Research article

Impact of land acquisition for large-scale agricultural investments on income and asset possession of displaced households in Ethiopia

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ABSTRACT

Displacement due to Large-Scale Agricultural Investments (LSAIs) is on the rise globally and in Africa. However, the impact of such displacement on the income and asset holding status of the displaced smallholders is not well explored. This study, therefore, empirically analyzed such impact taking Ethiopia as a case. A household survey covering different aspects of rural income sources and assets was collected from 255 displaced farmers and 266 non-displaced farmers in Adamitulu and Dugda districts. Propensity score matching technique (PSM) was applied to assess the impacts. The study findings indicated a significant reduction of income and assets among the displaced households. The mean annual income of the displaced households has declined by 72% (97,000 Ethiopian Birr (ETB)) compared to that of the income of the non-displaced households. Moreover, the livestock and productive assets holding of the displaced smallholders declined by 2.4 tropical livestock units (TLU) and 5219.6 ETB (69%) respectively compared to the non-displaced households. This implies displacement due to the LSAIs has worsened the income and asset condition of the displaced households in Ethiopia. Therefore, policymakers should put in place specific interventions to protect the income and asset holding of displaced smallholders. Empirical analysis of the impacts of LSAIs on livestock and productive asset possession of the displaced households is a key contribution of this study, and not well researched before.

1. Introduction

Existing evidence shows that 100–200 million people were displaced worldwide since the 1980s due to development interventions such as large agricultural investments (Agrawal and Redford, 2009). Sources also indicate that 10–15 million people are displaced annually because of large-scale land acquisitions for development purposes globally (Patil et al., 2017). According to IFC (2012), displaced smallholders or farmers refer to those that have lost their farmland due to land acquisition for large-scale agricultural investments (LSAIs). Globally, 83 million hectares of land under LSAIs were reported from developing countries by 2010 (Deininger et al., 2011). Of this, 69% LSAIs is in Africa, 22% in Asia and 9% in Latin America. From Africa, 28 countries were prioritized for LSAIs since 2000 including Ethiopia, Madagascar, Mozambique, Sudan, Tanzania and Uganda (Anseeuw et al., 2012; Richards, 2013; Davis et al., 2014). East Africa has experienced the most land transactions in recent years (Baumgartner et al., 2015). Over 12 million people were displaced due to LSAIs in Africa (Davis et al., 2014). This is more than one-third of internally displaced people worldwide (29 million); and a quarter of people migrated (32 million) due to natural hazards in 2012 (Davis et al., 2014). In Ethiopia alone, over a million people were displaced as a result of LSAIs (Davis et al., 2014; Rahmato, 2014).

Various factors drive LSAIs in many countries across the globe. These include the 2007–2008 food hike (Braun and Meinzen-Dick, 2009; Deininger et al., 2011); population growth and global demand for food, water and energy (UN DESA, 2020); and demand for biofuel and consequent replacement of food crops with biofuel crops (ABCG, 2013). Moreover, the demand for biofuel has increased over the last years as a means to reduce gas emissions by cutting the consumption of fossil fuel. While there is an incentive for biofuel production from the developed countries, there has been also an incentive from the developing countries to reduce imports of fossil fuel that consume much of their foreign currencies. The need for promoting export-oriented production and foreign direct investment by many African countries also has a crucial role in the expansion of LSAIs. These factors and many others have led to the proliferation of international and local companies engaged in commercial
large-scale farming in Africa (Deininger et al., 2011). In the case of Ethiopia, the demand of land for LSAs was on the rise during the last decades. The country’s agricultural development-led industrialization (ADLI) policy has encouraged the expansion of LSAs. Over 2.7 million hectares of land was transferred to LSAs from the mid-90s to 2016 (Legesse, 2016); and 3.6 million hectares of additional land was delineated for further expansion of LSAs in the country (Rahmato, 2014). Overall, 2,039 LSAI projects were operational in Ethiopia from 1992 – 2016 (Legesse, 2016); and this number increased to 2,360 LSAI projects in 2018 (EIC, 2018). Thus, there has been a growing concern over the increasing number of LSAs and their impact on the livelihoods of the displaced people.

