

Article

## Effects of Large-Scale Acquisition on Food Insecurity in Sierra Leone

Genesis Tambang Yengoh <sup>1,\*</sup> and Frederick Ato Armah <sup>2</sup>

<sup>1</sup> Lund University Center for Sustainability Studies—LUCSUS, Fingatan 10, SE-22100 Lund, Sweden

<sup>2</sup> Frederick Ato Armah, Department of Geography, The University of Western Ontario, ON N6A 3K7, Canada; E-Mail: farmah@uwo.ca

\* Author to whom correspondence should be addressed; E-Mail: yengoh.genesis@lucsus.lu.se; Tel.: +46-46-222-0690.

Academic Editor: Marc A. Rosen

Received: 2 May 2015 / Accepted: 10 July 2015 / Published: 17 July 2015

---

**Abstract:** The recent phenomenon of large-scale acquisition of land for a variety of investment purposes has raised deep concerns over the food security, livelihood and socio-economic development of communities in many regions of the developing world. This study set out to investigate the food security outcomes of land acquisitions in northern Sierra Leone. Using a mixture of quantitative and qualitative research methods, the study measures the severity of food insecurity and hunger, compares the situation of food security before and after the onset of operations of a land investing company, analyzes the food security implications of producing own food *versus* depending on wage labour for household food needs, and evaluates initiatives put in place by the land investing company to mitigate its food insecurity footprint. Results show an increase in the severity of food insecurity and hunger. Household income from agricultural production has fallen. Employment by the land investing company is limited in terms of the number of people it employs relative to the population of communities in which it operates. Also, wages from employment by the company cannot meet the staple food needs of its employees. The programme that has been put in place by the company to mitigate its food insecurity footprint is failing because of a host of reasons that relate to organization and power relations. In conclusion, rural people are better off producing their own food than depending on the corporate structure of land investment companies. Governments should provide an enabling framework to accommodate this food security need, both in land investment operations that are ongoing and in those that are yet to operate.

**Keywords:** food security; livelihood; land acquisition; small-holders; Africa

---

## 1. Introduction

Large-scale land acquisitions (LSLA) in sub-Saharan Africa (SSA) have been characterized by controversies in many sectors of social, economic and cultural lives of populations in regions where these acquisitions have occurred. Some of the controversies that have been reported include cases of suppression of free speech and other forms of human rights [1,2], the alienation of local populations from decision making on land acquisitions, intimidation of local populations by local law enforcement bodies, and local populations being deprived of access to vital local natural resources [1,3–6]. Given the heavy dependence of most countries in sub-Saharan Africa on agriculture for a variety of social and economic reasons, and especially the almost complete reliance of rural populations on farming, it can arguably be stated that depriving rural communities of farming land (where it exists) is one of the most contentious of these controversies.

Even before the rush and competition to secure large tracts of fertile land in SSA that has characterized the last decade, some countries in the region were prone to food supply deficits [7] and nutritional emergencies of varying degrees during some months of the year. In many urban centers, the frequent increases in food prices had not always been adequately matched by increases in supply, mainly from the rural farming populations. While a majority of the rural populations depend on farming activities to meet their food and livelihood needs, it is common to note that each year, many households are trapped in the struggle to sustain their year-round food and nutrition needs [8]. When households are constantly engaged in such a struggle to feed themselves, they will tend to focus less on investments that can significantly boost farm production (in the short to medium term) and permit investment in the longer term [9].

The importance of assuring food and nutrition security for LSLA initiatives in regions where small-holder agriculture is the main activity should be of utmost priority. This is because the main economic and social activity of such communities (agriculture) directly determines their access to food and nutrition. They do not depend on income from other sources to meet their food needs, but on the land they cultivate and the labour they invest in the practice of agriculture. The desire to satisfy household food needs is prioritized by households engaged in small-holder agriculture above all else. The need to attain food security is not limited to only households engaged in small-holder agriculture in developing regions of the world. It is the most basic of human needs within a hierarchy of concerns and needs [10]. On the importance of food security as a fundamental human need, Hopkins (1986) argues that: “*food security stands as a fundamental need, basic to all human needs and the organization of social life. Access to necessary nutrients is fundamental, not only to life per se, but also to stable and enduring social order*” [10]. This importance does not change with the level of household or individual wealth. However, the means by which the food imperative is satisfied or food security is assured may vary depending on the types of personal, social, economic and even political assets of individual, households, communities, or countries.

Richards (2013) identifies the accumulation of information and data in recent years on more general attributes of LSLA such as size of area acquired and regions or countries involved. He however decries the limited information of specific attributes of LSLA such as the actual impacts on the ground—an attribute that can permit planners and other stakeholders to predict, avoid or mitigate negative impacts of the practice [3]. The main economic and social asset of small-holder agriculturalists in rural Sierra Leone is farmland, and agriculture is not only an economic activity, but a way of life as it is in many other rural communities in SSA. By acquiring land for large-scale monocultures, LSLA has the potential of affecting this way of life profoundly. Some of the effects are gender differentiated [11]. One of the most profound of these effects would be on food and nutrition security. Given the relative newness of the phenomenon of LSLA, there is still very limited formal knowledge on its implications at local level [12]. According to Rulli and D’Odorico [13], there is potential for positive outcomes of LSLA on food security. Through technology transfer, LSLAs can help close the large yield gaps that exist between actual and potential yields of major food crops in LSLA host regions [13]. Typically, however, most of the food produced from large-scale land investments are exported to non-host regions and countries [13].

This study will contribute to the development of specific and focused knowledge on the impacts of LSLA on food and nutrition security in rural communities of Northern Sierra Leone where LSLA has occurred. While results reported in this paper will focus on the food and nutrition security outcomes of LSLA on local communities, this paper represents the one in a series of papers that explores different social and economic outcomes of LSLA on local communities in different parts of Sierra Leone. Others have examined the gender implications of LSLA [11], as well as issues of land constraints and access to land resources [8]. The goal of this study is to examine the impacts of LSLA on the food and nutrition security of local communities in Sierra Leone. To achieve this goal, this study will attempt to answer the following questions:

- (1) What are the impacts on food and nutrition security where LSLA has occurred and how severe are they?
- (2) What is the income requirement for sustaining the security of staple food for rural Sierra Leonean households?
- (3) To what extent can income from wage employment in a local company support rural household food needs, compared to traditional practices of subsistence?

We begin with a background to the study area and an introduction to the large-scale land investment company (Addax Bioenergy) operating in the area. This is followed by a presentation of the position of major LSLA stakeholders in Sierra Leone on the approach to attaining food security. We discuss the methods used (the sampling routines, questionnaire design and administration, definition and measurement of food security, focus groups, and the use of income derived from food crop sales as a proxy for household food security). The results report the severity of food insecurity as well as major drivers of this outcome. The discussions explore the implications of the results from the local to the national level. This is also put within the context of the attainment of key objectives of Sierra Leone’s Second Poverty Reduction Strategy (food security, youth employment, socially dynamic and economically productive rural landscapes). I conclude with a summary of what may be done to mitigate/alleviate LSLA outcomes on food security.

## 2. Background

Sierra Leone is a small West African country with a population of about 6 million [14], and is one of the poorest and least developed countries in the world [15]. In 2011, the national poverty headcount ratio (proportion of the population below the poverty line) stood at about 53%, and life expectancy in 2012 was 45 years [14]. It ranked 183 out of 187 countries in 2013 in the Human Development Index of the United Nations Development Programme [16]. In the same light, its indicators on access to education, health, gender equality and many other vital human development statistics are quite modest [16]. In 2013, Sierra Leone's score on corruption perception was 30 out of 100, ranking it 119 of 177 countries [17]. The country's post-war recovery and development approach has been centered on a strategy outlined in the Agenda for Change, Poverty Reduction Strategy. The Second Poverty Reduction Strategy (PRSP-II), the Agenda for Change, prioritizes economic growth through a strong emphasis on agriculture, energy and the development of road infrastructure [18]. Effort is also being made to tackle the root causes of corruption and present the country as attractive to foreign investment [18,19]. The country has witnessed an increase in real GDP growth from 5% in 2010 to 5.7% in 2011. Real GDP growth was forecast at 14% in 2014 [19,20]. It must be noted however that most of this growth is driven by the extractives industries [19,20]. While the population living below the international poverty line of US\$1.25 per day is high, the majority of Sierra Leonean households rely on subsistence families for household food supply and for meeting a range of socio-economic demands. According to the Food and Agriculture Organization of the United Nations Organization, the hunger burden in Sierra Leone remains high in both absolute and relative terms [21]. A typical family's diet consists of rice, or cassava root, with leafy greens and beans, complemented by locally sourced fish, chicken, or "bushmeat" (a common name attributed to wild game). The palm oil commonly used in Sierra Leonean cuisine is generally produced locally from plots that tend to be reserved for economic trees.

### 2.1. Socio-Economic Background of the Study Area

The indigenous population of the study area is made up of the Temne, Fullah, Limba and the Mandingoes [22] who have had a long history of peaceful coexistence as well as socio-economic cooperation. Subsistence agriculture and limited pastoral farming has been the main economic activities here for many generations. The World Food Programme carried out a comprehensive study of the food situation in rural Sierra Leone in 2007 [23]. This study can provide a good basis for understanding the situation of food security in the areas affected by LSLA before the onset of operations of Addax Bioenergy. It can also contribute to an understanding of situations that may be prevalent in areas not currently affected by LSLA activities. The population of the Chiefdom of Makarie Gbanti is about 53,742 inhabitants, and that of Bombali Shebora about 88,674 inhabitants [22]. The average household sizes for the districts in which Addax Bioenergy operates were as follows: Bombali 11.4 and Tonkolili, 14.6 persons. Male-headed households were found to be 91% in Bombali and 90% in Tonkolili. Food crop production employed about 95% of the population of these rural areas in 2007 [23]. The main food crops cultivated are rice (of the upland, inland valley swamps (IVS) and other varieties), cassava, groundnuts, sweet potatoes and maize (Table 1).

**Table 1.** Percentage of households who cultivated food crops in 2006/2007 season by district [23].

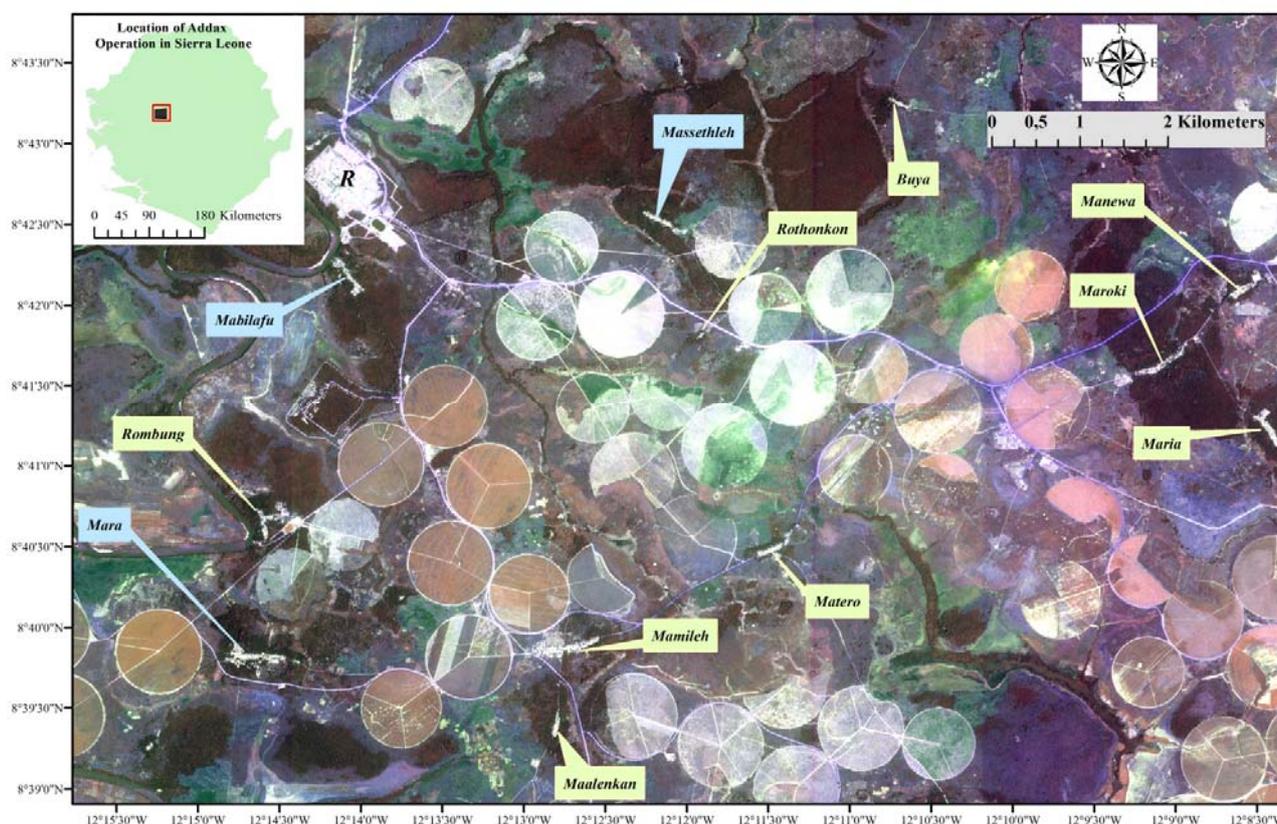
District	Rice [Upland]	Rice [IVS]	Rice [Others]	Cassava	Groundnuts	Sweet Potatoes	Maize
Bombali	69	68	7	38	33	10	1
Tonkolili	91	73	10	40	19	6	1
<i>Average</i>	80	70.5	8.5	39	26	8	1

