The Impact of Large-Scale Agricultural Investments on Household Food Security in Africa: A Comparative Analysis of Kenya, Madagascar and Mozambique

New Proposal

by

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ABSTRACT

There has been an increase in large-scale land in developing countries following the 2007/8 food price crisis. However, the impact of these large-scale agricultural investments in food security is controversial. Literatures said that large-scale agricultural investments that are producing food crops for the domestic market have a positive impact on food security by increasing the availability of food to the domestic market. The investment may bring much-needed employment and income opportunities in the agricultural, non-farm and services sectors in the host country. Such opportunities could play a role in reducing poverty and improving food security through increasing incomes, improving the infrastructure and the distribution of food. On the other hand, large-scale agricultural investments have an adverse impact on food security. Large-scale agricultural investments can lead to a loss of land rights, threatening household food sovereignty. These investments may have potentially destructive effects on local livelihoods for both the current land users that may face increased commercial pressure on land as well as for those who depend on the commons for grazing and fishing grounds and forest access. Others in the community, particularly those who lose their land, face the risk of income loss, especially if employment alternatives are limited or the investment constraints or compete with traditional livelihood activities. However, very little research exists that objectively and thoroughly assesses the impact of such investments on household food security. Most available studies of land acquisitions in these countries have focused on environment and socio-economic impacts. This study seeks to conduct a comparative analysis of the impact of large-scale agricultural investments on food security of households in three African countries: Kenya, Madagascar and Mozambique. The study will provide an in-depth analysis of the impacts from a food security perspective using four internationally recognised food security indicators and other econometrics models that describe food security in all four dimension of food security (availability, access, utilization and stability). The finding of this study will address some of the disputed outcomes of the impact of large-scale agricultural investments on food security.
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1. INTRODUCTION

1.1. Background

The 2008 food price and fuel price crisis accelerated large-scale agricultural investments (LSAIs) in many developing countries (Cotula et al., 2014; Di matteo and Schoneveld, 2016; Scheidel and Sorman, 2012). This triggered large-scale acquisitions of farmland in Africa, Asia and Latin America (Cotula, 2011). According to a Land Matrix Report (2016), Africa has been the most targeted continent, with 422 agricultural deals involving a total area of almost 10 million hectares concluded between 2000 and 2016. Asia was the second targeted continent, with 305 deals (4.9 million hectares) followed by Eastern Europe 96 deals (5 million hectares), Latin America 146 deals (4.5 million hectares) and Oceania 35 deals (2.2 million hectares) between 2000 and 2016 (Nolte et al., 2016).

Studies demonstrate that large-scale agricultural investments have the potential to create jobs, increase the rate of technology adoption and input use (Baumgartner et al., 2015; Deininger and Xia, 2016; Hufe and Heuermann, 2017). However, large-scale agricultural investments can also have an adverse impacts on livelihoods, environment, natural resources and conflict due to the loss of land rights in host countries (Aisbett and Barbanente, 2016; Breu et al., 2016; German et al., 2013; Hess et al., 2016; Lunstrum, 2015; Yengoh and Armah, 2015).

Land is very important to the livelihoods, food security and social identity of many people (Cotula et al., 2009; Cotula et al., 2011; Daniel, 2011). One of the principal causes of hunger and poverty is a lack of adequate and secure access to land and natural resources. Globally, half of those suffering from hunger are smallholder-farming households, and one in five of these households are landless (Schoneveld, 2011). The socio-economic impacts of the growing number of large-scale agricultural investments have been heavily debated (Ali et al., 2011; Cotula, 2013; Herrmann, 2017; Nolte and Ostermeier, 2017).

It is widely acknowledged that agricultural investment is an important and effective strategy for poverty alleviation and reducing hunger in rural areas - where the majority of the world’s most indigent population live (Deininger, 2011; FAO, 2012; Liu et al., 2013; World Bank, 2008). Investing in agriculture increases productivity and incomes. In turn, improved agricultural production increases the availability of food in the market and reduces prices for consumers. Lower stable food prices enable the consumers to diversify their diets, leading to the inclusion of more vegetables, fruit, eggs, and milk that improve dietary quality (Bouis et al., 2000).

In 2003, African leaders endorsed the Comprehensive African Agricultural Development Programme (CAADP) as a plan of action and committed to increasing public investment in agriculture to at least 10 percent of the national budget (NEPAD, 2003) and striving to achieve annual agricultural growth rates of at least 6 percent. In addition, the Group of Seven (G7) and Group of Twenty (G20) have made firm commitments to supporting and increasing agricultural investment in developing country to improve food security (Liu et al., 2013). Despite this prioritisation of agricultural growth and investment, many African countries have struggled to achieve these commitments. Foreign direct investment (FDI) is still the primary source of capital to fill the investment gap in the agriculture sector in developing countries
(Mahmoodi and Mahmoodi, 2016). However, in most developing countries, foreign direct investment in agriculture remains comparatively low.