In economic terms, the impacts of LSAs have been subjected to fierce debates across different countries in Africa (German et al., 2013). Two contending views prevail in this regard. According to the proponents of LSAs, such investments would improve sources of earning and income of rural people including the displaced. Along with this, existing evidence indicates LSAs have contributed to rural competitiveness, employment, and other off-farm income-earning opportunities (Khadjavi and SipanguleThiele, 2017). Other findings (e.g. Persson, 2016; Nolte and Ostertmeier, 2017) indicate that LSAs positively contribute to the modernization of agriculture and increased rural income through improved technology transfer, better farm productivity, and promoting labor-intensive techniques. Moreover, the LSAs bring with them the badly needed capital resource that contributes to the transformation of rural livelihoods and income (Araya, 2013; Rahmato, 2014).

On the contrary, LSAI opponents claim that most of the displaced rural people end up being worse off because of loss of land and livelihoods. Land acquisition for LSAs disrupts the livelihoods and income of displaced people and communities, leading to their marginalization and social exclusion (Penz et al., 2011; Sharma, 2011). Displacing people from their farmland without providing the opportunity for alternative livelihoods would exacerbate unemployment and income shortage, thereby leading to impoverishment of the displaced communities (Penz et al., 2011; Oxfam, 2012). Landlessness, low income and unemployment are among the key challenges facing displaced communities and rural people in many African countries (UN DESA, 2020; IFC, 2012). This implies there is no agreement among the proponents and opponents of the LSAs regarding the economic impacts of displacement due to the LSAs on the displaced people. It also implies that the impacts of LSAs on the displaced people should be analyzed by taking into consideration contextual factors of a given country. The type of impacts and their spillover effect on the displaced communities under the specific local context justifies the values of LSAs (Deininger and Xia, 2016); and a win-win approach can be realized when the LSAs become viable investments and the displaced people are protected (Liu, 2014).

In the case of Ethiopia, the relevant contextual factors include who owns the land, who acquires the land, the nature of land acquired, and whether the dispossessed people are adequately compensated or not. According to the constitution of the country, land is a common property of nations, nationalities and people of Ethiopia (FDRE Constitution, 1995). The same source further indicates that farmers and herdsmen have indefinite land-use right over the land they occupy. However, other government directives indicated these farmers and herdsmen have to give up such use-right at any time when the government wants to transfer the land to other entities including the LSAs, whose activities and investments are deemed to benefit the wider public (Council of Ministers, 2007). Actions and investments that are deemed to contribute to the wider public benefits or purposes were broadly defined and include engagements that bring in more income tax for the government; create employment opportunities for citizens; or activities that contribute to capital inflow (i.e. hard currency) for the country. Hence, LSAs that are anticipated to contribute to one or more of these public purposes are eligible to acquire smallholders’ land from the government (Council of Ministers, 2007).

Different authors have put forward different definitions of land acquisition for LSAs. For instance, an agricultural investment established over 1,000ha or more land is considered as LSAI (Taylor, 2012). According to ECA (2014), an LSAI is defined as an investment established over 200ha or more land. While Lay et al. (2018) referred to an LSAI as an establishment over 20ha or more land. Other sources argued that LSAs should not only be defined in terms of size of investment land acquired, but should also consider economic size in terms of capital, technology and labor involved (Zaehringer et al., 2018a,b). This implies there is not a set limit to the land size or other criteria referring to LSAs locally and globally. Hence, for this research, land acquisition for LSAs is defined as the transfer of land-use rights (50ha or more land) from smallholders and communities to agricultural investors through lease or concession for commercial farming or agro-processing (Davis et al., 2014). Here, it is claimed that LSAs should not necessarily cover large land size as long as they have a large capacity in terms of capital, technology and labor investment. Based on this, close to 2,360 LSAs projects comprising of sugar and cotton-producing farms, horticultural farms, floriculture, integrated agro-industrial parks and others, acquired land from the government from 1992 – 2018 and registered in Ethiopia (EIC, 2018). Various sources have indicated different estimates of land transferred to LSAs in Ethiopia. Poor-record keeping of investment land provided to agricultural investors and use of unreliable sources such as satellite imagery information has affected the accuracy of land transferred to LSAs in Ethiopia (Rahmato, 2014; Keeley et al., 2014). Our estimate of land transferred to agricultural investors from 1992 – 2018 based on the data from the federal government indicates 2,765,916ha (EIC, 2018). The majority of the investment land transferred to the investors was a larger size, 1,000ha or more. This accounts for 77% of the total land transfer from 1992 - 2018. The land transferred ranging from 50ha –1000ha during the same period all together accounts for 23% of the total land acquired by the LSAs. Region-wise, based on the data received from (EIC, 2018), the highest land transfer to LSAs was made in Oromia (26%) followed by Amhara (18%) and SNNPR (16%). Thus, Oromia is chosen for this study because it hosts the largest size of land transferred to LSAs during the same period.

