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Production and food security implications of large-scale land deals: Evidence from agricultural households in northern Ghana

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ABSTRACT

Although large-scale land acquisition (LSLA) - pejoratively referred to as land grabbing – and its implications on livelihoods have been extensively studied, the literature is still unclear about how LSLA by different actors affects household's livelihoods. Using data from 664 households and counterfactual analysis, this study analyses the effects of LSLA by domestic and foreign entities on food production and food security in Northern Ghana. Our results show that both LSLA by domestic and foreign actors reduce the total value of crop output, self-sufficiency in food production and food consumption scores thereby decreasing household food access scores. In all cases, however, the effect of LSLA by domestic entities is higher than that of LSLA by foreign entities. This implies that LSLA by domestic entities reduces food production and food security as compared to LSLA by foreign entities. The study recommends that concerns among stakeholders on the effect of LSLA should not only focus on LSLA by transnational corporations.

Keywords: *Large-scale Land Acquisition, Food Security, Food Production, Potential-outcome Framework; Ghana.*

INTRODUCTION

The potential role of food security in sustainable development has long been recognized and acknowledged in international development discourse. Improved food security can reduce poverty and hunger, and promote sustainable consumption as well as economic growth (Scharlemann et al., 2020). Unfortunately, food insecurity has been a major challenge for most developing regions of the globe including Africa and its subregions (FAO, 2020). This is particularly true in sub-Saharan Africa where the number of malnourished populations has been increasing (*ibid.*). Given that agriculture is still a major source of livelihood for most people in Africa (FAOSTAT, 2020), growth in the productivity of the agriculture sector can enhance food security and consequently, sustainable development (Scharlemann et al., 2020). For these reasons, several efforts are made by most governments to expand the agriculture sector in the region. Among these efforts is the promotion of large-scale land acquisition (LSLA) for agricultural investment, a process in which government agencies independently or in collaboration with traditional authorities, continuously transfer land on a large-scale to transnational investors and domestic agribusiness entities, in the hope of increasing welfare opportunities for their populations (Cotula et al., 2009). Although LSLA has existed since the colonial period, the pace and scale of acquisitions following the 2007-08 multiple crises intensified. For example, between 2008 and 2012, a total of 35 million hectares was acquired globally (GRAIN, 2016), and over 2 million hectares in Africa (Cotula et al., 2009). The rise in LSLA has generated debate among academics and development practitioners. Proponents have argued that LSLA can bring about productivity growth and food security (World Bank, 2010). This notion assumes that investments facilitated by LSLA will increase employment opportunities for peasants, with the income earned used in the output and input markets to purchase food and inputs and eventually leading to improved food security. Those who oppose the facilitation of LSLA however argue that the benefits associated with such acquisitions do not often materialize and the enclosures of large tracts of land threaten the livelihoods of smallholder households. Theting and Brekke (2010) in particular opined that investments from LSLA often failed to fulfill the promise of job creation. Behrman et al. (2012) also argued that even in situations where farmers are employed, the conditions contained in the contracts are not favourable and employees are few due to the mechanized nature of the process in large-scale plantation farms or agribusiness entities. Following such conflicting arguments, several empirical studies (e.g., Baumgartner et al., 2015; Bottazzi et al., 2018; Nolte & Ostermeier, 2017; Shete & Rutten, 2015) have investigated the livelihood implications of LSLA on local occupants. However, the results from these studies have been mixed. Moreover, many of these studies lumped all LSLAs and did not attempt to differentiate investors or actors involved despite evidence that LSLAs were being done by both domestic entrepreneurs (DE) and transnational agribusiness corporations (e.g., Cotula et al., 2014). This paper investigates the effects of LSLA on food production and food security of agricultural households in northern Ghana. The paper takes into account the evidence that LSLAs occur at different levels and by different actors. Specifically, the study examined the effects of exposure to LSLA by DE and FE on food production and food security relative to non-exposure to LSLA. Such analysis could provide policymakers with insights into how differently LSLAs by DEs and transnational corporations affect agricultural households.

LSLA involves the acquisition of land above 20 hectares (Lands Commission, 2016). Such acquisitions are usually characterised by investment in the production of food and energy for sale in either domestic or international markets (Borras & Franco, 2012). Further, LSLA by DE includes all forms of LSLA that are wholly perpetuated by domestic entities (Levien, 2011). On the other hand, LSLA by FE includes all forms of LSLA that are perpetuated by foreign entities (Amanor, 2012). Exposure to LSLA includes losing land, and land-based resources such as forest and forest products, water and water products to domestic or foreign entities.

The paper is organised into five sections. Section two explores food security from the perspective of agricultural policies and LSLA in Ghana. Section three describes the study area, the data and the analytical approaches employed by the study. Sections four and five present the results and discussion respectively.

Food security, agricultural policies, and the rise of LSLA in Ghana

Like other countries in sub-Saharan Africa, Ghana has to deal with the challenge of food insecurity (Ministry of Food and Agriculture, 2015a). Recent statistics show that between 1999 and 2019, the number of severely food-insecure people in Ghana increased from 2.1 million to 2.5 million (FAO, 2020). It is probably for this reason that most policy efforts including the Ghana Commercial Agriculture Project (Ministry of Food and Agriculture, 2015b), the Ghana Agricultural Investment Plan (Ministry of Food and Agriculture, 2018), and the Planting for Food and Jobs programme (Ministry of Food and Agriculture, 2023) are geared towards achieving food security. While these efforts may have contributed to food security in Ghana, they also facilitated LSLA - at the expense of small-scale farming - in which large tracks of land are transferred to domestic and transnational investors for the production of grains, oil palm, forestry, rubber, sorghum, soybean, sugarcane, wheat, soybean or biofuel for export (Civic Response, 2017; Land Matrix, 2020). Between 2000 and 2019, LSLA in Ghana, including northern Ghana, grew from less than 50,000 to over 350,000 ha (Land Matrix, 2020). Within this period (i.e., between 2012/2013 and 2016/2017), small farms (farms less than 5 ha) declined by 2.93% while medium-scale acquisitions (5-20.23 ha) and LSLA, respectively, grew by 2.79% and 0.14% (Ghana Statistical Service, 2018) and involved both foreigners and Ghanaians. Cotula et al. (2014), for instance, showed that 27% of LSLA in Ghana involved Ghanaians while at least 40% involved foreigners. Jayne et al. (2014) revealed that area under domestic and foreign LSLA is 2.20 million hectares in Ghana. Given that smallholder agriculture, which is the main source of livelihood for most households in Ghana, largely depends on expanding acreage (FAOSTAT, 2020), food production and food security in smallholder agricultural households are likely to be affected by the proliferation of LSLA by DE and FE. The knowledge of how LSLA by these actors affect food production per hectare and food security of smallholder agricultural households would be enhanced by this research. Our paper would add to the literature and knowledge generated by other authors like Abdallah et al., (2022) who conducted a similar study but focusing on food security and not food production as measured by the total value of output per hectare. This study focuses on production and food security effects of LSLA in northern Ghana with specific reference to LSLA by DE and FE. The paper offers several valuable contributions to knowledge, first, by examining how large-scale land deals influence household food security helps to improve the understanding of how LSLAs affect food security on the one hand and access to agricultural land by smallholders on the other hand. Second, the research contributes to the broader discourse on sustainable development by aligning its findings with the United Nations Sustainable Development Goals (SDGs), particularly SDG 2 (Zero Hunger), SDG 1 (No Poverty), and SDG 15 (Life on Land). It highlights how LSLAs can support or hinder progress towards these goals. Finally, the study employs innovative methodological approaches, such as the multinomial endogenous switching regression, which can be applied in similar contexts globally.

