engage	
HDDS	Contract farming (ATT)	8.16	6.23	1.93***	5.96	8.72	-2.76***
	Non-engaged (ATU)	6.72	7.29	-0.56***	9.06	5.87	3.19***
	Heterogeneous effects	1.44	-1.06	2.49	-3.10	2.85	-5.95
FCS	Contract farming (ATT)	82.28	69.86	12.41***	38.91	38.01	0.89
	Non-engaged (ATU)	70.82	75.34	-4.52***	46.12	38.78	7.34***
	Heterogeneous effects	11.46	-5.48	16.93	-7.21	-0.77	-6.45
MAHFP	Contract farming (ATT)	10.33	9.84	0.49**	8.18	6.97	1.21***
	Non-engaged (ATU)	9.24	9.93	-0.69***	12.29	7.85	4.44***
	Heterogeneous effects	1.09	-0.09	1.18	-4.11	-0.88	-3.23

Note: ATE- average treatment effect; ATT- average treatment effect for treated; ATU-average treatment effect for untreated; ** $p<0.05$, ***$p<0.01$.

The summary of the ATT, signifying the effect of contract farming on contracted households' food security status, is presented in Table 6.5. The positive sign of the ATT for the three food security indicators (HDDS, FCS, and MAHFP) in Kenya indicated that households engaged in contract agreement with an LSAI had better food security than non-engaged households. This finding concurred with other studies results that contract farming improved the food security status of the households (Bellemare & Novak, 2017; Ton *et al*., 2017). While only the MAHFP had positive and statistically significant ATT in Madagascar, the ATT for FCS was positive but not statistically substantial, indicating that contract farming did not impact the food security status of contract households in Madagascar.

The negative sign of the ATT for HDDS in Madagascar implied that households engaged in a contract agreement with an LSAI consumed less diversified food than non-engaged households (Table 6.5). This variation might be because contract farming households in Kenya produced vegetables for an LSAI that helped diversify their diets; however, in Madagascar, contract farming households grew barley, and Madagascar's staple food is rice. Another reason for the variation among food security indicator results might be that the two countries' economic status differed. On average, Kenyan farmers had a better financial status than Madagascar.

Table 6.5: Comparing results of Average treatment effects for treated (ATT)

Outcome variables	**Country ATT**	
	Kenya	Madagascar
Household dietary diversity score (HDDS)	1.93***	-2.76***
Food consumption score (FCS)	12.41***	0.89
The month of adequate household food provision (MAHFP)	0.49**	1.21***

Note: ATT- average treatment effect for treated; ** p<0.05, ***p<0.01.

6.4 Summary

The findings of the study confirmed that engaging in a contract farming agreement with a LSAI improved household food security in Kenya. While in Madagascar, only one indicator showed a positive impact of contract farming on household food security. This might be because contract

farming households in Kenya produced vegetables for a LSAI that helps to diversify their diets. While in Madagascar, households produced barley and Madagascar's main staple food is rice. Contract farming did not affect land ownership of the households in both countries. Further studies with detailed information on income and wealth are needed to investigate the extensive and long-lasting impact of LSAIs. The next chapter identifies the most vulnerable households to deepening levels of food insecurity relative to the nature of their engagement with the LSAI (Chapter 7).

Chapter 7: Large-scale agricultural investments and household vulnerability to food insecurity: Evidence from Kenya, Madagascar, and Mozambique

7.1 Introduction

Food insecurity remains high in Africa despite the commitment of African governments to reduce hunger, malnutrition, food insecurity and prioritising agriculture and food security programmes (Yengoh *et al*., 2016). The G7 Heads of States also committed to lifting 500 million people from hunger and malnutrition by 2030 to tackle this challenge. Von Braun *et al.* (2021) estimated that approaching the challenge by 2030 will require donors and developing countries to double their current spending on these efforts.

Some developing countries consider FDI in the agriculture sector essential to acquire agricultural inputs, increase productivity, and achieve sustainable growth and poverty reduction to achieve food security for their populations (Mahmoodi & Mahmoodi, 2016; Persson, 2016). Africa has the highest number of large-scale land acquisitions in the global South attributable to the continent's agroecological suitability and the relatively low cost of land and labour (Andrews and Cochrane, 2021; Nolte *et al*., 2016). In these countries, FDIs produce food, fibre crops, biofuels, and flowers for export (Glover & Jones, 2019; Mechiche-Alami *et al*., 2021).

African Union member states and other stakeholders developed guidelines for LSAIs in Africa (AUC-ECA-AfDB Consortium, 2014). The guidelines are based on human rights and gender equality. They promote the following six fundamental principles:

- Respecting the human rights of communities
- Respecting the land rights of women
- Assessing investments
- Recognising the significant role of smallholder farmers (inclusiveness) in achieving food security and poverty reduction
- Promoting collaboration among member states
- Enhancing accountability and transparency to improve governance (AUC-ECA-AfDB Consortium, 2014)

While these guidelines ensure sustainable benefits for communities, investors, and governments, LSAIs might not follow these guidelines. This will increase the vulnerability of households in areas where such investments are located to food insecurity. Establishing LSAIs may affect livelihoods and household well-being through reduced access to land, natural resources, such as water, pasture lands, and tenure insecurity (Eriksen *et al*., 2005; Verma, 2014).

This chapter investigates the function of LSAIs on household vulnerability to food insecurity in sample communities in Kenya, Madagascar, and Mozambique. The chapter discusses the third study objective, which tests the hypothesis that various households were unequally vulnerable to food insecurity using the principal component and ordered probit analysis. The study findings were published on the *African Journal on Land Policy and Geospatial Sciences*. The chapter has four sections. The first section provides information about the chapter. Then the second section provides information on the concept of vulnerability and food insecurity. The third section describes the data sources and methods of data analysis. Finally, the fourth section discusses the study findings.

7.2 The concept of vulnerability to food insecurity

The term ‘food insecurity’ describes the current and past conditions of households. Vulnerability represents the risk of future food insecurity or worsened food insecurity (Hendriks, 2015). The term food security is defined as “a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life” (HLPE, 2020). Vulnerability is defined as the

range of factors that place people at risk of becoming food-insecure, including factors affecting their ability to cope (Proag, 2014; Sileshi *et al*., 2019). Vulnerability is determined by exposure to the risk and the ability of individuals and households to cope with or withstand stressful situations (Conte, 2005; Thomas *et al*., 2018; Sileshi *et al.*, 2019). These risk factors may be natural or human-induced, such as climate change, droughts, flooding, frost, land degradation, pests, rainfall patterns, or risks related to population densities and price shocks (Dercon & Christiaensen, 2011; Gelaw & Sileshi, 2013; Sileshi *et al*., 2019). Household food security is not static, because of the seasonal nature of food availability. It can change over time, existing on a continuum of experiences on which households move between more and less severe levels of food insecurity depending on their specific context (Hendriks, 2015).

Food-insecure households are vulnerable to shocks (Babatunde *et al*., 2008; Limon *et al*., 2017; Sileshi *et al*., 2019) and adopt food consumption coping strategies to mitigate food shortages (Shariff & Khor, 2008). Vulnerability also arises from the complex interactions among socio-economic, institutional, and environmental systems (Eriksen *et al*., 2005; Krishnamurthy *et al*., 2014; Lazarte, 2017; Wineman, 2016). New investments, technologies, and safety net programmes could offer opportunities to improve or secure new livelihoods for households (West & Haug, 2017).

Establishing LSAIs might affect smallholder vulnerability to food insecurity (Behrman *et al*., 2012). Behrman *et al*. (2012) suggest that if LSAIs are adequately implemented and follow an inclusive business model, they can distribute local resources more evenly and provide employment opportunities. Some studies implied that contract farming business models might be more inclusive and beneficial for smallholder farmers' livelihoods and food security than plantation systems (Hall *et al*., 2017; Paglietti & Sabrie, 2013).

Several food security studies employed the CSI to evaluate food insecurity (Bekele & Abdissa, 2019; Dunga & Dunga, 2017; Ibrahim *et al*., 2016). The CSI has also been widely applied (the World Food Program/Vulnerability Analysis Mapping Unit (WFP/VAM) and FAO (Bindraban *et al*., 2003). The CSI measures food security indirectly by directing questions to households related to food consumption behaviour (Maxwell & Caldwell, 2008). It measures the severity of behaviours that households adopt to mitigate amidst or anticipation of food shortages.

Maxwell and Caldwell (2008) categorised the coping strategies into four severity levels. The severity weighted as four (4) indicates the most severe strategy, such as sending household members to beg, skipping the entire days without eating, and collecting and consuming wild fruits or immature crops. The severity level weighted as level three (3) includes practices, such as consuming seed stocks held for the next season and restricting the food consumption for adult members.

The severity level weighted as level two (2) (less severe strategies) includes borrowing food from relatives or friends, buying food on credit, sending a household member to eat elsewhere, feeding working family members, and reducing the number of daily meals. Finally, the least severe strategies (weighted as level one (1)) include eating less preferred and less expensive foods and reducing meal sizes or limiting proportions. The socio-economic characteristics identified by several studies associated with vulnerability to food insecurity are summarised in Table 7.1.

Table 7.1: Variables, definitions and relation with vulnerability

Variables	Description	Hypothesised relationship with vulnerability to food insecurity
Household categories	Diverse groups of households (employed, contract and non-engaged	Employed and contract farming groups were less vulnerable to food insecurity (Behrman *et al.*, 2012; Ibrahim *et al.*, 2016; Loopstra *et al*., 2019)
Sex of the household head	Sex of the household head	Female-headed households were more vulnerable than male-headed (Eriksen *et al*., 2005; Mendy *et al*., 2020; Nkegbe *et al*., 2017)
Marital status of the household head	Marital status of the household head	Married households were less vulnerable than other groups (single, divorced, and widowed) (Mthethwa and Wale, 2021; Mustapha *et al*., 2016; Nkegbe *et al*., 2017)
Education status of the household head	Education status of the household head	Educated households were less vulnerable than others (Eriksen *et al*., 2005; Lazarte, 2017; Mendy *et al*., 2020; Yengoh, 2016)
Household size	Total number of the household	The larger the household size, the more vulnerable the household (Ibrahim *et al*., 2016; Mendy *et al*., 2020; Sileshi, *et al.*, 2019)
Migration status of the household head	Migration status of the household	Migrant households were less vulnerable than non-migrant (Gartaula *et al*., 2012, Sam *et al*., 2019)
Household lost their land right	The household that lost their land right or not	The household that lost their land right were more vulnerable to food insecurity (Shete & Rutten, 2015)
Livestock ownership	Number of the livestock owned by the household head	Households with more livestock were less vulnerable to food insecurity (Eriksen *et al.*, 2005; Ibrahim *et al*., 2016)
Land size	Total cultivated land sized owned by the household(ha)	The larger the land size, the less vulnerable the household (Ibrahim *et al*., 2016; Sileshi *et al*., 2019)

This chapter investigates the function of LSAIs on household vulnerability to food insecurity in sample communities in Kenya, Madagascar, and Mozambique, based on their adoption of coping strategies. The analysis employed the CSI, and an ordered probit model to identify households most vulnerable to deepening levels of food insecurity relative to their engagement with the LSAI.

7.3 Data source and methods of data analysis

In this chapter, data from Kenya, Madagascar, and Mozambique from 1651 representative households from the three countries are employed (Table 7.2). The data were collected by the AFGROLAND project using semi-structured questionnaires in 2016 and 2017 (January to March 2017 from Kenya; March to April 2017 from Madagascar; September to October 2016 from Mozambique) (Reys, 2016; Reys & Burnod, 2017; Reys & Mutea, 2017).

Table 7.2: Countries sample size

Country	**District**	**Number of households interviewed**	**Household category**		
			Total households employed in LSAIs	Total households engaged in contract	Non-engaged households
Kenya	Nanyuki	546	46	58	442
Madagascar	Satrokala and Ambatofinandrahana	601	61	124	416
Mozambique	Gurué and Monapo	504	121		383
Total sample		**1651**	**228**	**182**	**1241**

Source: Reys and Burnod (2017).

Households were classified into the following three categories, based on their engagement in LSAIs:

- With a member employed by an LSAI (employed)
- In an out-grower contract with an LSAI (contract)
- In the same communities, where a member was neither employed nor contracted to an LSAI (non-engaged households)

The study employed the CSI to measure food security and vulnerability (Maxwell & Caldwell, 2008). The data were collected for a seven-day recall period, and the score calculated as (Maxwell & Caldwell, 2008) follows:

$$\text{CSI} = (\text{frequency CS1} * \text{severity CS1}) + (\text{frequency CS2} * \text{severity CS2}) + \cdots + (\text{frequency CS12} * \text{severity CS12})$$

Where CSI: is the coping strategy index; CS1 to CS12 indicated varied coping strategies. The frequency (how many days in the last week a household had adopted a strategy) was scored as "never" (0) to "every day" (7).

The frequency was multiplied by the severity weighting taken from Maxwell and Caldwell (2008). It was weighted as four for the most severe category of strategies, three for the next-less severe category, two for the less severe category, and one for the least severe category. The CSI was the sum of the frequency multiplied by the severity of the 12 coping strategies. The higher CSI represented greater food insecurity (Maxwell & Caldwell, 2008; Ibrahim *et al*., 2016). PCA was used to identify the more frequently practised coping strategies by each household category. Finally, an ordered probit model was employed to identify the determinant factors of household coping ability during food shortages, based on the results of the CSI scores.

7.4 Results

The results of the analysis are presented in the following three sections. The first section explains the descriptive results of the sampled household. The second section focuses on the results of PCA. The last section provides the determinant factors of household coping ability during food shortages (food insecurity).

7.4.1 Descriptive statistic results

The summary of descriptive statistics results is presented in Table 7.3. Males headed the most sampled households in the three countries. Only a few household heads had not attended school. More than half the household heads completed primary education. Around 20% of the sample households completed secondary school. Only a few household heads attended college or university.

Mozambique had more married household heads than Kenya and Madagascar. The Kenyan sample had the fewest married household heads. On average, contract farming and non-engaged households in Madagascar were more significant than those in Kenya and Mozambique. In Kenya, LSAI-employed member households were the smallest (Table 7.3).

More LSAI-employed household heads migrated from neighbouring communities in the Kenyan and Malagasy samples. On average, more households in Mozambique lost their land rights than in Kenya and Madagascar. Non-engaged households in Madagascar had more livestock and more extensive landholdings than other households in all three countries. Households with LSAI-employed members and non-engaged households in Mozambique had the lowest number of livestock (Table 7.3).

Table 7.3: Descriptive results of the total sampled households

Variable	Description	Category	Kenya				Madagascar				Mozambique		
			Employed (%)	Contract (%)	Non-engaged (%)	Chi-square (p-value)	Employed (%)	Contract (%)	Non-engaged (%)	Chi-square (p-value)	Employed (%)	Non-engaged (%)	Chi-square (p-value)
SEX	Sex of the household head, 1 if sex of the household head male = 1, 0 for female	Male	58	75	60	0.01**	85	89	85	0.08*	94	87	0.08**
		Female	42	25	40		15	11	15		6	13	
EDU	Education status of the household head, (If the household head no schooling = 0, primary = 1, secondary = 2 & college/university = 3)	No school	17	21	21	0.80	18	8	15	0.79	16	16	0.01
		Primary	52	53	49		47	69	64		51	49	
		Secondary	31	26	28		35	23	21		26	27	
		College	0	0	2		0	0	0		7	8	
MARST	Marital status of the household head, 1 if the household head married, 0 otherwise	Married	71	74	65	0.18	73	82	83	0.94	92	85	0.07**
		Single/divorce	29	25	35		26	18	17		8	15	
MIGR	Migration status of the household, 1 for migrant and 0 if non-migrant	Migrant	85	84	17	0.62	75	32	31	0.65	54	53	0.08**
		Non-migrant	15	16	83		25	68	69		46	47	
LANLR	Land rights lost, 1 if yes, 0 otherwise	Yes	2	5	5	0.81	5	0	0	1.00	25	18	0.08*
		No	98	95	95		95	100	100		75	82	
Continuous variables			Mean	Mean	Mean		Mean	Mean	Mean		Mean	Mean	
HHS	Household size		3.9	4.5	4.1	0.44	4.8	5.8	6.1	0.14	4.8	4.8	0.01
LVSK	Livestock holdings in tropical livestock unit (TLU)		2.3	4.5	2.9	2.39**	2.1	1.4	14.3	0.07	0.1	0.1	0.02
LAND	Land size (hectares)		1.3	1.0	1.3	0.27	2.2	1.1	7.8	0.08	2.2	2.3	0.05
Observation			46	58	442		61	124	416		121	383	

Note: *p<0.10, ** p<0.05, ***p<0.01.