Sierra Leone is made up of 19 districts. The Bombali and Tonkolili Districts are famed for their fertile soils and large contribution to national food staples. In the 2006/2007 farming season (before the onset of Addax Bioenergy land conversion operations), Bombali and Tonkolili Districts were producing a combined 13% (6% and 7%, respectively) of the national total production of upland rice (one of the main rice varieties consumed and sold in the country). Bombali and Tonkolili Districts were the highest producers of IVS and other lowland rice varieties in the country, accounting for 15% and 12% of national production, respectively [23]—a combined total of 27% of the national total in these districts where Addax currently operates. The production in the 2006/2007 farming season the study area represented increases of 74% (Bombali) and 51% (Tonkolili) from the 2004/2005 farming season. Such increases in the production of staple foods have been a common feature of major areas with high biophysical potential for food production in post-war Sierra Leone. Through this level of production, districts in Addax operating areas were able to sustain reasonable levels of self-sufficiency in staple food crops. In the 2006/2007 farming season, for example, Bombali and Tonkolili sustained a self-sufficiency level for staple foods of 94% and 92%, respectively [23].

## 2.2. Addax Bioenergy in Northern Sierra Leone

Addax Bioenergy is a subsidiary of the Swiss-based private investment group Addax & Oryx Group (AOG). In 2010, the company acquired lease rights for 50 years (with the possibility of a 21-year extension) to over 15,000 ha of land in Bombali District, Northern Province, Sierra Leone. The primary goal is to cultivate sugarcane for the production of bioethanol with targets of about 85,000 m<sup>3</sup> of bioethanol per year expected by end 2016. The project therefore consists of a sugarcane plantation, ethanol distillery, biomass power plant and related infrastructure. The project area is located in Northern Sierra Leone (Figure 1), about 15 km west of the town of Makeni in the districts of Bombali and Tonkolili. The Chiefdoms targeted for Addax operations are Makarie Gbanti and Bombali Shebora in the Bombali District and in the Chiefdom Malal Mara in the Tonkolili District. Famed for its fertile soils, this area is made up of gently undulating plains interspersed by inland valley swamps that are suitable for year-round cultivation of crops and vegetables. Many of these swamps (locally called *bolilands*) are tributaries of the main hydrological feature of the region, the Rokel River to the south.

A Partial View of Sections of Addax Bioenergy Installations in Northern Sierra Leone



**Figure 1.** Location of Addax Bioenergy operations in Sierra Leone and a partial view of installations. Some of the communities studied are in blue inset. Those in yellow indicate other communities in Addax operations area. Due to the wide area covered by the operations, they cannot all be contained in a single image while sustaining eligibility. The round circles are Addax Bioenergy’s sugarcane plots and R is the company’s ethanol refinery. The installations presented in this figure represents about a quarter of the total installations of Addax Bioenergy in this region. The satellite image was acquired by Digital Globe’s WorldView-2 on 8 January 2014 and new developments might have occurred as of date. Data was provided by the National Geospatial-Intelligence Agency and the National Aeronautics and Space Administration (NGA-NASA) (<http://cad4nasa.gsfc.nasa.gov>).

To acquire the vast quantities of land required for its operations, Addax Bioenergy used methods that have been described by many local community-based organizations, common initiative groups and farmers as controversial. Among the many issues associated with land acquisition for the operations of Addax Bioenergy are reports of lack of a proper consultation and transparency of land transactions, poor representation of local communities in meetings where decisions on land leases were made, insufficient compensation for land leases, insufficient compensation for the loss of important economic assets on the land that is leased (economic trees), corruption and intimidation of local people to sign land lease agreements [24–27]. It was estimated that the project (up to 2013) would have affected 13,617 people in 60 villages [28]. To reduce its negative footprint on the food production capacity and livelihoods of communities, the company instituted the Farmer Development Program (ActionAid 2013). The FDP is designed to last for only the first three of the 50 years of initial lease of community lands. The programme

focuses on the high input driven monoculture of rice instead of the traditional low external input polyculture of rice (the main staple) with a multitude of pulses, fruits and vegetables that support household food needs.

### 2.3. The Position of Major Stakeholders in Meeting Local Food Needs

While food insecurity is a global problem [29], the situation of food insecurity and hunger is especially dire in SSA [30]. The causes of food insecurity in SSA are many, including poor crop yields, post-harvest losses, weather conditions associated with climate change, agricultural pests, weak institutions, political instability [30–32]. LSLA is increasingly becoming one of the main factors affecting food security in regions where large-scale land appropriation has taken place. In such areas (Sierra Leone being an example), this implies that increasingly, the problems of pronounced gaps between actual and potential crop yields as main drivers of low food production in sub-Saharan Africa [33] are being compounded by a shrinking per capita land base for food crop production as a result of LSLA. The displacement of local peoples from indigenous lands and a reduction in their food production capacity as a result has been noted as potentially one of the most contentious outcomes in sub-Saharan Africa where hunger continues to be common place [12]. Interestingly, the loss of local land for food crop production to LSLA is being seen by some LSLA stakeholders as a means towards achieving food security in the communities and countries involved. This puts LSLA in the cross-hairs of debate on key paradigms of food security at the local and country levels.

#### 2.3.1. Food Security *versus* Food Sovereignty: Drawing from Insights in Sierra Leone

The conceptualization of what is necessary for the elimination of food insecurity and hunger is different between two sets of stakeholders in Sierra Leone: On the one hand, the government, local politicians, companies investing in LSLA and their international protagonists (hereafter non-local people); and on the other hand, local communities, community based common initiative groups and cooperatives, as well as their international partners (hereafter referred to as the local people).

Non-local people tend to adopt a food security perspective (based on the definition of food security put forward by the FAO (2010)) in relation to actions and policies towards eliminating food insecurity and hunger. According to the FAO (2010), “food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life”. The food security approach tends to be neo-liberal in addressing access to food and the elimination of hunger [34]. It is more concerned with the availability of food and less so with issues regarding the type of food, environmental issues associated with where the food is produced, and the socio-cultural context of food production, access and consumption. This approach to eliminating food insecurity and hunger fails to place access to food in the broad picture where it belongs. Food production, transport, storage, sale, consumption and waste management are all operating within a socio-cultural, economic and environmental context that cannot be ignored when looking for sustainable solutions to problems of food insecurity and hunger. Food security implies that local communities can rely on the global economy based on liberalized agricultural markets to address issues of food insecurity and hunger. It has long been established that the socio-economic and political realities of many developing countries cannot support such reliance [35]. Scholars such as Stephens

(2011) consider the recent and ongoing LSLAs as a response to the perfect storm of three recent crises experienced by the global economic system—the global financial crisis, the food crisis, and the energy crisis [36]. The answer to these pro-neoliberal economic failures tends to be green neoliberal capitalization of land and associated resources in developing countries [6,37]. Instead of addressing constraints to development in the local areas where there is potential land for food production, local peoples and their constraints are expected to reinvent themselves such as to fit in the casts of large-scale land investments. The food security concept is a convenient framework for the non-local people chiefly because it can be used to justify the appropriation of land and associated food production resources with reasons being: to increase productivity, provide employment, and meet other social and economic needs of rural livelihoods.

Local people tend to align with the food sovereignty perspective of eliminating food insecurity and hunger. The Declaration of the Forum for Food Sovereignty held in Nyéléni, Mali, 2007 provides a much broader concept in addressing food insecurity and hunger than food security [38]. It defined food sovereignty to encompass: “The right of peoples, communities, and countries to define their own agricultural, labour, fishing, food and land policies which are ecologically, socially, economically and culturally appropriate to their unique circumstances. It includes the true right to food and to produce food, which means that all people have the right to safe, nutritious and culturally appropriate food and to food-producing resources and the ability to sustain themselves and their societies. Food sovereignty means the primacy of people’s and community’s rights to food and food production, over trade concerns”. Food sovereignty therefore draws on bigger questions of environmental sustainability, social justice, the rights of farmers and indigenous communities to own and control their own resources, as well as make decisions on their choice of agricultural resource use and development [34,39]. In this context, the need to strive towards local control of food resources and food self-sufficiency override the perception of food production as a purely economic activity and food items purely as economic commodities. Given that rural areas in which LSLA occur are primarily agriculture-dependent communities, the loss of land to LSLA is therefore a loss of rights and access to a wide variety of resources which determine the structure and pace of life in these rural communities. LSLA has variously been described as an agenda to control local resources [2,5,37]. The control of land in such communities invariably comes with the power to determine the agenda of local development. This should explain why the tenets of food sovereignty are not palatable for non-local people.

### 2.3.2. The Right to Food

The perception of food production as a purely economic activity, and food items as essentially economic commodities is a neo-liberal approach on which the food security model of understanding problems of food insecurity and hunger is based. This approach of understanding and addressing problems of food insecurity and hunger is problematic at different levels and in many respects. One of the most important of these problems is that the need to address hunger is a universal, constant and compulsory obligation for everyone. The satisfaction of this need cannot be postponed indefinitely without significant implications for the health and lives of the individual or people involved. It is in this regard that the demand for food and the need to satisfy hunger is different from the demand for other commodities (for example, diamonds, or gold). This importance of food in human life has encouraged

others to explore a rights-based approach to understanding and addressing food insecurity and hunger. Accountability, participation and empowerment are vital elements which provide a human right base for food security or food sovereignty. Together, these elements provide a legal framework for the right to be free from food insecurity and hunger. According to Windfuhr and Jonsen [40], “*food security is more of a technical concept, and the right to food a legal one, food sovereignty is essentially a political concept.*” The rights-based principle comes with guidance on the design, implementation and approach to programmes and projects designed to address issues of food insecurity and hunger [41]. In Sierra Leone, civil society organizations such as the Sierra Leone Network on the Right to Food (SiLNoRF) advocate for a rights-based approach to addressing issues of food insecurity and hunger.

### 3. Methods

The study was carried out in two phases. An initial phase took place in October and November 2013, and consisted of a cross-sectional survey of land assets, access and use change in the study area (see Supplementary Material 1). The aim of this survey was to explore the outcomes of large-scale land acquisitions and investments on the social, economic and environmental conditions of areas where such processes occur in Sierra Leone. A second phase of the study took place in January and February 2014 and drew from results of the cross-sectional survey of October and November 2013. The goal of this phase of the study was to investigate some of the issues that emerged during the first phase of the study. One of such burning issues explored by this paper is the matter of food security.

#### 3.1. Selection of Communities for the Study

The main criteria for inclusion in this study was whether the community was hosting Addax Bioenergy large-scale land investments or not. The selection of communities was therefore random within the population of communities that host Addax Bioenergy operations.

Our study area is quite homogeneous based on the following characteristics:

- (1) It has a similar geographic situation in Northern Sierra Leone with similar agro-ecology;
- (2) It comprises of a single ethnic group—The *Temne* people whose language is also called *Temne*;
- (3) Agricultural production systems and patterns are uniform, with small-holder farm dominating food production;
- (4) Farming techniques tend to be basic and the primary goal of food production is for household consumption;
- (5) The level of dependence of local residents on some livestock, cash crops, fishing, forest resources and off-farm income activities to supplement household income and resources is the same;
- (6) It has a common system of land ownership where communal land is family-owned. The system of land inheritance is also similar where offspring demand from and get land from elders in their families.