METHODOLOGY

Conceptual Framework

Transfer of land from smallholder farmers to agribusiness investors means land use may change from one use to another or even if the land remains in agricultural use, the farming system could change. Such land use change could have implications for production and food security for the former owners. To conceptualize how LSLA affects food production and food security, this study draws from the theoretical and empirical literature on LSLA and livelihoods. Following, the sustainable livelihood framework (DFID, 1999) and the extant literature on drivers of LSLA (e.g., Arezki et al., 2013; Lay & Nolte, 2018), we argue that exposure to LSLA is driven by both supply-side and demand-side factors. However, household's exposure to LSLA is not without immediate consequences as enclosures from LSLA can lead to changes in farmland access, labour supply and farm investment decisions (Ali et al., 2019; Behrman et al., 2014; Dessy et al., 2012; Kleemann & Thiele, 2015). Other consequences may include environmental pollution, degradation, and destruction of forest areas (Mbaya, 2015). Consequently, the dynamics in land access, labour supply and farm investment due to exposure to LSLA may affect production and food security through several paths (Dessy et al., 2012; Ju et al., 2016; Kleemann & Thiele, 2015). For instance, in rural areas where agricultural production depends mainly on land, land loss may affect food quantity harvested, prices, number of meals taken and food diversification. Summarily, LSLA along with index of farmland access, labour supply, land-improving techniques and supply- and demand-side factors influence household food production and food security. For estimation purposes, these dynamics can be captured in a reduced form equation specified as:

$$Q_{ij} = \alpha_j X_i + \beta_i LSLA_i + \varepsilon_{ij} \qquad (1)$$

Where Q_i is a vector of food production per area and food security indicators for household i; $LSLA_i$ is a vector of exposure to LSLA by DE and FE; X_i is a vector of farmland access, labour, land-improving techniques, supply-side/pull and demand-side/push factors; α_j and β_i are the respective coefficients; and ε_{ij} is a random term. If all factors in equation (1) are properly observed, then β_i represent the effect of $LSLA_i$ on production and food security Q_{ij} if the OLS model is estimated. However, exposure to LSLA is also based on demand-side factors including managerial skills, brands and firm-specific factors (Lay & Nolte, 2018). However, these factors may be unavailable to researchers (i.e., missing variable problem) as they are considered confidential by investors and may lead to correlation between X_i and ε_{ij}. Failure to account for such correlation could lead to inconsistent estimates of the effect of LSLA. This study employed multinomial endogenous switching regression (MESR) to estimate the effect of exposure to LSLA on production and food security. The next section outlines how the MESR model is employed to control for selection bias and as well estimate the impacts of the LSLA on food production and food security.

Estimation of the MESR model

The MESR is estimated in two stages (Bourguignon et al., 2007). In the first stage, the probability of exposure to LSLA is estimated using the multinomial logit selection model specified as:

$$Pr(A_{ij} = j|z_i) = \frac{exp(\delta_j z_i)}{\sum_{i=1}^{N} exp(\delta_k z_i)} \qquad (2)$$

where A is the index of the LSLA (i.e., j= non-exposure, exposure to LSLA by domestic entities and exposure to LSLA by foreign entities] affecting household i; $Pr(A_{ij} = j|z_i)$ refers to the probability of exposure to a particular categories of LSLA [i.e., non-exposure, exposure to LSLA by DE and exposure to LSLA by FE], given farmland access, labour, land improving techniques, supply-side/pull and demand-side/push factors z_i. Equation (2) was estimated through maximum likelihood approach using the '*mlogit*' command in Stata 15. J-1 coefficients were estimated for J categories with 'non-exposure' as the base category. The estimated coefficients described the probability of exposure to LSLA by DE and FE relative to the base category (i.e., non-exposure to LSLA). Such estimation represents the first stage of the MESR.

In the second stage of the MESR, the relationship between the outcomes Q (i.e., food production and food security) and a set of exogenous variable X is estimated for each of the categories (i.e., non-exposure, exposure to LSLA by DE and exposure to LSLA by FE). The second stage estimates the effect of multiple treatment categories [j= non-exposure, exposure to LSLA by DE and exposure to LSLA by FE] on Q (i.e., food production and food security indicators) following Bourguignon et al. (2007). The equations of the outcome Q (i.e., production and food security) for the three categories are given as:

$$\begin{cases} Regime\ 1: \quad Q_{iNE} = \alpha_1 X_i + u_{i1} \ \ if \ \ LSLA = 1 \\ Regime\ 2: \quad Q_{iDE} = \alpha_2 X_{i2} + u_{i2} \ \ if \ \ LSLA = 2 \\ Regime\ 3: \quad Q_{iFE} = \alpha_3 X_{i3} + u_{i3} \ \ if \ \ LSLA = 3 \end{cases} \quad (3)$$

where $Q_{ij}'s$ are production and food security indicators of the ith household in regime j, and the error terms $u_{ij}'s$ are distributed with $E(u_{ij}|z,X) = 0$ and $var(u_{ij}|z,X) = \sigma_j^2$. If the $\varepsilon_{ij}'s$ and $u_{ij}'s$ are not independent, OLS estimates of $\alpha_i's$ in equation (3) will be biased. For a consistent estimation of $\alpha_i's$, inclusion of the selection correction terms of the alternative choices in Eq. (3) is necessary. For Bourguignon et al. (2007), consistent estimates of $\alpha_i's$ in the (3) can be obtained by estimating the following MESR models:

$$\begin{cases} Regime\ 1: \quad Q_{iNE} = \alpha_1 X_i + \sigma_1 \hat{\lambda}_{i3} + \omega_{i1} \\ \qquad\qquad if \ \ LSLA = 1 \\ Regime\ 2 \quad Q_{iDE} = \alpha_2 X_{i2} + \sigma_2 \hat{\lambda}_{i2} + \omega_{i2} \\ \qquad\qquad if\ LSLA = 2 \\ Regime\ 3: \quad Q_{iFE} = \alpha_3 X_{i3} + \sigma_3 \hat{\lambda}_{i3} + \omega_{i3} \\ \qquad\qquad if\ LSLA = 3 \end{cases}$$

(4)

where σ_j is the covariance between $\varepsilon_{ij}'s$ and $u_{ij}'s$; $\omega_{ij}'s$ are error terms with an expected value of zero; and $\hat{\lambda}_j$ is the inverse mills ratios computed from the estimated probabilities of the first stage multinomial logit selection model. The inverse mills ratio $\hat{\lambda}_j$ is specified as:

$$\lambda_j = \sum_{m \neq j}^{J} \rho_j \left[\frac{\hat{P}_{im} ln(\hat{P}_{im})}{1 - \hat{P}_{im}} + \ln(\hat{P}_{ij}) \right] \quad (5)$$

where ρ is the correlation coefficient of $\varepsilon_{ij}'s$ and $u_{ij}'s$ and $\hat{P}_{ij}$ is the probability that household i is exposed to a choice j. Standard error of each equation in Eq. (4) are bootstrapped to account for the heteroscedasticity arising from the generated regressors due to the two-stage estimation procedure.