7.4.2 Applying coping strategies by sampled households

A range of food consumption coping strategies was practised to mitigate food shortages. Consuming less expensive foods and limiting portion sizes were the most prevalent coping strategies among the households. Households with LSAI-employed members in Kenya typically purchased food on credit and reduced the number of daily meals. In Madagascar, LSAI-employed member households practised coping strategies more than non-engaged households, including borrowing food from friends or relatives, restricting adults' food consumption and skipping days without eating. Households in Mozambique borrowed food, collected wild foods, and reduced the daily number of meals. More non-engaged households in Mozambique consumed seed stock held for the next season. Sending household members to eat elsewhere, sending household members to beg, and feeding working members at the expense of non-working members were not frequently practised in the sampled households (Figure 7.1).

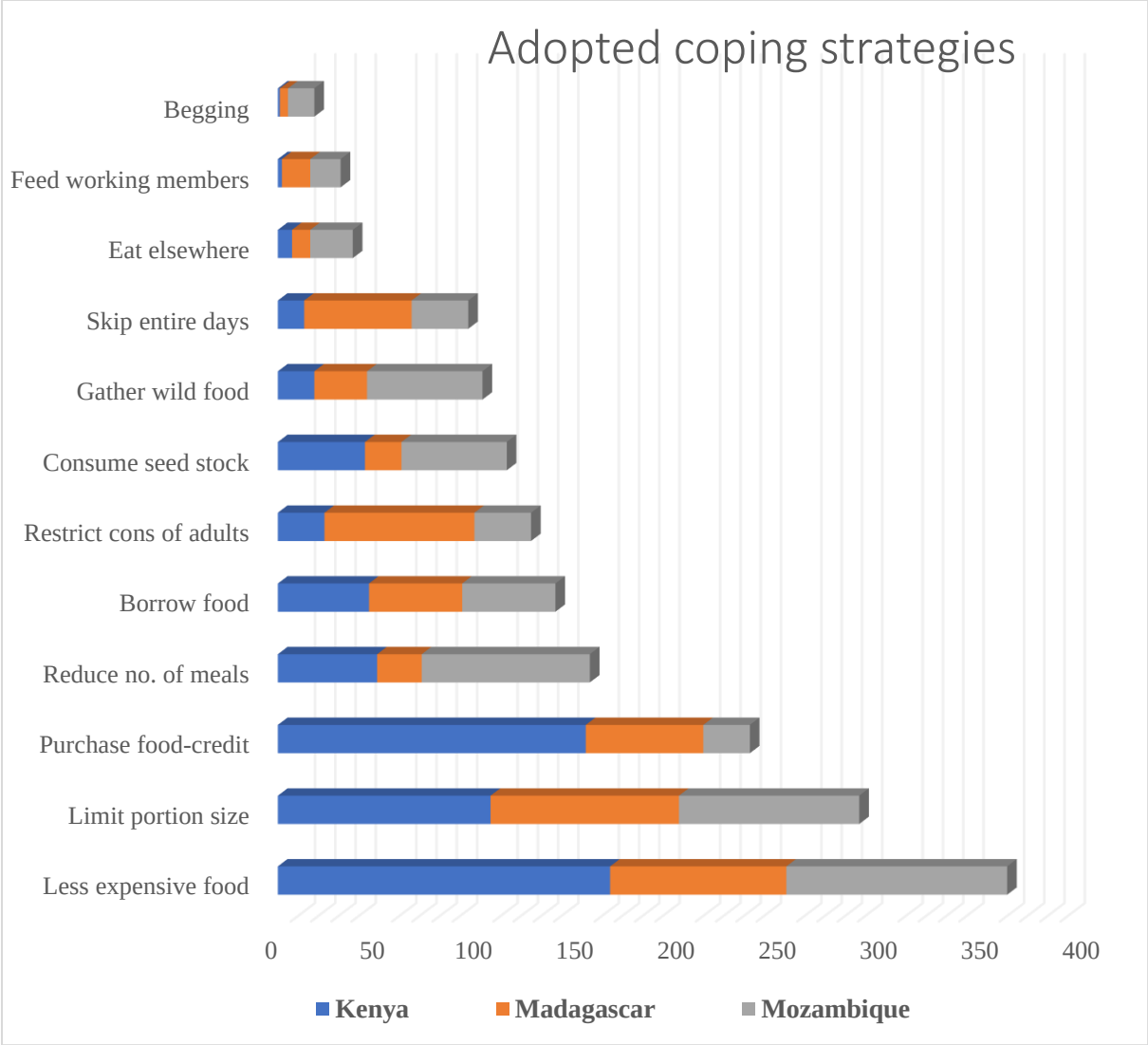


Figure 7.1: Adopted coping strategies

Source: Prepared by authors from 2016 to 2017 data.

Table 7.4 illustrates the patterns of household coping strategy adoption in Kenya. The PCA results signified that households with LSAI-employed members and non-engaged households in Kenya and Madagascar adopted coping strategies more than other households. Contract farming households in Kenya and Madagascar and members employed in Mozambique adopted fewer coping strategies than other households. In Kenya, contract farming households were more food-secure than other households, only practising eight from 12 coping strategies (Table 7.4).

Table 7.4: Patterns of principal components of coping strategies in Kenya

Coping strategy	Employed			Coping strategy	Contract			Coping strategy	Non-engaged		
	PC1	PC2	PC3		PC1	PC2	PC3		PC1	PC2	PC3
Less expensive food	0.599			Less expensive food	0.388			Less expensive food	0.392		
Borrow food	0.345			Purchase food _credit	0.428			Borrow food	0.321		
Restrict cons. of adults	0.382			Restrict cons. of adults	0.441			Purchase food _ credit	0.357		
Limit portion size	0.304			Reduce no. of meals	0.424			Restrict cons. of adults	0.307		
Gather wild food	0.327			Gather wild food	0.474			Limit portion size	0.392		
Eat elsewhere	0.332			Borrow food		0.330		Reduce no. of meals	0.409		
Skip entire days	0.339			Limit portion size		0.579		Skip entire days	0.321		
Feed working members		0.422		Consume seed stock			0.345	Eat elsewhere		0.554	
Purchase food _credit		0.413		Skip entire days				Begging		0.602	
Consume seed stock			0.563	Eat elsewhere				Gather wild food			0.679
Reduce no. of meals			0.673	Begging				Feed working members			0.692
Begging				Feed working members				Consume seed stock			0.839
Eigenvalue	5.75	1.58	0.99	Eigenvalue	3.14	1.61	0.98	Eigenvalue	3.00	1.62	1.15
Percentage variability	52.3	14.3	9.1	Percentage variability	43.0	20.1	12.3	Percentage variability	25.0	13.5	9.6

Source: Prepared by authors from 2017 data.

Table 7.5: Patterns of principal components of coping strategies in Madagascar

Coping strategy		Employed			Coping strategy	Contract			Coping strategy	Non-engaged		
		PC1	PC2	PC3		PC1	PC2	PC3		PC1	PC2	PC3
Less expensive food	0.374				Purchase food _ credit	0.385			Less expensive food	0.342		
Borrow food	0.389				Restrict cons. of adults	0.391			Borrow food	0.354		
Purchase food _ credit	0.346				Limit portion size	0.385			Restrict cons. of adults	0.300		
Restrict cons. of adults	0.375				Gather wild food	0.312			Reduce no. of meals	0.351		
Limit portion size	0.399				Reduce no. of meals	0.415			Purchase food _credit		-0.443	
Gather wild food	0.329				Feed working members		0.704		Begging		0.393	
Begging		-0.484			Consume seed stock		0.482		Limit portion size		-0.327	
Feed working members		0.535			Less expensive food		0.375		Feed working members			0.436
Reduce no. of meals			0.469		Begging			0.992	Consume seed stock			0.779
Consume seed stock			0.931		Skip entire days			0.614	Skip entire days			0.296
Eat elsewhere			0.686		Borrow food			0.453	Eat elsewhere			0.794
Skip entire days					Eat elsewhere				Gather wild food			-0.363
Eigenvalue	4.28	1.70	1.38		Eigenvalue	3.88	1.33	1.22	Eigenvalue	4.45	1.53	1.28
Percentage variability	38.9	15.5	12.6		Percentage variability	35.3	12.1	11.1	Percentage variability	37.0	12.7	10.7

Source: Prepared by authors from 2017 data.

Households with LSAI-employed members in Kenya frequently adopted seven coping strategies, presented as the first principal components in Table 7.4. Employed household members and non-engaged households in Kenya adopted the same seven coping strategies. Contract farming households in Kenya were more food-secure than other groups of households. They frequently adopted five of the less severe coping strategies. Non-engaged households adopted more severe coping strategies, including consuming seed stock held for the next season, sending a household member to beg, and collecting wild foods or harvesting immature crops (Table 7.4).

In Madagascar, households with LSAI-employed members frequently adopted six coping strategies (Table 7.5). Contract farming households in Madagascar frequently adopted five coping strategies. In Madagascar, the most severe coping strategies (sending household members to beg, consuming seed stock held for the next season and skipping entire days without eating) did not widely practise.

Households with employed and non-engaged households in Mozambique adopted fewer coping strategies than households in Kenya and Madagascar. Restricting adults' food consumption, limiting portion sizes, reducing the number of meals consumed daily, and skipping entire days without eating was practised frequently by households with employed members in Mozambique. Non-engaged households in Mozambique regularly implemented five coping strategies (Table 7.6).

Table 7.6: Patterns of principal components of coping strategies in Mozambique

Coping strategy	Employed			Coping strategy	Non-engaged		
	PC1	PC2	PC3		PC1	PC2	PC3
Limit portion size	0.364			Restrict cons. of adults	0.351		
Restrict cons. of adults	0.449			Borrow food	0.323		
Reduce no. of meals	0.352			Consume seed stock	0.329		
Skip entire days	0.388			Skip entire days	0.322		
Purchase food with credit		0.223		Purchase food _credit	0.257		
Eat elsewhere		0.354		Feed working members		0.433	
Feed working members		0.359		Limit portion size		0.521	
Less expensive food			0.201	Reduce the number of meals		0.506	
Borrow food			0.331	Begging		-0.347	
Gather wild food			0.345	Gather wild food			0.772
Consume seed stock			0.605	Less expensive food			0.866
Begging			-0.367	Eat elsewhere			0.306
Eigenvalue	2.89	1.66	1.31	Eigenvalue	3.32	1.54	1.04
Percentage variability	24.1	13.8	10.9	Percentage variability	27.7	12.9	8.69

Source: Prepared by authors from 2016 data.

7.4.3 Household vulnerability to food insecurity among sample households

Predictor variables in Mozambique were statistically insignificant in determining food insecurity. This indicated that both food-secure and insecure (mildly, moderately, and severely food-insecure) households were equally vulnerable to worsened food insecurity levels should shocks occur.

Table 7.7 and Table 7.8 present the ordered probit model results of the four household groups (food-secure and mildly, moderately, and severely food-insecure households) in Kenya and Madagascar. The ordered probit model findings for Kenya and Madagascar were significant at a 1% level of significance ($p<0.01$) (Table 7.7 and Table 7.8). The estimated cut-off points (μ) for the two countries achieved the required conditions (that $\mu1 < \mu2 < \mu3$), indicating these categories of food insecurity were ranked in order (Knight *et al.*, 2006). The first cut-off point Y=0 for "food-secure" group was a benchmark.

The findings indicated that the household category (i.e. households with an LSAI-employed or contracted members or non-engaged households) and the household head's education status were common predictors of households' adaptive capacity in Kenya and Madagascar (Table 7.7 and Table 7.8). The variables household size and land size were also predictors of adaptive capacity in Kenya. In Madagascar, the household head's marital and migration status were additional predictors of households' adaptive capacity.

The household group was a significant predictor of the level of food insecurity in Kenya. The negative coefficient indicated that LSAI-employed member households were less food-insecure than non-engaged households. The marginal effect (ME) revealed that if an LSAI employed a member of a non-engaged household, the household would remain food secure.

The more educated the household head was in Kenya, the less likely the household was food insecure. The ME indicated that an improvement in the head's education would make the household less vulnerable to food insecurity. The household size was also a significant determinant of the level of food insecurity in Kenya. The positive coefficient indicated that larger households were more food-insecure (Table 7.7). The ME revealed that an increase in household size made a household more vulnerable to deeper levels of food insecurity.

Plot size was a significant predictor of moderately and severely food-insecure households in Kenya. The larger the plot size, the less food-insecure the household was. The findings concurred with the results of other studies (Dunga & Dunga, 2017; Ibrahim *et al*., 2016; Mendy *et al*., 2020) as set out in Table 7.1.

Table 7.7: Determinants of food insecurity among farming households in Kenya

Variable	Coefficient	Food-secure			Mildly food-insecure			Moderately food-insecure			Severely food-insecure		
		SE	z-vale	ME (dy/dx)	SE	z-vale	ME (dy/dx)	SE	z-vale	ME (dy/dx)	SE	z-vale	ME (dy/dx)
HHCATG	-0.624	0.065	3.65***	0.2367	0.023	-1.60	-0.0374	0.038	-4.14***	-0.1557	0.010	-4.34***	-0.0437
SEX	0.146	0.037	-1.37	-0.0513	0.003	-0.77	-0.0023	0.028	1.36	0.0386	0.011	1.35	0.0151
EDU	-0.202	0.024	2.92***	0.0709	0.004	0.90	0.0032	0.019	-2.87***	-0.0533	0.008	-2.73***	-0.0208
MARST	0.094	0.039	-0.86	-0.0331	0.002	-0.63	-0.0015	0.029	0.85	0.0249	0.011	0.85	0.0097
HHS	0.149	0.009	-5.21***	-0.0520	0.003	-0.92	-0.0002	0.008	4.87***	0.0391	0.004	4.34***	0.0153
LVSK	-0.015	0.005	1.07	0.0053	0.001	0.71	0.0002	0.004	-1.07	-0.0040	0.001	-1.06	-0.0016
LAND	-0.063	0.013	1.76	0.0222	0.001	0.83	0.0010	0.009	-1.75*	-0.0167	0.004	-1.72*	-0.0064
MIGR	0.060	0.046	-0.45	-0.0211	0.002	-0.41	-0.0009	0.016	0.45	0.0159	0.014	0.45	0.0062
LANLR	0.279	0.081	-1.21	-0.0980	0.006	-0.74	-0.0044	0.061	1.20	0.0737	0.024	1.19	0.0287
Cut 1	0.153												
Cut 2	1.076												
Cut 3	2.309												

Model specification: observations: 497; LR chi2 =53.43; Prob>chi2= 0.0000; log likelihood= -598.846; ***, **, * 0.01, 0.05 and 0.1 significance levels, respectively.

Four statistically significant predictors affected food insecurity in Madagascar, such as the household category and the household head's education, marital, and migration status (Table 7.8). In Kenya, the positive coefficient for education indicated that the more educated the household head was, the more food security a household was in Madagascar. Similarly, an improvement in the head's education would make the household less vulnerable to food insecurity.

A positive sign regarding marital status indicated that married household heads were more food-secure than single household heads. This result concurs with previous studies, directing that married household heads were likely to be less food-insecure (for example, Mthethwa & Wale, 2021; Mustapha *et al*., 2016; Nkegbe *et al*., 2017). Most of the sampled household heads in Madagascar were married.

Households with migrant household heads in Madagascar were less food-insecure than local household heads. ME revealed that a change in migration status of the household head (from non-migrant to migrant) did not lead to greater vulnerability to food insecurity (Table 7.8).

Besides the aforementioned predictors, the household group was another predictor of food-secure and mildly food-insecure households in Madagascar. Unlike in Kenya, in Madagascar, the household category's positive coefficient indicated that households with an employed member were more food-insecure than non-engaged households. This might be because food security was higher among sample households in Kenya than in Madagascar.