A significant number of smallholders were displaced due to LSAs during 1992–2018 in Ethiopia. According to the government, these displaced households are entitled to compensation. IFC (2012) defined compensation as a measure designed and implemented to offset residual risks and impacts on people due to displacement by the LSAs. These measures may not eliminate all adverse risks and impacts but seek to offset through the provision of comparable resources (IFC, 2012). The government of Ethiopia has put in place regulation No 135/2007 to compensate the displaced people for what they have lost from the land (Council of Ministers, 2007). This includes compensation for lost assets and sources of livelihoods earning including crops (annual and perennial crops). Specific compensation rates are established and applied for different types of resources (annual crops, perennial crops, etc). According to this regulation, the displaced rural households are eligible to receive cash compensation equivalent to ten times of the value of crop harvest they can produce from their farmland (Council of Ministers, 2007). Moreover, the LSAs are expected to contribute to technology transfer; provide employment opportunities; and improve access to social services for the displaced communities. The LSAs, however, are not responsible to provide compensation to the displaced households. The displaced households are expected to use the government-provided cash compensation and other support from the LSAs to restore their livelihoods, income and assets.

However, existing evidence indicates that the displaced people suffered from declining farm and non-farm sources of income as compared to the pre-displacement situation (Rahmato, 2011; Richards, 2013; Wondimu et al., 2015). In many countries, the LSAs have taken away irrigated land from the rural communities or dried-up community water sources and impeded crop production (Waterhouse et al., 2010; Richards, 2013; Yengoh and Armah, 2015). Similarly, studies from other African
countries indicated LSAIs have undermined livestock production through creating pasture shortage thereby limiting animal productivity and income there-off (Waterhouse et al., 2010). Displacement due to LSAIs has also impacted non-farm activities that include agricultural and non-agricultural wage employment, non-farm enterprises and other income sources. These sources of rural earnings have a positive role in the income of displaced households in many African countries (Waterhouse et al., 2010; Richards, 2013). Despite this, studies from Ethiopia and elsewhere indicated that communities hosting LSAIs benefited less in most cases from such investments mainly because the local people are illiterate and lack the necessary skill (Gobana, 2010; Deininger et al., 2011; Bekele, 2016).

From the above, one can understand that the impact of LSAIs on the livelihoods of the displaced people is noticeable. However, most of the available studies on the subject are descriptive, not comprehensive or lack rigor. Empirical and context-specific studies analyzing such impacts particularly on various sources of household income and assets are limited in Ethiopia. This study has, therefore, analyzed empirically the impact of LSAIs on the different income sources of displaced households. It also assessed how the displacement due to the LSAIs affected the asset holding status of the displaced households taking the case of Adamitulu district in Oromia region, from where a significant number of people were displaced due to several LSAI projects in the last two decades (Oromia Investment Office, 2018).

2. Materials and methods

2.1. Study area

This study was carried out in two adjacent districts - Adamitulu (i.e. treatment area) and Dugda (i.e. control area) - of East Showa zone, Oromia region. Adamitulu district, which is located in the Southern direction of the Lake Ziway, was purposely sampled as a treatment area because of the high concentration of LSAI in the area. This district host sixteen LSAIs projects comprising of floriculture, horticulture and agro-processing companies (Oromia Investment Office, 2018). Availability of irrigation water from Lake Ziway and its tributary rivers, access to road facilities, and cheap labor availability have contributed to the concentration of LSAIs in Adamitulu district. On the other hand, Dugda district is located in the Northern direction of Lake Ziway, on the opposite direction to Adamitulu district, and not affected by LSAIs. The sample communities in the two districts fall within the Lake Ziway catchment whereby the communities in Adamitulu were displaced by several LSAIs; while those on the Dugda side were not displaced by the LSAIs. Hence, all the displaced households were sampled from Adamitulu district; while all the non-displaced households (i.e. control units) were sampled from Dugda district.