For identification of the treatment equation, it is recommended that the z variables in Equation (2) contain at least one selection instrument in addition to those automatically generated by the non-linearity of the selection model. This variable should influence exposure to LSLA but not outcomes Qs in Equation (4). This study uses as selection instruments, variables related to land governance, information sources and power. Areas with weak land governance slows expropriation since dangers of conflict with local users tend to be common in such locations. Thus, acquirers with investments that has long-term horizon of production cycles are less likely to invest in areas with weak land governance (Arezki et al., 2013; Lay & Nolte, 2018). Also, knowledge of other households affected by LSLA in other communities has often serve as first-hand information regarding the LSLA by investors, as well as the effects of the LSLA. Farmers with such knowledge therefore tend to employ strategies that enhances tenure security, thereby reducing exposure to LSLA. Suhardiman et al. (2015) for instance revealed that farmers who had prior information from relatives and related networks about LSLA tend to enhance security of their remaining land through investment in rubber plantations. Similarly, households with power tend to have more influence and are therefore less likely to lose land even if it is fallowed (Goldstein & Udry, 2008). For instance, elders, opinion leaders or natives of the community have power and are more influential than migrants. Because of their power and social influence, they are less likely to be affected by LSLA as compare to the powerless or migrants (Arezki et al., 2013). We use three indicators to account for land governance, information and power, namely, availability of land institution (measured as 1 if formal land institution such as lands commission, land survey department and town and country planning is available; 0 if otherwise), knowledge of any farmer affected by LSLA (measured as 1 if any member of the household had prior knowledge of farmers in other communities affected by LSLA; 0 if otherwise) and leadership position (measured as 1 if a farmer is in leadership position in the community; 0 if otherwise). These variables were expected to influence exposure to LSLA but not outcome, Q's (i.e., food production and food security indicators). We established the admissibility of these instruments by performing a simple falsification test: if a variable is a valid selection instrument, it will affect the household exposure to LSLA, but it will not affect the outcomes of interest (i.e., food production and food security indicators). Table A1 of the appendix and Tables S1-S4 of the supplementary material show that the knowledge and information sources can be considered as valid selection instruments: they are statistically significant determinants of the household's exposure to LSLA by DE and FE (Table A1 of the appendix) but not significant in food production (Table S1 of the supplementary material) and food security equations (Tables S2-S4 of the supplementary material). Although the model is already identified without inclusion of instrument, our inclusion of these variables as instruments in z_i is preferable. This is because the selection correction terms may not be sufficient to identify outcome equations and may lead to multi-collinearity problems (Bourguignon et al., 2007).

Using the above framework, the average treatment effects on the treated (ATT) was then computed as follows:

Exposed households with exposure (actual):

$$E[Q_{ij} | LSLA = j, X_{ij}, \hat{\lambda}_{ij}] = \alpha_j X_{ij} + \sigma_j \hat{\lambda}_{ij} \quad (6)$$

Non-exposed households without exposure (actual):

$$E[Q_{i1} | LSLA = 1, X_{i1}, \hat{\lambda}_{i1}] = \alpha_1 X_{i1} + \sigma_1 \hat{\lambda}_{i1} \quad (7)$$

Exposed households had they not been exposed (counterfactual):

$$E[Q_{i1} | LSLA = j, X_{ij}, \hat{\lambda}_{ij}] = \alpha_1 X_{ij} + \sigma_1 \hat{\lambda}_{ij} \quad (8)$$

Non-exposed households had they been exposed (counterfactual):

$$E[Q_{ij} | LSLA = 1, X_{i1}, \hat{\lambda}_{i1}] = \alpha_j X_{i1} + \sigma_j \hat{\lambda}_{i1} \quad (9)$$

Consequently, the average treatment effects on the treated (ATT) is computed as the difference between (6) and (8) while the average treatment on the untreated is also computed as the difference between (7) and (9).

Study Area

The study was conducted in the Northern Region of Ghana (now Northern, Savannah and North East region). The region has a total population of 2,479,461 inhabitants and a land area of about 70,384 km^2 (Ghana Statistical Service, 2013), controlled by two complementary systems of governance. The four paramount chiefs in the area – the Ya-Naa of Dagbong, Bimbilla Naa of Nanung, Nayiri of Mamprugu, and the Yagbonwura of the Gonja Traditional Area – constitute the first of the two systems. These chiefs operate with varied customs and traditions that influence land use, transfers and management. Moreover, transfer under the customary system are mostly informal and are not necessarily protected by law (Kasanga et al., 1996). The second tier is the Ministry of Lands and Natural Resources which is responsible for ensuring efficient and equitable land delivery services (Ministry of Lands and Natural Resources, 2019). However, the ministry is also challenged with several problems including inability to promote efficient land markets and lack of coordination of the various land administration agencies (*ibid.*). The availability of land coupled with the challenges of the two complementary systems make the region a hotbed for LSLA in which traditional and state authorities transfer land in large scales to domestic and foreign actors. Special cases include the 23,762ha acquired by Biofuel Africa Limited (Boamah & Overa, 2015), the Integrated Tamale Fruit Company which has a nucleus farm of over 568ha and over 2000 out-growers (Kuusaana, 2017). Another company that merits explicit mention in this connection is the Integrated Water and Agricultural Development, which acquired 400 hectares in Mamprugu-Moagduri district for agricultural investment (Ayelazuno, 2019).

Data and Variable Description

Given the fact that information provided by farmers can sometimes be scattered, shady and difficult to understand (Nyantakyi-Frimpong & Kerr, 2016), the study employed household survey. To begin, a total of 690 agricultural households consisting of exposed and nonexposed households were selected from 240,238 agricultural households (Ghana Statistical Service, 2013), following Yamane (1967) cited in Visco (2008) as:

$$n = \frac{N}{1 + N(e)^2} \qquad (1)$$

Where n is the total number of agricultural households or sample size to be used for the study; N is the population size (N=240,238); e is the is the margin of error or level of precision which was 5 percent with 95 percent confidence level to be tolerated in this study. By substitution, a sample size of 399.335 was achieved. The value was however adjusted to 690 to cover more households and to cater for errors and nonresponses that might arise in the survey.