Variables were statistically insignificant in Mozambique. This indicated that households with employed members and non-engaged households were equally vulnerable to food insecurity in Mozambique (Table 7.9). Food security was generally lower among sample households in Mozambique than in Kenya and Madagascar. The lower level of livestock that could be liquidated to cope with food shortages in Mozambique could also have influenced this outcome.

Table 7.8: Determinants of food insecurity among households in Madagascar

Variable	Coefficient	Food-secure			Mildly food-insecure			Moderately food-insecure			Severely food-insecure		
		SE	z-vale	ME (dy/dx)	SE	z-vale	ME (dy/dx)	SE	z-vale	ME (dy/dx)	SE	z-vale	ME (dy/dx)
HHCATG	0.314	0.069	-1.67*	-0.1169	0.027	1.81*	0.0488	0.041	1.55	0.0633	0.005	1.08	0.0049
SEX	0.135	0.082	-0.57	-0.0474	0.041	0.55	0.0226	0.039	0.59	0.0233	0.002	0.59	0.0014
EDU	-0.135	0.027	1.77*	0.0486	0.013	-1.72*	-0.0223	0.014	-1.74*	-0.0247	0.001	-1.21	-0.0016
MARST	0.427	0.085	-1.80*	-0.1535	0.040	1.75*	0.0705	0.044	1.77*	0.0779	0.004	1.20	0.0050
HHS	0.002	0.010	-0.08	-0.0008	0.005	0.08	0.0004	0.005	0.08	0.0004	0.000	0.08	0.0000
LVSK	-0.001	0.001	0.43	0.0004	0.004	-0.43	-0.0002	0.004	-0.43	-0.0002	0.000	-0.41	-0.0000
LAND	-0.008	0.002	1.22	0.0030	0.001	-1.18	-0.0013	0.001	-1.22	-0.0015	0.000	-0.99	-0.0001
MIGR	-0.734	0.058	4.55***	0.2638	0.032	-3.84***	-0.1212	0.032	-4.16***	-0.1339	0.006	-1.51	-0.0087
LANLR	0.225	0.133	-0.63	-0.0842	0.049	0.70	0.0351	0.077	0.60	0.0457	0.007	-1.13	0.0035
Cut 1	-0.738												
Cut 2	0.034												
Cut 3	1.489												

Model specification: observations: 302; LR chi2 =50.51; Prob>chi2= 0.0000; log likelihood= -251.002; ***, * 0.01 and 0.1 significance levels, respectively.

Table 7.9: Determinants of food insecurity among households in Mozambique

Variable	Coefficient	Food-secure			Mildly food-insecure			Moderately food-insecure			Severely food-insecure		
		SE	z-vale	ME (dy/dx)	SE	z-vale	ME (dy/dx)	SE	z-vale	ME (dy/dx)	SE	z-vale	ME (dy/dx)
HHCATG	0.301	0.043	-0.24	-0.0105	0.007	0.26	0.0002	0.034	0.24	0.0083	0.009	0.24	0.0020
SEX	-0.005	0.078	0.02	0.0018	0.002	-0.02	-0.0001	0.061	-0.02	-0.0014	0.015	-0.02	-0.0003
EDU	-0.002	0.021	0.03	0.0006	0.001	-0.03	-0.0001	0.016	-0.03	-0.0004	0.004	-0.03	-0.0011
MARST	-0.060	0.075	0.28	0.0211	0.002	-0.24	-0.0005	0.059	-0.28	-0.0165	0.014	-0.28	-0.0040
HHS	-0.017	0.009	0.68	0.0059	0.000	-0.39	-0.0001	0.007	-0.68	-0.0047	0.002	-0.68	-0.0011
LVSK	-0.043	0.038	0.40	0.0152	0.001	-0.30	-0.0004	0.030	-0.40	-0.0119	0.007	-0.39	-0.0029
LAND	-0.002	0.006	0.12	0.0007	0.000	-0.12	-0.0000	0.005	-0.12	-0.0058	0.001	-0.12	-0.0001
MIGR	-0.078	0.035	0.78	0.0272	0.002	-0.40	-0.0007	0.027	-0.78	-0.0213	0.007	-0.77	-0.0052
LANLR	-0.008	0.043	0.06	0.0027	0.001	-0.06	-0.0001	0.034	-0.06	-0.0021	0.008	-0.06	-0.0005
Cut 1	-0.604												
Cut 2	0.461												
Cut 3	1.794												

Model specification: observations: 504; LR chi2 =2.37; Prob>chi2= 0.997; log likelihood= -595.132 ***, **, *0.01, 0.05 and 0.1 significance levels, respectively.

Figure 7.2 depicts the summary of the outcomes. Based on the CSI, the households were classified into four groups, food-secure and mildly, moderately, and severely food-insecure. Because of the seasonal nature of food availability and other factors, households might move from left to right on the continuum (move from food insecure to food secure) or right to left (from food secure to vulnerable, becoming food insecure and finally becoming food insecure) (Figure 7.2).

In general, severely food-insecure households practised more severe coping strategies such as skipping the entire days without eating, begging and gathering wild food, hunting or harvesting immature crops. Moderately food-insecure households practised severe strategies such as consuming seed stock held for the next season. Mildly food-insecure households practised least severe strategies such as restricting consumption of adults, reducing the number of meals, feeding the working members, sending household members to eat elsewhere, borrowing food and purchasing food on credit. Food secure households were categorised into two groups: food secure and vulnerable to become food secure. Households vulnerable to becoming food insecure were food secure during the period of data collection time but were concerned about future food access and relying on less preferred and less expensive foods. According to the ordered probit results, households were vulnerable to food insecurity if they were larger, had smaller plot sizes, or the household head was less educated.

According to the CSI indicator result, contract farming or having an LSAI-employed member improved household food security. Contract farming households with adequate food intake but who were concerned about future food access typically practised less severe coping strategies (Figure 7.2). As a result, in Kenya, LSAI-employed member households were moderate to mildly food-insecure.

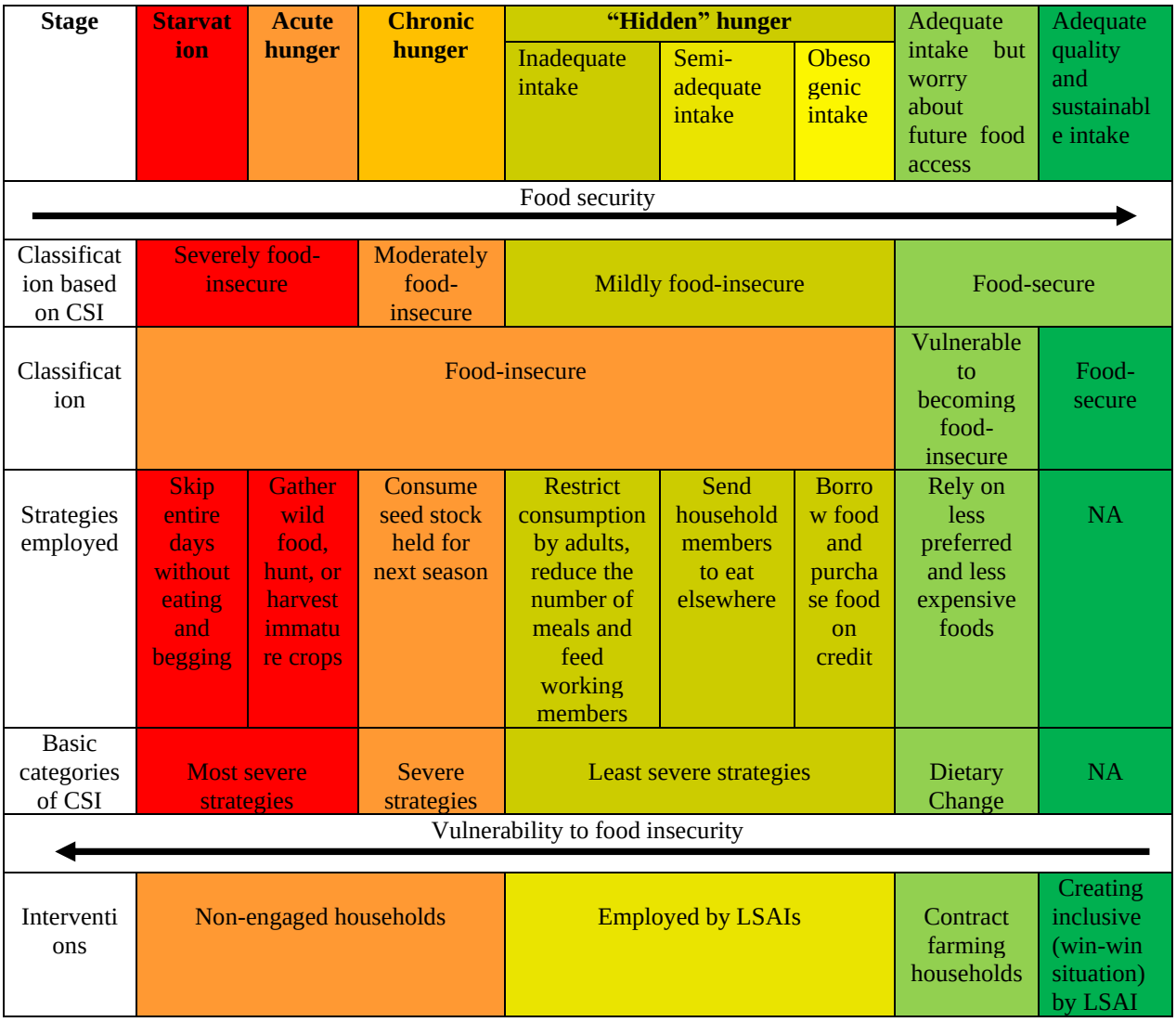


Figure 7.2: Continuum of food insecurity, coping strategies, and LSAI interventions

Source: Adapted from Hendriks (2015).

7.5 Summary

The findings of the study confirmed that contract farming households seemed to cope better during food shortages (based on the marginal effects of the model). In comparison, households with members employed by a LSAI adopted more coping strategies than contract farming households. This might be because households with employed members had fewer livestock and smaller landholdings. Many LSAIs jobs were seasonal and low-paid, making the household less able to cope with food shortages. Further research using time-series data with a large sample size and focus group discussion is needed to account for the seasonal fluctuations of food security and the long-lasting impact of LSAIs on household food security.

Chapter 8: Summary, conclusions, and recommendations

The literature on the impact of LSAIs on household food security is contentious. Very few studies have been published on the impact of LSAIs on food security; therefore, this study estimated the impact of LSAIs on household food security in Kenya, Madagascar, and Mozambique. This chapter summarises the significant research findings, providing the study conclusions, recommendations, and contributions.

8.1 Summary

The study's main objective was to examine the impact of LSAIs on household food security in Kenya, Madagascar, and Mozambique. The study employed secondary data—the AFGROLAND project collected cross-sectional data from three areas in the three selected countries. The data were collected from January to March 2017 from Kenya; March to April 2017 from Madagascar; September to October 2016 from Mozambique. The lean seasons in the three countries are dissimilar in Kenya from May to September, Madagascar from January to March, and Mozambique from September to February. It was impossible to account for the seasonal fluctuations of food security using the ‘snap-shot’ cross-sectional data. The study findings and recommendations, therefore, remain limited to the data collection period. The study discussed the three specific objectives in Table 8.1.

Table 8.1: Summary table of research objectives, hypotheses, and findings

No.	Objective	Hypothesis	Methods	Food security indicator	Country and household impact										
					Kenya				Madagascar				Mozambique		
					Employed	Contract	Non-engaged	Counterfactual	Employed	Contract	Non-engaged	Counterfactual	Employed	Non-engaged	Counterfactual
1	To examine and compare the food security status of the households in the three countries using various food security indicators	H1: The food security status of households with LSAI-employed members and contract farming households was expected to be more food-secure than the non-engaged and counterfactual households	Food security indicators and PCA methods	HDDS	+	+	+	+	+	+	+	+	+	+	+
				FCS	+	+	+	+	+	+	+	+	+	+	+
				WDDS	-	+	-	-	-	-	-	-	-	+	-
				MAHFP	+	+	-	-	+	-	-	-	+	-	-
				CSI	-	-	-	-	-	+	-	+	-	-	-
				Asset	-	-	-	-	-	-	-	-	-	-	-
				CARI	+	+	+	-	-	-	-	-	-	-	-
2	To analyse the impact of large-scale agricultural investment on households' food security in the three countries	H2: The food security status of households with LSAI-employed members and contract farming households was expected to be better than the non-engaged and counterfactual households	ESR analysis	HDDS	+	+	+		+	-	+		+	NC	
				FCS	+	+	+		+	NC	+		+	-	
				MAHFP	+	+	NC		NC	+	+		+	NC	
				Food exp. share	+		+		-		-		+	+	
3	To identify the most affected food-insecure household group	H3: It was expected that various groups of households were not equally to become food-insecure	PCA and ordered probit model	CSI	+	+	-		-	+	-		+	-	

*NC: no change

The first specific research objective was to examine and compare the food security status of the household groups in the three countries. Households with LSAIs-employed members and contract farming households were expected to be more food-secure than the non-engaged and counterfactual households. Seven internationally recognised food security indicators were examined: HDDS, FCS, WDDS, MAHFP, CSI, Asset, CARI, and PCA. Most of the food security indicators results (Table 8.1) confirmed the rejection of the null hypothesis that various groups of households held similar food security statuses.

Non-engaged households in the investment zones enjoyed a similar food security status to counterfactual households in all three countries. This indicated that living in the influence zone did not have significant adverse effects on the food security of non-engaged households.

According to the study findings, Kenyan households were more food-secure than those in Madagascar and Mozambique. The variation among countries and indicators might be because of the countries' economic contexts. Kenya has a better economic status than Madagascar and Mozambique. The other reason might be because of the data collection period and the seasonal nature of food availability. For example, in Madagascar, data were collected during the lean season. Most households in Madagascar were classified as less food-secure. The crops grown with contract agreements with LSAIs might have been another reason for the variation among countries. In Kenya, contracted households, growing vegetables for LSAIs, could diversify their diets. In Madagascar, contracted households grew barley, whereas the dominant staple food in Madagascar is rice. Barley production may have competed for farm resources, harming household food security.

In Kenya, the findings of HDDS, FCS, MAHFP, and CARI indicated that households with LSAIs-employed members and households engaged in contract agreements with an LSAI were more food-secure than non-engaged counterfactual households. In Madagascar, the results for the HDDS, FCS, and MAHFP indicators indicated that households with LSAIs-employed members were more food-secure than non-engaged households. The finding for the HDDS, FCS, and CSI indicators in Madagascar indicated that contract farming, and counterfactual households were more food-secure than non-engaged households. Contracted and counterfactual households in Madagascar adopted

fewer coping strategies than other households. In Mozambique, the findings for the HDDS, FCS, and MAHFP indicators inferred that households with LSAIs-employed members were more food-secure than non-engaged households.

Households with LSAIs-employed members in the three countries were more food-secure concerning HDDS and the MAHFP than other households (Table 8.1). This might be because households with LSAI employees received regular wages. The lack of assets to liquidate in times of stress and their adoption of more precautionary than contract farming households may indicate that their wages were lower than the net incomes of contract households. Their wages were too low to allow for savings and investments to tide them over stressful periods.

Except for contracted female-headed households in Kenya and counterfactual female-headed households in Mozambique, most female-headed households in the three countries were food-insecure. This might be because female-headed households in the study areas have limited access to LSAI employment and contract farming opportunities. Most of the employed households were migrants from the nearby districts that may have displaced local women's job opportunities.

The second specific objective of the study was to analyse the impact of LSAIs on household food security in the three countries. LSAIs could have a positive effect on household food security. This hypothesis was confirmed by the non-parametric analysis results and the outcome of the ESR model. The ESR model indicated heterogeneity in the sample that could have arisen from unobserved factors and self-selection.

LSAIs positively affected the food security of households with LSAI-employed members and contract farming households. Households with LSAIs-employed members in Kenya and Mozambique and contracted households in Kenya were more food-secure than non-engaged households. This finding confirmed the results of other studies that LSAI employment opportunities had an income and food security benefit (Baumgartner *et al*., 2015; Kirigia *et al.*, 2016; Smalley, 2013; Speller *et al*., 2017). In Madagascar, the empirical results indicated that non-engaged households were more food-secure than households with LSAIs-employed members and contracted households. This might be because most households with LSAIs-employed members in Madagascar were migrants from nearby districts with few assets to liquidate in times of stress.