The characteristics that govern our assessment of homogeneity in this study may differ slightly if this study were applied to the rest of Sierra Leone. While the study area is located in the savannah woodlands agro-ecological zone (occupying 32% of the country’s land area), there are four other main zones in the country, namely the rain forest; rainforest/savannah; grassland hills/mountains; and

mangrove/swamp/grassland coastal plains [42]. Besides the *Temne* ethnic group which occupies the area in which this study was carried out and constitute just over 31% of the population, there are many ethnic groups in Sierra Leone. The *Temne* and the *Mende* are the largest, together making up more than 60% of the population [43]. Other ethnic groups include the *Limba*, *Kono*, *Koranko*, *Fullah*, *Susu*, *Loko*, *Kissi*, *Mandingo*, *Creole*, and others [43,44]. The system of land ownership and tenure is not uniform nationwide. Communal land which is largely family-owned accounts for about 83% of land owned in all districts outside the Western Region which is the main urban center of Sierra Leone [45]. Rural land where all of the current LSLA occurs is therefore mainly communal land. It is important to note here that the system of land administration in Sierra Leone has (especially in recent years) been characterized by weaknesses that have raised questions and competing claims over land ownership and disputes over boundaries [46]. Notwithstanding the differences in agro-ecology nationwide and systems of land administration outside the western area, the sample used in this study can make the study applicable in other areas of Sierra Leone undergoing LSLA. This is because key aspects of land use, land tenure, and the role of agriculture in socio-economic life are similar for rural areas throughout Sierra Leone [44]. The low input agricultural system, characterized by small land holdings and poor land tenure that we find in our case studies are characteristics that are common in many rural settings across sub-Saharan Africa [47,48]. Lessons from the implications of LSLA in rural Sierra Leone can therefore serve to broadly inform and guide policy on the subject matter in other regions and countries in Africa.

Based on the generally even geographical situation, limited diversity in ethnicity and common socio-economic activities of the study area [18], we concluded that the affected population was reasonably uniform. Drawing on this conclusion, sample villages were selected for the study (Table 2).

**Table 2.** Communities studied and questionnaires administered. Yainkissa was used to pre-test questionnaires only.

Village	Main Survey	Focus Groups	Food Security Survey
Lungi Acre	92	Yes	
Mabilafu		Yes	42
Mara	170	Yes	47
Maronko		Yes	
Masethleh	90	Yes	40
Romaro		Yes	
Worreh Yeamah	90	Yes	
Yainkissa	For pre-testing questionnaires		
Total	442		129

With the aim of this study was to analyse the outcomes of Addax Bioenergy's operations on local communities, the first step in identifying communities of interest was to separate communities in which Addax is operating from those in which it is not. The communities to participate in the study were chosen based on being representative along the following criteria:

- (1) LSLA was ongoing, meaning that investment in sugarcane production and associated activities was already in progress
- (2) There were members of the community that were employed by Addax Bioenergy and these members were ready to participate in the research

- (3) The Farmer Development Programme (FDP) to support food production was already in place or members of the community had the opportunity to participate in this programme in locations outside their community
- (4) The community was accessible through a means of transport and members had accepted to work with the research team

Given that Addax Bioenergy started operations in these communities in 2010 (just three years ago), it was reasonable to assume that local residents (a vast majority of whom have lived most of their lives in these communities) were best suited to provide information on the changes that have been observed in the communities over this period. From the sub-group of interests, communities where data for the study would be derived were identified based on factors such as ease of access, availability of local facilitators for focus groups, length of time in interaction with Addax operations (with communities that have interacted with the company for longer periods being favoured). The result was four communities chosen from the Makari Gbanti Chiefdom in the Bombali District (Lungi Acre, Maronko, Romaro and Worreh Yeama) and three from the Malal Mara Chiefdom in the Tonkolilli District (Mabilafu, Mara and Massaethleh), see Table 2 and Figure 1.

### 3.2. *Contacts with Addax Bioenergy*

Despite intense efforts and repeated requests (written, via phone calls, and through other means), we were unable to obtain any information from Addax Bioenergy, an interview with any of its staff; permission to visit any of their facilities; any of the documentation of the procedures and outcomes of their activities. In written requests for the above, Addax Bioenergy was repeatedly urged to point to communities which could showcase the positive outcomes of their engagements in local communities where they operate to no avail.

### 3.3. *Study Design*

This study employed a before-and-after design. A before-and-after study measures particular characteristics of a population, group of individuals, or communities at the end of an event or intervention and compares them with those characteristics before the event or intervention. Before and after studies are carried out to examine an outcome after the implementation of a policy [49]. Before-and-after case studies can contribute to deepening the “understanding of aspects of the before period of the case study; identify the pivotal event(s); and clarify the changes in the after period” [50]. When properly implemented, a before and after study will demonstrate clear and consistent inclusion and exclusion criteria in subject selection. Similarly, connection between intervention and outcome will often be strengthened when observed changes are significant and occur soon after the intervention [49–51]. Before and after studies are generally considered to have lower internal validity than study designs in which outcomes in the intervention group are compared with outcomes of a group where intervention was not done (the control group). An important consideration to be made when undertaking before and after studies involves evaluating whether or not there is any evidence for a prevailing temporal trend that may confound study findings and explain the changes in the observed variables being studied [51]. Another important consideration for a before and after study is the absence of selection bias [51].

### 3.4. Questionnaire Administration and Analysis

Once the communities were identified, the number of households in that community was estimated using the most current data available from community-based organizations operating in the area. The number of questionnaires to be administered was decided based on the number of households in each community. A cross-sectional survey was carried out from October 2013 to November 2013 and from January 2014 to February 2014 in the selected communities. Structured data was derived from questionnaires administered to individual households by enumerators. The design of these questionnaires benefited from discussions with key stakeholders in the local communities, policy makers and civil society. Different sections of the questionnaire captured the personal information of respondents; data on household conditions; sources of income; land assets and use; the access to and use of land resources; issues of local development associated to LSLA; food security; and water.

Enumerators were trained on the administration of the questionnaire by the researchers in a workshop. The enumerators were drawn from the local community, they all spoke the local language (*Temne*), and had all lived in the local community for more than five years. During the training, enumerators were given the opportunity to review each of the questions in the questionnaire and urged to suggest modifications that would better reflect the local context as well as increase the clarity of questions when translated to the local language. Several terms were modified to reflect the local realities of the study area. Some questions were rephrased to make sense in translation to the local language. The questionnaires were pretested in Yankissa—One of the villages where LSLA has occurred. After the pre-tests, the questionnaire was further modified with suggestions from enumerators in a meeting. The questionnaires were eventually administered in the local language *Temne* in the respondents' homes. The questionnaires were administered to household heads. In this study, the household heads (for non-single families) are considered to be made up of the male and female heads of any household. Both members of the household were therefore eligible for questionnaire administration. Effort was made to have both partners present where there was more than one household head. A total of 442 questionnaires (Supplementary Material 1) were administered on land assets, access and use change.

To maximize the representativeness of the information derived from questionnaires, a systematic approach was adopted for administering the questionnaires in the first cross-sectional survey. Questionnaires were administered systematically from one homestead to the next until the community quota was attained. It was expected that abstentions and declines to participation in the questionnaire administration could make up for less than 20 percent of households in each community. To further maximize the chances of better representativeness of all facets of households in the community, enumerators were living in the communities during the duration of the questionnaire administration. This increased the chances of meeting and interviewing household members that were employed by Addax Bioenergy (since most of them left home early for work and returned to their homes late in the evening). The questionnaire administration for the second part of the study also followed the same methodology as the first—the use of a random systematic approach. In this case, however, instead of a systematic administration of questionnaires from one household to the next, every other household was chosen for the interviews. Given the general uniformity of the communities in social, economic and ethnic mix, we did not see any inherent bias with this sampling method. A total of 129 food security questionnaires were administered (Supplementary Material 2).

Given the skewed nature of the income distribution data, the Wilcoxon Signed Rank test is used to compare household incomes from food crop farming before and after the onset of Addax operations. Wilcoxon Signed Rank test is the nonparametric equivalent of the dependent (paired-samples) t-test. The requirements for this test are that: the two samples are dependent groups and that the attributes are measured at ordinal or continuous. The following hypotheses are used to test for the distribution of incomes from food crop farming before and after the onset of Addax operations:

$H_0$ : There is no difference in distribution of the two samples.

$H_a$ : There is a difference in distribution of the two samples.

Chi-square inferential statistics were used to evaluate the association/independence of the outcome variable (household food insecurity) and other theoretically relevant variables such as age, gender of respondent and farm size. To assess the effect size of chi square tests of independence, Cramer's V statistic was also computed. Jacob Cohen's benchmarks for small, medium, and large effect are used to evaluate effect size results [52]. A Cramer's V value  $<0.3$  is considered a small effect, a value  $>0.5$  is considered a large effect and an intermediate value is considered a medium effect.

### 3.5. Definition and Measurement of Household Food Security

Household food security in this research is conceptualized based on the definition put together by an expert working group of the American Institute of Nutrition, published in 1990 by the Life Sciences Research Office (LSRO) of the Federation of American Societies for Experimental Biology and reported in Bickel *et al.* [53]. It defined household food security as: "access by all people (of the household) at all times to enough food for an active, healthy life. Food security includes at a minimum: (1) the ready availability of nutritionally adequate and safe foods; and (2) an assured ability to acquire acceptable foods in socially acceptable ways (e.g., without resorting to emergency food supplies, scavenging, stealing, or other coping strategies)." Household food insecurity is therefore defined as: "Limited or uncertain availability of nutritionally adequate and safe foods or limited foods or limited or uncertain ability (for households) to acquire acceptable foods in socially acceptable ways" [53]. Hence, while we use the term food security, it does not indicate that we take a stand with the non-local perspective defined earlier on meeting local food needs.

#### 3.5.1. Measurement of the Severity of Food Insecurity and Hunger

The measurement of household food insecurity uses a modified version of the *Guide to Measuring Household Food Security* [53]. This guide is a revision of an initial framework developed in 1997—*Guide to Implementing the Core Food Security Module* [54]. The key modification of the Bickel (2000) assessment modules made to accommodate rural realities of food security in rural Sierra Leone involved mainly an incorporation of food access through own production (see Supplementary Material 1). The subsistence nature of food production in rural Sierra Leone made this modification necessary (while relatively unimportant in the United States context where a majority of food is derived through corporate food supply chains and networks). These modifications do however maintain the kinds of household conditions, events, behaviours and reactions that are assessed by the core module of questions indicated in Bickel *et al.* [53].

The use of behavioral markers to assess the severity of food insecurity has been shown to be more flexible in allowing room for less tangible factors that develop from the experience people use to describe their experiences [29,55]. The alternative to this subjective-qualitative approach is the use of objective-quantitative tools for food insecurity assessment whose measures are based on definitions of levels of poverty [56]. The objective-quantitative approach relies on a monetary measure of individual or household economic welfare indicators such as expenditure on goods and services, for which nutritional requirements are met or not met at given prices [29]. This approach has been criticized for being too theoretical, too focused on monetary values, and too remote from the *de facto* experience of extreme poverty and access to food and nutrition [29,56]. In this study, I use the subjective-qualitative approach to assess behavioral markers to assess the severity of food insecurity. Broadly speaking, the weights increase as households evolve from being merely concerned about the possibility of meeting basic food needs (the lowest level—smallest weight) to cases where even children begin starving (the highest level—largest weight) (Table 3).

**Table 3.** Weighting of questions according to household reactions and subjective responses to the severity of food insecurity.

Level	Household conditions and reactions	Applicable Questions *	Weight %
1	Anxiety that the household food supply may be insufficient to meet basic needs	2; 3	3
2	The experience of running out of food, without alternatives to obtain more	4; 5	3.5
3	Perceptions that the food eaten by household members was inadequate in quality or quantity	6; 7; 12	4.5
4	Adjustments to normal food use, substituting fewer and cheaper foods than usual;	8; 9; 9a; 10	5
5	Incidences of reduced food consumption by adults in the household, or consequences of reduced intake such as the physical sensation of hunger or loss of weight	11; 13; 13a	6
6	Instances of reduced food consumption or consequences of reduced consumption, for children in the household	14; 15; 15a; 16; 17	7

\* Questions in the questionnaire that address different household conditions to which the different weights are attributed.