Regarding sampling, six districts including Central Gonja, Mampurugu-Muagdure, Mion, North Gonja, Sagnarigu and Savelegu were selected based on predominance of arable land under commercial deals. Next, 41 affected communities were profiled from the six districts through scoping exercise. The final stage involved contrasting and selection of 23 affected communities that best represent LSLA by DE and FE. The study area showing sampled districts and communities are shown in Figure 1.

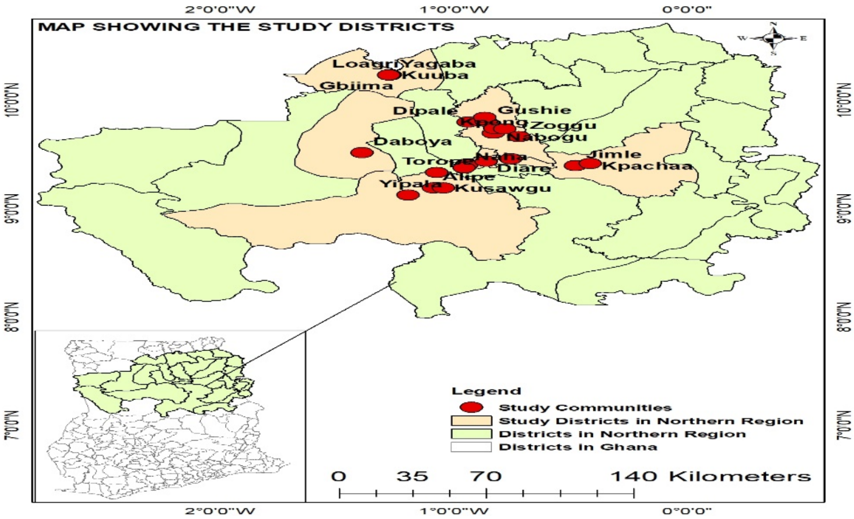

Figure 1: Northern regional map showing the study districts and communities.
Source: Authors' design, 2018

Next, a total of 30 agricultural households were randomly selected from each of the 23 communities, making a total of 690 agricultural households. These households were interviewed with questionnaire capturing a series of questions that lead to construction of households' exposure to LSLA by DE and FE, food production and food security. Following, the extant literature on drivers of LSLA (Arezki et al., 2013; Lay & Nolte, 2018), questions on power relations, location and institutional conditions were also included to capture supply-side factors. It must be pointed out that the questions focused on only supply-side variables because demand-side factors are investor/firm-specific factors that were unavailable at firm level. Further, the questionnaires covered information regarding land access, labour allocation and farm investments. The survey was conducted during the 2017/2018 cropping season with the enumerators making personal visits to the destination of the respondents. The data employed for this study contains information on household's exposure to LSLA, food production, food security, farmland access, labour allocation, farm investment and supply-side factors.

LSLA was first captured as a binary variable derived from the question "Have you lost land to anybody in the last five years?" Based on the responses to this question, respondents were asked questions concerning the details of the loses due to LSLA. Finally, respondents were further asked to specify who acquired their land. Based on responses to these questions, households were classified as: (1) non-exposed [i.e., 1 if household is not affected by LSLA; 0 if otherwise] (2) exposed to LSLA by DE [i.e., 1 if households lost farmland and farmland-based resources to LSLA by DE; 0 if otherwise]; and (2) exposed to LSLA by FE (i.e., 1 if households lost farmland and farmland-based resources to LSLA by FE; 0 if otherwise)[1]. Figure 2 indicates that about 30% of the sampled households are exposed to LSLA by DE whiles 24% are exposed to LSLA by FE. On the other hand, about 46% of the sampled households are not affected by either type of LSLA.

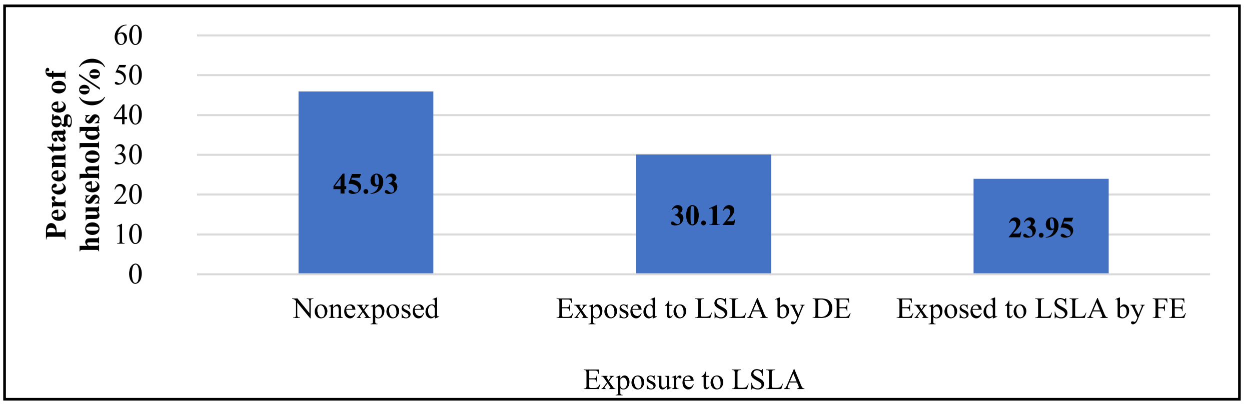

Figure 2: Distribution of Sampled Households by Exposure to LSLA

[1] We have conducted a Small-Hsiao test for the IIA assumption and Wald test of combining outcome categories. However, the null hypotheses fail to be rejected, suggesting that we have appropriately categorized households into nonexposed, exposed to LSLA by DE and FE (see Tables S5-S6 of the supplementary material).

Source: Author's computation based on household survey data, 2018

As stated earlier, food crop production and food security are the outcomes of interest in this study. By way of diversification, households in most parts of sub-Saharan Africa mostly intercrop with more than one crop, making estimation of food production difficult. For this reason, we captured food production in this study using total value of crop output (TVCO)[2] per are. This approach involved aggregating the values of all crops on a plot into a single measure using the output and prices provided by the households[3]. Such approach has been used by Abdallah et al. (2020) in sub-Saharan Africa. TVCO depends on output and prices. We therefore assumed that LSLA influences TVCO per acre through the quantity of output produced.