The third specific research objective was to identify the most affected household groups. It was expected that the impact of the LSAI on food security may not be the same for distinct groups of households. This hypothesis was assessed using the CSI data, PCA, and an ordered probit model. The findings rejected the null hypothesis that the impact of LSAIs on household food security was similar for the four household groups. Instead, the results revealed that households with LSAI contract agreements adopted fewer coping strategies than other households. Contract farming households seemed less likely to slip into deeper levels of food insecurity when encountering adversity. This finding concurred with findings of other studies (Bellemare and Novak, 2017; Ton *et al*., 2017).

The ordered probit model also confirmed that households with LSAIs-employed members were less likely to slip into deeper levels of food insecurity should they encounter adversity. Smaller households with more educated heads, larger plot sizes, and more livestock were also less likely to slip into deeper levels of food insecurity in times of stress. Households with large plot sizes and more livestock were also more resilient during food shortages. They can produce more than households on smaller plots and sell their livestock to purchase food items in times of stress.

8.2 Conclusions

The study examined the impact of LSAIs on household food security. It is a comparative analysis among countries such as Kenya, Madagascar, and Mozambique. These include diverse household groups, such as employed, contract, non-engaged, and counterfactual.

LSAIs affected the four household groups differently. Households with LSAI-employed members in the three countries were more food-secure than other households regarding the HDDS and the MAHFP. Employment may, therefore, have helped smooth consumption despite employment likely being seasonal; however, female-headed households in the study areas have less access to LSAI employment and contract farming opportunities. This may be due to people's in-migration from the counterfactual zones, displacing women’s job opportunities.

LSAI contract agreements also affected the food security status of households. Contract farming households adopted fewer coping strategies and were more resilient, owing more assets that could

be liquidated in times of stress; however, contract farming did not always benefit household food security. This may have been affected by the crops grown in contract agreements with the LSAIs.

There was no significant difference was established between the food security status of non-engaged and counterfactual households. Being in the influence zone did not intensely harm unemployed household members or those contracted to LSAIs in these three communities.

Overall, not all LSAIs harmed households food security. In these communities, few households lost their land rights, particularly where contract farming respected these rights rather than displacing communities.

8.3 Recommendations

Strengthening public policy that forces investors to invest in public infrastructure (for example, clinics, roads, schools, and water) and technology transfer to benefit the local communities need to be considered. Governments hosting LSAIs and investors should protect the local community from losing their land rights by giving these households secure access to other productive land or proper compensation. The government could also promote contract farming to protect smallholder land rights through agreements presenting clear conditions for the mandatory and monitored transfer of new technology, distribution of farm inputs and market access.

Most of LSAIs jobs were seasonal and low-paid. Investors and governments hosting LSAIs should set a minimum wage to prevent labour exploitation and protect people against poverty. The governments hosting LSAIs and investors should also prioritise local employment. Considering policies related to quotas favouring female employment and preference for contract farming are essential to improve the food security status of female-headed households.

Some LSAI projects failed in Africa owing to conflict and adverse effects on the local communities. Therefore, governments hosting LSAIs and investors should consult and engage the surrounding community about planned investment, crop growing, compensation, communal land, and other issues at each step of agreements and implementations. Land is essential to the livelihoods, food security, and social identity of several people in rural areas. To improve the livelihoods of smallholder farmers and for sustainable investments in agriculture, the government

should provide incentives, motivating households to continue farming activities. These should include providing inputs and credit, improving market access, providing access to information technology and other services supporting farmers' activities. The household can consider employment as a source of additional income to diversify their diet and improve food security. Establishing and strengthening civil society organisations and labour unions is essential to protect land rights and protect workers. Such organisations help merge bargaining power to attend to minimum wages; negotiate with the product prices and provide public infrastructure and monitor and evaluate the impact of investment on the local community.

National food security monitoring systems must monitor the food security situation of households in such areas. Such systems could facilitate accountability systems to ensure that the food security and welfare of the local communities are not compromised and that the action is taken with deterioration or should the agribusiness withdraw from the areas.

8.4 Limitations of the study and recommendations for future research

This study used cross-sectional data rather than pre- and post-intervention or panel data. The sample size of some of the factual groups were small. The survey only collected data on the household head due to resource constraints. It was impossible to investigate the long-lasting impact of LSAIs on household food security using cross-sectional data. Further research using time-series data with large sample size and focus group discussion is needed to account for the seasonal fluctuations of food security, investigating the substantial and long-lasting impact of LSAIs on household food security.

Due to the lack of detailed information on the wage rate and income of the households, this study used food security indicators rather than income and wealth indicators. Further studies with detailed information on the wage rate, income and wealth are needed to investigate the extensive and long-lasting impact of LSAIs.

This study compared data for three African countries, two business models, and four household groups using non-parametric and econometrics models. As Africa is the most targeted continent

for LSAIs, further studies are needed to replicate this study across regions using diverse crops, business models, investors (foreign vs domestic and private vs government).

Further studies are needed to examine the impact of LSAIs on the surrounding communities besides food security. LSAIs may also harm the environment, land tenure, and community livelihood, further exacerbating food insecurity. It is essential to do a consistent project impact evaluation to investigate all these aspects.

8.5 Contribution to the knowledge

The impact of LSAIs in international literature is controversial. Different authors report the adverse effects of land acquisitions on the local community, whereas others report that large-scale land acquisitions benefit local communities. Objectively assessing the food security status of the households is, therefore, essential.

The study findings provide evidence and information for policy dialogues that large-scale land investments can benefit household food security through employment and contract farming. Most previous impact studies used qualitative analysis with one or two food security indicators to analyse the impact of project or programme interventions. This study employed seven internationally recognised food security indicators with econometric models to capture the multidimensional nature of food security. The study provides a framework for future multi-indicators assessment of food security. The combination of approaches allowed for the multi-perspective evaluation of the patterns in household food consumption and coping behaviour during the food shortage through the PCA. The ESR analysis controlled the selection bias while estimating the impact of LSAIs.

References

Aabø, E. & Kring, T. 2012. The political economy of large-scale agricultural land acquisitions: Implications for food security and livelihoods/employment creation in rural Mozambique. United Nations Development Programme Working Paper, 4, 1-61. Maputo.

Abdulai, A. & Huffman, W. 2014. The adoption and impact of soil and water conservation technology: An endogenous switching regression application. *Land Economics*, 90, 26-43.

Abebe, G.K., Bijman, J., Kemp, R., Omta, O., & Tsegaye, A. 2013. Contract farming configuration: Smallholders' preferences for contract design attributes. *Food Policy*, 40, 14-24. https://doi.org/10.1016/j.foodpol.2013.01.002.

Abramovich, J. & Krause, S. 2014. Outgrower schemes: A pathway to sustainable agriculture. Available: http://nextbillion.net/outgrower-schemes/. Accessed date, [24 May 2021].

Alden Wily, L. 2018. The community land act in Kenya opportunities and challenges for communities. *Land*, 7, 12. https://doi.org/10.3390/land7010012.

Ali, D.A., Deininger, K., & Harris, A. 2017. Using national statistics to increase transparency of large land acquisition: Evidence from Ethiopia. *World Development*, 93, 62-74. https://doi.org/10.1016/j.worlddev.2016.12.027.

Andrews, N. & Cochrane, L. 2021. International political economy and the land rush in Africa: Trends, scale, narratives and contestations: In the *Transnational Land Rush in Africa* (pp. 1-24). Palgrave Macmillan, Cham.

Andrianirina-Ratsialonana, R., Ramarojohn, L., Burnod, P., & Teyssier, A. 2011. After Daewoo? Current status and perspectives of large-scale land acquisition in Madagascar. Commercial Pressures on Land (CPL). International Law Commission, Rome.

Anseeuw, W. 2020. Access to land and the emergence of international farm enterprises. The IAASTD+ 10 Advisory Group Report, 69. Berlin.

Anseeuw, W., Wily, L.A., Cotula, L., & Taylor, M. 2012. Land rights and the rush for land: Findings of the global commercial pressures on land research project. International Law Commission, Rome.

Arouna, A., Michler, J.D., & Lokossou, J.C. 2021. Contract farming and rural transformation: Evidence from a field experiment in Benin. *Journal of Development Economics*, 151, 102626. https://doi.org/10.1016/j.jdeveco.2021.102626.

Assefa, B.T. 2015. Food price changes and food security in developing countries: A multidimensional analysis. Wageningen University and Research Centre. Minor Thesis. Available: https://edepot.wur.nl/333657. Accessed date, [05 September 2020].

AUC & NEPAD NPCA. 2015. The CAADP results framework 2015–2025, Going for results and impacts. African Union Commission and NEPAD Planning and Coordinating Agency. Addis Ababa, Midrand.

AUC (African Union Commission). 2014. Malabo Declaration on accelerated agricultural growth and transformation for shared prosperity and improved livelihoods. AUC, Addis Ababa.

AUC (African Union Commission). 2020. Second biennial review report of the African Union Commission on the implementation of the Malabo Declaration on accelerated agricultural growth and transformation for shared prosperity and improved livelihoods. AUC, Addis Ababa.

AUC-ECA-AfDB Consortium. 2014. Guiding principles on large-scale land-based investments in Africa. AUC-ECA-AfDB, Addis Ababa.

Babatunde, R., Omotesho, O.A., Olorunsanya, E.O., & Owotoki, G. 2008. Determinants of vulnerability to food insecurity: A gender-based analysis of farming households in Nigeria. *Indian Journal of Agricultural Economics*, 63*, 116-125*.

Baker, J.L. 2000. Evaluating the impact of development projects on poverty*:* A handbook for practitioners. *World Bank Publications*, No. 305.56 B3. Washington, DC.

Barrett, C.B., Bachke, M.E., Bellemare, M.F., Michelson, H.C., Narayanan, S., & Walker, T.F. 2012. Smallholder participation in contract farming: Comparative evidence from five countries. *World Development*, 40, 715-730.

Baumgartner, P., Von Braun, J., Abebaw, D., & Müller, M. 2015. Impacts of large-scale land investments on income, prices, and employment: Empirical analyses in Ethiopia. *World Development*, 72, 175-190. https://doi.org/10.1016/j.worlddev.2015.02.017.

Becker, C., Mamlouk, K., & Li, H. 2016. Budget impact analysis of Nanoliposomal Irinotecan for treatment of pancreatic cancer following progression on Gemcitabine-A us payer perspective. *Value in Health*, 19, A718-A719.

Behrman, J., Meinzen-Dick, R., & Quisumbing, A. 2012. The gender implications of large-scale land deals. *Journal of Peasant Studies*, 39, 49-79. https://doi.org/10.1080/03066150.2011.652621.

Bekele, A.E. & Abdissa, F.M. 2015. Vulnerability to food insecurity and households' coping strategies. *Journal of Rural Development*, 34, 529-542.

Bellemare, M.F. 2010. Agricultural extension and imperfect supervision in contract farming: Evidence from Madagascar. *Agricultural Economics*, 41, 507-517. https://doi.org/10.1111/j.1574-0862.2010.00462.x.

Bellemare, M.F. 2012. As you sow, so shall you reap: The welfare impacts of contract farming. *World Development*, 40, 1418-1434. https://doi.org/10.1016/j.worlddev.2011.12.008,

Bellemare, M.F. & Novak, L. 2017. Contract farming and food security. *American Journal of Agricultural Economics*, 99, 357-378. https://doi.org/10.1093/ajae/aaw053.

Bilinsky, P. & Swindale, A. 2010. Months of adequate household food provisioning (MAHFP) for measurement of household food access: Indicator guide. Food and Nutrition Technical Assistance II Project (FANTA), Version 4. Washington, DC.

Bindraban, P., Aalbers, H., Moll, H., Brouwer, I., Van Dorp, M., Houtman, C., Brouwer, M., Zuurbier, M., & Hagenaars, E. 2003. Focus on food insecurity and vulnerability: A review on the UN System common country assessments and World Bank poverty reduction strategy papers. Washington, DC.

Birch, I. (2018). Agricultural productivity in Kenya: barriers and opportunities. K4D Helpdesk Report. Institute of Development Studies, UK.

Bluwstein, J., Lund, J.F., Askew, K., Stein, H., Noe, C., Odgaard, R., Maganga, F., & Engström, L. 2018. Between dependence and deprivation: The interlocking nature of land alienation in Tanzania. *Journal of Agrarian Change*, 18, 806-830. https://doi.org/10.1111/joac.12271.

Bolwig, S., Ponte, S., Du Toit, A., Riisgaard, L., & Halberg, N. 2010. Integrating poverty and environmental concerns into value-chain analysis: A conceptual framework. *Development Policy Review*, 28, 173-194. https://doi.org/10.1111/j.1467-7679.2010.00480.x.

Boone, C., Lukalo, F., & Joireman, S.F. 2021. Promised land: Settlement schemes in Kenya, 1962 to 2016. *Political Geography*, 89, 102393. https://doi.org/10.1016/j.polgeo.2021.102393.

Borras Jr, S.M., Hall, R., Scoones, I., White, B., & Wolford, W. 2011. Towards a better understanding of global land grabbing: An editorial introduction. *The Journal of Peasant Studies*, 38, 209-216. https://doi.org/10.1080/03066150.2011.559005.

Bottazzi, P., Crespo, D., Bangura, L.O., & Rist, S. 2018. Evaluating the livelihood impacts of a large-scale agricultural investment: Lessons from the case of a biofuel production company in Northern Sierra Leone. *Land Use Policy*, 73, 128-137. https://doi.org/10.1016/j.landusepol.2017.12.016.

Bouis, H., Low, J., McEwan, M., & Tanumihardjo, S. 2013. Biofortification: Evidence and lessons learned linking agriculture and nutrition. The Food and Agriculture Organization of the United Nations (FAO) and the World Health Organization (WHO): Rome, Geneva.

Breu, T., Bader, C., Messerli, P., Heinimann, A., Rist, S., & Eckert, S. 2016. Large-scale land acquisition and its effects on the water balance in investor and host countries. *PLoS One*, 11, e0150901. https://doi.org/10.1371/journal.pone.0150901.

Burnod, P., Rakotomalala, H., Rasolofo, P., & Brès, A. 2015. Large-scale plantation and contract farming effects: qualitative and quantitative assessment in Madagascar. Proceedings of the LANDac International Conference on Land Governance for Equitable and Sustainable Development. The Netherlands Land Academy, Utrecht.

Burnod, P., Rakotomalala, H., Saint-Macary, C., & Gubert, F. 2017. Responsible land governance: Towards an evidence-based approach in Madagascar. Annual World Bank Conference on Land and Poverty, Washington, DC.

Burnod, P., Ratsialonana, R.A., & Teyssier, A. 2013. Process of land acquisition on a large scale in Madagascar: What field regulations? *Cahiers Agricultures*, 22, 33-38.

Butaumocho, B. & Chitiyo, P.T. 2017. A comparative analysis of household food security measures in rural Zimbabwe. *International Journal of Food and Agricultural Economics*, *5*, 41-58. Palgrave Macmillan, Cham.

Carletto, C., Zezza, A., & Banerjee, R. 2013. Towards better measurement of household food security: Harmonizing indicators and the role of household surveys. *Global Food Security*, 2, 30-40. https://doi.org/10.1016/j.gfs.2012.11.006.

Chagomoka, T., Drescher, A., Glaser, R., Marschner, B., Schlesinger, J., & Nyandoro, G. 2017. Contribution of urban and peri-urban agriculture to household food and nutrition security along the urban–rural continuum in Ouagadougou, Burkina Faso. *Renewable Agriculture and Food Systems*, 32, 5-20. https://doi.org/10.1017/S1742170515000484.

Chagomoka, T., Unger, S., Drescher, A., Glaser, R., Marschner, B., & Schlesinger, J. 2016. Food coping strategies in northern Ghana. A socio-spatial analysis along the urban–rural continuum. *Agriculture and Food Security*, 5, 1-18. https://doi.org/10.1186/s40066-016-0052-x.