This study seeks to conduct a comparative analysis of the impact of large-scale agricultural investments on food security of households by using AFGROLAND project data from three sub-Saharan African countries: Kenya, Madagascar and Mozambique. Most available studies of land acquisitions in these countries have focused on environment and socio-economic impacts (Borras et al., 2011; Burnod et al., 2013; Duvail et al., 2014; Hufe and Heuermann, 2017; Kibugi, et al., 2012; Veldwisch, 2015; Zaehringer et al., 2018). This study will provide an in-depth analysis of the impacts from a food security perspective.

1.2. Statement of the problem

There has been an increase in large-scale land acquisitions in developing countries following the 2007/8 food price crisis (Cotula et al., 2009; Cotula et al., 2014; Deininger, 2011). However, the impact of these large-scale agricultural investments in food security is contested (Mesfin, 2013). Very little research exists that objectively and thoroughly assesses the impact of such investments on household food security.

Land acquisitions take the form of purchases, long-term (99-year) leases or concessions of more than 200 hectares by an external actor for agricultural production (food or agro-fuel production), timber extraction, carbon trading, mineral extraction, conservation or tourism (Nolte et al., 2016). The Land Matrix reports that there was an increasing trend in agricultural deals between 2000 and 2016 (Nolte et al., 2016). Eleven African countries are among the most targeted investment destinations (Figure 1).

![Figure 1: Nature of deals by continent](image)

Source: Land Matrix Report (2016)

Many developing country governments see these investments as an opportunity to increase their revenue and modernise their agriculture sector (Cotula et al., 2009). The investment may bring much-needed
employment and income opportunities in the agricultural, non-farm and services sectors in the host country. Such opportunities could play a role in reducing poverty and improving food security through increasing incomes, improving the infrastructure and the distribution of food.

Large-scale agricultural investments that are producing food crops for the domestic market have a positive impact on food security by increasing the availability of food to the domestic market (Aabø and Kring, 2012; Kirigia et al., 2016). Large-scale agricultural investments can be creating a substantial number of jobs for local people, which improve food security in two ways (Smalley, 2013). Some companies provide meals for their employees by purchasing food from local markets, which contribute to eradicating hunger and poverty (Deininger and Xia, 2016). At the same time, the additional income that employed households receive improves their purchasing power and helps to diversify their consumption.

However, large-scale agricultural investments also have an adverse impact on food security. A large-scale agricultural investments can lead to a loss of land rights, threatening household food sovereignty (Cotula et al., 2014; Daniel; 2011; GRAIN, 2008). These investments may have potentially destructive effects on local livelihoods for both the current land users that may face increased commercial pressure on land as well as for 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, face the risk of income loss, especially if employment alternatives are limited or the investment constraints or compete with traditional livelihood activities. In some cases, the anticipated jobs do not materialise or companies hire in labour from outside. In some cases, they bring their own labour, especially for more skilled labour jobs (Anseeuw et al., 2013).

However, there is no significant body of empirical evidence existing that shows these large-scale acquisitions positively or negatively affect household food security and rural livelihoods in Africa in general. Hufe and Heuermann (2017) review of large-scale acquisitions in Africa found that only four of 60 case studies covering 146 acquisition projects in 22 countries could show that food security was adversely affected. The studies do not provide insight into the underlying reasons for this. Moreover, when Jatropha was inter-cropped with traditional food crops, no signs of adverse effects on local food security were found by these studies (Hufe and Heuermann, 2017). Therefore, this study aims to accomplish a comparative analysis of the impact of large-scale agricultural investments on food security of households in three African countries.

1.3. Research objectives
The main objective of this study is to conduct a comparative analysis of the impact of large-scale investments on agricultural land on household food security using three countries case studies from Kenya, Mozambique and Madagascar.
Specific objectives are:
1. to examine the food security status both factual (area, which large-scale agricultural investments are available) and counterfactual (area without availability of large-scale agricultural investments) households in the study areas.
2. to analyses the impact of large-scale agricultural investments on food security in the study area (both factual and counterfactual areas).
3. to identify the most vulnerable food insecure households in the three countries.
1.4. Contribution to knowledge

As mentioned above, the impact of large-scale agricultural investments is controversial. Different authors report adverse effects on local producers and others purport positive effects for Africa’s rural development. 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 used one or two food security indicators to evaluate the food security status of the households. This study will use four internationally recognised food security indicators and other econometrics models that describe food security in all four dimension of food security (availability, access, utilization and stability), allowing for comparability of indictors and enabling a deeper understanding of the various elements of food security constructs.

Many studies have been conducted on the impact of large-scale agricultural investments on environmental, social, ecological, land right and other issues rather than food security (Borras et al., 2011; Burnod et al., 2013; Duvail et al., 2014; Hufe and Heuermann, 2017; Kibugi, et al., 2012; Veldwisch, 2015; Zaehringer et al., 2018). Some of studies that analysed the impact of large-scale agricultural investments on food security in Africa are mention below in Table 1. This study focuses on the impact of large-scale agricultural investments on food security. Therefore, the finding of this study will address some of the disputed outcomes of the impact of large-scale agricultural investments on food security. This study also examines and compares the food security status of the households that participated as a contractual base and employed in large-scale agricultural investments. This will help to identify which business model (contract or employed) is more participatory and important for smallholder farmers.
### Table 1: Overview of case studies on the impact of LSAIs on food security in Africa