Given that food security is multidimensional issue, we employed three indicators namely, the self-sufficiency in food production (SSF), food consumption score (FCS) and household food insecurity access score (HFIAS). Thus, the effect of exposure to LSLA on food security is estimated through these indicators. Our first indicator, which is SSF, captures the total grain produced from maize and maize equivalent, and available for household's own consumption (Thomson & Metz, 1998). In areas where agricultural production is the main livelihood activity, and food purchases are constrained by prices, lack of income or access to markets (Pieters et al., 2013), food security is strongly linked to share of the produce available for household's consumption (Thomson & Metz, 1998). SSF is continuous variable constructed as follows:

$$SSF_i = \frac{Total\ available\ cereal}{Population\ of\ family\ unit} \quad (10)$$

Where:

$\text{Total available cereal} = TC + CPH$; TC is total refined cereal in a maize equivalent basis specified as:

$$TC = [(\text{MP*0.90*0.97}) + (\text{SP*0.90*0.97}) + (\text{RP*0.65*0.99}) + (\text{CP*0.85})$$

with 0.90, 0.90, 0.65 and 0.85 as the milling ratios for millet, sorghum, rice and maize respectively and 0.97, 0.97 and 0.99 as the maize equivalent of millet, sorghum and rice on a milled basis, respectively. Further, CPH is the cereal in maize equivalent basis that is purchase from cash crops such as cotton, groundnut, cowpea, and other legumes. The calculation of self-sufficiency in this study is based on a threshold of 170kg of cereal per capita annual equivalent employed by von Braun and Eileen (1994). Thus, a household is self-sufficient and has food throughout the 2017/2018 cropping season if the calculated total grain produced and available for household's own consumption is greater or equal to 170kg per capita per annum.

The second indicator, HFIAS, is households' perception of quantity and quality components of their diet in the past 30 days. It is a continuous variable that measures food security in terms of access. The HFIAS assumes that households' experiences of food insecurity cause predictable reactions which can be captured and quantified into a score. This score indicates frequency of consumption of less preferred foods to skipping of meals (Coates et al., 2007). It is captured by aggregating the product of responses to nine questions on occurrence and frequency of occurrence of food insecurity situation.

[2]*Our survey revealed Amaranthus, Jute mallow (Corchorus olitorius), Spinach (Spinacia oleracea) sorghum, maize, rice, millet, sorghum cowpeas, groundnuts, cassava and yam as the main crops produced in the area.*

[3]*Regarding the prices, we employed the median prices of the prices provided by the farmers to avoid the effect of variations in local prices.*

The nine questions focused on experience of food insecurity in 2017/2018 cropping season and reflects (Q1a) anxiety about food adequacy; (Q2a) eating less-preferred foods; (Q3a) eating foods of a limited variety; (Q4a) inability to eat less-preferred foods; (Q5a) eating smaller meals than needed; (Q6a) eating fewer meals in a day; (Q7a) failing to obtain food of any kind; (Q8a) going to bed hungry; and (Q9a) going the whole day or night without eating. A 'yes' response to any of these questions is given a value of one and a 'no' response is given a value of zero. A question on frequency-of-occurrence (F) then followed each severity question. These questions asked how often a reported condition occurred during the previous 30 days with 1, 2 and 3 representing 'rarely' 'sometimes' and often respectively. Using these responses, the HFIAS is then calculated by summing the scores generated from the responses as follows:

$$\begin{aligned} HFIAS &= (\mathrm{Q1a})(\mathrm{F1}) + (\mathrm{Q2a})(\mathrm{F2}) + (\mathrm{Q3a})(\mathrm{F3}) \\ &+ (\mathrm{Q4a})(\mathrm{F4}) + (\mathrm{Q5a})(\mathrm{F5}) + (\mathrm{Q6a})(\mathrm{F6}) \\ &+ (\mathrm{Q7a})(\mathrm{F7}) + (\mathrm{Q8a})(\mathrm{F8}) \\ &+ (\mathrm{Q9a})(\mathrm{F9}) \qquad (11) \end{aligned}$$

Summarily, the minimum HFIAS is zero and is obtained when a household is food secure and responds 'no' to occurrence and frequency of occurrence. A HFIAS value above zero means that some level of food insecurity exists for the household. The highest score is 27, which is obtained when a household is food secure and responds in the affirmative to all the questions on occurrence and 'often' to questions concerning rate of occurrence. Our third indicator, which is FCS, represents the dietary diversity, energy, macro, and micro value of the food consumed (WFP, 2009). The FCS is a continuous variable measured by first recording frequency or the number of food groups consumed by an individual within a household over a reference period, usually a seven-day period. The food groups are nine in number according to (WFP, 2009) and include: (i) Cereals and tubers; (ii) Pulses; (iii) Vegetables, relish and leaves; (iv) Fruits (v) Meat, fish and eggs; (vi) Milk and other dairy products; (vii) Sugar and sugar products, and honey (viii) Oils, fats and butter; and (ix) Condiments. The frequency of consumption of each food group A by household i, is then multiplied by a predetermined weight B, assigned to each food group to generate a score defined mathematically as:

$$FCS_i = \sum_{i=1}^{n} A_i B_i \qquad (4)$$

The definition/measurement and descriptive statistics of the variables employed are presented in Table 1. The statistics show differences between exposed and nonexposed households in area. With respect to TVCO, the statistics show that average TVCO of the nonexposed households is GH¢1,974.12 per acre whiles that of exposed households ranged between GH¢815.18 per acre and GH¢954.60 per acre for DE and FE. The statistics also indicate that nonexposed households are food secure whiles the exposed households are food insecure in the sample. Specifically, the food self-sufficiency of nonexposed (364.19kg of maize equivalent per capita consumption per annum) is far higher than the food self-sufficiency of the exposed households which ranged between 113.94kg and 123.kg of maize equivalent per capita consumption per annum. This implies that nonexposed households are self-sufficient in staple food supplies especially if von Braun and Eileen's (1994) rule-of-thumb figure of 170kg of maize equivalents per capita per annum is applied. Thus, whereas an individual in a nonexposed household is food self-sufficient, the same cannot be said of households exposed to LSLA by DE and FE. Similarly, FCS of nonexposed household is higher (98.9) than that of the exposed households which ranged between 34 and 41 respectively. On the contrary, HFIAS is higher among the exposed households than the nonexposed households. Whereas HFIAS ranged between 10.7 and 8.7 for households exposed to LSLA by DE and FE, HFIAS is 3.7 for nonexposed households.