The questions are weighted based on the behavioral response of households on cases of food insecurity over the last 12 months (see weighting scale in Table 3). During the past 12 months for which experiences of food insecurity were examined, there have been no reported disruptions to food production in the study area (such as drought, floods, large-scale invasion by pests, other natural disruptions, civil strife or other human disruption to food production) apart from the changes in land access and use resulting from the presence of Addax operations. Bickel *et al.* [53] outlined six main household conditions that households are likely to experience which correspond to degree of severity of food insecurity. When food insecurity sets into a household, the first general response is a decrease in the quantity and quality of food consumed by the household (as a whole). Hence, positive responses to these questions give an indication of the onset of food insecurity. As food insecurity progresses, adult

members of the family will start reducing their intake and even forgoing consumption at certain times of the day (higher weights for questions associated with this behavior in households). By the time it is most acute, children will start missing food (the highest weights on questions that affirm children experiencing decline in food intake or missing food). These levels (with few modifications) were reported in the study area (Table 3). The weights of the severity of household food insecurity reflect these levels. The severity of food insecurity for each household is the weighted sum of responses for individual questions, expressed as a fraction of the weighted sum of positive responses for each of the questions. The depth (severity) of food insecurity is presented as scores in a range of severity (Table 4).

**Table 4.** Categories of severity of food insecurity for individual households.

Score	Food Security Status Level (Severity Ranges)
9.0–10	Food secure
7.0–8.9	Food insecure without hunger
5.0–6.9	Food insecure with hunger—moderate
3.1–4.9	Food insecure with hunger—high
<3	Food insecure with hunger—severe

### 3.5.2. Using Household Income and Size of Income Earners as Food Security Proxies

A number of studies have recognized that small-scale farmers tend to sell food crops only after meeting household food needs [57–60]. Fafchamps (1992) noted that even when it comes to the allocation of land for cash crop farming, the tendency is that households will tend to prioritize their food security [61]. Only when this food security is guaranteed will farmers look to investments in cash crop production [61]. The attainment of basic food security as a foundation for planning and strategizing on medium to long-term livelihood developments has been described by Olsson and Jerneck (2012) as the “food imperative”. Food imperative is defined as “as the state of a person's mind in which acquiring food for yourself and your household is a constant superordinate priority that cannot be postponed in favor of other goals, such as the planning and financing of short-term production oriented experiments or long-term changes in your livelihood” [9]. For communities in high dependence in food crop production for their household food needs and for income to meet other socio-economic imperatives, income derived from the sale of food surpluses after meeting household food needs can therefore be used as a proxy for the extent to which households are food secure. Higher incomes from food crop production would indicate more food production, drawing from the supposition that the household has met household food needs and still been able to raise such income from surpluses. Lower incomes or a shift to no income from food crop production would indicate the opposite.

More than 95% of persons in these communities depend solely on agriculture as a means of livelihood [23]. Being primarily subsistence, these households tend to sell food crops only after household food needs have been assured. The amount of money they make from agriculture can therefore be used as an indicator of the extent to which they have met household food needs and remain comfortable to seek financial income for other household livelihood needs. To compare the situation of this indicator before and after the onset of operations of Addax Bioenergy, a detailed summary of

descriptive statistics of reported household income from the sale of food crops for the two periods before the onset of Addax operation and the present is performed Figure 3a,b.

One of the key arguments for conversion of local small-holder farmlands to large-scale company-owned biofuel monocultures is the potential for local employment that such initiatives stand to offer [8]. This calls for a comparison of the number of people employed as well and the income level of wage level employment by the Addax Bioenergy with the number of people employed and the income derived by local households in their own agricultural activities. By presenting the outlines of multiple histograms of these income from these activities on the same graph, the frequency distribution of household earnings from food crop farming before and after the onset of operations of Addax Bioenergy are compared with household earning from employment by the company (Figure 3).

### 3.6. Focus Groups

Focus groups were held in villages where questionnaires were administered. Through the analysis of secondary sources on LSLA as well as initial consultations with local community and local civil societies, a number of key themes (“burning issues”) were identified as potential themes for focus group sessions. These themes included the outcomes of LSLA on: gender (particularly women’s issues); youth and employment; as well as on the outcomes of LSLA on environmental resources. Food security was a cross-cutting theme across all focus groups. These themes were proposed to the group of enumerators for their inputs during the revision of the questionnaires after pre-testing. The focus groups in each community were organized by a local resource person. After the initial introductions of the research team, objectives and expected outcomes, local residents taking part in the sessions would divide into groups according to the different themes of the focus groups. Permission was requested from the members of each focus group to use voice recorders. These recordings were later transcribed to English by native *Temne* speakers with proficiency in the English language.

### 3.7. Calculating Household Income Requirements for Security in Staple Food

In other words, such a calculation will answer the question: To what extent will average earnings from employment by Addax Bioenergy meet the needs of household supply of Sierra Leone’s staple food (white polished rice)? The average consumption of rice per person and the cost of rice at current market prices is derived from local residents in focus groups. Together with data on average household (HH) size for rural Sierra Leone from a secondary source [23], the annual cost of sustaining a household on the staple food of the region is computed (at current local market prices).

With an average household size of 10 persons [23] and average consumption of polished rice (inclusive of the extra for visitors) of 0.4 kg/person, the average daily consumption per household (HH) will be  $10 \text{ persons/HH} \times 0.4 \text{ kg/person/day} = 4 \text{ kg/HH/day}$ .

The average annual consumption will therefore be  $4 \text{ kg/HH/day} \times 365 \text{ days/year} = 1460 \text{ kg/HH/year}$ . In bags (the standard measure of large-scale rice purchase) annual HH consumption will be  $1460 \text{ kg/HH/year} / 50 \text{ kg/bag} = 29.2 \text{ bags/year}$ .

The market price per bag of rice at the time of this study (November 2013–February 2014) was 130,000 SLL. Hence, annual consumption of rice per average household would be  $29.2 \text{ bags/year} \times 130,000 \text{ SLL} = 3,796,000 \text{ SLL}$ , ( $1\$ = 4350 \text{ SLL}$ ).

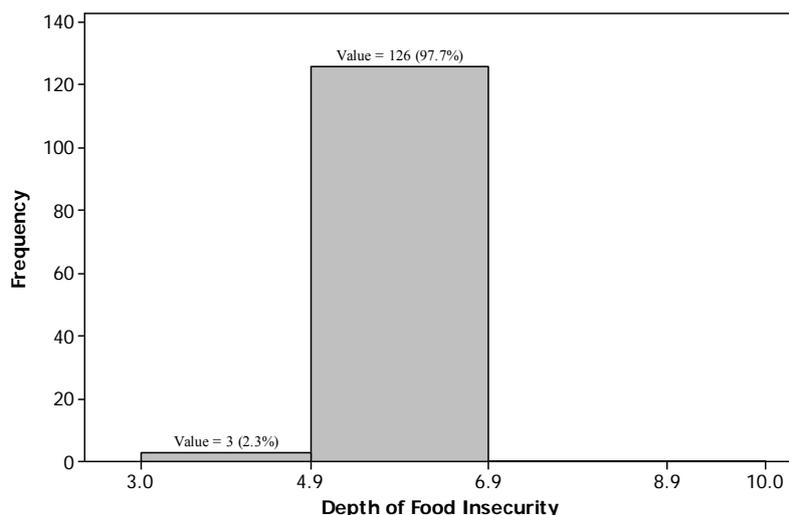
## 4. Results

Household food security was associated with geographical location (village of residence). For this association, Pearson  $\chi^2$  is 110.457 at  $\alpha < 0.0001$ . Cramér's V is 0.654 indicating the effect size of the association is strong. Farm size was also associated with geographical location (village of residence) where Pearson  $\chi^2$  is 49.723 at  $\alpha < 0.0001$ . Cramér's V for the association of farm size and geographical location is 0.439 indicating the effect size of the association is medium. Household food security was however, not associated with gender since Pearson  $\chi^2$  is 26.617 at  $\alpha > 0.05$ . The effect size was medium as Cramér's V was 0.454. Similarly, Age and farm size were each not associated with household food security.

### 4.1. The Severity of Food Insecurity and Hunger

The severity of hunger calculated for the study area is presented in Figure 2. In total, 97.7% of the population falls under the category of being food insecure with hunger—moderate. This is lower than the two better categories of food security (see Table 4). The meaning of this level of food security was derived from focus groups—on questions relating to household food consumption and security concerns. This level of food insecurity is characterized by more regular (up to five days a week) reduced food intake by adults. In all of the communities studied, lower variety of foods consumed by households is reported as well as the absence of buffers of stocks of pulses such as groundnuts and beans to last throughout the year. The number of hunger months in all the communities studied has increased from about three before the onset of Addax activities to about eight currently. Hunger months are months within the year (they used to occur generally after planting of the staple crop, rice) when farmers are waiting for the staple crop to mature. While farmers awaited their rice crop to mature, they depended on other non-staples such as cassava, yams, potatoes and a host of vegetables. Access to these food crops has been seriously jeopardized following land acquisition. A woman in a focus group in Worreh Yeama comments on the changes observed since the onset of Addax operations: “I was farming rice with other tuber crops. The produce was too much to be kept for ourselves so we sent some to our brothers and sisters in the city. I processed gari [a local flour produced from grated cassava] to send the children to school. ... I am suffering now, always hungry. My children have been sent out of school because I cannot pay their fees”.

Just over 2% of the population falls in the *food insecure with hunger—high* category of food insecurity. In this category of food insecurity, besides the characteristics of the other 97.7% of the population, it also features more effects on food insecurity on children. Hence, besides consuming food of lower variety as the rest of the household, children begin having food portions rationed because of falling supplies. In focus groups, respondents were keen to point out that the situation is likely to get worse as Addax phases out the Farmer Development Programme (FDP). Farmers claim that they moved from a situation of *food security* before the onset of Addax activities to the current situation of *food insecurity with hunger—moderate*, and will potentially move to *food insecurity with hunger (high and severe)* when the FDP activities phase out this year. Over 97% of the households fall in this category of *food insecurity with hunger—moderate* (Figure 2). The place of the FDP in the question of food security in areas of Addax operations is discussed further ahead.



**Figure 2.** The number of households falling within different ranges of the severity of food insecurity scale. (N = 129).

4.2. Change in Food Security since the Onset of Addax Operations

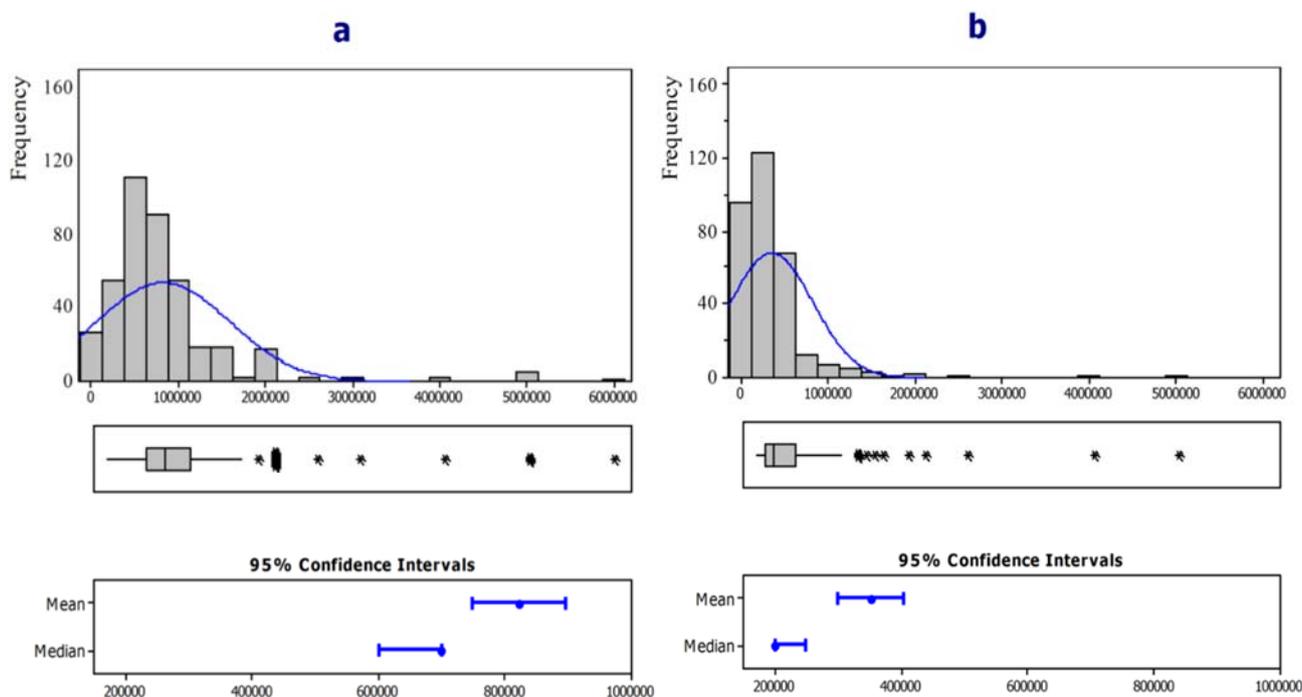
Table 5 shows results of the Wilcoxon signed-rank (Two-tailed) test. As the computed *p*-value is lower than the significance level  $\alpha = 0.05$ , we reject the null hypothesis  $H_0$ , and accept the alternative hypothesis  $H_a$ . The risk to reject the null hypothesis  $H_0$  while it is true is lower than 0.01%.