<table>
<thead>
<tr>
<th>Source</th>
<th>Country</th>
<th>Purpose</th>
<th>Method</th>
<th>Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aabø and Kring</td>
<td>Mozambique</td>
<td>The political economy of large-scale agricultural land acquisitions: Implications for food security and livelihoods</td>
<td>Descriptive analysis</td>
<td>Projects built infrastructure and generated employment, but it have a significant number of land conflicts and a series of negative social, economic and environmental impacts of many of these projects.</td>
</tr>
<tr>
<td>Baumgartner et al. (2015)</td>
<td>Ethiopia</td>
<td>Impacts of large-scale land investments on income, prices, and employment</td>
<td>Linear programming model</td>
<td>Simulation result shows smallholder commercialization have more significant and longer-lasting positive effects on local livelihoods and market integration can improve local food security.</td>
</tr>
<tr>
<td>Burnod et al. (2015)</td>
<td>Madagascar</td>
<td>Large-scale plantation and contract farming effects</td>
<td>qualitative and quantitative assessment method</td>
<td>The result mention large-scale plantations worsen poverty, because the company only contributes on employment partly to their reconstruction efforts. Contract farming models, were more profitable for the company, the farmers and more generally for the local development.</td>
</tr>
<tr>
<td>Daniel (2011)</td>
<td>World</td>
<td>Land grabbing and potential implications for world food security</td>
<td>Reviewed literature</td>
<td>Land deals diminish the possibility of reaching food self-sufficiency for poor nations and some view land concessions as governments out-sourcing food at the expense of food security.</td>
</tr>
<tr>
<td>Dye (2014)</td>
<td>Ethiopia and Tanzania</td>
<td>The impact large-scale land acquisitions on food security</td>
<td>qualitative and case study methodology</td>
<td>Large-scale land acquisitions maintain a system of social, political, and economic entitlements that foster uneven structures that result in low levels of food security and access to land.</td>
</tr>
<tr>
<td>Kronenburg (2015)</td>
<td>Kenya</td>
<td>Food security and land governance</td>
<td>Reviewed literature</td>
<td>Land rental markets are the most important means available to smallholder farmers to access additional land for cultivation and increase their food security. However, biofuel production and the leasing out of agricultural land are significant and costly.</td>
</tr>
<tr>
<td>Lay et al. (2017)</td>
<td>Zambia</td>
<td>large-scale farms and smallholders: evidence from Zambia</td>
<td>Difference-in-Difference</td>
<td>Smallholders inwards with large-scale farms increase their area cultivated and maize</td>
</tr>
<tr>
<td>Study (Year)</td>
<td>Region</td>
<td>Title</td>
<td>Methodology</td>
<td>Findings</td>
</tr>
<tr>
<td>-------------</td>
<td>--------</td>
<td>-------</td>
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<td>---------</td>
</tr>
<tr>
<td>Lisk (2013)</td>
<td>Africa</td>
<td>‘Land grabbing’ or harnessing of development potential in agriculture? East Asia’s land-based investments in Africa</td>
<td>Reviewed literature</td>
<td>‘land grabbing’, which limits access of smallholder farmers to land, deprives local people of their livelihoods and threatens local and national food security across the continent.</td>
</tr>
<tr>
<td>Matondi et al. (2011)</td>
<td>Africa</td>
<td>The impact of land grabbing for growing biofuels and to ensure food security</td>
<td>Reviewed literature</td>
<td>The study argues that ‘the rapid growth in biofuel production will affect food security at the national and household levels mainly through its impact on food prices increase.</td>
</tr>
<tr>
<td>Miggiano et al. (2010)</td>
<td>World</td>
<td>Links between land tenure security and food security</td>
<td>Reviewed literature</td>
<td>Lack of access to land increases farmers’ vulnerability to food insecurity. Without access to land, farmers would depend on seasonal farm work.</td>
</tr>
<tr>
<td>Moreda (2018)</td>
<td>Ethiopia</td>
<td>to explore the implications of large-scale agricultural investments for local food security and the right to food</td>
<td>Case study</td>
<td>It argues that large-scale agricultural investments pervert the realisation of food security. This is due to, declining access to agricultural, pastoral and forest land resources among the rural poor.</td>
</tr>
<tr>
<td>Hall et al. (2017)</td>
<td>Ghana, Kenya and Zambia</td>
<td>Plantation, out growers and commercialisation and implications on employment</td>
<td>Business model</td>
<td>Good opportunity for livelihood improvement (additional source of income, especially poor women).</td>
</tr>
<tr>
<td>Schoneveld (2011)</td>
<td>Ghana</td>
<td>analysed the impact of biofuel feedstock development in Ghana.</td>
<td>Case study</td>
<td>Results shows that this can significantly aggravate rural poverty as communities lose access to vital livelihood resources. Vulnerable groups, such as women and migrants, are found to be most profoundly affected.</td>
</tr>
<tr>
<td>Author(s)</td>
<td>Country(s)</td>
<td>Study Title</td>
<td>Research Methods</td>
<td>Findings</td>
</tr>
<tr>
<td>------------------------</td>
<td>---------------------</td>
<td>------------------------------------------------------------------------------</td>
<td>------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Shete and Rutten (2015)</td>
<td>Ethiopia</td>
<td>Impacts of LSAIS on economic development, household food security and the environment</td>
<td>Multiple regression, PSM, NPV, Consumption</td>
<td>Short-run positive effect on food security (around crop produced company) and negative food security impact for those losing their land. Negative socio-economic and environmental impacts.</td>
</tr>
<tr>
<td>Speller (2016)</td>
<td>Ethiopia, Cambodia, Mozambique and Tanzania</td>
<td>Analyse the impact of vegetable contract farming income</td>
<td>Comparative analysis</td>
<td>Finding shows that employment creation remained a principal benefit that communities perceived from the presence of an investor, especially in terms of income and food security aspects.</td>
</tr>
<tr>
<td>Yengoh and Armah (2015)</td>
<td>Sierra Leone</td>
<td>Effects of large-scale acquisition on food insecurity in Sierra Leone</td>
<td>A mixture of quantitative and qualitative research methods</td>
<td>Increase in the severity of food insecurity and hunger. Household income from agricultural production has fallen. This is because of employment by the land investing company is limited and wages from employment cannot meet the staple food needs of its employees.</td>
</tr>
</tbody>
</table>
2. LITERATURE REVIEW