Aside from the differences in TVCO, SSF, FCS and HFIAS, there are differences between the exposed and nonexposed households in terms of other characteristics. For instance, whereas average expenditure on labour ranged between GH¢177.19 and GH¢206.95/acre under exposure to LSLA by DE and FE, average labour expenditure is GH¢87.14/acre under non-exposure. The high labour expenditure for the exposed households was attributed to the fact that household members providing farm labour for such households have been affected by LSLA and therefore migrated to urban areas to look for jobs. This led to shortage of family labour of exposed households who now hire labour to replace the family labour and hence the high expenditure on labour. With regards to agrochemicals including fertilizer, weedicides and pesticides, average expenditure for the exposed households is higher and ranges between GH¢183.20/acre and GH¢369.65/acre for DE and FE whiles expenditure for nonexposed households is GH¢176.88/acre. During a focus group discussion, the participants explained that some of the affected household members resort to more use of inputs on the remaining plots and hence, the high expenditure on agrochemicals. Similarly, there were differences between exposed and nonexposed households in terms of gender, age, level of education, landholding, compensation received, social group membership, district of location, access to land institution, prior knowledge of households affected by LSLA, proximity to market, extension office and financial institution. Thus, the observed differences in TVCO, SSF, FCS and HFIAS of nonexposed and exposed households cannot be considered as causal interpretation. This is because the differences could be arising from differences in other factors rather than LSLA. To account for such differences and as well examine the effects of LSLA on production and food security, we employed the MESR model. The results from the MESR model are presented in the following section.

Table 1: Variable definition/measurement and a priori expectations

Variable	Definition/measurement	Nonexposed	Exposed LSLA by DE	Exposed LSLA by FE
TVCO	Total value of crop produce (GH¢/acre)	1,974.12 (82.44)	815.18 (70.39)	954.60 (79.52)
SSF	Self-sufficiency in food production: Share of the total grain produced and available for household's own consumption (kg/acre)	364.19 (5.93)	123.51 (7.70)	113.94 (3.30)
HFIAS	Household food insecurity access score: A food secure household has a score of 0, absolutely food insecure has a score of 27.	3.67 (5.26)	10.67 (2.38)	8.65 (1.75)
FCS	Daily food consumption score	98.90 (4.81)	34.22 (2.62)	41.04 (2.92)
Household income	Sum of income from farm and off-farm activities in GH¢	5,349.23 (13.31)	1434.11 (16.22)	1168.61 (46.60)
Landholding	All the land under the management and control of household (acres)	10.60 (3.87)	5.05 (2.24)	6.05 (2.02)
Labour	Labour application (hours/acre)	87.14 (7.27)	177.19 (6.88)	206.95 (6.72)
Agrochemicals	Cost of agrochemicals including fertilizer, pesticides and weedicides (GH¢/ha)	176.88 (7.43)	183.20 (7.10)	369.65 (9.71)
Gender	1 if household head is male, 0 otherwise	0.91 (0.29)	0.93 (0.26)	0.92 (0.26)
Age	Age of household head (years)	45.56 (2.90)	46.97 (2.87)	47.28 (3.44)
Education	Number of years spent in formal education	2.21 (4.18)	1.97 (3.86)	1.28 (2.96)
Household size	Number of people residing in a household	11.93 (7.63)	12.44 (7.28)	12.59 (8.18)
Compensation	Payment received after displacement (GH¢/acre)	-	358.56 (12.11)	658.55 (32.14)
Knowledge	1 if the household has prior knowledge of other households affected by LSLA; 0 if otherwise)	0.66 (0.48)	0.61 (0.49)	0.53 (0.50)
Land institution	Dummy (1 if household has access to formal land institution; 0 if otherwise)	0.41 (0.23)	0.32 (0.18)	0.11 (0.09)
Leadership position	Dummy (1 if household head is in any leadership position; 0 if otherwise)	0.25 (0.43)	0.31 (0.46)	0.23 (0.42)
TLU[a]	Tropical livestock units (livestock numbers converted to a common unit)	2.58 (8.83)	2.69 (10.64)	1.83 (10.64)
Market distance	Distance to main market (km)	4.78 (1.05)	2.99 (1.13)	5.87 (1.63)
Remittances	1 if household has access to remittances; 0 if otherwise	0.18 (0.17)	0.14 (0.34)	0.11 (0.24)
Social group	Membership to social group (1=yes; 0=no)	0.43 (0.50)	0.39 (0.49)	0.38 (0.49)
Credit	1 if household has access to credit; 0 if otherwise	0.18 (0.38)	0.16 (0.37)	0.31 (0.46)
Water sources	1 if household has access to good water source; 0 if otherwise	0.59 (0.12)	0.13 (0.27)	0.12 (0.15)

Good fertile	1 if fertility of the soil is good; 0 if otherwise	0.35 (0.48)	0.47 (0.50)	0.37 (0.48)
Moderate fertile	1 if fertility of the soil is moderate; 0 if otherwise	0.45 (0.50)	0.40 (0.49)	0.46 (0.50)
Poor fertile	1 if fertility of the soil is poor; 0 if otherwise	0.19 (0.40)	0.13 (0.34)	0.17 (0.37)
Sagnarigu	1 if farmer is located in Sagnarigu district, 0 otherwise	0.28 (0.45)	0.17 (0.38)	0.06 (0.24)
Mion	1 if farmer is located in Mion district, 0 otherwise	0.11 (0.32)	0.09 (0.29)	0.07 (0.25)
Central Gonja	1 if farmer is located in Central Gonja district, 0 otherwise	0.06 (0.24)	0.18 (0.39)	0.23 (0.42)
Savelegu	1 if farmer is located in Savelegu district, 0 otherwise	0.23 (0.42)	0.36 (0.48)	0.46 (0.50)
Yagba-Kubori	1 if farmer is located in Yagba-Kubori district, 0 otherwise	0.27 (0.44)	0.17 (0.38)	0.17 (0.38)
North Gonja	1 if farmer is located in North Gonja district, 0 otherwise	0.15 (0.21)	0.12 (0.15)	0.11 (0.09)

Notes: [a]Conversion factors for TLU are cattle = 0.5, sheep = 0.1, goats = 0.1, pigs = 0.2, chicken = 0.01 (Chilonda & Otte, 2006). Standard deviations are in parentheses. GH¢ is Ghanaian currency (US$1 = GH¢5.76 at the time of the study).

RESULTS AND DISCUSSION

As mentioned previously, the MESR model estimates determinants of households' exposure to LSLA, and the determinants of TVCO, SSF, FCS and HFIAS as well as the average treatment effect of exposure to LSLA on TVCO, SSF, FCS and HFIAS. However, only the results of the average treatment effect of exposure to LSLA on TVCO, SSF, FCS and HFIAS are presented in this section. The determinants of household's exposure to LSLA, TVCO, SSF, FCS and HFIAS are presented in Tables A1-A5 of the appendix but are not discussed due to space limitation. It must however be noted that many of the selection correction terms ($\lambda_i{}'s$) in the food production and food security equations are significant at least at the 5% level. This confirms the presence of endogeneity due to selection bias and thus, suggest that the use of linear regression would have produced biased results.