**Table 5.** Results of the Wilcoxon Signed Rank test is used to compare household incomes from food crop farming before and after the onset of Addax operations. *W* denotes the value or magnitude of the sum of ranks of the group with the smaller sample size and *Z*, the test statistic for the two sample procedure.

Statistic	Value
<i>V</i>	77,537,500
<i>Expected value</i>	39,900,000
<i>Variance (V)</i>	5,307,473,125
<i>p-value (Two-tailed)</i>	<0.0001
<i>alpha</i>	0.05

Figure 3 represents descriptive statistics of reported household income from food crop production (combined for all communities studied) before the onset of operations of Addax Bioenergy (a) and at the time of the study (indicated as the present (b)). The number of households practicing food crop production of any kind has fallen from 405 to 320 since the onset of Addax operations in the study area. It must be noted that within the 320 households still practicing agriculture, there are those that have had to seek new agricultural lands in different chiefdoms that have not yet been affected by LSLA. The new arrangements of seeking farms in other chiefdoms or communities are characterized by longer distances to farms, seasonal arrangements with new landowners, inability to make long-term investments on crop production, limited ability to grow off-season food items (such as vegetables), *etc.* There is a marked drop in the mean and median household income over these two periods. The strong skew and small variance at present (relative to the period before the onset of Addax operations) also indicate that people

tend to derive less income from food crop farming than they used to do prior to the onset of activities of Addax Bioenergy.



**Figure 3.** Descriptive statistics of household income from food crop farming for communities where Addax operates in the Makeni District (a) = before the onset of Addax operations; (b) = at present. The x-axis represents household income in SLL (1 \$ = 4350 SLL).

The positive skewness of greater than 3 before the onset of Addax operations and at present indicate long-tailedness of income distributions to the right (Figure 3). There is a higher frequency of lower income bins (Figure 3). However, the skewness of income distribution has changed from 3.47, before the onset of Addax operations to 5.38 at present, indicating a greater concentration of households in the lower ends of the distribution of farm income.

#### 4.3. The Land Investment Company Employs Few People and Its Low Wages Cannot Meet Food Security Needs

It can readily be assumed that the drop in the number of people deriving income from food crop production may be matched by more people deriving higher incomes from being employed by Addax Bioenergy in its operations in the community. This assumption is plausible because one of the key reasons being advanced by the national government, local politicians in favour of LSLA, Addax Bioenergy and its protagonists, and other proponents of LSLIs in the community is that such investments are there to create jobs and raise local incomes. This is not however the case for a number of reasons that were derived during focus group sessions. Primarily, the number of people employed by Addax Bioenergy is very few to meaningfully and positively affect local incomes beyond the few households with members employed in high positions by the company. Secondly, the salaries paid by Addax Bioenergy to the unskilled labour offered by a vast majority of those employed by the company, are quite small. These labourers claim daily wages of 10,000 SLL (approximately USD 2) for a 10 h

minimum work day, as well as arbitrary deductions of wages by payment officers of the company. They also claim that a majority of the workers employed are for seasonal tasks (with contracts generally ranging from three to six months), in which employees are never sure of when and if they will have another opportunity to work. That the monthly salary of an individual cannot sustain the food needs for an average household is a point that never ceases to be stressed at every opportunity in focus groups.

Table 6 shows the frequency of annual reported household earnings from food crop farming (before and after the onset of operations of Addax Bioenergy) and from people employed by Addax Bioenergy. The annual reported on employment by Addax Bioenergy in Table 6 is based on the assumption of year-round employment. Respondents tend to be employed on three to six months contracts. Annual income from Addax employment is approximately 3 million SLL. This translates to about USD 50 per month for the income earner when employed year-round. At the level of the community, the question of how many people are employed by the company also becomes relevant (Table 7). While the mean income from food crop and cash crop farming is lower than that of employment with the company (Table 6), farming activities employed more than 11 times more people than the company. A youth in a focus group in Lungi Acre observed: “Before Addax came to the community, we as youth would be all occupied in crop cultivation in the farms. Others will be out hunting or fishing. You would not have been able to meet people idling at home at about this time of the day”. In the same light, a women’s focus group participant remarks: “... right now we are really suffering. We went to find a job at the company [Addax] but they refused to employ us [me and my husband]. We have no way to get food now. Sometimes we go to bed without food”.

In relation to the incomes reported for different livelihood activities, income reported from food crop sales is income that is derived after household needs of food have been met, while income from company employment is income prior to food purchases. Respondents employed by the company were keen to stress that while the work could not support annual household food needs, it left no opportunity for workers to undertake any other economic activities either inside or outside the community.

**Table 6.** Income (in SLL) reported for major livelihood activities in the study area. FCF\_BEF is food crop income before the onset of Addax operations, FCF\_PRES is current income from food crop farming, CCF\_BEF is income from cash crop production before the onset of Addax operations, CCF\_PRES is current income from cash crop farming, PPT\_BEF is income from petty trading before the onset of Addax operations, PPT\_PRES is current income from petty trading, Company is income from company employment. (N = 442 and 1\$ = 4350 SLL).

Variable	N	Mean	SE Mean	St. Dev	Minimum	Median	Maximum
FCF_BEF	405	821,728	37,639	757,474	15,000	700,000	6,000,000
FCF_PRES	320	352,291	26,366	471,649	10,000	200,000	5,000,000
CCF_BEF	10	352,291	92,195	291,548	200,000	500,000	1,000,000
CCF_PRES	2	350,000	100,000	141,421	100,000	200,000	300,000
PTT_BEF	50	200,000	44,809	316,844	20,000	450,000	1,500,000
PTT_PRES	60	458,083	59,244	458,899	15,000	335,000	3,000,000
Company	38	3,067,211	204,713	1,261,937	350,000	3,600,000	6,000,000

**Table 7.** Number of respondents employed in major livelihood activities and changes observed since the onset of Addax operations. When land is available, the practice of more than one activity is common in many households—for example, having a cash crop farm and a food crop farm. (N = 442).

Activity	Period	Females	Males	% Change in Locals Practicing	
				Females	Males
Food Crop Farming	Before 2008	209	196		
	During Addax Operations	166	154	−20.6	−21.4
Cash Crop Farming	Before 2008	2	8		
	During Addax Operations	2	0	0	−100
Petty Trading	Before 2008	35	15		
	During Addax Operations	41	19	17.1	26.7
Company Employment	Addax Employment (Current)	8	30		

Notwithstanding, they had to work because they had no other means of supporting their families. From a food security standpoint, the employed labourers have to depend completely on their income for the purchase of food which they are keen to stress is grossly insufficient. The reported income derived from food crops can be seen as a production surplus for local households. In other words, income from crops sold after household food needs have been met. This is confirmed by farmers in focus groups. It also builds on a well-established observation that the meeting of household food needs tends to take priority over selling of farm produce for most small-scale farming households [62].

When given the chance to agree or disagree on comments regarding their food security before and after the onset of operations of Addax Bioenergy, respondents clearly pointed to a deteriorating trend on the amount and variety of food available to their households (Table 8). These comments illustrate the falling potential for households to access food in quantity and variety, either by producing it themselves (the traditional means of accessing food that prevailed before the onset of Addax operations) or by buying (the expected means that was supposed to come about when local residents earn income from being employed by the new, main land user in their communities).

**Table 8.** Opinion on the situation of food security before the onset of Addax Bioenergy operations and at present (N = 442).

Statement of Food Production Situation	No	Yes
We now produce more food than we used to	427 (96.6%)	15 (3.4%)
We now have more diversified food items than we used to	438 (99.1%)	4 (0.9%)
We now produce less food than we used to	26 (5.9%)	416 (94.1%)
The variety of crops we produce has fallen	114 (32.6%)	298 (67.4%)

Note: 11 respondents answered “No” to “We now produce more food than we used to” as well as “No” to “We now produce less food than we used to” indicating that their food production status had not changed since the onset of Addax operations. Responses are presented as: Frequency (Percentage).

#### 4.4. Farmers Are Better off Producing Their Own Food than Being Employed

The food security situation of respondents who were employed by Addax bioenergy can be put within the context of their annual earnings from employment by the company (reported in Table 6). The annual cost (calculated based on market prices during the study) of the main staple food to support an average family in the study area is 3,796,000 SLL. Being the cost of staples solely, this cost does not cover the cost of a host of other associated needs for healthy food and nutrition security required by local households. A few of these costs reported in focus groups include: vegetable to prepare local soups and sauces that are eaten with rice; cooking oil and other condiments; fish, meat and/or local beans that accompany almost all soups and serve as protein sources; other non-rice food stuffs such as cassava, yams, groundnuts, sweet potato, cashew nuts, *etc.* that supplement the rice staple and offer nutritional variety; and firewood for cooking.

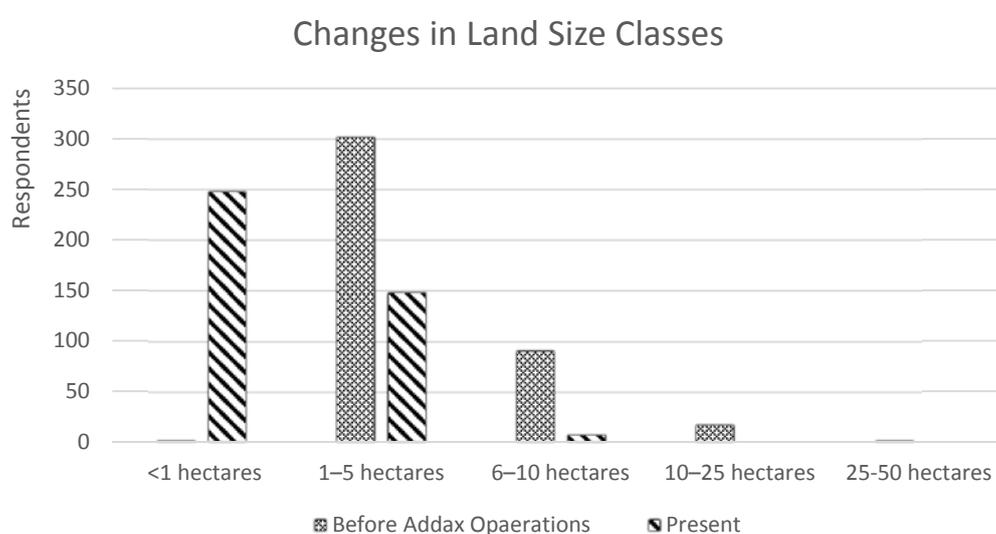
To put food needs beyond cost of the staple crop in context, the WFP [23] computed expenditures on food items in rural communities of Sierra Leone and reported mean household expenditures to stand at 169,706 SLL/month. Hence, an annual cost requirement of 2,036,472 SLL for families already producing most of their staple food needs. This cost, the study outlines, is for communities in which as much as 97 percent of the population are active farmers (engaged in producing much of their own staple food). Based on the above reported cost, it can be estimated that for households whose land is no longer available to support food production, an annual income of approximately 5,832,472 SLL (meaning: 3,796,000 SLL for staple food crop + 2,036,472 SLL for additional food requirement) would be required to support household food security only. This translates to about 486,039 SLL (or about USD 112) monthly. The income reported by a majority of respondents under Addax employment is 230,000 SLL (about USD 53) monthly which is expected to cover household food and all other livelihood expenses.

#### 4.5. Access to Land is a Constraint to Food Crop Production and Food Security

Prior to the onset of Addax activities, a profile of the Bombali District [22] reported that 93.5% of people were employed in crop farming (89% males and 97.3% females) [22]. According to this survey, a total of 1.1% of the population was looking for work—technically unemployed [22]. At full operation, Addax will be able to provide “*employment for approximately 2200 permanent and 2500 seasonal workers locally*” [63]. The population of the chiefdoms directly implicated in the project is 142,416 persons [63]. According to the environmental, social and health impact study of Addax Bioenergy [63], prior to the onset of activities of the company, 1.4% of the population cultivated <1 acre (0.4 hectare), 33.8% cultivated 1–5 acres (0.4 to 2 hectares), 50.7% of the population cultivated 5 to 20 acres (2 to 8 hectares), and 10% cultivated >20 acres (>8 hectares) of farmland during the rainy season (the main farming season of the study area).