Large-scale farming, sometimes know as ‘land grabbing’ by those who view the practice negatively. The Land Matrix defines large-scale land acquisitions as:

“land purchases, leases or concessions of lands of 200 hectares or more by an 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. p3)

Large-scale land acquisitions are often classified as contract farming, large-scale plantation and commercial farming (Smalley, 2013). Donors, international actors and national government encourage the links between large-scale agricultural investments and smallholders for transforming agriculture and to enabling poverty reduction (Deininger 2011). However, social media and other commentators point to the adverse effect of large-scale agricultural investments. Recently, the demand of investing on non-food crops such as biofuels and other traditional high-value crops (e.g. rubber, palm oil and cotton) are high (Achterbosch et al., 2014; Hallam, 2009; Gebresilassie and Bekele, 2015; Shete and Rutten, 2015).

A number of factors have been proposed as drivers of large-scale investments. Emerging economies largely drive the global land acquisitions in search of alternative ways to secure food and fuel supply of the nearby future (Verhoog, 2013). One of the main drivers of large-scale agricultural investment is the food price crisis of 2008 that increased competition for land and water resources (Daniel, 2011). Food importing countries with land and water constraints, such as the capital-endowed Gulf States are the leaders of new investments in developing countries. Countries with large populations and food security concerns like China, South Korea and India are also seeking opportunities to produce food abroad to balance domestic production risks and diversify food sources (Shete and Rutten, 2015). These investments focus on developing countries where production costs are much lower and land and water are abundant (Daniel and Mittal, 2009). Besides to this, population growth in the developing countries will lead to increased demand for food products, expanding urbanization, and rising incomes that needs to be meet by bringing more land into farming and by improving productivity.

Climate change is also driving interest in the green energy, including biofuel production (Deininger, 2013). On the other hand, climate change have recently impacted agricultural production in many regions, which contributing to higher food prices and rising concerns over food and energy security (Davis, Rulli and D’Odorico, 2015). In African countries like Ethiopia and Madagascar, biofuel production is the dominant purpose for the land deals (Friis and Reenberg, 2010).

The extent of land tenure security is an additional driving factor for land acquisitions (Dwyer, 2013). Studies show that there is a strong correlation between weak land tenure security and land acquisitions (Deininger, 2013; Anseeuw et al., 2012). For instance, countries like Cambodia, Ethiopia, Madagascar, Laos and Ghana that have weak land tenure security and highly targeted by large-scale agricultural investments. This is more likely related to political and institutional factors. Sub-Saharan African land is
considered underutilized and targeted as cheap and fertile land for acquisitions. Some African governments are encouraging land acquisitions by foreign companies, providing investment incentives such as zero import duties and tax holidays for many years, has made the country an attractive place for investment in agribusiness (Cotula et al., 2009). Investors that export their products are highly encouraged than those which do not. This indicates that the main purpose of the shift to large-scale agriculture is foreign exchange earnings while it has less to do with domestic food security.

3. METHODS AND PROCEDURES

3.1. Descriptions of the study areas
This section illustrates detail descriptions of the study areas in the three countries. This study will be used a case study approaches for comparing three African countries impacts of large-scale agricultural investments on food security. According to (Reys, 2016; Reys and Burnod, 2017; Reys and Mutea, 2017) study areas in the three countries were selected purposively by AFGROLAND project based on the availability of large-scale agricultural investment for factual group and with no large-scale agricultural investments for counterfactual group.

Nanyuki is one of the districts in central Kenya in which commercial farming is common. The land acquisition plantations within the Nanyuki district have undergone various transitional changes. Six farm sites with land acquisition investments and one site without investment were selected purposively by the project. Companies in Buuri, Kangaita and Nyariginu are involved in flower farming; whereas farms in Naibor and Tigithi are involved in growing vegetables; Mutarakwa- Kiambogo farmers produced vegetables in contract bases and Barrie is counterfactual area without large-scale agricultural investments (Masola, Hendriks and Reys 2018; Reys and Mutea, 2017).