The two adjacent study districts share similar agro-ecology and socio-economic characteristics and therefore, belong to the same population within the central rift valley region of Ethiopia. Both districts are located at about 160km in the south direction from the country capital, Addis Ababa (Yadete, 2008). In geographical terms, the districts are located between 7°36’ to 8°24’ N latitude and 38°24’ to 38°58’ E longitudes (Figure 1). Adamitulu district has a total population of 186,998 of whom 49.6% are men and 50.4% are women. The total estimated area of the district is 1,274.54 km2. Similarly, Dugda district is home to 196,678 people of whom 51.3% are men and 48.7% are women (CSA, 2017). The district has a total area of 959.45 km2.

2.2. Sampling

Survey households were sampled from four communities of the two districts within the same population. Available sources indicate in-state comparison groups produce less bias than out-of-state groups according to Michalopoulos et al. (2004) implying the need to sample comparison groups within the same population. These communities were included in this study based on their proximity as well as agro-ecological and socio-economic similarities. The displaced households (i.e. treated units) were sampled from two communities affected by the LSAIs in Adamitulu district; while the non-displaced households (i.e. control units) were sampled from two sampled communities of Dugda district. The following steps were applied to determine the sample size. Firstly, the list of all displaced households from Adamitulu district was obtained from the District Investment Office. According to this information, 652 households were displaced from the two sample communities of this district. The following steps were applied to determine the sample size. Firstly, the list of all displaced households from Adamitulu district was obtained from the District Investment Office. According to this information, 652 households were displaced from the two communities of this district. These displaced households were affected in similar ways by the LSAIs and lost all or part of their farmland. More than 95% of the displaced households live in the two sample communities of this district (Adamitulu Investment Office,
2018). Secondly, the following formula put forward by Cochran (1977) was applied to estimate the sample size for the displaced households. Several authors have claimed that this formula is appropriate and widely used to determine sample size with a definite population (Malterud et al., 2016; Chow et al., 2017).

\[ n = \frac{n_0}{1 + \left(\frac{n_0 - 1}{N}\right)} \quad \text{(Eq 1)} \]

\[ n_0 = \frac{Z^2pq}{e^2} \quad \text{(Eq 2)} \]

Where;

- \( N \) is sampling frame, which is 652 displaced households in the two communities of Adamitulu district;
- \( n \) is the sample size when the population is finite and \( n_0 \) is sample size when the population is infinite considering the below parameters;
- \( Z \) is the selected critical value (1.96) of the desired confidence level (95%);
- \( P \) is the estimated proportion of attributes which is present in the population, that is 0.5 assuming maximum variability;
- \( q = 1 - P \); and
- \( e \) is the desired level of precision (+5%).

Accordingly, a total of 521 households were sampled from the two study districts. Of this, 255 sample units (49%) are the displaced households that were proportionally sampled using systematic random sampling technique from the two communities in Adamitulu district (Table 1). The remaining 266 households (51%) are the control units sampled using a similar sampling technique from the two adjacent communities in Dugda district that were not affected by the LSAIs. The sample includes a 5% correction for sampling and data collection errors. Higher control sample size was considered to ensure the comparison between the two groups based on pre-displacement characteristics. Sampling was made based on a list of all households living in the four communities of the two districts. Male and female-headed households were included in the sample proportional to gender composition in the population. Overall, the female-headed households comprise 21% of sample households in the displaced group and 16% among the control group. The Chi-square test result (\( X^2 \)) indicates the difference among the sample male and female-headed households between the displaced and non-displaced households is statistically insignificant.