Chambers, R. 2006. Editorial introduction: Vulnerability, coping and policy. Available: https://opendocs.ids.ac.uk/opendocs/bitstream/handle/20.500.12413/662/Chambers.pdf?se. Accessed date, [12 September 2021].

Chilombo, A. 2021. Questioning the narrative of land marginality in large-scale land acquisition deals: Case study of Nansanga Farm Block in Zambia. *Journal of Land Use Science*, 16, 188-204. https://doi.org/10.1080/1747423X.2021.1882599.

Cochrane, L., Anku, J.H., & Andrews, N. 2021. Beyond the land rush? Reflections on transnational interactions and the future IPE of Africa. In the *Transnational Land Rush in Africa* (pp. 261-278). Palgrave Macmillan, Cham.

Conte, A. 2005. Household food security profiles. VAM analytical approach. World Food Programme Thematic Guidelines. World Food Programme, Rome.

Cotula, L. 2009. Land grab or development opportunity? Agricultural investment and international land deals in Africa. International Institute for Environment and Development, London.

Cotula, L. 2011. Land deals in Africa: What is in the contracts? International Institute for Environment and Development, London.

Cotula, L. 2013. The new enclosures? Polanyi, international investment law and the global land rush. *Third World Quarterly*, 34, 1605-1629. https://doi.org/10.1080/01436597.2013.843847.

Cotula, L., Oya, C., Codjoe, E.A., Eid, A., Kakraba-Ampeh, M., Keeley, J., Kidewa, A.L., Makwarimba, M., Seide, W.M., & Nasha, W.O. 2014. Testing claims about large land deals in Africa: Findings from a multi-country study. *Journal of Development Studies*, 50, 903-925. https://doi.org/10.1080/00220388.2014.901501.

Daley, E., Flower, C., Miggiano, L., & Pallas, S. 2013. Women's land rights and gender justice in land governance: Pillars in the promotion and protection of women's human rights in rural areas. International Land Coalition Network, Rome.

Daniel, S. 2011. Land grabbing and potential implications for world food security. *Sustainable Agricultural Development* (pp. 25-42). https://doi.org/10.1007/978-94-007-0519-7_2.

Daniel, S. & Mittal, A. 2009. The great land grab: Rush for world's farmland threatens food security for the poor. The Oakland Institute, Oakland.

Davis, K.F., Rulli, M.C., & D'Odorico, P. 2015. The global land rush and climate change. *Earth's Future*, 3, 298-311. https://doi.org/10.1002/2014EF000281.

De Schutter, O. 2011. How not to think of land-grabbing: Three critiques of large-scale investments in farmland. *The Journal of Peasant Studies*, 38, 249-279. https://doi.org/10.1080/03066150.2011.559008.

Deans, H., Ros-Tonen, M.A., & Derkyi, M. 2018. Advanced value chain collaboration in Ghana's Cocoa Sector: An entry point for integrated landscape approaches? *Environmental Management*, 62, 143-156. https://doi.org/10.1007/s00267-017-0863-y.

Deininger, K. 2013. Global land investments in the bio-economy: Evidence and policy implications. *Agricultural Economics*, 44, 115-127. https://doi.org/10.1111/agec.12056.

Deininger, K. & Xia, F. 2016. Quantifying spillover effects from large land-based investment: The case of Mozambique. *World Development*, 87, 227-241. https://doi.org/10.1016/j.worlddev.2016.06.016.

Deininger, K., Ali, D.A., & Alemu, T. 2011. Impacts of land certification on tenure security, investment, and land market participation: Evidence from Ethiopia. *Land Economics*, 87, 312-334.

Dercon, S. & Christiaensen, L. 2011. Consumption risk, technology adoption and poverty traps: Evidence from Ethiopia. *Journal of Development Economics*, 96, 159-173. https://doi.org/10.1016/j.jdeveco.2010.08.003.

Di Falco, S., Veronesi, M., & Yesuf, M. 2011. Does adaptation to climate change provide food security? A micro-perspective from Ethiopia. *American Journal of Agricultural Economics*, 93, 829-846. https://doi.org/10.1093/ajae/aar006.

Di Matteo, F. & Schoneveld, G.C. 2016. Agricultural investments in Mozambique: An analysis of investment trends, business models and social and environmental conduct (Vol. 201). Center for International Forestry Research, Bogor.

Dindi, E.A. 2013. The managerial factors influencing sugarcane production by farmers of Mayoni Division, Mumias Sugar Company in Kenya. School of Business in partial fulfillment of the requirements for the degree of Masters in Business Administration (Human Resource), Department of Business Administration, Kenyatta University, Nairobi.

Dunga, H.M. & Dunga, S.H. 2017. Coping strategies among the food-insecure household in MALAWI, A case of female and male-headed household in South Eastern of Malawi. *International Journal of Social Sciences and Humanity Studies*, 9, 91-107.

Dutoit, L. 2007. Heckman's selection model, exogenous switching models, a survey; University of Lausanne, Lausanne.

Dwyer, M.B. 2013. Building the politics machine: Tools for 'resolving' the global land grab. *Development and Change*, 44, 309-333. https://doi.org/10.1111/dech.12014.

Eaton, C. & Shepherd, A. 2001. Contract farming: Partnerships for growth. FAO, Rome.

Eriksen, S.H., Brown, K., & Kelly, P.M. 2005. The dynamics of vulnerability: Locating coping strategies in Kenya and Tanzania. *Geographical Journal*, 171, 287-305. https://doi.org/10.1111/j.1475-4959.2005.00174.x.

FAO. 2006. Food and agricultural Organization of the United Nations. Food security. Policy brief no. 2. FAO, Rome.

FAO. 2012. High-level expert forum on how to feed the World in 2050. Available: http://www.fao.org/wsfs/forum2050/wsfs-forum/en/. Accessed date, [28 January 2021].

FAO. 2021. Cereal supply and demand balances for sub-Saharan African countries: Situation as of June 2021. Rome. Available: https://doi.org/10.4060/cb5610en. Accessed date, [20 September 2021].

Field, A. 2009. Discovering statistics using SPSS third edition. Sage Publications, London.

Fitawek, W. & Hendriks, S.L. 2021. Evaluating the impact of large-scale agricultural investments on household food security using an endogenous switching regression model. *Land*, 10, 323. https://doi.org/10.3390/land10030323.

Fitawek, W., Hendriks, S., Reys, A., & Fossi, F. 2020. The effect of large-scale agricultural investments on household food security in Madagascar. *Food Security*, 12, 1349-1365. https://doi.org/10.1007/s12571-020-01055-6.

Friis, C. & Reenberg, A. 2010. Land grab in Africa: Emerging land system drivers in a tele-connected world. Global Land Programme Report, 1, 1-42. Bern.

Garcia, A.K., Baltissen, G., Betsema, G., & Schuurman, J. 2015. Food security and land governance factsheet Kenya. LANDac, Utrecht.

Gartaula, H., Niehof, A., & Visser, L. 2012. Shifting perceptions of food security and land in the context of labour out-migration in rural Nepal. *Food Security*, 4, 181-194. https://doi.org/10.1007/s12571-012-0190-3.

Gelaw, F. & Sileshi, M. 2013. Impact of grain price hikes on poverty in rural Ethiopia. *African Journal of Agricultural and Resource Economics*, 8, 69-89.

Giger, M., Mutea, E., Kiteme, B., Eckert, S., Anseeuw, W., & Zaehringer, J.G. 2020. Large agricultural investments in Kenya's Nanyuki Area: Inventory and analysis of business models. *Land Use Policy*, 99, 104833. https://doi.org/10.1016/j.landusepol.2020.104833.

Giger, M., Oberlack, C., Anseeuw, W., Adelle, C., Bourblanc, M., Kiteme, B., Burnod, P., Eckert, S., Fouilleux, E., & Hendriks, S. 2019. How and why large-scale agricultural investments induce different socio-economic, food security, and environmental impacts: Evidence from

Kenya, Madagascar, and Mozambique [913]. Global Land Programme: University of Bern, Bern.

Glover, S. & Jones, S. 2019. Can commercial farming promote rural dynamism in sub-Saharan Africa? Evidence from Mozambique. *World Development*, 114, 110-121. https://doi.org/10.1016/j.worlddev.2018.09.029.

Gloy, B.A., Akridge, J.T., & Whipker, L.D. 2000. Sources of information for commercial farms: Usefulness of media and personal sources. *The International Food and Agribusiness Management Review*, 3, 245-260. https://doi.org/10.1016/S1096-7508(01)00046-5.

GRAIN. 2008. Seized: The 2008 land grab for food and financial security. GRAIN briefing. Available:https://grain.org/article/entries/93-seized-the-2008-landgrab-for-food-and-financial-security. Accessed date, [03 June 2021].

Greene, W.H. 2000. Econometric analysis 4th edition. *International edition*, New Jersey: Prentice Hall, 201-215.

Gunasekera, D., Cai, Y., & Newth, D. 2015. Effects of foreign direct investment in African agriculture. *China Agricultural Economic Review*, 7, 167-184.

Hakizimana, C., Goldsmith, P., Nunow, A.A., Roba, A.W., & Biashara, J.K. 2017. Land and agricultural commercialisation in Meru County, Kenya: Evidence from three models. *The Journal of Peasant Studies*, 44, 555-573. https://doi.org/10.1080/03066150.2016.1260555.

Hall, R. 2011. Land grabbing in Southern Africa: The many faces of the investor rush. *Review of African Political Economy*, 38, 193-214. https://doi.org/10.1080/03056244.2011.582753.

Hall, R., Scoones, I., & Tsikata, D. 2017. Plantations, outgrowers and commercial farming in Africa: Agricultural commercialisation and implications for agrarian change. *The Journal of Peasant Studies*, 44, 515-537. https://doi.org/10.1080/03066150.2016.1263187.

Hallam, D. 2009. International investments in agricultural production. Land grab. FAO Expert meeting on How to Feed the World in 2050. FAO, Rome.

Heckman, J.J. 1979. Sample selection bias as a specification error. *Econometrica: Journal of the Econometric Society*, 153-161.

Hendriks, S.L. 2015. The food security continuum: A novel tool for understanding food insecurity as a range of experiences. *Food Security*, 7, 609-619. https://doi.org/10.1007/s12571-015-0457-6.

Hendriks, S.L., Van der Merwe, C., Ngidi, M.S., Manyamba, C., Mbele, M., McIntyre, A.M., Mkandawire, E., Molefe, Q.N., Mphephu, M.Q., & Ngwane, L. 2016. What are we measuring? Comparison of household food security indicators in the Eastern Cape Province, South Africa. *Ecology of Food and Nutrition*, 55, 141-162. https://doi.org/10.1080/03670244.2015.1094063.

Herrmann, R.T. 2017. Large-scale agricultural investments and smallholder welfare: A comparison of wage labor and outgrower channels in Tanzania. *World Development*, 90, 294-310. https://doi.org/10.1016/j.worlddev.2016.10.007.

Herrmann, R., Jumbe, C., Bruentrup, M., & Osabuohien, E. 2018. Competition between biofuel feedstock and food production: Empirical evidence from sugarcane outgrower settings in Malawi. *Biomass and Bioenergy*, 114, 100-111. https://doi.org/10.1016/j.biombioe.2017.09.002.

Hess, T.M., Sumberg, J., Biggs, T., Georgescu, M., Haro-Monteagudo, D., Jewitt, G., Ozdogan, M., Marshall, M., Thenkabail, P., & Daccache, A. 2016. A sweet deal? Sugarcane, water and agricultural transformation in sub-Saharan Africa. *Global Environmental Change*, 39, 181-194. https://doi.org/10.1016/j.gloenvcha.2016.05.003.

Hirvonen, K., Taffesse, A.S., & Hassen, I.W. 2016. Seasonality and household diets in Ethiopia. *Public Health Nutrition*, 19, 1723-1730. https://doi.org/10.1017/S1368980015003237.

Hjelm, L., Mathiassen, A., & Wadhwa, A. 2016. Measuring poverty for food security analysis: Consumption-versus asset-based approaches. *Food and Nutrition Bulletin*, 37, 275-289. https://doi.org/10.1177%2F0379572116653509.

HLPE. 2020. Food security and nutrition: Building a global narrative towards 2030. High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security, Rome.

Hufe, P. & Heuermann, D.F. 2017. The local impacts of large-scale land acquisitions: A review of case study evidence from sub-Saharan Africa. *Journal of Contemporary African Studies*, 35, 168-189. https://doi.org/10.1080/02589001.2017.1307505.

Ibrahim, H.Y., Adeola, S.S., & Ibrahim, H.I. 2016. Determinants of food insecurity among farming households in Katsina state, North Western Nigeria: An ordinal logit regression approach. *Journal of Agricultural Sciences, Belgrade*, 61, 291-301. https://doi.org/10.2298/JAS1603291I.

IFPRI (International Food Policy Research Institute). 2006. Review and validation of dietary diversity, food frequency and other proxy indicators of household food security. IFPRI, Rome.

Index, G.H. 2019. The challenge of hunger and climate change. International Food Policy Research Institute, Washington, DC.

Jalan, J. & Ravallion, M. 1998. Transfer benefits from welfare: A matching estimate for Argentina. World Bank, Washington, DC.

Kabunga, N.S., Dubois, T., & Qaim, M. 2012. Yield effects of tissue culture bananas in Kenya: Accounting for selection bias and the role of complementary inputs. *Journal of Agricultural Economics*, 63, 444-464. https://doi.org/10.1111/j.1477-9552.2012.00337.x.

Kagwiria, F. & Gichuki, N. 2017. Factors influencing contractual farming in Kenya: A case of Buuri Constituency, Meru County, Kenya. *International Academic Journal of Information Sciences and Project Management*, 2, 161-178.

Kassie, M., Jaleta, M., & Mattei, A. 2014. Evaluating the impact of improved maize varieties on food security in rural Tanzania: Evidence from a continuous treatment approach. *Food Security*, 6, 217-230. https://doi.org/10.1007/s12571-014-0332-x.

Kennedy, G., Razes, M., Ballard, T., & Dop, M.C. 2010. Measurement of dietary diversity for monitoring the impact of food based approaches. International Symposium on Food and Nutrition Security, Rome.

Kibugi, R., Mwathane, I., & Makathimo, M. 2016. Large scale land acquisitions for investment in Kenya: Is the participation, and benefits of affected local communities meaningful, and equitable? A case study of the situation in Lamu, Isiolo and Siaya counties. Land Development and Governance Institute, Nairobi.

Kibugi, R., Wardell, D.A., Segger, M.-C.C., Haywood, C., & Gift, R. 2015. Enabling legal frameworks for sustainable land-use investments in Tanzania: Legal Assessment Report (Vol. 191). Center for International Forestry Research, Bogor.

Kirigia, J.M., Pannenborg, C.O., Amore, L.G.C., Ghannem, H., IJsselmuiden, C., & Nabyonga-Orem, J. 2016. Global Forum 2015 dialogue on "From evidence to policy–thinking outside the box": Perspectives to improve evidence uptake and good practices in the African Region. *BMC Health Services Research*, 16, 305-314.

Klopp, J.M. & Lumumba, O. 2017. Reform and counter-reform in Kenya's land governance. *Review of African Political Economy*, 44, 577-594. https://doi.org/10.1080/03056244.2017.1367919.

Knight, E.P., House, L., Nelson, M.C., & Degner, R.L. 2006. An evaluation of consumer preferences regarding goat meat in the South. *Journal of Food Distribution Research*, 37, 88-96.

Kokeyo, P.L. 2013. An Assessment of the factors affecting contract farming: The case of sugarcane production in Migor*i* County, Kenya. University of Nairobi, Nairobi.

Konda, I., Sigauque, R., & Payetiii, P. 2008. Guidance: How to measure the number of months of adequate household food provisioning (MAHFP) based on quantitative methods and isolating food aid provisions. *Africare Food Security Review*, Washington, DC.

Krishnamurthy, P., Lewis, K., & Choularton, R. 2014. A methodological framework for rapidly assessing the impacts of climate risk on national-level food security through a vulnerability index. *Global Environmental Change*, 25, 121-132. https://doi.org/10.1016/j.gloenvcha.2013.11.004.

Land Matrix. 2021. Web of transnational deals. Available: https://landmatrix.org/charts/web-of-transnational-deals : Accessed date, [15 March 2021].