Buuri is a sub-location where farm Blooming Dale Roses and Kisima Flowers are located. The main activity done by these land acquisition investment is mainly flower farming. Kangaita is a sub-location where Kariki Limited farm is located (Masola, Hendriks and Reys 2018). The surrounding households farming activity are mainly food production. Nyariginu is also another sub-location where both farm Equinox and HM Clause Kenya Limited are located. The main farming activity practiced by households in the surrounding area is growing crops (Reys and Mutea, 2017).

Tigithi is a sub-location area where the farm AAA Growers-Chestnut is located. AAA Growers-Chestnut is a farm enterprise, which involved in vegetable production. The area is inhabited by recently migrated community members, most of whom do not have shambas (cultivated areas). These households practice livestock farming mainly sheep, goats and chicken. The Naibor sub-location is an area where KHE farm is located. Small-scale farmers that produce crops mainly inhabited this area. The sub-location of Mutarakwa- Kiambogo is located near the town of Timau where Vegpro group, currently re-branded to VP food producers and exports in Kenya. Vegpro has six farms and manages 1700 smallholder farmers that produce peas. Barrier is the counterfactual group sub-location, which is located North-East of Nanyuki area (Masola, Hendriks and Reys 2018; Reys and Mutea, 2017). Barrier is rural sub-location without land acquisition investments (Figure 2).
In the case of Madagascar, the project selected two companies to collect data in the Satrokala and Ambatofinandrahana municipalities (labelled Company X and Y). X is a 10-year-old Italian company that mainly produces maize and geranium on about 3500 ha in Satrokala (Fitawek et al., 2018; 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 that is situated on a plateau (Figure 3). Satrokala town’s population has been growing steadily since the establishment of the Company in 2009. Most households in the town were reportedly migrants. The plateau is a highland grassland terrain suitable for extensive grazing of livestock. Most households in the area were cattle breeders and farmers. The neighbouring commune of Ambatolahy, that in the past had refused to give land to company X, was chosen to represent the counterfactual zone. The fokontany of Ambatolahy and Ivaro-Est were selected because of their relative similarity to Satrokala in terms of accessibility (distance from the main road), agriculture landscape, practices and population (Reys and Burnod, 2017).

Company Y deals with 7200 farmers in three regions: Vakinankaratra, Amoron’Imania and HauteMatsiatra. Ambatofinandrahana is one of the communes in Amoron’Imania region. In the region, at the time of sampling, 2636 farmers were involved and cultivated in total 256 ha. A few households in this area were contracted to Company Z to produce artemisinin or wormwood, an antimalarial agent (Reys and Burnod 2017). Therefore, this sub-sample cannot be considered a ‘pure’ counterfactual. Three fokontany located in the vicinity of Ambatofinandrahana-town were selected: Matahimasina, Sambalahy and Ambatomenaloha. Matahimasina (located 5km at the South-West of Ambatofinandrahana-town); Sambalahy (located 5km at the West of Ambatofinandrahana-town) and Ambatomenaloha (located 5km at
the North-West of Ambatofinadrahana-town). On the other hand, they selected Ifasina commune as counterfactual zone, which is located 25km at the West of Ambatofinadrahana-town (Figure 3).

![Map showing the location of the study sites in Madagascar](image)

**Figure 3:** Map showing the location of the study sites in Madagascar

Source: Reys and Burnod (2017)

The project selected two districts from Mozambique in the Nacala Corridor (Northern Mozambique) based on the presence of large-scale agricultural investments; Monapo in the Nampula province and Gurué in the Zambezia province (Mawoko et al., 2018; Reys, 2016). Three factual zones (Manlé and Ruacé from Gurué and Ramiane from Monapo) and two counterfactual zones (Muela in Gurué and Canacué in Monapo) were selected from the two districts (Figure 4).

Manlé is a rural area located near a tea plantation “Cha Magoma” in Gurué district. The counterfactual selected for Manlé was Muela. Muela is a rural locality without a nearby large-scale plantation. The other investment area in the Gurué district is Ruacé, which is a town located near a soya plantation “Hoyo Hoyo”. It is reported that since 2010, about one thousand households were displaced by this investment. Another soya plantation, Rei Do Agro, is located approximately 11 km away. This plantation was established in 2014, but its development was quite slow and has since stopped in May 2017. In the Monapo district, Ramiena was selected as an investment area, which is located adjacent near to sisal plantation “Ramiena” (Figure 4). The counterfactual area for the Monapo district was Canacué. This little rural town is not located near a large-scale plantation (Mawoko et al., 2018; Reys, 2016).
3.2. Methods of data collection and sample size

The study will be used both qualitative and quantitative data from the three countries (Kenya, Madagascar and Mozambique). The primary data were collected by AFGROLAND project through formal survey techniques using semi-structured questionnaire for both factual and counterfactual areas. The data were collected from January to March 2017 from Kenya, March to April 2017 from Madagascar and September to October 2016 from Mozambique.