Effect of LSLA on household food production

With regards to the effect of exposure to LSLA on food production, the study compared TVCO of the treated households (in this case, households exposed to LSLA by DE and FE) to their counterfactual households. The results are presented in Table 2 and revealed significant decrease in TVCO for both households exposed to LSLA. However, the decrease is higher among households exposed LSLA by domestic entities as compared to households exposed to LSLA by foreign entities. For instance, TVCO decreased by GH¢881.10/acre for households exposed to LSLA by domestic entities as compared to nonexposed households. On the other hand, TVCO decrease by GH¢783.33/acre for households exposed to LSLA by foreign entities (Table 2). These suggest that both LSLA by DE and FE decreases food production in northern Ghana but the decrease in food production is higher for LSLA by domestic entities. The results further suggest that households who lost farmland and farmland-based resources due to LSLA by domestic entities will experience significant reduction in food production than households who lost farmland and farmland-based resources due to LSLA by foreign entities in northern Ghana. The lower decrease in food production among households exposed to LSLA by FE could attributed to the fact that acquisition from FE co-opt members of the affected households and the income earned by these farmers are reinvested in production or used in food purchases. Foreign entities might be subject to stricter international scrutiny and corporate social responsibility standards, leading to better compensation and support for displaced households. This could include investment in local infrastructure, education, and health services, which can indirectly support agricultural productivity. In contrast, domestic entities might not face the same level of scrutiny or pressure to adhere to high compensation standards. As a result, local households might receive inadequate compensation and support, exacerbating the negative impact on their agricultural productivity. Further, foreign entities are often required to comply with stringent environmental and social regulations both locally and internationally. This can lead to better outcomes for displaced households and less drastic reductions in crop output. On the contrary, the regulatory framework governing domestic entities might be less rigorous or less effectively enforced. This can result in poorer outcomes for local communities and greater reductions in agricultural productivity. Also, whereas foreign entities might invest more in building trust and collaborative relationships with local communities, which can result in better cooperation and more sustainable outcomes, domestic entities might have more complex and potentially adversarial relationships with local communities, leading to conflicts, resistance, and less effective collaboration, further reducing productivity. There is a notion that where households lose access to productive resources upon which their livelihoods depend, food production of these households will be affected (e.g., Dessy et al., 2012; Ju et al., 2016; Kleemann & Thiele, 2015). Overall, the results lend support to this notion as loss of land due to LSLA decreases the food production of affected households. The results confirm the findings of Twene (2016) and yet, contradict the study of Boamah and Overa (2015) and Hamenoo et al. (2018) who found weak evidence of reduced food production due to LSLA in southern Ghana. The results are consistent with previous studies - outside Ghana - which found a negative effect of land acquisition on the agricultural income of affected households (Baumgartner et al., 2015; Bottazzi et al., 2018; Shete & Rutten, 2015).

Table 2: MESR-based treatment effects of exposure to LSLA on TVCO.

Outcome variable	Exposure to LSLA (j)	Status of Exposure		ATT
		Exposed (j = 2,3)	Nonexposed (j = 1)	
		(1)	(2)	(3) = (1) – (2)
Farm income (GH¢/acre)	Exposed to LSLA by DE	566 (14.44)	1,377 (54.44)	-811.10 (44.11)***
	Exposed to LSLA by FE	2,396 (35.13)	3,179 (21.22)	-783.33 (33.55)***

Notes: ** and *** indicate statistical significance at 5% and 1% respectively. Standard deviations are in parenthesis; j represents the type of exposure to LSLA. Standard errors in parenthesis.

Effect of LSLA on household food security

Concerning the food security effect of LSLA, the study presents the self-sufficiency in food (SSF) production, food consumption score (FCS), and food insecurity access score under the actual case that the farm households are exposed to LSLA by domestic and foreign actors and the counterfactual case that they are not exposed to LSLA by any of these actors. The results are presented in Table 3. Generally, the results show that both LSLA by DE and FE significantly decrease household food security in Northern Ghana. The decrease in food security is however higher among households exposed LSLA by DE as compared to those exposed to LSLA by FE. For instance, whereas decrease in average SSF is 985.2kg of maize equivalent per capita consumption per annum for households exposed to LSLA by DE, the decrease in SSF is 349.9kg of maize equivalent per capita consumption per annum for households exposed to LSLA by FE. These represent a 79.7% and 67.7% reduction in SSF for households that lost land to LSLA by DE and FE. Also, FCS decreased by 7.36 (14.6%) and 6.97 (13.4%) respectively for households exposed to LSLA by DE and FE. On the contrary, HFIAS appear to be increasing because of both LSLA by DE and FE. Specifically, HFIAS increased by 1.45 (48% increase) and 0.95 (28.1% increase) respectively, for households exposed to LSLA by DE and FE. This is not surprising since FCS and HFIAS have been shown to relate inversely (e.g., Maxwell et al., 2013). The results therefore imply that losing farmland and farmland-based resources due to land enclosures by DE and FE leads to a decrease in household food security in Northern Ghana. This is plausible for several reasons. First, agriculture which constitutes a major livelihood for most households in Northern Ghana (Ghana Statistical Service, 2013) is largely dependent on land. Thus, losing access to land to either domestic or foreign entities will affect livelihood outcomes including food security. Second, foreign entities might create more economic opportunities through employment and local business development. By providing jobs and economic activities, they can partially offset the loss of land, leading to better food security outcomes compared to domestic entities. On the contrary, domestic entities might offer fewer employment opportunities and local economic benefits. As a result, households affected by LSLAs from domestic entities experience a more significant drop in food security due to the lack of alternative income sources. Third, foreign investors often bring advanced agricultural technologies and practices that can improve overall productivity (Behrman et al., 2014). Thus, even if land is taken away from smallholders, the new methods introduced can sometimes lead to increased local food production, mitigating the negative impacts on food security. Finally, foreign entities often have better-established supply chains and market access, which can help stabilize food prices and availability. Improved market access can mean that even if local production decreases, food can still be accessed relatively easily and affordably. These findings confirm Sen's (1981) entitlement approach to starvation and famines which argues that an individual can be plunged into food insecurity if his/her endowment collapses either through a fall in the endowment bundle. These results also confirmed the notion that large-scale LSLA in poor and vulnerable areas poses a potential threat to their economies and livelihoods and endangers their chances of achieving food security (e.g., GRAIN, 2016; Robertson & Pinstrup-Andersen, 2010). Similar results have been found in other studies examining the impacts of LSLA on food security in Ghana. For instance, the results are consistent with Nyantakyi-Frimpong and Kerr (2016) who found that LSLA leads to food insecurity among the affected households. The results also confirmed empirical studies which found that large-scale acquisition decreases food security (e.g., Alamirew et al., 2015; Shete & Rutten, 2015). On the other hand, the results are contrary to Santangelo (2018) who found mixed effects of LSLA on food security. The decrease in food security due to LSLA can have serious implications for the sustainable development of local people in the area. This is because poverty and hunger reduction, sustainable consumption, and economic growth which are the central pillars of sustainable development (Scharlemann et al., 2020) could be affected in the area.