Lazarte, A. Lazarte-Hoyle, A. 2017. Understanding the drivers of rural vulnerability towards building resilience, promoting socio-economic empowerment and enhancing the socio-economic inclusion of vulnerable, disadvantaged and marginalized populations for an effective promotion of Decent Work in rural economies. International Labour Organization, Geneva.

Lee, L.-F. 1982. Some approaches to the correction of selectivity bias. *The Review of Economic Studies*, 49, 355-372. https://doi.org/10.2307/2297361.

Leroy, J.L., Ruel, M., Frongillo, E.A., Harris, J., & Ballard, T.J. 2015. Measuring the food access dimension of food security: A critical review and mapping of indicators. *Food and Nutrition Bulletin*, 36, 167-195. https://doi.org/10.1177%2F0379572115587274.

Limon, G., Fournié, G., Lewis, E.G., Dominguez-Salas, P., Leyton-Michovich, D., Gonzales-Gustavson, E.A., Gonzalez, A.E., Cabezas, A.H., Pinto, J., & Rushton, J. 2017. Using mixed methods to assess food security and coping strategies: A case study among smallholders in the Andean region. *Food Security*, 9, 1019-1040. https://doi.org/10.1007/s12571-017-0713-z.

Liu, P., Koroma, S., Arias, P., & Hallam, D. 2013. Trends and impacts of foreign investment in developing country agriculture: Evidence from case studies. FAO, Rome.

Lokshin, M. & Sajaia, Z. 2004. Maximum likelihood estimation of endogenous switching regression models. *The Stata Journal*, 4, 282-289.

Loopstra, R., Reeves, A., & Tarasuk, V. 2019. The rise of hunger among low-income households: An analysis of the risks of food insecurity between 2004 and 2016 in a population-based study of UK adults. *Journal of Epidemiol Community Health*, *73*, 668-673. http://dx.doi.org/10.1136/jech-2018-211194.

Lunstrum, E. 2016. Green grabs, land grabs and the spatiality of displacement: Eviction from Mozambique's Limpopo National Park. *Area*, 48, 142-152. https://doi.org/10.1111/area.12121.

Mahmoodi, M. & Mahmoodi, E. 2016. Foreign direct investment, exports and economic growth: Evidence from two panels of developing countries. *Economic Research-Ekonomska Istraživanja*, 29, 938-949. http://dx.doi.org/10.1080/1331677X.2016.1164922.

Malik, K. 2015. Impact of foreign direct investment on economic growth of Pakistan. *American Journal of Business and Management*, 4, 190-202.

Malikov, E., Sun, K., & Kumbhakar, S.C. 2018. Non-parametric estimates of the clean and dirty energy substitutability. *Economics Letters*, 168, 118-122. https://doi.org/10.1016/j.econlet.2018.04.017.

Manda, J. 2016. Econometric analysis of improved maize varieties and sustainable agricultural practices (SAPs) in Eastern Zambia. Doctoral dissertation, Wageningen University, Netherlands.

Matenga, C.R. & Hichaambwa, M. 2017. Impacts of land and agricultural commercialisation on local livelihoods in Zambia: Evidence from three models. *The Journal of Peasant Studies*, 44, 574-593. https://doi.org/10.1080/03066150.2016.1276449.

Matondi, P.B., Havnevik, K., & Beyene, A. 2011. Introduction: Biofuels, food security and land grabbing in Africa. Zed Books (pp. 1-19). Stockholm.

Maxwell, D. & Caldwell, R. 2008. Field methods manual. Cooperative for Assistance and Relief Everywhere. CARE, WFP: Geneva, Rome.

Maxwell, S. & Smith, M. 1992. Household food security: A conceptual review. Household food security: Concepts, indicators, measurements, 1, 1-72.

Mechiche-Alami, A., Yagoubi, J., & Nicholas, K.A. 2021. Agricultural land acquisitions unlikely to address the food security needs of African countries. *World Development*, 141, 105384. https://doi.org/10.1016/j.worlddev.2020.105384.

Mekonnen, D.A. & Gerber, N. 2017. Aspirations and food security in rural Ethiopia. *Food Security*, 9, 371-385.

Mendy, J., Asongwe, G.A., & Nkongho, R.N. 2020. Vulnerability to food insecurity and coping strategies of agrarian households in the lower river region of the Gambia: Implication for policy. *International Journal of Agricultural Science and Food Technology*, 6, 115-126.

Minot, N. & Sawyer, B. 2016. Contract farming in developing countries: Theory, practice, and policy implications. Innovation for inclusive value chain development: Successes and challenges. *IFPRI*, 127-158. Washington, DC

Mthethwa, S. & Wale, E. 2021. Household vulnerability to food insecurity in rural South Africa: Evidence from a nationally representative survey data. *International Journal of Environmental Research and Public Health*, 18, 1917. https://doi.org/10.3390/ijerph18041917.

Mujenja, F. & Wonani, C. 2012. Long-term outcomes of agricultural investments: Lessons from Zambia. International Institute for Environment and Development, London.

Müller-Mahn, D., Mkutu, K., & Kioko, E. 2021. Mega projects-mega failures? The politics of aspiration and the transformation of rural Kenya. *The European Journal of Development Research*, 1-22. https://doi.org/10.1057/s41287-021-00397-x.

Mustapha, S., Mohammed, T., & Abdul Fatahi, A. 2016. Determinants of household food insecurity in northern Ghana: An ordered probit approach. *Journal of Economics and Sustainable Development*, 7, 27-*37*.

Mutea, E., Bottazzi, P., Jacobi, J., Kiteme, B., Speranza, C.I., & Rist, S. 2019. Livelihoods and food security among rural households in the north-western Mount Kenya region. *Frontiers in Sustainable Food Systems*, 3, 98. https://doi.org/10.3389/fsufs.2019.00098.

Mwambi, M.M., Oduol, J., Mshenga, P., & Saidi, M. 2016. Does contract farming improve smallholder income? The case of avocado farmers in Kenya. *Journal of Agribusiness in Developing and Emerging Economie*, 6, *1-20.*

Nguyen, A.T., Dzator, J., & Nadolny, A. 2015. Does contract farming improve productivity and income of farmers? A review of theory and evidence. *The Journal of Developing Areas*, 49, 531-538.

Nkegbe, P.K., Abu, B.M., & Issahaku, H. 2017. Food security in the Savannah Accelerated Development Authority Zone of Ghana: An ordered probit with household hunger scale approach. *Agriculture and Food Security*, 6, 1-11. https://doi.org/10.1186/s40066-017-0111-y.

Nolte, K. & Ostermeier, M. 2017. Labour market effects of large-scale agricultural investment: Conceptual considerations and estimated employment effects. *World Development*, 98, 430-446. https://doi.org/10.1016/j.worlddev.2017.05.012.

Nolte, K., Chamberlain, W., & Giger, M. 2016. International land deals for agriculture: Fresh insights from the land matrix: Analytical report II. Bern Open Publ, Bern.

Odhiambo, V.O., Hendriks, S.L., & Mutsvangwa-Sammie, E.P. 2021. The effect of an objective weighting of the global food security index's natural resources and resilience component on country scores and ranking. *Food Security*, 1-15. https://doi.org/10.1007/s12571-021-01176-6.

Olounlade, O.A., Li, G.-C., Kokoye, S.E.H., Dossouhoui, F.V., Akpa, K.A.A., Anshiso, D., & Biaou, G. 2020. Impact of participation in contract farming on smallholder farmers' income and food security in rural Benin: PSM and LATE parameter combined. *Sustainability*, 12, 901. https://doi.org/10.3390/su12030901.

Onyalo, P. O. (2019). Women and agriculture in rural Kenya: role in agricultural production. *International Journal of Humanities and Social Science*, 4, 1-10.

Osabohien, R., Awolola, O.D., Matthew, O., Itua, O.Q., & Elomien, E. 2020. Foreign direct investment inflow and employment in Nigeria. *Investment Management and Financial Innovations*, 17, 77-84.

Osabuohien, E.S., Ogundipe, A., & Efobi, U.R. 2013. The land rush in Africa: Implications and institutional panacea. In the *Harnessing land and water resources for improved food security and ecosystem services in Africa* (pp, 92-106)

Osabuohien, E.S., Olokoyo, F.O., Efobi, U.R., Karakara, A.A., & Beecroft, I. 2020. Large-scale land investments and household livelihood in Nigeria: Empirical insights from quantitative analysis. In *the Palgrave Handbook of Agricultural and Rural Development in Africa* (pp. 133-152). https://doi.org/10.1007/978-3-030-41513-6_7.

Paglietti, L. & Sabrie, R. 2013. Review of smallholder linkages for inclusive agribusiness development. FAO Investment Centre. Rome.

Persson, A.G. 2016. Foreign direct investments in large-scale agriculture: The policy environment and its implications in Ethiopia. PhD Thesis University of Cape Town, South Africa.

Porsani, J., Börjeson, L., & Lehtilä, K. 2017. Land concessions and rural livelihoods in Mozambique: The gap between anticipated and real benefits of a Chinese investment in the Limpopo Valley. *Journal of Southern African Studies*, 43, 1181-1198. https://doi.org/10.1080/03057070.2017.1377932.

Porsani, J., Caretta, M.A., & Lehtilä, K. 2019. Large-scale land acquisitions aggravate the feminization of poverty: Findings from a case study in Mozambique. *GeoJournal*, 84, 215-236. https://doi.org/10.1007/s10708-017-9836-1.

Proag, V. 2014. The concept of vulnerability and resilience. *Procedia Economics and Finance*, 18, 369-376. https://doi.org/10.1016/S2212-5671(14)00952-6.

Quansah, C., Ansah, W.O., & Mensah, R.O. 2020. Effects of large-scale land acquisition on livelihood assets in the Pru East District of Ghana. *Journal of Environment and Earth Science*, 10, 72-83.

Ravallion, M., Galasso, E., Lazo, T., & Philipp, E. 2005. What can ex-participants reveal about a program's impact? *Journal of Human Resources*, 40, 208-230. https://doi.org/10.3368/jhr.XL.1.208.

Reys, A. 2016. African food, agriculture, land and natural resource (AFGROLAND). Mozambique sample and survey method report. CIRAD, Paris.

Reys, A. & Burnod, P. 2017. African food, agriculture, land and natural resource (AFGROLAND). Madagascar sample and survey method report. CIRAD, Paris.

Reys, A. & Mutea, E. 2017. African food, agriculture, land and natural resource (AFGROLAND). Kenya sample and survey method report. CIRAD, Paris.

Ronald, P.C. 2014. Lab to farm: Applying research on plant genetics and genomics to crop improvement. *PLoS Biology*, 12, e1001878. https://doi.org/10.1371/journal.pbio.1001878.

Rosenbaum, P.R. & Rubin, D.B. 1983. Assessing sensitivity to an unobserved binary covariate in an observational study with binary outcome. *Journal of the Royal Statistical Society: Series B (Methodological)*, 45, 212-218. https://doi.org/10.1111/j.2517-6161.1983.tb01242.x.

Ruml, A. & Qaim, M. 2021. Smallholder farmers' dissatisfaction with contract schemes in spite of economic benefits: Issues of mistrust and lack of transparency. *The Journal of Development Studies*, 57, 1106-1119. https://doi.org/10.1080/00220388.2020.1850699.

Sam, A.S., Abbas, A., Padmaja, S.S., Kaechele, H., Kumar, R., & Müller, K. 2019. Linking food security with household's adaptive capacity and drought risk: Implications for sustainable rural development. *Social Indicators Research*, 142, 363-385. https://doi.org/10.1007/s11205-018-1925-0.

Scheidel, A. & Sorman, A.H. 2012. Energy transitions and the global land rush: Ultimate drivers and persistent consequences. *Global Environmental Change*, 22, 588-595. https://doi.org/10.1016/j.gloenvcha.2011.12.005.

Schoneveld, G.C., German, L.A., & Nutakor, E. 2011. Land-based investments for rural development? A grounded analysis of the local impacts of biofuel feedstock plantations in Ghana. *Ecology and Society*, 16, 10. http://dx.doi.org/10.5751/ES-04424-160410.

Scoones, I., Hall, R., Borras Jr, S.M., White, B., & Wolford, W. 2013. The politics of evidence: methodologies for understanding the global land rush, *The Journal of Peasant Studies*, 40, 469-483. https://doi.org/10.1080/03066150.2013.801341.

Shariff, Z.M. & Khor, G.L. 2008. Household food insecurity and coping strategies in a poor rural community in Malaysia. *Nutrition Research and Practice*, 2, 26-34. https://doi.org/10.4162/nrp.2008.2.1.26.

Shete, M. & Rutten, M. 2015. Impacts of large-scale farming on local communities' food security and income levels: Empirical evidence from Oromia Region, Ethiopia. *Land Use Policy*, 47, 282-292. https://doi.org/10.1016/j.landusepol.2015.01.034.

Sileshi, M., Kadigi, R., Mutabazi, K., & Sieber, S. 2019. Analysis of households' vulnerability to food insecurity and its influencing factors in East Hararghe, Ethiopia. *Journal of Economic Structures*, 8, 1-17. https://doi.org/10.1186/s40008-019-0174-y.

Singh, S. 2002. Contracting out solutions: Political economy of contract farming in the Indian Punjab. *World development*, 30, 1621-1638. https://doi.org/10.1016/S0305-750X(02)00059-1.

Smalley, R. 2013. Plantations, contract farming and commercial farming areas in Africa: A comparative review: A comparative review. Institute for Poverty, Land and Agrarian Studies (PLAAS), Cape Town.

Smith, L.C. & Subandoro, A. 2007. Measuring food security using household expenditure surveys (Vol. 3). IFPRI, Washington, DC.

Speller, W.R., Mirza, H., Giroud, A., Salguero Huaman, J., Dixie, G., & Okumura, A. 2017. The impact of larger-scale agricultural investments on local communities: Updated Voices from the Field. World Bank, Washington, DC.

Suit, K.C. & Choudhary, V. 2015. Mozambique agricultural sector risk assessment. Risk prioritization. Agriculture global practice technical assistance paper. World Bank, Washington, DC.

Swift, J. 2006. Why are rural people vulnerable to famine? *Institute of Development Studies Bulletin*, Vol. 37. University of Sussex, Falmer.

Swindale, A. & Bilinsky, P. 2006. Household dietary diversity score (HDDS) for measurement of household food access: Food and Nutrition Technical Assistance Project, Academy for Educational Development: Indicator guide. Washington, DC.

Tamura, Y. 2021. Contexts behind differentiated responses to contract farming and large-scale land acquisitions in Central Mozambique: Post-war experiences, social relations, and power balance of local authorities. *Land Use Policy*, 106, 105439. https://doi.org/10.1016/j.landusepol.2021.105439.

Teyssier, A., Ramarojohn, L., & Ratsialonana, R.A. 2010. Land for international agro-industry? A dilemma for Malagasy land policy. *EchoGéo*,11.

Thomas, K., Hardy, R.D., Lazrus, H., Mendez, M., Orlove, B., Rivera-Collazo, I., Roberts, J.T., Rockman, M., Warner, B.P., & Winthrop, R. 2019. Explaining differential vulnerability to climate change: A social science review. *Wiley Interdisciplinary Reviews: Climate Change*, 10, e565. https://doi.org/10.1002/wcc.565.

Ton, G., Desiere, S., Vellema, W., Weituschat, S., & D'Haese, M. 2017. The effectiveness of contract farming for raising income of smallholder farmers in low-and middle-income countries: A systematic review. *Campbell Systematic Reviews*, 13, 1-131. https://doi.org/10.4073/csr.2017.13.

Umeh, J.C. & Asogwa, B.C. 2012. Determinants of farm household food expenditure: Implications for food security in rural Nigeria. International Conference on Ecology, Agriculture and Chemical Engineering (ICEACS 2012), Phuket.

Vabi Vamuloh, V., Panwar, R., Hagerman, S.M., Gaston, C., & Kozak, R.A. 2019. Achieving Sustainable Development Goals in the global food sector: A systematic literature review to examine small farmers engagement in contract farming. *Business Strategy and Development*, 2, 276-289. https://doi.org/10.1002/bsd2.60.

Väth, S.J. & Kirk, M. 2013. Do land ownership and contract farming matter? Evidence from a large-scale investment in Ghana. The 4th International Conference of the African Association of Agricultural Economists, Hammamet.