The project was used a three-stage stratified random sampling procedure to selected sample households. In the first stage, seven sub-locations were selected from Nanyuki area in Kenya, six were factual groups (i.e. Buuri, Tigithi, Kangainta, Nyarigaita, Naibor and Mutarakwa-Kiambogo) and one counterfactual (i.e. Barrier). Two different municipalities were purposively selected from Madagascar (Ambatofinandrahana and Statrokal) and Mozambique (Gurué and Monapo) based on availability of large-scale agricultural investment. In the second stage, companies were purposively selected based on level of development, area of cultivated and number of households potentially impacted (through contracts, jobs or land grab). In the third stage, representative households were randomly selected for interview from the two strata (factual and counter factual groups). The numbers of households interviewed in the three countries are mentioned in the table below (Table 2).
Table 2: Countries survey details

<table>
<thead>
<tr>
<th>Country</th>
<th>Number of HH interviewed</th>
<th>Factual</th>
<th></th>
<th>Counterfactual</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Total HH Employee in LSAIs</td>
<td>Total HH engaged in contract</td>
<td>Non-engaged HH</td>
</tr>
<tr>
<td>Kenya (Nanyuki)</td>
<td>546</td>
<td>46</td>
<td>58</td>
<td>282</td>
</tr>
<tr>
<td>Madagascar (Aombatofinandrahan &amp; Satrokala)</td>
<td>601</td>
<td>61</td>
<td>124</td>
<td>230</td>
</tr>
<tr>
<td>Mozambique (Gurue &amp; Monapo)</td>
<td>504</td>
<td>121</td>
<td></td>
<td>155</td>
</tr>
<tr>
<td><strong>Total sample</strong></td>
<td><strong>1651</strong></td>
<td><strong>228</strong></td>
<td><strong>182</strong></td>
<td><strong>667</strong></td>
</tr>
</tbody>
</table>

3.3. Methods of data analysis
Since food security is a multidimensional nature and there is no internationally recognized single perfect measure that captures all aspects of food security (Hendriks et al., 2016). Therefore, this study will use four internationally recognized food security indicators to analyse the first objective of this study (to evaluate and compare the food security status of different household groups).

**Table 3: Methods calculating food security indicators**

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Recall period</th>
<th>Formula and food groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food Consumption Score (FCS)</td>
<td>7-days</td>
<td>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</td>
</tr>
<tr>
<td>Coping Strategies Index (CSI)</td>
<td>7-days</td>
<td>CSI = (frequency CS1 * severity CS1) + (frequency CS2 * severity CS2) + … + (Frequency CS10 * severity CS10)</td>
</tr>
<tr>
<td>Months of Adequate Household Food Provisioning (MAHFP)</td>
<td>12 months</td>
<td>MAHFP is calculated by asking the household two question: the first question is, by asking the household did you had problems not getting enough food to meet you family’s need in the last 12 months?. If the answer is for instance, Yes continue to the second question , if No, then the responses A-L of question two should be coded as zero. Value of A through L will be either “0” or “1”. MAHFP= 12 – Sum (A+B+C+D+E+F+G+H+I+J+K+L)</td>
</tr>
<tr>
<td>Food Expenditure Share</td>
<td>30-days</td>
<td>The food expenditure share will be calculated by dividing the total food expenditure by the total household expenditure as follows: $food_expenditure_share = \frac{food_monthly}{Total_expenditure\left(food_monthly + nonfood_monthly\right)}$</td>
</tr>
</tbody>
</table>
This study will employ both descriptive and econometrics statistical tools. Descriptive statistical tools like mean, percentage, chi-square and Spearman’s correlation will be used to analyse the first objective. Econometric models like probit regression, endogenous switching regression model and principal component analysis will be used to analyses objective two and three.

There are many econometric models to analyse the impact of programme, project or policy. Some of the methods are Difference-in-Difference, Propensity Score Matching, Instrumental Variable, Reflexive comparisons and Endogenous Switching Regression Method. Difference-in-Differences (DID) is a method which compares a treatment and comparison group before and after a project (Baker, 2000). However, constructing panel data sets can be expensive and time consuming. Besides, the design assumes that there is potential selection bias (Baker, 2000; Jalan and Ravallion, 1999). Propensity score matching was proposed by Rosenbaum and Rubin (Rosenbaum and Rubin, 1983) has been widely employed to examine the impact of a program or project (Rosenbaum and Rubin, 1983). Propensity score matching tries to create the observational similarity with an experiment in which everyone has the same probability of participation. Hence, there are always concerns about remaining selection bias in estimating the propensity score (Ravallion et al., 2005).

Instrumental variable is one of the econometric techniques that can be used to compare program participants and non-participants by correcting selection bias (Baker, 2000). However, it is difficult to get a strong instrument (Becker, 2016). Reflexive comparisons: is another type of quasi-experimental design, it needs a baseline survey of participants before project implementation and a follow-up survey after implementation (Baker, 2000). The problem is reflexive comparisons may not be able to distinguish between the program and other external factors, thus affect the reliability of results (Ravallion et al., 2005). Endogenous switching regression model is better to account the selection bias in our estimation of the impact on participation in large-scale agricultural investment on food security than the above mentioned impact analysis models.