Table 1: MESR-based treatment effects of exposure to LSLA on food security

Outcome variables	Under exposure to LSLA by domestic entities			
	Exposure to LSLA (j)	Status of Exposure: Exposed ($j = 2{,}3$)	Nonexposed ($j = 1$)	ATT
		(1)	(2)	(3) = (1) – (2)
SSF	Exposed to LSLA by DE	25.54 (26.18)	1236.76 (19.30)	-985.22 (12.50)***

	Exposed to LSLA by FE	167.47 (20.83)	517.33 (61.23)	-349.86 (38.57)***
FCS	Exposed to LSLA by DE	42.99 (1.97)	50.35 (1.58)	-7.36 (1.39)***
	Exposed to LSLA by FE	45.17 (1.75)	52.14 (4.87)	-6.97 (2.54)***
HFIAS	Exposed to LSLA by DE	4.46 (0.30)	3.02 (0.23)	1.45 (0.27)***
	Exposed to LSLA by FE	4.33 (0.25)	3.38 (0.89)	0.95 (0.37)***

Notes: ** and *** indicate statistical significance at 5% and 1% respectively. Standard deviations are in parenthesis.

Source: Author's computation from field survey, 2018

CONCLUSIONS AND POLICY IMPLICATIONS

Despite the growing literature on LSLA, less attention has been paid to the production and food security effects of LSLA by the actors. Most of the existing studies focused on LSLA by FE while LSLA by DE occurs at the blind side of research. Using the multinomial endogenous switching regression model and data from 664 agricultural households collected through a multi-stage sampling technique, this study examined the implication of LSLA on food production and food security in Northern Ghana.

Regarding the implication of LSLA on food production, the results revealed that both LSLA by DE and FE reduce the total value of crop output. However, LSLA by DE reduces food production than LSLA by FE in northern Ghana. This suggests that households that lose land and land-based resources due to LSLA by DE experience a reduction in food production than those that lose land and land-based resources due to LSLA by FE in northern Ghana. On the food security implication of LSLA, the results showed that both LSLA by DE and FE decrease self-sufficiency in food production and food consumption score but increase household food insecurity access score in the area. The decrease in self-sufficiency in food production and food consumption score is higher for households exposed to LSLA by DE as compared to households exposed to LSLA by FE. Also, the increase in household food insecurity access score is higher for households exposed to LSLA by DE as compared to households exposed to LSLA by FE. This therefore suggests that households that lose land and land-based resources due to LSLA by DE will experience a reduction in food security than those that lose land and land-based resources due to LSLA by FE.

The findings can have serious implications for sustainable development. First, the concerns among policymakers, media, development practitioners, and civil society organizations about the negative implications of LSLA on the livelihood of local occupants should be geared towards LSLA by both domestic and foreign entities since they both have negative impacts on food production and food security. However, such concerns should take into consideration the purpose and use of land by each entity since these entities have different uses and purpose for acquiring land. For instance, foreign entities often acquire land for large-scale commercial farming. This includes the cultivation of cash crops like cocoa, coffee, palm oil, rubber, and biofuels. These ventures are primarily export-oriented, aimed at international markets and improving livelihoods of local occupants. Also, some foreign investors focus on agribusinesses that include processing facilities, storage infrastructure, and distribution networks. These investments can improve agricultural value chains and benefit local food security. Foreign entities also engage in industrial projects, including mining, energy production (such as solar farms or wind turbines), and manufacturing plants. These projects can provide employment opportunities but often displace agricultural activities. On the other hand, most domestic entities engage in commercial farming and subsistence agriculture. However, the scale and efficiency may be lower compared to foreign investments. These activities may include growing staple crops like maize, millet, sorghum, and rice. They also engage in smaller-scale agribusinesses, focusing on local markets and food security. These ventures can be more directly beneficial to local communities but might lack the scale to significantly boost productivity. Thus, the aforementioned purposes should guide any action for LSLA by foreign and domestic entities. Otherwise, development-oriented investments may be halted, and this may further exacerbate problems face by affected communities.

Second, since the land loss to LSLA reduces food production and food security, the sustainable development agenda of Ghana could be affected. Thus, ensuring access to farmland by agricultural households is crucial for improving production, food security, and sustainable development. The government can improve access to farmland by ensuring that farmers get the compensation due to them. This will enable them to acquire land for production to improve food security. Individuals in the area without farmland after the LSLA may also be encouraged to negotiate with members who have adequate farmland for production. The negotiation can include agreement between the farmer and the landowner on how produce should be shared.

Third, since the study was conducted in only northern Ghana, the findings and conclusions may not reflect what prevails elsewhere in Ghana. For this reason, the study suggest that future research should consider the effects of LSLA by DE and FE in other areas of Ghana.

Lastly, this study investigated only the effects of LSLA by DE and FE on household food production and food security. However, such effects do not translate into an incremental effect of LSLA by DE and FE. As the scale of land acquired by DE and FE increases, production and food security effect of LSLA by DE and FE may differ. For this reason, the study suggest that future research should extend the analysis to effects of intensity of LSLA by DE and FE on production and food security.

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Appendix

Table A1: Multinomial logit model estimates of households' exposure to LSLA

Variable	Exposed to LSLA by DE	Exposed to LSLA by FE
Household power relations		
Gender	1.55 (0.69)**	0.46 (0.08)***
Education	-1.98 (0.84)**	-0.69 (0.12)***
Knowledge	-0.43 (0.25)*	-2.09 (1.01)**
Leadership position	-0.11 (0.04)***	-0.37 (0.07)***
Landholding	0.32 (0.09)***	0.20 (0.06)***
Tenure security	-0.32 (0.27)	-0.07 (0.37)
Location factors		
Good fertile	0.85 (0.44)*	0.32 (0.13)**
Moderately fertile	0.02 (0.34)	0.38 (0.29)
Fallow period	0.09 (0.05)*	0.12 (0.03)***
Water sources	-0.8 (0.53)*	-0.06 (0.04)*
Wage rate	-0.28 (0.46)	-0.01 (0.13)
Compensation	-1.01 (0.04)	0.10 (0.28)
North Gonja	0.29 (0.04)***	0.56 (0.15)***
Mion	-0.05(0.02)**	-0.42 (0.08)***
Central Gonja	0.21 (0.03)***	2.09 (1.01)**
Savelegu	-0.06 (0.30)	-0.30 (0.26)
Yagba-Kubori	0.29 (0.04)***	0.56 (0.15) ***
Institutional factors		
Social group	0.04 (0.27)	-0.03 (0.03)
Financial institution	0.21 (0.05)***	-0.10 (0.02)***
Land institution	-0.06 (0.04)*	0.21 (0.05) ***
Constant	2.19 (0.16)***	-1.98 (0.84)**
Pseudo R^2	0.55	
Joint significance of excluded instruments: χ^2 (6)	11.84***	
Wald χ^2 (40)	300.16***	
Observations	664	

Note: *, ** and *** indicate statistical significance at 10%, 5% and 1%, respectively. The baseline category is non-exposure to LSLA. Standard errors are in parenthesis.