One of the main reasons behind the fall in the total amount of food produced by participants has been the loss of land resulting from LSLA. Figure 4 shows that prior to the onset of Addax operations, a majority of the respondents (65.8%) had farming lands ranging in size from 1 to 5 hectares, while less than 0.5% had farming land of less than 1 hectare. Currently, the number of respondents with farming land of 1 to 5 hectares has fallen to 33.7% while the number of people with land sizes of less than 1 hectare has increased to 56.3%. With an average of 10 persons per household [23] and an average

consumption of 0.4 kg of polished rice per person (inclusive of the extra required for visitors), the average daily consumption per household of rice will be:  $10 \text{ persons/HH} \times 0.4 \text{ kg/person/day} = 4 \text{ kg/HH/day}$ . This translates to an annual consumption of  $4 \text{ kg/HH/day} \times 365 \text{ days/year} = 1460 \text{ kg/HH/year}$ . The average yield of polished rice in Sierra Leone is 352 kg/acre. Hence, the acreage required to produce 1460 kg/HH/year is  $1460 \text{ kg/HH/year} / 352 \text{ kg/acre} = 4.15 \text{ acres/HH/year}$  (about 1.68 hectares/HH/year). This estimate indicates that over 56% of respondents are unable to produce their own food because they lack sufficient land to do so. Reflecting on access to farming land, a focus group participant in Lungi Acre stated: “Addax has taken all of the land. If you have to work on any land here, you have to take permission from Addax. When they plant their sugarcane in the next few years, there will be no land even to beg from them”.



**Figure 4.** Changes in the size of land owned by respondents (N = 442).

While the techniques and technologies of farming and food production were basic, participants in focus groups claim that they were able to feed themselves year-round. These communities were major producers of the staple food crop of Sierra Leone prior to the acquisition of land for large-scale investment. In the 2006/2007 crop production season, for example, Bombali District produced over 15,200 metric tons (15% on national production) of lowland rice, the second highest producer in the country after Kambia District which produced 16%. In the same year Tonkolili District produced 12% of the country’s total, ranking fourth in national production [23]. Evidence of this food self-sufficiency is illustrated in a number of changes which participants identify as having occurred in their communities over the last three years. Some of the main changes reported include:

- i. During the rice farming season, the food that was eaten while the farming activities were going on was rice from the previous year’s harvest. This means that harvests generally sustained families year-round.
- ii. Some vegetables such as cassava leaves and sweet potato leaves (key food vegetables in the Sierra Leonean diet) were never sold in the communities. This is because it was very common to find

these vegetables—there were sufficient places for farming them. Presently, if you do not have a garden of your own, you will be forced to pay for these vegetables.

- iii. There has been a serious drop in the variety of food crops available for households. As households struggle to meet the need for basic staples, prospects of a diversified food basket are ever unlikely.

#### 4.6. Farmer Development Programme (FDP) Is not Contributing to Food Security

The FDP has been publicized as a flagship programme for mitigating against the food security impacts of Addax operations. This programme had two main divisions: one division involved the cultivation and seeding of rice fields on behalf of affected villages; and the other, the training of farmers in Farmer Field & Life Schools (FFLSs). The land being used for the FDP is land that has been acquired from the communities in question. Each community is then allocated a plot of land to grow rice. It must be noted that individuals or the communities do not have the right to decide how much land they cultivate on these plots, what they grow, when they should perform different agricultural activities, *etc.* A farmer who has been registered in the FDP does not own or control the land he/she is allocated. It is land that has been acquired from the communities and is currently under Addax control. The fields are commonly ploughed, seeded, and fertilized by Addax. Addax decides how the fields will be allocated to people registered in the FDP. Farmers will not return to the same fields from one year to another. All of these are decided and controlled by Addax. In the first year, Addax provided inputs (such as ground preparation and fertilizers) to the cultivation of rice on plots allocated to individuals. In subsequent years, individuals have had to repay for these inputs. The repayment is in the form of rice crop after harvest (Figure 5). Addax controls all activities on the plots and organizes harvest days during which its staff will be on hand to monitor the harvest and take what they consider to be the equivalent of their inputs in harvested rice.



**Figure 5.** Rice is being weighed in Maroki to repay for Addax services (Photo Credits: Lansana Sowa).

During focus groups, locals have stated that the FDP has not contributed to the food security of their households or the communities as promised. A focus group participant observed regarding the FDP: “The FDP has not solved the food security situation during these last three years. ... now, we thought they will be improving with time. But they say the programme is ending now, even though they will be here for fifty years”. They raise a number of criticisms of the rice production component of the programme:

- i. Over the years, a number of agricultural activities necessary to achieve optimal yields have not been timely. Examples include the late ploughing, harrowing and seeding in 2010 that affected harvests of rice in communities such as Lungi Acre, Romaro, Yainkissa, and Worreh Yeama.
- ii. Addax staffs managing the FDP adopt a high-handed approach which limits the ability for locals to contribute with advice on many agricultural issues that the staff are ignorant. Examples cited include the use of poorly adapted seeds for some local soils and the use of inappropriate planting techniques for ill-suited ecologies (“broadcasting” rice as a means of planting when they should be transplanting).
- iii. The land set aside for the FDP is not amongst the fertile plots of land acquired by Addax from the communities. In Many communities (for example, Lungi Acre and Woreh Yeama) the fertile prices of land appropriated by Addax is under sugarcane cultivation, not for food crop cultivation.
- iv. Addax planned to phase out support for farmers in “a sliding scale whereby Addax is increasingly recompensed by residents for its inputs” [64]. The complete phase out of this support has been realized in just three years, even though the lease period for the land Addax has acquired is 50 years. Locals are asking why their lands should continue to be under occupation for 50 years while support for agriculture is for just three.
- v. The claim by Addax and reports in favour of its operations that what is taken as recompense for inputs is “surplus” yield [64] from what is needed to meet the food security of locals is vehemently rejected in focus groups. Locals claim that during the harvest days (when Addax staff come to collect the equivalence of their inputs in ploughing and seeding), no mention or consideration is given to household food security needs.
- vi. The FDP focuses on rice production, but this is grossly insufficient to ensure adequate food and nutrition security, even if the yields were optimal. The acquisition of land has limited access to a host of food items that accompanied rice and food items in the local area. Besides food items, associated resources required to ensure food and nutrition (such as firewood, bushmeat, fish) have become commodities that most people have to buy, instead of harvesting from their own forests and lands.

The second arm of the FDP involves the training of farmers in Farmer Field & Life Schools (FFLSs). This venture marketed to be a resource for farmers to not only learn about improved agricultural techniques, but also about “life skills” such as community savings and loans, health, literacy and numeracy [64]. While Addax and its protagonists believed this to be “the largest independent agricultural programme in Sierra Leone” with dreams of “how the FDP might develop into a fully self-sustaining agricultural project operating within the context of the Government of Sierra Leone’s agricultural policy”, this arm of the FDP is also coming under very serious criticisms in local communities where Addax operates. Two of the main criticisms raised in focus groups are:

- i. Principally, trainees from the FFLSs do not have land to put into practice the knowledge gained from FFLS training. The acute lack of farmland in most of the communities that have been affected by LSLA puts into question the utility of training people to practice agriculture.
- ii. The skills being imparted in these training sessions are geared towards agricultural intensification using high levels of external inputs. This is not necessarily compatible with a population that does not have the economic capacity to access the tools and inputs required for this form of agriculture. Agriculture in these communities has been supported by low external input strategies.

Evidence of the shortcomings of the FDP can be seen in communities where Addax operates. For example, whole communities (such as Yainkissa) have opted out of the programme, citing its unfairness of the programme and its inability to meet the outcomes being professed. In Yainkissa as well as other communities, people express their shock at how much is being reported to be spent on the FDP—claiming that such amounts are grossly over-exaggerated. Individuals in other communities were voicing their intention (during the focus groups) of not participating in the programme in the future. In 2013, more than 150 farmers were prevented from continuing in the FDP because they were unable to pay back the cost of ploughing and seeds to Addax [27]. The food security of households supported by these farmers will therefore be in serious jeopardy if they do not have land on which to engage in production, using the techniques, inputs and tools that have supported them in the past. Locals specified that the number of hunger months have not only increased from three (July to September) to eight (February to September), but also deepened in severity.

## 5. Discussion

The operations of Addax Bioenergy in Northern Sierra Leone have led to a reduction in the amount of land available for food production (Figure 4). This reduction has led about 56% of the population of the study area having land that is not enough to produce enough food to support household food security. The loss of land has led to a fall in the total population engaged in agriculture (Table 7) as well as the total output from food crop farming, reflected in household income generated by the activity (Table 6). At the local level, this fall in food production has increased the severity of food insecurity, which is manifested through a decrease in the amount and diversity of food intake, and increase in the number of hunger months, increase in food prices and decrease in the contribution of agricultural income on the livelihoods of households. At the country level, activities of LSLA such as the case of Addax Bioenergy serve to roll back progress towards attaining some of the country's key development objectives. The attainment of food security, rural employment, and assured access of local communities to land and other natural resources are among the key tenets of the Government of Sierra Leone's Second Poverty Reduction Strategy (PRSP-II) [18].

Concerns regarding the prioritization of biofuel crops over local food production are not new in the LSLA literature [65]. While it is common to blame the low level of technological development, limited use of external inputs into agriculture, low capitalization, and low levels of market penetration for low agricultural productivity in such communities, it is important to note that the practice of rotational intercropping coupled with fallowing has supported reasonable levels of food and livelihood security here for generations. At the very least, rural people enjoyed some level of food sovereignty—having the choice to plan their production activities to respond to their socio-cultural relationships with agricultural

activities and food, as well as respond to household requirements. In the absence of politico-social constraints (such as the decade-old civil war in Sierra Leone) and climate accidents (such as the 2009 failed start of the rainy season which affect other parts of sub-Saharan Africa), rural communities in the case studies deny suffering any major failures of agricultural activities that led to severe stresses on the food production system. Food production in Sierra Leone has been largely supported by the same systems that are being replaced for large-scale biofuel monocultures. The tendency among proponents of LSLA has been to associate small-holder and small-scale agricultural production with low productivity, inefficiency, famine, and poverty. This is in contradiction to studies which have proven that the efficiency of small-farms is in many cases, higher than those of large-scale monocultures [66], and that income from small-holder agricultural production is two to ten times higher than what they could get from selling wage labour in plantations [67]. Small farms usually achieve higher productivities with lower capital intensities than large farms [68]. Besides these, the benefits of small farms in preserving ecosystem functions and contributing to the social and economic lives of communities [69] is never brought into the comparison of small-scale polycultures and large-scale monocultures.

Some of the main arguments for LSLA in favour of large-scale biofuel monocultures in Sierra Leone have been the opportunities for employment that such investments are supposed to bring to local communities. According to local residents, the promise of company employment and better earnings for them and their families, as well as a host of social and economic development promises (the provision of housing, roads, schools, hospitals, electricity, *etc.*) made by the company, convinced them to cede their lands to the company. Higher incomes derived from employment by the company were supposed to sufficiently meet the needs of household food supplies. The promise of abundant employment claimed to have been made to local land owners and users has not been met (Table 7) and the income from those employed does not cover household requirements for staple foods. That communities consistently identify access to food, firewood and water as the key resource needs that override any other (housing, roads, schools, electricity, *etc.*) should underlie the importance of safe-guarding these resources in any plans for large-scale land investments. The desire for socio-economic development pursued by the national government should be adequately balanced by a safeguard of the populations' right to affordable and nutritious food.