3.3.1. Endogenous Switching Regression (ESR) Model

Endogenous switching regression model was developed by Lee in 1982, as a generalization of Heckman’s selection correction approach. Endogenous switching regression model accounts for selection bias by treating selectivity as an omitted variable problem (Dutoit, 2007); (Heckman, 1979). At the beginning of programme participation, the household might not be randomly exposed to large-scale agricultural investments, they might have self-selected to participate or the investment forced to participate (Malikov and Kumbhakar, 2018). Like instrumental variables techniques, endogenous switching regression model relies on normality assumptions, but endogenous switching regression model is more efficient than instrumental variables (Besley and Case, 2017). Therefore, the endogenous switching regression model is essential to control endogeneity problems by estimating a simultaneous equations model by full information of maximum likelihood (Kabunga et al., 2012; (Kassie et al., 2014; Lokshin, 1977; Malikov and Kumbhakar, 2018; Shiferaw et al., 2014).

Recently, many impact assessment studies have interested using an endogenous switching regression model to reduce selection bias (Abdulai and Huffman, 2014; Alene and Manyong, 2007; Amare et al., 2012; Asfaw et al., 2012; Carter and Milon, 2005; Di Falco et al., 2011; Mesfin, 2013; Shiferaw et al.,
Due to our given interest in examining the determinants of participation, as well as the impacts of participation in employment and contract in large-scale agricultural investment, this study will use an endogenous switching regression model.

Probit model will be used to identify the socio-economic factors that determine food security status of the households and used as a selection equation in the first stage of endogenous switching regression analysis. Both linear regression and probit models as outcome equations (food security indicators) will be used in the second stage.

Endogenous switching regression model is estimating as follows (Di Falco et al., 2011)

\[
Z_i^* = a + \gamma Q_i + e_i \tag{1}
\]

Where \(Z_i^*\) is a continuous latent variable (utility of participation), \(a\) is an intercept, \(Q_i\) is a vector of exogenous variables influencing the participation decision such as sex of the household head, marital status, educational level, family size, land size, livestock number owned (Tropical Livestock Unit), distance from market (km), distance from the main road (km), employment status and migration status. \(\gamma\) is a vector of coefficient and \(e_i\) is the disturbance term with zero mean and a constant variance. The corresponding observable variable, is dichotomous and takes the value 1 if the household is a participant and is 0 if it does not participate. The behavioural equation is:

Regime 1: \(Y_{1i} = X_{1i}^{'}\beta_1 + \sigma_{1e}\lambda_{1i} + \eta_{1i}\) if \(A_i = 1\) for participant households ………. (2)

Regime 2: \(Y_{2i} = X_{2i}^{'}\beta_2 + \sigma_{2e}\lambda_{2i} + \eta_{2i}\) if \(A_i = 0\) for non-participant households ………. (3)

Where \(Y_i\) represent outcomes variables (the four food security indicators that mentioned above) of household \(i\) for each regime (1 = for participant and 0 = non-participant), \(X_i\) is a vector of covariates that mentioned above, which affect household participation in large-scale agricultural investment, and \(\lambda_{1i} = \frac{e^{(Z_i^*)}}{\Phi(Z_i^*)}\) and \(\lambda_{2i} = \frac{1}{1 - \Phi(Z_i^*)}\) are the inverse Mill’s ratio of participation computed from the selection Eq. (1) and are included in Eq. (2) and Eq. (3) to correct for selection biases in two-step estimation procedure (i.e. endogenous switching regression). \(\beta\) and \(\sigma\) are parameters to be estimated, and \(\eta\) is an independently and identically distributed error term. The standard errors in Eqs. (2) and (3) will check the robustness to account for the heteroscedasticity arising from the regressor (\(\lambda\)).

Endogenous switching regression is important to estimate the average effect of participating in large-scale agricultural investment on food security that means the average treatment effect on the treated (ATT). The average treatment effect is represented by \(Y_i\) (outcomes variables) in this case different food security indicators (FCS, MAHFP, CSI and Food expenditure share). The structure of the expected conditional and average treatment effects under factual and counterfactual are given as follows:

a. \(E[Y_{1i}/X, A_i = 1] = X_{1i}^{'}\beta_1 + \sigma_{1e}\lambda_{1i}\) (Participants (employed or contract with LSAIs) …… (4)

b. \(E[Y_{2i}/X, A_i = 0] = X_{2i}^{'}\beta_2 + \sigma_{2e}\lambda_{2i}\) (Non-participants in LSAIs) …………………….. (5)

c. \(E[Y_{2i}/X, A_i = 1] = X_{1i}^{'}\beta_2 + \sigma_{2e}\lambda_{1i}\) (Participants, they decided not to participate in LSAIs) …… (6)
d. \[ E[Y_{1i}/X, A_i = 0] = X_{2i} \beta_1 + \sigma_\epsilon \lambda_{2i} \quad \text{(Non-participants, they decided to participate in LSAIs)} \quad (7) \]

Situation (a) and (b) are observed from the survey data. However, (c) and (d) are the hypothetical unobserved but expected situation (counterfactual outcomes). This will happen when the participant becomes non-participant and the non-participant becomes a participant. Therefore, the expected change in the level of food security for participant households, which is the average treatment effect on treated households (ATT) is given as:

\[ \text{ATT} = (a) - (c) \]
\[ = E[Y_{1i}/X, A_i = 1] - E[Y_{2i}/X, A_i = 1] \quad \text{................................................. (8)} \]
\[ = X_{1i}(\beta_1 - \beta_2) + \lambda_{1i}(\sigma_1 - \sigma_2) \quad \text{................................................. (9)} \]