Väth, S.J., Gobien, S., & Kirk, M. 2019. Socio-economic well-being, contract farming and property rights: Evidence from Ghana. *Land Use Policy*, 81, 878-888. https://doi.org/10.1016/j.landusepol.2017.04.023.

Veldwisch, G.J. 2015. Contract farming and the re-organisation of agricultural production within the Chókwè Irrigation System, Mozambique. *The Journal of Peasant Studies*, 42, 1003-1028. https://doi.org/10.1080/03066150.2014.991722.

Verhoog, S. 2013. The politics of land deals: A comparative analysis of global land policies on large-scale land acquisition. *Land Divided: Land and South African Society*, 24-27.

Verma, R. 2014. Land grabs, power, and gender in East and Southern Africa: So, what's new? *Feminist Economics*, 20, 52-75. https://doi.org/10.1080/13545701.2014.897739.

Vermeulen, S. & Cotula, L. 2010. Over the heads of local people: Consultation, consent, and recompense in large-scale land deals for biofuels projects in Africa. *The Journal of Peasant Studies*, 37, 899-916. https://doi.org/10.1080/03066150.2010.512463.

Von Braun, J. & Meinzen-Dick, R. 2009. Land grabbing" by foreign investors in developing countries: Risks and opportunities: International Food Policy Research Institute Washington. *Policy Brief*, 13. Washington, DC.

Von Braun, J., Chichaibelu, B.B., Torero Cullen, M., Laborde, D., & Smaller, C. 2021. Ending hunger by 2030–policy actions and costs. The Scientific Group for the UN Food Systems Summit. United Nations Food System Summit 2021, Barcelona.

Von Grebmer, K., Bernstein, J., Alders, R., Dar, O., Kock, R., Rampa, F., Wiemers, M., Acheampong, K., Hanano, A., Higgins, B., & Chéilleachair, R.N. 2020. Global Hunger Index: One decade to zero hunger: Linking health and sustainable food systems. Welthungerhilfe, Bonn.

Wainaina, P.W., Okello, J.J., & Nzuma, J.M. 2012. Impact of contract farming on smallholder poultry farmers' income in Kenya. IAAE Triennial Conference, Foz do Iguaçu.

Wainaina, P.W., Okello, J.J., & Nzuma, J.M. 2014. Blessing or evil? Contract farming, smallholder poultry production and household welfare in Kenya. *Quarterly Journal of International Agriculture*, 53, 319-340.

West, J.J. & Haug, R. 2017. The vulnerability and resilience of smallholder-inclusive agricultural investments in Tanzania. *Journal of Eastern African Studies*, 11, 670-691. https://doi.org/10.1080/17531055.2017.1367994.

WFP (World Food Programme). 2006. Food consumption analysis: Calculation and use of the food consumption score in food security analysis. WFP, Rome.

WFP (World Food Programme). 2008. Vulnerability analysis and mapping. Food consumption analysis: Calculation and use of the food consumption score in food security analysis. WFP, Rome.

WFP (World Food Programme). 2014. Consolidated Approach Reporting Indicators Food Security (CARI), WFP, Rome.

Wiesmann, D., Hoddinott, J., Aberman, N.-L., & Ruel, M. 2006. Review and validation of dietary diversity, food frequency and other proxy indicators of household food security. Report submitted to the World Food Programme, Rome.

Wineman, A. 2016. Multidimensional household food security measurement in rural Zambia. *Agrekon*, 55, 278-301. https://doi.org/10.1080/03031853.2016.1211019.

World Bank. 2007. World development report: Agriculture for development. The World Bank. Washington, DC.

World Bank. 2019. World development report: Agriculture and food. The World Bank. Washington, DC.

Yengoh, G.T. & Armah, F.A. 2015. Effects of large-scale acquisition on food insecurity in Sierra Leone. *Sustainability*, 7, 9505-9539. https://doi.org/10.3390/su7079505.

Yengoh, G.T., Steen, K., Armah, F.A., & Ness, B. 2016. Factors of vulnerability: How large-scale land acquisitions take advantage of local and national weaknesses in Sierra Leone. *Land Use Policy*, 50, 328-340. https://doi.org/10.1016/j.landusepol.2015.09.028.

Zaehringer, J.G., Atumane, A., Berger, S., & Eckert, S. 2018a. Large-scale agricultural investments trigger direct and indirect land use change: New evidence from the Nacala corridor, Mozambique. *Journal of Land Use Science*, 13, 325-343. https://doi.org/10.1080/1747423X.2018.1519605.

Zaehringer, J.G., Wambugu, G., Kiteme, B., & Eckert, S. 2018b. How do large-scale agricultural investments affect land use and the environment on the western slopes of Mount Kenya? Empirical evidence based on small-scale farmers' perceptions and remote sensing. *Journal of Environmental Management*, 213, 79-89. https://doi.org/10.1016/j.jenvman.2018.02.019.

Zaehringer, J.G., Messerli, P., Giger, M., Kiteme, B., Atumane, A., Da Silva, M., Rakotoasimbola, L., & Eckert, S. 2021. Large-scale agricultural investments in Eastern Africa: Consequences for small-scale farmers and the environment. *Ecosystems and People*, 17, 342-357. https://doi.org/10.1080/26395916.2021.1939789.

Appendix A: Ethics approval letter

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Natural and Agricultural Sciences
Ethics Committee

E-mail: ethics.nas@up.ac.za

26 March 2020

ETHICS SUBMISSION: LETTER OF APPROVAL

Mrs WB Fitawek
Department of Agricultural Economics Extension and Rural Development
Faculty of Natural and Agricultural Science
University of Pretoria

Reference number: NAS113/2019
Project title: The Impact of Large-Scale Investments in Agricultural Land on Household Food Security in Africa: A Comparative Analysis of Kenya, Madagascar and Mozambique

Dear Mrs WB Fitawek,

We are pleased to inform you that your submission conforms to the requirements of the Faculty of Natural and Agricultural Sciences Research Ethics committee.

Please note the following about your ethics approval:

- Please use your reference number (NAS113/2019) on any documents or correspondence with the Research Ethics Committee regarding your research.
- Please note that the Research Ethics Committee may ask further questions, seek additional information, require further modification, monitor the conduct of your research, or suspend or withdraw ethics approval.
- Please note that ethical approval is granted for the duration of the research (e.g. Honours studies: 1 year, Masters studies: two years, and PhD studies: three years) and should be extended when the approval period lapses.
- The digital archiving of data is a requirement of the University of Pretoria. The data should be accessible in the event of an enquiry or further analysis of the data.

Ethics approval is subject to the following:

- The ethics approval is conditional on the research being conducted as stipulated by the details of all documents submitted to the Committee. In the event that a further need arises to change who the investigators are, the methods or any other aspect, such changes must be submitted as an Amendment for approval by the Committee.
- **Applications using Animals:** NAS ethics recommendation does not imply that AEC approval is granted. The application has been pre-screened and recommended for review by the AEC. Research may not proceed until AEC approval is granted.

Post approval submissions including application for ethics extension and amendments to the approved application should be submitted online via the Ethics work centre.

We wish you the best with your research.

Yours sincerely,

Chairperson: NAS Ethics Committee

Appendix B: Ethics clearance for using AFGROLAND data

Rome, 10/02/2020

To: Prof SL Hendriks

Head of Department, Agricultural Economics, Extension and Rural Development

Faculty of Natural and Agricultural Sciences

University of Pretoria

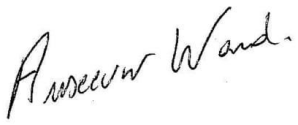
Dear Prof Hendriks,

I hereby grant permission for the following Postgraduate students to use the data collected through this project as secondary data sources for their PhDs and Masters theses and dissertations as well as papers arising from these studies at the University of Pretoria.

1. Wegayehu Fitawek
2. Zaka Diana Mawoko
3. Livhuwani Masola.

The students are requested to acknowledge the African Food, Agriculture, Land and Natural Resource Dynamics (AFGROLAND) project funded by the Belmont Forum and the Joint Programming Initiative on Agriculture, Food Security and Climate Change (FACCE-JPI) with funding by the Swiss National Science Foundation, the French National Research Agency and the South African National Research Foundation.

Yours sincerely,



Dr Ward Anseeuw

Team Leader: AFGROLAND

Senior Technical Specialist | Knowledge, Learning and Innovation

CIRAD researcher

ILC secretariat at IFAD

Via Paolo di Dono 44, 00142 Rome, Italy

Ph +39 06 5459 2100

Appendix C: AFGROLAND – WP4 survey questionnaire

Household food security survey 2016 and 2017 from Kenya, Madagascar and Mozambique

No.	Questions	Descriptions
1	What is your name?	
2	For how many years has your family live here? (If the family has always lived here put 99, is here since less than 1 year put 1)	
3	Where the head of your household is from (County and Province if Kenyan, Country if foreigner)	
4	Why did you come here? (in this County/ Province)	
5	How many people live in this household?	
6	What is the relationship to the head of the household?	- Head/acting head - Husband /wife /partner - son / daughter / stepchild / adopted child - brother / sister / stepbrother /stepsister - father /mother / stepfather/ stepmother - Grandparent /great grandparent - Grandchild /great grandchild - Other relative (e.g. in-laws or aunt/uncle) - Non-related persons
7	Sex	- Male - Female
8	Age	
9	What is the highest level of education completed? (those above 5 years)	- Never went to school - Primary school - Secondary /College - University - Technical/professional high school
10	What is your marital status?	- Single - Married - Divorced - Widowed
11	Do you own any animals?	- Yes - No
12	Animals Owned Several options possible	- Ox for plough - Ox - Dairy Cow - Pig Breeder - Pig Fattener - Sheep,Goat - Chicken - Ducks and others - Donkeys - Rabits
13	Do you have access to land?	- Communal

		- Plots - Both - None
14	If no, why not?	- I am not orginally from this area - I didn't inherit any land - I don't have the financial resources to buy land - There is no land availible to buy, rent etc - Other
15	How many plots (hectares)?	
16	Which mode of securisation do you have?/ Which type of land title do you have?	- Informal Small Paper - Title deed - Customary Recognition - Other - Don't Know
17	Have the large agricultural investments impacted on this increase or decrease in land availability?	- Yes - No
18	Which annual crop did you plant on this plot last year?	- Maize, Sorghum, Millet, Manioc, Bean, Wheat, Sunflower, Sesame, Tomatoes, Peas, Spinach,Rice, Other
19	Which perennial crop did you plant on this plot last year?	- Banana, Other
20	Which shrub crop did you plant on this plot last year?	- Tobacco, Cotton, Tea, Coffee, Cashew Nuts, Macadamia Nut, Lime, Orange, Mangos, Coconut, Roses,Other
Dwelling information, service delivery and assets		
21	How distant is the house from the paved road, by foot?	- Less than 30 minutes - Between 30 minutes and one hour - More than one hour
22	How distant is the house from the nearest market, by foot?	- Less than 30 minutes - Between 30 minutes and one hour - More than one hour
23	What is the main material used for the walls of the main dwelling?	- Cement block/concrete - Corrugated iron/zinc - Wood - Plastic - Cardboard - Mud and cement mix - Wattle and daub - Tile - Mud - Thatching/grass - Asbestos - other (specify)
24	What is the main material used for the walls of the main dwelling other	
25	What is the main material used for the roof of the main dwelling?	- Cement block/concrete - Corrugated iron/zinc - Wood

		- Plastic - Cardboard - Mud and cement mix - Wattle and daub - Tile - Mud - Thatching/grass - Asbestos - other (specify)
26	How many of the following does the household own? Bed with mattress	
27	How many of the following does the household own? Sofa Set	
28	How many of the following does the household own? Table (dining/desk)	
29	How many of the following does the household own? Electric Stove / Gas Stove	
30	How many of the following does the household own? Radio-working condition	
31	How many of the following does the household own? Mobile	
32	How many of the following does the household own? Tape or	
33	How many of the following does the household own? Television	
34	How many of the following does the household own? Motor	
35	How many of the following does the household own?	
36	How many of the following does the household own? Washing	
37	How many of the following Equipment for agricultural work does the household own? Plough	
38	How many of the following Equipment for agricultural work does the household own? Weeder	
39	How many of the following Equipment for agricultural work does the household own? Harrow	
40	How many of the following Equipment for agricultural work does the household own? Ox cart	
41	How many of the following Equipment for agricultural work does the household own? Rototiller	
42	How many of the following Equipment for agricultural work does the household own? manual Sprayer	
43	How many of the following Equipment for agricultural work does the household own? Motor pump	
44	How many of the following Equipment for agricultural work does the household own? Husker	
45	How many of the following Equipment for agricultural work does the household own? Irrigation system	
46	How many of the following Equipment for agricultural work does the household own? Other specify	

Household food consumption (for the last 24hr, 7 days and 30 days)

	Food items consumed	Did household members eat this food in	How many days per week is this food group usually	How many days per month is this food group usually	Where was the food obtained from ? (source)

		the last 24 hours?	eaten in the household?	eaten in the household?	
47	Cereals Consumption *Cereals: maize, rice, wheat, sorghum, millet, and any other foods made from cereals such as porridge, bread and noodles*	- Yes - No			- Self Production - Donations/event Gift/food bank/school feeding - Local Market - Local shops - Small shop in town - Supermarket in town - Other(Restaurants, middlemen…)
48	White roots and tubers consumption *White roots and tubers: Potatoes, white sweet potato and cassava*	- Yes - No			- Self Production - Donations/event Gift/food bank/school feeding - Local Market - Local shops - Small shop in town - Supermarket in town - Other(Restaurants, middlemen…)
49	Orange-flesh vegetables consumption *Orange-flesh vegetables: Pumpkin, carrot, butternut or sweet potato*	- Yes - No			- Self Production - Donations/event Gift/food bank/school feeding - Local Market - Local shops - Small shop in town - Supermarket in town - Other(Restaurants, middlemen…)
50	Dark green leafy vegetables consumption *Dark green leafy vegetables, including wild/indigenous vegetables*	- Yes - No			- Self Production - Donations/event Gift/food bank/school feeding - Local Market - Local shops - 5Small shop in town - Supermarket in town - Other(Restaurants, middlemen…)
51	Other vegetables consumption *Other vegetables: tomato, onion, green beans, gem squash, eggplant, including wild/indigenous vegetables*	- Yes - No			- Self Production - Donations/event Gift/food bank/school feeding - Local Market - Local shops - Small shop in town - Supermarket in town - Other(Restaurants, middlemen…)
52	Orange-colored fruit consumption	- Yes			- Self Production

	Orange-coloured fruit:ripe mango, apricot, spanspek, papaya, dried peach and 100% fruit juice made from	- No			- Donations/event Gift/food bank/school feeding - Local Market - Local shops - Small shop in town - Supermarket in town - Other(Restaurants, middlemen…)
53	Other fruit Consumption *Other fruit: oranges, banana, apple, pear etc.), including wild/indigenous vegetables*	- Yes - No			- Self Production - Donations/event Gift/food bank/school feeding - Local Market - Local shops - Small shop in town - Supermarket in town - Other(Restaurants, middlemen…)
54	Organ meat Consumption *Organ meat: liver, kidney, heart or other organ meats or blood-based*	- Yes - No			- Self Production - Donations/event Gift/food bank/school feeding - Local Market - Local shops - Small shop in town - Supermarket in town - Other(Restaurants, middlemen…)
55	Meat Consumption *Meat: beef, goat, sheep, poultry, pork, insects*	- Yes - No			- Self Production - Donations/event Gift/food bank/school feeding - Local Market - Local shops - Small shop in town - Supermarket in town - Other(Restaurants, middlemen…)
56	Eggs from any animal Consumption *Eggs from any animal*	- Yes - No			- Self Production - Donations/event Gift/food bank/school feeding - Local Market - Local shops - Small shop in town - Supermarket in town - Other(Restaurants, middlemen…)
57	Fish and Seafood Consumption *Fish and Seafood: fresh, tinned or dried and shellfish*	- Yes - No			- Self Production - Donations/event Gift/food bank/school feeding - Local Market