Besides access to physical food resources, LSLA has been reported to affect resources that are associated to ensuring food security such as access to water of sufficient quantity and good quality. In a global study of water resources associated with LSLAs, Rulli *et al.* [70] report that "per capita volume of grabbed water often exceeds the water requirements for a balanced diet and would be sufficient to improve food security and abate malnourishment in the grabbed countries". To have access to ample water supply for their operations, all industrial plantations currently operating in Sierra Leone lie close to river sources [38]. The large volumes of water drawn by companies for the irrigation of large areas of planted crops and nurseries have effects on communities that depend on the rivers for a multitude of purposes including for drinking and other domestic purposes, fishing and for watering off-season food crops and vegetables [38]. Crops in the field may require even more water especially in the dry season when water tables are very low. Besides the outcome of lowering water tables and reducing the availability of water for local populations (especially in the dry seasons), the use of water for industrial agriculture on such large scales can also lead to pollution of local sources resulting from agrochemical use. Such pollution will impact local biodiversity, deprive local people of fish resources (an important

source of protein for many local communities in the study area), and impact on human health. These impacts were already uncovered in focus groups and other stakeholder engagement fora during the course of this study. Together, the loss of land and water resources resulting from LSLAs has the potential of placing the food security of some countries at risk [70].

In most regions of SSA, women play an important role as agricultural producers and food resources managers in various households [11,71]. Women and children are however among the most vulnerable groups regarding the food security outcomes of large-scale land acquisitions [11,24,25,72]. Traditionally rural women in Sierra Leone tend to be more attached to land than men—depending almost entirely on food crop farming to meet household food needs as well as other personal and household demands. Notwithstanding this strong attachment and reliance on the land, the land tenure system in this part of the country strongly discriminates against women [11]. Women had little or no say in the land lease arrangements and consultations [25]. Since women cannot own or inherit land but can access it for farming through male relatives (in rural Sierra Leone), land lease fees are for the most part paid to and shared by male family members. Also, women tend to be about three times less likely to be employed in non-farm employment offered by the local company than men (Table 7). While women are side-lined in land lease arrangements, their role as primary providers of household food needs has not changed even after the decline or loss of their food production potential resulting from land acquisitions [11].

Among the lessons drawn from this study is the recognition of how the effects of LSLA can be pervasive—extending beyond the locations and localities in which land has been acquired and investments made. When news of our study went to neighboring communities, we were approached by people (from neighboring communities to those in which Addax has operates) who claim that they too are affected because their farms were in the communities that now host Addax operations. Through inter-community marriages, family ties and other social relationships, individuals and even households may depend substantially on farmland in communities outside their areas of habitation. It follows that even though there may be no Addax operations in their communities, some members of neighboring communities may lose out on farmlands and non-farm based sources of food supplies following LSLA. In the same vein, communities downstream from Addax operations complain of a fall in the quality of water for drinking and domestic use even though they do not host Addax operations. While there was no formal process of investigating these communities during this study, some of these claims point to how difficult the task of distinguishing between communities that are affected from those that are not affected in LSLA can be.

The relationship between LSLA, food security and food sovereignty is rather complex and subject to a plethora of conceptualizations. Food security is more of a technical concept, and the right to food a legal one, food sovereignty is essentially a political concept. Several implications emanate from the diverse conceptualizations of these terminologies. Food sovereignty emphasizes local control and self-sufficiency, while food security accentuates reliance on the global economy based on liberalized agricultural markets. For this reason, food security cannot guarantee food sovereignty. Similarly, LSLA cannot guarantee food sovereignty as the former fundamentally focuses on producing food for external markets, and fails to ensure that at least some of this food remains behind for local use. Where some food is held back however, this can raise concerns over its impact on any local production that might be surviving, as the “LSLA food” is likely to be cheaper than that from local farms. Also, even where farm income might be the main source of food security, land use and the rights that go with it can be more

complex than they seem. In Sierra Leone as in many parts of sub-Saharan Africa, “farming” involves much more than growing crops or raising animals. Hunting, grazing in communal areas or over long distances, collecting fuel and medicines from forests, can all be part of the food security equation. Rivers—whether full or virtually dry—offer different opportunities at different times of the year, and water sources are a critical resource in whatever area is occupied or “owned” by a family. Large areas of apparently unused land may look unoccupied, but can be the basis of fallow systems with cycles of a decade or more; or they may just be kept in reserve for future generations as population grows. In this context, De Schutter [2] argues that in our analysis of food security as a system “we have forgotten the cultural significance of land, and we reduce land to its productive elements—we treat it as a commodity, when it means social status and a lifeline for the poorest rural households”.

Based on our findings, we argue that the effects of LSLA on food insecurity are far more nuanced than the protagonists on either side of the LSLA argument would have everyone believe. Consequently, it is imperative to look for deeper understandings of the phenomenon of LSLA and its longer-term implications for agricultural and rural futures. In this context, two research issues are pertinent. First, emphasis on dynamics of well- and ill-being in the context of multiple processes affecting agrarian household development offers a useful approach to looking at the wider and equally complex context of food security. Secondly, more attention is required on legal empowerment and organizational strengthening measures at community level. Paralegal and local capacity building programmes linked to measures to secure local land rights can, in an enabling environment created *and supported by governments*, make LSLA investments a people-focused phenomenon, within a wider context of looking for “options ... and workable alternatives to corporate land accumulation and large-scale industrial farming” [73].

Sierra Leone remains one of the poorest countries in the world with the majority of the population relying on subsistence agriculture. One may tend to wonder therefore if the decline of food security is not linked to the country’s general economic performance. One of the most challenging episodes in Sierra Leone’s recent history prior to the onset of LSLA was the 11 year long civil war (1991–2002). The destruction of human resources, as well as physical, social, and economic infrastructure resulting from this conflict has been widely reported [74]. Another serious challenge that the country had to deal with was the 2008 to 2009 global economic and financial crisis. Despite the many challenges that the country faced as a result of the armed conflict and the global economic crisis, Sierra Leone made significant progress over the past decade in terms of post-conflict recovery and has been firmly on the path towards economic development. Through contributions from different sectors of the economy, the country’s real GDP Annual Growth Rate averaged 2.89% from 1961 until 2014, reaching an all-time high of 20.14% in 2013. Between 2009 and 2013, the annual average GDP growth rate was 10% [75]. This made Sierra Leone one of the fastest growing economies in Sub-Saharan Africa. The role of agriculture in Sierra Leone’s economic growth story is significant. In 2013, for example, agriculture contributed 41% to the country’s GDP [75]. The Ebola Virus Disease (EVD), which struck Sierra Leone in May, 2014 is expected to have a substantial negative effect on the near and medium term development of Sierra Leone. Prior to the outbreak of the EVD, Sierra Leone was recording double-digit GDP growth rates of 15.2% and 20.1% in 2012 and 2013, respectively [75]. Given the widespread effects of the disease across different sectors, development in key social and economic indicators may be negatively affected. According to Statistics Sierra Leone, the EVD may reduce economic growth by as much as

50% [75]. The effects of the EVD on the situation of food security within the study area and period are not taken into account since the food security situation under analysis was that prior to the outbreak of the disease. It is therefore unconvincing to attribute the decline of food security in areas affected by LSLA on the general situation of the country's economic performance.

While there are clear advantages of examining the outcomes of LSLA at the local level (among communities that host such projects, interact with them on a daily basis, and are the first to experience their outcomes), the selection of communities based on whether they host or do not host LSLA projects may have some limitations. Chief among the limitations could be the representativeness of results of such local studies, and the extent to which understanding of these local circumstances in one study can be applied to other socio-economic and geographical contexts. While this study is representative for the population studied, and broadly for other cases of LSLA in Sierra Leone, its application in other geographical and socio-economic contexts should take account of local socio-cultural, economic and political circumstances as well as the nature of relationships between LSLA investors and local communities. The before-and-after design used in this study may also have limitations. One of the main limitations is based on the observation that such designs are best for conditions in which the connection between intervention and outcome are significant and occur soon after the intervention [49–51]. The length of intended operations of land investing companies in Sierra Leone are comparatively longer than the time they have already spent in communities that host these operations. Whereas outcomes of such investments are already being reported on access to land resources, local rights of consent and participation, gender differentiated impacts, and other sectors [2,6,45], LSLA in its new form is still in its early days. It is therefore not yet clear the extent to which such acquisitions would affect host communities in the future.

## 6. Conclusions

The implications of LSLA on food and nutrition security have been examined at the local scale and for communities where land investment operations are already underway. The evidence gathered point to a deterioration of the food security situation in these communities following LSLA. Rural households are found to be better-off when they were in charge of meeting their food security needs. The system of mitigation of food insecurity outcomes of large-scale land acquisition put in place by the land investing company has serious organizational and operational flaws. Also, the power relations in these structures prevent local communities from contributing to making these structures better. Failure to address issues of food and nutrition security in the framework of operations for investing companies is a casualty of the poor legal framework in which LSLIs operate in Sierra Leone. A framework that addresses the food security needs of local populations should be put in place to address the situation of food insecurity for ongoing land investment projects. Such a framework should ideally explicitly uphold the rights of local communities to be able to produce the foods they like, when they want to and in the most ideal lands for food production. Opportunities for the development of large-scale biofuel monocultures should succeed not precede the definition of local food security needs. Future land investments should be legally obliged to adhere to this framework.

## Acknowledgments

The authors sincerely thanks all those who contributed with information, time and other resources leading to the preparation of this report. This includes individuals, non-governmental organizations and members of community groups in the Northern Sierra Leone. This work has benefited from inputs of two anonymous reviewers to whom we are deeply grateful. We greatly appreciate support from the Swedish Research Council VR (Contract No. 2013-187: Unintended implications of climate policies—Large scale land acquisitions) under which this study was carried out. This research was carried out within the framework of the Linnaeus Centre LUCID (Lund University Centre of Excellence for Integration of Social and Natural Dimensions of Sustainability). We gratefully acknowledge the financial support to LUCID from the Swedish Research Council Formas.

## Author Contributions

Genesis Tambang Yengoh undertook the field work, analyzed the data, and wrote the manuscript. Frederick Ato Armah analyzed the data, wrote and revised the manuscript.

## Conflicts of Interest

The authors declare no conflict of interest.

## References

1. Claeys, P.; Vanloqueren, G. The minimum human rights principles applicable to large-scale land acquisitions or leases. *Globalizations* **2013**, *10*, 193–198.
2. De Schutter, O. Green rush: The global race for farmland and the rights of land users. *Harv. Int. Law J.* **2011**, *52*, 504–559.
3. Richards, M. *Social and Environmental Impacts of Agricultural Large-Scale Land Acquisitions in Africa—With a Focus on West and Central Africa*; Rights and Resources Initiative: Washington, DC, USA, 2013; p. 59.
4. Anseeuw, W.; Wily, L.A.; Cotula, L.; Taylor, M. *Land Rights and the Rush for Land: Findings of the Global Commercial*; ILC: Rome, Italy, 2012.
5. Mehta, L.; Veldwisch, G.J.; Franco, J. Introduction to the special issue: Water grabbing? Focus on the (re) appropriation of finite water resources. *Water Altern.* **2012**, *5*, 193–207.
6. Fairhead, J.; Leach, M.; Scoones, I. Green grabbing: A new appropriation of nature? *J. Peasant Stud.* **2012**, *39*, 237–261.
7. Rakotoarisoa, M.; Iafrate, M.; Paschali, M. *Why Has Africa Become a Net Food Importer*; FAO: Rome, Italy, 2011.
8. Yengoh, G.T.; Armah, F.A. Land access constraints for communities affected by large-scale land acquisition in southern sierra leone. *GeoJournal* **2015**, doi:10.1007/s10708-014-9606-2.
9. Olsson, L.; Jerneck, A. Farmers fighting climate change—From victims to agents in subsistence livelihoods. *Wiley Interdiscipl. Rev. Clim. Chang.* **2010**, *1*, 363–373.