On the other hand, the expected change in the food security of non-participant household, the average treatment effect of the untreated households (ATU) is given as:

\[ \text{ATU} = (d) - (b) \]
\[ = E[Y_{1i}/X, A_i = 0] - E[Y_{2i}/X, A_i = 0] \quad \text{................................................. (10)} \]
\[ = X_{2i}(\beta_1 - \beta_2) + \lambda_{2i}(\sigma_1 - \sigma_2) \quad \text{................................................. (11)} \]

3.4.2. Principal Component Analysis (PCA)

The term food security describes the current condition of the household. However, vulnerability is used to describe the level of risk for future food insecurity. Food Insecurity and Vulnerability Information and Mapping System (FIVIMS) defines vulnerability as:

"the full range of factors that place people at risk of becoming food-insecure, including those factors that affect their ability to cope."

The degree of vulnerability of individuals, households or groups of people is determined by their exposure to the risk factors and their ability to cope or withstand stressful situations. Like food security, vulnerability is also difficult to measure (Conte, 2005). Given the complexity and multi-dimensional nature of vulnerability and the lack of benchmarks for measuring vulnerability, it is difficult to know the range of shocks and risks that related to them (Conte, 2005). Vulnerability arises from the complex interactions between socio-economic, institutional and environmental systems. For the purpose of this study, vulnerability refers to institutional or policy interventions (land grab, contract farming and land lost right).

The Vulnerability Analysis and Mapping (VAM) analytic approach describe household food security and vulnerability by developing household food security index for different groups (Conte, 2005). The intent is to describe household food security and vulnerability regarding its characteristics, rather than attempting to rank different situations of food insecurity (Wineman, 2014). The index provides a means of identifying sub-groups within the population by clustering households that share similar food security characteristics and outcomes (i.e. livelihoods, access to food, and utilization of food) and identifying most and least food insecure groups and their characteristics (Krishnamurthy et al., 2014).

Household food security index is created by following two-step process. The first step is selected food security indicators by principal component analysis, and then followed by cluster analysis. The principal
Component analysis is one of the techniques of multivariate analysis that describes the underlying relationships amongst the variables by creating new indicators (factors or principal components) (Conte, 2005). This created “principal components” capture the essence of the associations between variables (Wineman, 2016; Wineman and Liverpool-tasie, 2017). Cluster analyse is used to translate this information into clusters or groups of households that share key characteristics and outcomes related to food security. Recently, many scholars used principal component analysis to measured food security, poverty and vulnerability (Alinovi et al., 2009; Assefa, 2015; Boukary et al., 2016; Brown et al., 2014; Hjelm et al., 2016; Krishnamurthy et al., 2014; Wineman, 2016).

Principal component analysis is a type of factor analysis that takes linear combinations of a correlated set of indicators, and reduces them into factors (components) by extracting the largest variance in the original variables (Field, 2009; Reig, 2012). However, the contribution of each principal component in explaining the total variance found among households will progressively decrease from the first principal component to the last. As a result, we should remove the principal component with the little explanatory power from the analysis.

Principal component analysis needs a minimum ratio of cases, variables to be 5 and it requires a fair amount of correlation between the variables a minimum correlation size of 0.3 between variables (Field, 2009). The first factor in principal component analysis captures the maximum variation between the factors and the subsequent components capture new but lower variation.

The factor mathematically model as follows:

\[ Y_i = b_1 X_{1i} + b_2 X_{2i} + \ldots + b_n X_{ni} \]  

Where \( Y_i \) represent factors or a linear combination of variables (in this study the four food security indicators), \( X_{ni} \) represents indicators from one to \( n \), and \( b \) denoted factor loading. In addition, the relation (correlation) of indicators will check using Bartlett’s test of sphericity, which test the appropriateness of a principal component (Assefa, 2015). The next step, after we check the appropriateness of a principal component is extract the indicators. Kaiser’s criterion and screen plot will be used to check how many indicators normally we should keep (Field, 2009). This factor (indicator) extraction is important to get weights (loading) of the variables on the first component to use them in the food security index construction.

Finally, develop the food security index, after getting the indicators weight. This can be calculated mathematically:

\[ FS_{ik} = \sum_{1}^{n} w_j \left( \frac{V_{ji} - V_j}{S_j} \right) \]  

… (13)

Where \( FS_{ik} \) is the normalized food security index \( k \) (the overall index or index of each of the component) of country \( i \), \( w_j \) represents the weight of indicator \( j \), \( V_{ji} \) is the value of indicator \( j \), \( V_j \) and \( S_j \) denotes the mean and the standard deviation of indicator \( j \) respectively.
Finally, cluster analysis will be used to compare the result with principal component analysis. Cluster analysis will group households that have a similar characteristic among the food security indicators as expressed in the principal components. The number of clusters is from a minimum one to a maximum equal to the total number of households included in the sample.

REFERENCES