### 2.3. Household survey

A household survey was carried out to collect the necessary data on various household sources of income, assets and other important variables. Qualitative data collection methods were also implemented to collect information required to substantiate or supplement the survey findings (see section 2.4 below for details).

Gross annual income and asset possession status of displaced households were assessed using data collected from the household survey. The income approach is chosen because this measures households’ command over different sources of earnings and associated resources; and can be considered as an effective proxy indicator of income available to households for consumption, production, saving or conversion into productive assets (UNECE, 2017). However, there is also evidence indicating that self-reported income is not often reliable to assess impacts due to several factors including under-reporting or difficulty of measuring some income elements (Meyer et al., 2015; UNECE, 2017). To address this gap, household asset possession, more specifically ownership of livestock and other productive assets, was analyzed to supplement household income analysis.

Data on household annual income and asset possession were collected from the sample households through individual interview. Household survey income comprising of crop production, livestock production, and non-farm sources (agricultural and non-agricultural wages, self-employment enterprises, and other sources) were gathered from both the treated and control households. Moreover, relevant data on household’s livestock and productive asset possession were collected from all survey households.

A structured questionnaire covering a range of the above issues was prepared and used to guide the primary data collection after being subjected to pretesting to ensure validity. Due focus was given to income earned during the year 2019 from farming, wage works and other non-farm sources. Experienced data collectors that have diploma level education or above and are capable of speaking the local languages were recruited, trained and deployed for the actual field survey data collection.

### 2.4. Community focus group discussion (FGDs)

Community FGDs comprising men and women displaced and non-displaced in sample areas were carried out to capture pertinent issues related to community participation during the land acquisition and compensation processes; compensation and services provided to the displaced people; quality and adequacy of services provided; and impacts of the LSAIs on the income and assets of the displaced households. Such information was analyzed using theme-based analysis, and used to triangulate and explain the quantitative survey findings as related to changes in household annual income and asset condition.

All the data collection instruments (household survey questionnaire and FGD checklists) were reviewed for ethical clearance and approved by the Regional Investment Commission of Oromia, Ethiopia. Moreover, informed consent was obtained from all surveyed households and FGD participants of this research.

### 2.5. Data analysis

#### 2.5.1. Descriptive analysis

The data gathered through the household survey was analyzed using STATA software (version 14). Descriptive statistics were applied during the data analysis. Means, proportions, percentages and charts/graphs are among the tools used in the descriptive analysis. Besides, two means comparison tests were applied as a preliminary method of estimating differences between the annual income and asset possession of the displaced and control households. The household annual income earned from various sources (i.e. crop, livestock, wage works, non-farm enterprises, and other sources excluding transfer and income earned from the disposition of fixed assets) were aggregated and analyzed to measure the annual income differences between the two groups. Similarly, household ownership of livestock and other productive assets was analyzed and compared between the groups.

#### 2.5.2. Empirical model

From the descriptive analysis, we observed varying characteristics between the displaced and non-displaced households. During the empirical analysis, these varying characteristics between the two groups were controlled to identify the treatment effect due to the displacement arising from the LSAIs.

| Household | Displaced HHs | Non-displaced HHs | Total | Level of significance |
|-----------|---------------|-------------------|-------|-----------------------|
| Female-headed | 54 | 43 | 97 | \( X^2 = 2.158 \) |
| Male-headed | 201 | 223 | 424 | 18.6 |
| Total | 255 | 266 | 521 | 81.4 |

Note: *Significance at 10%; ** significance at 5%; *** significance at 1%.
2.5.2.1. Estimation of treatment effect (ATT). In observation studies, such as this impact assessment, where there is no baseline data, quasi-experimental designs like matching methods offer promising results in assessing treatment effect (Dehejia and Wahba, 1999; Baker, 2000). Hence, the propensity score matching method (PSM) was applied to analyze the effect of displacement on the annual gross income and asset possession of the displaced households in this study. PSM is an appropriate tool for estimating impacts of participation on the outcome of interest, if displacement is not self-selection, as this introduces bias into the outcome (Dehejia and Wahba, 1999; Barrett et al., 2012). In this study, the displacement due to the LSAsIs is compulsory. Hence, PSM is a suitable approach to control for observable sources of biases and assess the effect of displacement on the income and assets of displaced households (Bekele, 2016). The displaced households and matched control units were compared based on ranges of specific observable characteristics considering household gross annual income and asset possession as an outcome of interest.