					- Local shops - Small shop in town - Supermarket in town - Other(Restaurants, middlemen…)
58	Dried beans Consumption *Dried beans, peas, lentils, nuts, seeds or foods made from these*	- Yes - No			- Self Production - Donations/event Gift/food bank/school feeding - Local Market - Local shops - Small shop in town - Supermarket in town - Other(Restaurants, middlemen…)
59	Milk Consumption *Milk and milk products (e.g. yoghurt, maas cheese)*	- Yes - No			- Self Production - Donations/event Gift/food bank/school feeding - Local Market - Local shops - Small shop in town - Supermarket in town - Other(Restaurants, middlemen…)
60	Oils and fats Consumption *Oils and fats: e.g. sunflower, margarine, lard, butter added to food or used for cooking*	- Yes - No			- Self Production - Donations/event Gift/food bank/school feeding - Local Market - Local shops - Small shop in town - Supermarket in town - Other(Restaurants, middlemen…)
61	Sweets Consumption *Sweets: e.g. sugar, honey, sweetened juices or fizzy drinks, sugary foods such as chocolate*	- Yes - No			- Self Production - Donations/event Gift/food bank/school feeding - Local Market - Local shops - Small shop in town - Supermarket in town - Other(Restaurants, middlemen…)
62	Spices Consumption *Spices (e.g. pepper and salt), condiments (e.g. tomato sauce), coffee, tea, alcoholic beverages*	- Yes - No			- Self Production - Donations/event Gift/food bank/school feeding - Local Market - Local shops - Small shop in town - Supermarket in town

					- Other(Restaurants, middlemen…)
Experience of hunger					
63	In the past 12 months, did any adult (18 years and above) in this household go hungry because of a lack of resources to get food?	- Never - Rarely (1 – 2 times a month) - Sometimes (3 – 10 times a month) - Often (more than 10 times a month) - Always - Not applicable (No adults in household)			
64	In the past 12 months, did any child (17 years or younger) in this household go hungry because of a lack of resources to get food?	- Never - Rarely (1 – 2 times a month) - Sometimes (3 – 10 times a month) - Often (more than 10 times a month) - Always - Not applicable (No adults in household)			
65	In the past 12 months, did any child (17 years or younger) in this household eat less often than you feel they should because of a lack of resources to get food?	- Never - Rarely (1 – 2 times a month) - Sometimes (3 – 10 times a month) - Often (more than 10 times a month) - Always - Not applicable (No adults in household)			
66	In the past 12 months, did any child (17 years or younger) in this household eat smaller meals than you feel they should because of a lack of resources to get food?	- Never - Rarely (1 – 2 times a month) - Sometimes (3 – 10 times a month) - Often (more than 10 times a month) - Always - Not applicable (No adults in household)			
67	In the past 12 months, was there any young person, aged 5 - 17 years, who has left this household, and you do not know his/her whereabouts or to live on the streets?	- Yes - No - Do not know - Not applicable (No children in household)			
68	Did your household run out of money to buy food during the past 12 months?	- Yes - No			
69	Has it happened 5 or more days in the past 30 days?	- Yes - No			
70	Did you cut the size of meals during the past 12 months because there was not enough food in the house?	- Yes - No			
71	Has it happened 5 or more days in the past 30 days?	- Yes - No			
Months did not have enough food					
72	Were there months, in the past 12 months, in which you did not have enough food to meet your family's needs?	- Yes - No			
73	Which were the months (in the past 12 months) in which you did not have enough food to meet your family's needs?	- January, February, March, April, May, June, July, August, September, October, November, December			
Coping strategies					
74	In the past 7 days, how many days, your household used this mechanism: Rely on less preferred and less expensive foods? Show how many days, in the last 7, did the household engage in these mechanisms?	- 0, 1, 2, 3, 4, 5, 6 7			

75	Borrow food, or rely on help from a friend or relative? Show how many days, in the last 7, did the household engage in these mechanisms?	- 0, 1, 2, 3, 4, 5, 6 7
76	Purchase food on credit? Show how many days, in the last 7, did the household engage in these mechanisms?	- 0, 1, 2, 3, 4, 5, 6 7
77	Gather wild food, hunt, or harvest immature crops? Show how many days, in the last 7, did the household engage in these mechanisms?	- 0, 1, 2, 3, 4, 5, 6 7
78	Consume seed stock held for next season? Show how many days, in the last 7, did the household engage in these mechanisms?	- 0, 1, 2, 3, 4, 5, 6 7
79	Send household members to eat elsewhere? Show how many days, in the last 7, did the household engage in these mechanisms?	- 0, 1, 2, 3, 4, 5, 6 7
80	Send household members to beg? Show how many days, in the last 7, did the household engage in these mechanisms?	- 0, 1, 2, 3, 4, 5, 6 7
81	Limit portion size at mealtimes? Show how many days, in the last 7, did the household engage in these mechanisms?	- 0, 1, 2, 3, 4, 5, 6 7
82	Restrict consumption by adults in order for small children to eat? Show how many days, in the last 7, did the household engage in these mechanisms?	- 0, 1, 2, 3, 4, 5, 6 7
83	Feed working members of HH at the expense of non-working members? Show how many days, in the last 7, did the household engage in these mechanisms?	- 0, 1, 2, 3, 4, 5, 6 7
84	Reduce number of meals eaten in a day? Show how many days, in the last 7, did the household engage in these mechanisms?	- 0, 1, 2, 3, 4, 5, 6 7
85	Skip entire days without eating? Show how many days, in the last 7, did the household engage in these mechanisms?	- 0, 1, 2, 3, 4, 5, 6 7
86	Has your overall food situation changed in the past 10 years?	- Yes - No
Food security status change		
87	How has your food situation changed since 2006 in terms of Quantity of meat?	- Much More - More - No Change - Less - Much Less - Much Better - Better - No Change - Less Good - Much Less Good
88	How has your food situation changed since 2006 in terms of Quantity of vegetables?	- Much More - More - No Change - Less - Much Less - Much Better - Better

		- No Change - Less Good - Much Less Good
89	How has your food situation changed since 2006 in terms of Quantity of staples?	- Much More - More - No Change - Less - Much Less - Much Better - Better - No Change - Less Good - Much Less Good
90	How has your food situation changed since 2006 in terms of Quality of meat?	- Much More - More - No Change - Less - Much Less - Much Better - Better - No Change - Less Good - Much Less Good
91	How has your food situation changed since 2006 in terms of Quality of vegetables?	- Much More - More - No Change - Less - Much Less - Much Better - Better - No Change - Less Good - Much Less Good
92	How has your food situation changed since 2006 in terms of Quality of staples?	- Much More - More - No Change - Less - Much Less - Much Better - Better - No Change - Less Good - Much Less Good
93	How has your food situation changed since 2006 in terms of Number of meals a day?	- Much More - More - No Change - Less - Much Less - Much Better - Better - No Change - Less Good - Much Less Good

94	How has your food situation changed since 2006 in terms of Periods of hunger a year?	- Much More - More - No Change - Less - Much Less - Much Better - Better - No Change - Less Good - Much Less Good
95	How has your food situation changed since 2006 in terms of amount of food purchased?	- Much More - More - No Change - Less - Much Less - Much Better - Better - No Change - Less Good - Much Less Good
96	How has your food situation changed since 2006 in terms of Amount of food self-produced?	- Much More - More - No Change - Less - Much Less - Much Better - Better - No Change - Less Good - Much Less Good
Food and non-food expenditures		
97	In the past 30 days, how much your household spent in cash to buy the following cereals: corn, rice...? *Cereals: maize, rice, wheat, sorghum, millet, and any other foods made from cereals such as porridge, bread and noodles*	
98	In the past 30 days, how much your household spent in credit/borrow to buy the following cereals: corn, rice...? *Cereals: maize, rice, wheat, sorghum, millet, and any other foods made from cereals such as porridge, bread and noodles*	
99	In the past 30 days, what was the value of self-production consumed by your household of the following cereals: corn, rice...? *Cereals: maize, rice, wheat, sorghum, millet, and any other foods made from cereals such as porridge, bread and noodles*	
100	In the past 30 days, how much your household spent in cash to buy white roots and tubers? *White roots and tubers: Potatoes, white sweet potato and cassava*	
101	In the past 30 days, how much your household spent in credit/borrow to buy white roots and tubers? *White roots and tubers: Potatoes, white sweet potato and cassava*	
102	In the past 30 days, what was the value of self-production consumed by your household of white roots and tubers? *White roots and tubers: Potatoes, white sweet potato and cassava*	
103	In the past 30 days, how much your household spent in cash to buy orange-flesh vegetables	

	Orange-flesh vegetables: Pumpkin, carrot, butternut or sweet potato	
104	In the past 30 days, how much your household spent in credit/borrow to buy orange-flesh vegetables *Orange-flesh vegetables: Pumpkin, carrot, butternut or sweet potato*	
105	In the past 30 days, what was the value of self-production consumed by your household of orange-flesh vegetables *Orange-flesh vegetables: Pumpkin, carrot, butternut or sweet potato*	
106	In the past 30 days, how much your household spent in cash to buy dark green leafy vegetables? *Dark green leafy vegetables, including wild/indigenous vegetables*	
107	In the past 30 days, how much your household spent in credit/borrow to buy dark green leafy vegetables? *Dark green leafy vegetables, including wild/indigenous vegetables*	
108	In the past 30 days, what was the value of self-production consumed by your household of dark green leafy vegetables? *Dark green leafy vegetables, including wild/indigenous vegetables*	
109	In the past 30 days, how much your household spent in cash to buy other kinds of vegetables? *Other vegetables: tomato, onion, green beans, gem squash, eggplant, including wild/indigenous vegetables*	
110	In the past 30 days, how much your household spent in credit/borrow to buy other kinds of vegetables? *Other vegetables: tomato, onion, green beans, gem squash, eggplant, including wild/indigenous vegetables*	
111	In the past 30 days, what was the value of self-production consumed by your household of other kinds of vegetables? *Other vegetables: tomato, onion, green beans, gem squash, eggplant, including wild/indigenous vegetables*	
112	In the past 30 days, how much your household spent in cash to buy orange-coloured fruit? *Orange-coloured fruit: ripe mango, apricot, spanspek, papaya, dried peach and 100% fruit juice made from these*	
113	In the past 30 days, how much your household spent in credit/borrow to buy orange-coloured fruit? *Orange-coloured fruit: ripe mango, apricot, spanspek, papaya, dried peach and 100% fruit juice made from these*	
114	In the past 30 days, what was the value of self-production consumed by your household of orange-coloured fruit? *Orange-coloured fruit: ripe mango, apricot, spanspek, papaya, dried peach and 100% fruit juice made from these*	
115	In the past 30 days, how much your household spent in cash to buy other kinds of fruits? *Other fruit: oranges, banana, apple, pear etc.), including wild/indigenous vegetables*	
116	In the past 30 days, how much your household spent in credit/borrow to buy other kinds of fruits? *Other fruit: oranges, banana, apple, pear etc.), including wild/indigenous vegetables*	
117	In the past 30 days, what was the value of self-production consumed by your household of other kinds of fruits? *Other fruit: oranges, banana, apple, pear etc.), including wild/indigenous vegetables*	

118	In the past 30 days, how much your household spent in cash to buy organ meat? *Organ meat: liver, kidney, heart or other organ meats or blood-based*	
119	In the past 30 days, how much your household spent in credit/borrow to buy organ meat? *Organ meat: liver, kidney, heart or other organ meats or blood-based*	
120	In the past 30 days, what was the value of self-production consumed by your household of organ meat? *Organ meat: liver, kidney, heart or other organ meats or blood-based*	
121	In the past 30 days, how much your household spent in cash to buy meat? *Meat: beef, goat, sheep, poultry, pork, insects*	
122	In the past 30 days, how much your household spent in credit/borrow to buy meat? *Meat: beef, goat, sheep, poultry, pork, insects*	
123	In the past 30 days, what was the value of self-production consumed by your household of meat? *Meat: beef, goat, sheep, poultry, pork, insects*	
124	In the past 30 days, how much your household spent in cash to buy eggs (from any animal)? *Eggs from any animal*	
125	In the past 30 days, how much your household spent in credit/borrow to buy eggs (from any animal)? *Eggs from any animal*	
126	In the past 30 days, what was the value of self-production consumed by your household of eggs (from any animal)? *Eggs from any animal*	
127	In the past 30 days, how much your household spent in cash to buy fish and seafood? *Fish and Seafood: fresh, tinned or dried and shellfish*	
128	In the past 30 days, how much your household spent in credit/borrow to buy fish and seafood? *Fish and Seafood: fresh, tinned or dried and shellfish*	
129	In the past 30 days, what was the value of self-production consumed by your household of fish and seafood? *Fish and Seafood: fresh, tinned or dried and shellfish*	
130	In the past 30 days, how much your household spent in cash to buy dried beans? *Dried beans, peas, lentils, nuts, seeds or foods made from these*	
131	In the past 30 days, how much your household spent in credit/borrow to buy dried beans? *Dried beans, peas, lentils, nuts, seeds or foods made from these*	
132	In the past 30 days, what was the value of self-production consumed by your household of dried beans? *Dried beans, peas, lentils, nuts, seeds or foods made from these*	
133	In the past 30 days, how much your household spent in cash to buy milk? *Milk and milk products (e.g. yoghurt, maas cheese)*	
134	In the past 30 days, how much your household spent in credit/borrow to buy milk? *Milk and milk products (e.g. yoghurt, maas cheese)*	
135	In the past 30 days, what was the value of self-production consumed by your household of milk? *Milk and milk products (e.g. yoghurt, maas cheese)*	
136	In the past 30 days, how much your household spent in cash to buy oils and fats? *Oils and fats: e.g. sunflower, rama, lard, butter added to food or used for cooking*	

137	In the past 30 days, how much your household spent in credit/borrow to buy oils and fats? *Oils and fats: e.g. sunflower, rama, lard, butter added to food or used for cooking*	
138	In the past 30 days, what was the value of self-production consumed by your household of oils and fats? *Oils and fats: e.g. sunflower, rama, lard, butter added to food or used for cooking*	
139	In the past 30 days, how much your household spent in cash to buy sweets? *Sweets: e.g. sugar, honey, sweetened juices or fizzy drinks, sugary foods such as chocolate*	
140	In the past 30 days, how much your household spent in credit/borrow to buy sweets? *Sweets: e.g. sugar, honey, sweetened juices or fizzy drinks, sugary foods such as chocolate*	
141	In the past 30 days, what was the value of self-production consumed by your household of sweets? *Sweets: e.g. sugar, honey, sweetened juices or fizzy drinks, sugary foods such as chocolate*	
142	In the past 30 days, how much your household spent in cash to buy spices? *Spices (e.g. pepper and salt), condiments (e.g. tomato sauce), coffee, tea, alcoholic beverages*	
143	In the past 30 days, how much your household spent in credit/borrow to buy spices? *Spices (e.g. pepper and salt), condiments (e.g. tomato sauce), coffee, tea, alcoholic beverages*	
144	In the past 30 days, what was the value of self-production consumed by your household of spices? *Spices (e.g. pepper and salt), condiments (e.g. tomato sauce), coffee, tea, alcoholic beverages*	
145	In the past 30 days, how much your household spent in cash to buy soap/detergent? *Soap/detergent*	
146	In the past 30 days, how much your household spent in cash to eat at restaurant/food out of the house? *Restaurant/food out of the house*	
147	In the past 30 days, how much your household spent in cash to buy house materials and equipment's? *House Materials and equipments*	
148	In the past 30 days, how much your household spent in cash to buy medicine/regular health expenses?	
149	In the past 30 days, how much your household spent in cash to pay rent?	
150	In the past 30 days, how much your household spent in cash in transport?	
151	In the past 30 days, how much your household spent in cash to buy charcoal/gas/wood?	
152	In the past 30 days, how much your household spent in cash to pay for water expenditures?	
153	In the past 30 days, how much your household spent in cash to pay for milling expenditures?	
154	In the past 30 days, how much your household spent in cash to pay for house construction or repairs expenditures?	

155	In the past 30 days, how much your household spent in cash to pay for education/school fees Expenditures?	
156	In the past 30 days, how much your household spent in cash to pay for special events expenditures (weddings, funerals, celebrations)?	
157	In the past 30 days, how much your household spent in cash to pay debts expenditures? *Repaying debts*	
158	In the past 6 months, how much your household spent in credit/borrow to pay expenses other than food (school fees, house construction, health...)? *Repaying debts*	