10. Hopkins, R.F. Food security, policy options and the evolution of state responsibility. In *Food, the State, and International Political Economy: Dilemmas of Developing Countries*; Tullis, F.L., Hollist, W.L., Eds.; University of Nebraska Press: Lincoln, NE, USA, 1986; pp. 1–36.
11. Yengoh, G.; Armah, F.; Steen, K. Women’s bigger burden: Disparities in outcomes of large scale land acquisition in Sierra Leone. *Gend. Issues* **2015**, doi:10.1007/s12147-015-9140-7.
12. Robertson, B.; Pinstrup-Andersen, P. Global land acquisition: Neo-colonialism or development opportunity? *Food Secur.* **2010**, *2*, 271–283.
13. Rulli, M.C.; D’Odorico, P. Food appropriation through large scale land acquisitions. *Environ. Res. Lett.* **2014**, *9*, 064030.
14. World Bank Group. *World Development Indicators 2012*; World Bank Publications: Washington, DC, USA, 2012.
15. Allouche, J. *Undercurrents of Violence: Why Sierra Leone’s Political Settlement Is Not Working*; 1479–974X; Institute of Development Studies (IDS): Brighton, UK, 2014.
16. UNDP. *Human development Report 2014—Sustaining Human Progress: Reducing Vulnerabilities and Building Resilience*; United Nations Development Programme: New York, USA, 2014; p. 239.
17. Transparency International. *Corruption Perception Index 2013*; Transparency International: Berlin, Germany, 2013.
18. IMF. *Sierra Leone: Poverty Reduction Strategy Paper—Progress Report, 2008–10*; International Monetary Fund (IMF): Washington, DC, USA, 2011; p. 98.
19. World Bank Group. *Sierra Leone—Country Assistance Strategy Progress Report for the Period fy10-fy13*; World Bank: Washington, DC, USA, 2012; p. 77.
20. AfDB. *African Economic Outlook—Sierra Leone*; AfDB, OECD, UNDP: Freetown, Sierra Leone, 2015; p. 13.
21. FAO; IFAD; WFP. *Meeting the 2015 International Hunger Targets: Taking Stock of Uneven Progress*; FAO: Rome, Italy, 2015; p. 62.
22. Thomas, A.C. *Population Profile of Bombali District and Makeni Town*; Statistics Sierra Leone: Freetown, Sierra Leone, 2010; p. 62.
23. WFP. *Sierra Leone: Household Food Security Survey in Rural Areas*; WFP-ODAV: Freetown, Sierra Leone, 2008; p. 79.
24. ActionAid. *Broken Promises: The Impacts of Addax Bioenergy in Sierra Leone on Hunger and Livelihoods*; ActionAid: London, UK, 2013.
25. Oakland Institute. *Addax & Oryx Group Bioenergy Investment in Sierra Leone*; Oakland Institute: Oakland, CA, USA, 2011.
26. Joseph, R.; Mohamed, C.; Caroline, K.; Constanze, V.O. Efforts to increase responsibility in agricultural investments: Policy frameworks and implementation challenges—Evidence from civil society in sierra leone. In *Proceedings of Annual World Bank Conference on Land and Poverty*, Washington, DC, USA, 8–11 April 2013; World Bank: Washington, DC, USA, 2013.
27. SiLNoRF. *Annual Monitoring Report on the Operations of Addax Bioenergy—For the Period July 2012–July 2013*; Sierra Leone Network on the Right to Food (SiLNoRF): Makeni, Sierra Leone, 2013.
28. AfDB. *Environmental, Social and Health Impact Report—Addax Bioenergy, Sierra Leone, Executive Summary*; African Development Bank (AfDB): Paris, France, 2012.

29. Webb, P.; Coates, J.; Frongillo, E.A.; Rogers, B.L.; Swindale, A.; Bilinsky, P. Measuring household food insecurity: Why it's so important and yet so difficult to do. *J. Nutr.* **2006**, *136*, 1404S–1408S.
30. Khan, Z.R.; Midega, C.A.; Pittchar, J.O.; Murage, A.W.; Birkett, M.A.; Bruce, T.J.; Pickett, J.A. Achieving food security for one million sub-saharan african poor through push–pull innovation by 2020. *Philos. Trans. R. Soc. B* **2014**, *369*, 20120284.
31. FAO. *The State of Food Insecurity in the World 2013—The Multiple Dimensions of Food Insecurity*; Food and Agriculture Organization of the United Nations (FAO): Rome, Italy, 2014.
32. Kimatu, J.N.; McConchie, R.; Xie, X.; Nguluu, S.N. The significant role of post-harvest management in farm management, aflatoxin mitigation and food security in sub-saharan Africa. *Green. J. Agric. Sci.* **2012**, *2*, 279–288.
33. Godfray, H.C.J.; Beddington, J.R.; Crute, I.R.; Haddad, L.; Lawrence, D.; Muir, J.F.; Pretty, J.; Robinson, S.; Thomas, S.M.; Toulmin, C. Food security: The challenge of feeding 9 billion people. *Science* **2010**, *327*, 812–818.
34. Holt-Giménez, E. Food security, food justice, or food sovereignty? Crises, food movements, and regime change. In *Cultivating Food Justice: Race, Class, and Sustainability*; Alkon, A., Agyeman, J., Eds.; MIT Press: Cambridge, MA, USA, 2011; pp. 309–330.
35. Ellis, F. Small farms, livelihood diversification, and rural-urban transitions: Strategic issues in Sub-Saharan Africa. In *Proceedings of the Future of Small Farms*, Wye, UK, 26–29 June 2005; Volume 135.
36. Stephens, P. The global land grab: An analysis of extant governance institutions. *Int. Aff. Rev.* **2011**, *XX*, 1–21.
37. Scoones, I.; Smalley, R.; Hall, R.; Tsikata, D. *Narratives of Scarcity: Understanding the 'Global Resource Grab'*; Future Agricultures Consortium: Brighton, UK, 2014; p. 34.
38. Nyéléni International Steering Committee. *Declaration of the Forum for Food Sovereignty, Nyéléni 23–27 February 2007*; Nyéléni International Steering Committee: Sélingué, Mali, 2007; p. 39.
39. Rosset, P. Food sovereignty and alternative paradigms to confront land grabbing and the food and climate crises. *Development* **2011**, *54*, 21–30.
40. Windfuhr, M.; Jonsen, J. *Food Sovereignty. Towards Democracy in Localized Food Systems*; FIAN-International and ITDG Publishing: Heidelberg, Germany, 2005.
41. Idris, S.M. Rights approach to food and nutrition security. *Int. J. Sci. Res.* **2013**, *2*, 70–73.
42. Paloma, S.G.Y.; Acs, S.; Matus, S.S.; Lakoh, A.; Baudouin, M.; Hites, G.; Sammeth, F. *Rural Poverty Reduction and Food Security: The Case of Smallholders in Sierra Leone*; European Commission, Joint Research Centre: Seville, Spain, 2012; p. 239.
43. Thomas, A.C. *Population Profile of Sierra Leone*; Sierra Leone Union For Population Studies: Freetown, Sierra Leone, 2007; p. 46.
44. GOSL. *Sierra Leone Integrated Household Survey (SLIHS) 2003/04*; Statistics Sierra Leone and DFID, Freetown, Sierra Leone, 2007; p. 132.
45. ActionAid. *From Marginalisation to Empowerment: The Potential of Land Rights to Contribute to Gender Equality—Observations from Guatemala, India and Sierra Leone*; ActionAid International: Johannesburg, South Africa, 2013.

46. Moyo, S.; Foray, K.M. *UNDP Scoping Mission Report: Key Land Tenure Issues and Reform Processes for Sierra Leone*; United Nations Development Programme (UNDP): Freetown, Sierra Leone, 2009.
47. Chikowo, R.; Zingore, S.; Snapp, S.; Johnston, A. Farm typologies, soil fertility variability and nutrient management in smallholder farming in sub-saharan africa. *Nutr. Cycl. Agroecosyst.* **2014**, *100*, 1–18.
48. Vanlauwe, B.; Coyne, D.; Gockowski, J.; Hauser, S.; Huising, J.; Masso, C.; Nziguheba, G.; Schut, M.; van Asten, P. Sustainable intensification and the african smallholder farmer. *Curr. Opin. Environ. Sustain.* **2014**, *8*, 15–22.
49. Hakim, C. *Research Design*; Allen Unwin: London, UK, 1987.
50. McDonald, V.L. *Before-and-after Case Study Design. Encyclopedia of Case Study Research*; SAGE Publications, Inc.: Thousand Oaks, CA, USA; pp. 52–55.
51. Miteva, D.A.; Pattanayak, S.K.; Ferraro, P.J. Evaluation of biodiversity policy instruments: What works and what doesn't? *Oxf. Rev. Econ. Policy* **2012**, *28*, 69–92.
52. Trusty, J.; Thompson, B.; Petrocelli, J.V. Practical guide for reporting effect size in quantitative research in the journal of counseling & development. *J. Couns. Dev.* **2004**, *82*, 107–110.
53. Bickel, G.; Nord, M.; Price, C.; Hamilton, W.; Cook, J. *Guide to Measuring Household Food Security*; Department of Agriculture Food and Nutrition Service: Alexandria, VA, USA, 2000.
54. Price, C.; Hamilton, W.; Cook, J. Household food security in the united states in 1995: Guide to implementing the core food security module. In *Report Prepared for USDA, Food and Consumer Service*; USDA: Alexandria, VA, USA, 1997.
55. Brock, K. *It's Not Only Wealth that Matters—It's Peace of Mind Too: A Review of Participatory Work on Poverty and Illbeing*; World Bank: Washington, DC, USA, 1999.
56. Easterlin, R.A. Will raising the incomes of all increase the happiness of all? *J. Econ. Behav. Organ.* **1995**, *27*, 35–47.
57. Tiftonell, P.; Vanlauwe, B.; Leffelaar, P.; Rowe, E.; Giller, K. Exploring diversity in soil fertility management of smallholder farms in western kenya: I. Heterogeneity at region and farm scale. *Agric. Ecosyst. Environ.* **2005**, *110*, 149–165.
58. Telfer, D.J.; Wall, G. Linkages between tourism and food production. *Ann. Tour. Res.* **1996**, *23*, 635–653.
59. Bacon, C. Confronting the coffee crisis: Can fair trade, organic, and specialty coffees reduce small-scale farmer vulnerability in northern nicaragua? *World Dev.* **2005**, *33*, 497–511.
60. Nagayets, O. The future of small farms: Proceedings of a research workshop. In *Small Farms: Current Status and Key Trends*; International Food Policy Research Institute (IFPRI): Washington DC, USA, 2005; pp. 355–367.
61. Fafchamps, M. Cash crop production, food price volatility, and rural market integration in the third world. *Am. J. Agric. Econ.* **1992**, *74*, 90–99.
62. Maxwell, S.; Smith, M. Household food security: A conceptual review. In *Household Food Security: Concepts, Indicators, Measurements*; Maxwell, S., Frankenberger, T., Eds.; IFAD: Rome, Italy; UNICEF: New York, NY, USA, 1992.

63. CES. *Sugar Cane to Ethanol Project, Sierra Leone, Draft Environmental, Social and Health Impact Report*; Coastal and Environmental Services (CES) and Cemmats Group Ltd.: Grahamstown, South Africa, 2009; p. 270.
64. Driver, P.; Bisset, R. *Environmental & Social Performance of the Addax Bioenergy Project in Sierra Leone—A Summary Report Prepared for Swedfund International AB*; Nippon Koei UK: Berkshire, UK, 2012.
65. Vermeulen, S.; Cotula, L. Over the heads of local people: Consultation, consent, and recompense in large-scale land deals for biofuels projects in africa. *J. Peasant Stud.* **2010**, *37*, 899–916.
66. Heltberg, R. Rural market imperfections and the farm size—Productivity relationship: Evidence from pakistan. *World Dev.* **1998**, *26*, 1807–1826.
67. Deininger, K.W.; Byerlee, D. *Rising Global Interest in Farmland: Can It Yield Sustainable and Equitable Benefits?* World Bank Publications: Washington, DC, USA, 2011.
68. Hazell, P.B. Is there a future for small farms? *Agric. Econ.* **2005**, *32*, 93–101.
69. Rosset, P. The multiple functions and benefits of small farm agriculture in the context of global trade negotiations. *Development* **2000**, *43*, 77–82.
70. Rulli, M.C.; Saviori, A.; D’Odorico, P. Global land and water grabbing. *Proc. Natl. Acad. Sci. USA* **2013**, *110*, 892–897.
71. Owoo, N.S.; Boakye-Yiadom, L. The gender dimension of the effects of land tenure security on agricultural productivity—Some evidence from two districts in kenya. *J. Int. Dev.* **2014**, doi:10.1002/jid.3028.
72. Behrman, J.; Meinzen-Dick, R.; Quisumbing, A. *The Gender Implications of Large-Scale Land Deals*; International Food Policy Research Institute (IFPRI): Washington, DC, USA, 2011.
73. White, B.; Borrás, S.M., Jr.; Hall, R.; Scoones, I.; Wolford, W. The new enclosures: Critical perspectives on corporate land deals. *J. Peasant Stud.* **2012**, *39*, 619–647.
74. Bellows, J.; Miguel, E. War and institutions: New evidence from sierra leone. *Am. Econ. Rev.* **2006**, *96*, 394–399.
75. Statistics Sierra Leone. *Report on the 2013 real Gross Domestic Product (GDP) Figures At 2006 Prices and the Impact of the Ebola Virus Disease (EVD) on The 2014 Gdp Projections*; Statistics Sierra Leone: Freetown, Sierra Leone, 2014.