Moreover, inverse probability treatment weighting (IPTW) was applied to confirm the robustness of the result of PSM. According to Imai (2019), IPTW is an efficient and effective tool for estimating the treatment effect. In this study, both the treated and control observations are weighted using their probabilities as a means to adjust for under-sampling of the treated units (T = 255) and over-sampling of the control units (C = 266) thereby improving covariate balancing between the two comparison groups. In a way, this attempts to create a weighted or pseudo population with equal probability of receiving treatment in both the treated and a control group, as if this is a randomized trial.

2.5.2.2. Model specification. With the above background, and assuming that Y1 is the gross household annual income or value of assets of displaced household and Y0 is the gross household annual income or value of assets of the same household if not displaced, the average effect of displacement on the income or value of assets of the displaced household is the difference between Y1 and Y0. According to Heckman et al. (1997) and Smith and Todd (2005), this can be expressed as:

\[
ATT = E(Y_1 - Y_0 | X, P = 1) - E(Y_0 | X, P = 0) \quad (\text{Eq 3})
\]

Where:

ATT is the average treatment effect on the income or value of assets of the displaced households;
X represents a multidimensional vector of pre-treatment household characteristics;
P indicates displacement status of households where (P = 1 for displaced household) and (P = 0, otherwise).

However, the E (Y0/X, P = 1) is missing data because the displaced household cannot be at the same time non-displaced households to assess what would have happened to them without the displacement situation. The construction of such an unobserved counterfactual situation to measure treatment effect is an ongoing challenge encountering researchers. To deal with this, E (Y0/X, P = 1) is substituted with the mean annual income or mean value of assets of the non-displaced household (i.e. \(E(Y_0 | X, P = 0)\)). Such replacement would bridge the gap created due to missing data (Rosenbaum, 2002), and is referred to as the estimated mean household annual income or value of assets of the displaced households under the counterfactual condition. Then, the difference in the household annual income or value of assets is estimated as the effect of displacement due to LSAsIs on the displaced households (Smith and Todd, 2005) as:

\[
ATT = E(Y_1 - Y_0 | X, P = 1) - E(Y_0 | X, P = 1) \quad (\text{Eq 4})
\]

2.5.2.3. Selection of covariates and balancing. The covariate selection should be guided by two theoretical backgrounds: a) that the covariates should not be affected by the treatment itself (i.e. forced displacement in our case); b) that the covariates simultaneously affect both the treatment and the outcome of interest (i.e. income or value of assets of the displaced households in this case) (Caliendo and Kopeinig, 2008). A similar source also indicated that local knowledge and past research findings should complement the process of covariates identification. The identified covariates are then used to estimate propensity scores for the displaced and non-displaced households. The scores can be generated using probit or logit model taking participation in displacement as a dependent variable (Y = 1, displaced household; Y = 0, control household). Both of these models tend to produce a similar result (Sianesi, 2004; Faltermeier and Abdulai, 2009). For this study, the logit model was chosen to estimate the matching scores based on the indicated observable covariates.

Balancing test was implemented to assess the similarity of covariates distribution between the displaced and control units using different statistics. Standard difference and variance ratio are the most relevant statistics to assess balancing (Austin, 2009). A perfectly balanced covariate has a standardized difference of zero and a variance ratio of one (Randolph et al., 2014).

3. Results

This section discusses the study findings. It starts with the descriptive results followed by empirical findings.

3.1. Descriptive analysis

3.1.1. Characteristics of survey households

The displaced and control households have similar characteristics in many regards. For instance, the proportion of family members in the productive age range is limited in both groups, only 38% among the displaced households and 36% among the control group (Table 2). On the other hand, dependency ratio (i.e. people younger than 15 and older than 64/working people aged 15–64) was assessed, and the result showed high dependency (95% or more) among both groups. There is no statistically significant difference between the two groups in terms of size of productive age family members or dependency ratio. This implies both groups are consumer heavy as a limited number of productive age family members are forced to feed many under-age and/or elderly population. Similarly, sizeable proportions of heads of sample households are illiterate in both groups. The proportion of illiterate heads of households accounts for 31% among the displaced households and 27% for the control households. About 53% of the heads in the displaced group have attended primary school, while this is close to 60% among the heads of the non-displaced group. The proportion of heads attending secondary or college level education was limited and similar among both groups. The chi-square test result also indicates no statistical difference in the education status of heads between the displaced and control units.

Table 2. Proportion of sample households with selected features.

|                          | Displaced HHs | Control HHs | Level of significance |
|--------------------------|--------------|-------------|-----------------------|
| Dependency ratio (%)     | 95           | 101         | t-test (t) = -0.760    |
| Labor capacity (%):      |              |             |                       |
| Young child (<14 years)  | 48.5         | 51.5        | X² = 6.771             |
| Working child (15–17 years) | 12.8     | 12.3        |                       |
| Adult labor (18–65 years) | 37.6        | 35.5        |                       |
| Working elderly (over 65 years) | 1.0      | 0.6         |                       |
| Persons with disability/chronically ill | 0.1 | 0.1 |               |
| Education status of head of HH (%) | | | |                      |
| Illiterate               | 31           | 27.1        | X² = 3.842             |
| Literate                 | 69           | 72.9        |                       |

Note: *Significance at 10%; ** significance at 5%; *** significance at 1%. Source: Survey data.
3.1.2. Farm production

3.1.2.1. Landholding. Like other rural communities, access to farmland is a key source of livelihood in the study area. The majority (97%) of the sample displaced households have land (Table 3). However, 3% of them were landless because of the LSAIs induced displacement. On the other hand, all of the sample control households (100%) have farmland. Looking into the distribution of landholding size, about half of the displaced group (52%) has less than a hectare holding size, while the remaining 48% have one or more hectare land. The overall landholding size of the displaced households has reduced from 1.7ha (pre-displacement situation) to 1.35ha (post displacement) due to the LSAIs.

Similarly, the control group has also a similar holding size with the displaced households—less than a hectare (51%), one or more hectare (49%) and 1.41ha on average. The descriptive analysis result indicates no statistically significant difference in the average holding size as well as the distribution between the two groups. The discussions conducted with communities in the study areas indicate a sizeable number of the displaced households accessed farmland either through invading less productive communal rain-fed lands or through the informal purchase of land from neighbors. However, a very limited number of displaced households were provided with replacement land from the government (i.e. 2 out of 255 cases). The existing government regulation emphasizes the provision of cash compensation, not replacement land to the displaced households (Council of Ministers, 2007).

The difference in farmland holding size was rather observed between the two groups in terms of the land-use type. While a sizeable proportion of the control group (66%) has access to irrigated farmland, however, this is very limited and only 3% for the displaced households (Table 3). Irrigated landholding size significantly varies between the groups with 0.02ha for the displaced households and 0.5ha for the control group. The difference is statistically significant at 1%. The displaced households lost almost all of their irrigated land (0.6ha on average) to the LSAIs, and the displacement can be termed as an irrigated land-focused displacement. Only 69% of the displaced households have received cash compensation from the government. The remaining 31% of the displaced households were denied compensation from the relevant authority.

3.1.2.2. Crop production. Several types of crops are grown in the study areas. These include food crops, pulses, oil crops, vegetables and fruits. Maize is the dominant food crop grown by over 95% of the displaced households followed by Wheat and Teff (Table 4). These food crops are also largely cultivated by the control households. Crops such as vegetables, pulses and fruits are important economic crops in the study districts. However, this study finding indicates that the displaced households have limited involvement in the production of these economic crops mainly due to shortage of irrigated land. While the control groups are largely engaged and earning a substantial proportion of their income from these crops. The displaced households are often relying on rain-fed and marginal lands that are less suitable for economic crops. Moreover, the displaced households are mainly poor and cannot afford to bear the capital investment that the production of cash crops requires. This implies the displaced households are mainly focused on production of consumption-oriented food crops, while the non-displaced groups mainly rely on the production of high economic value crops to improve income.

The displaced households have dedicated a large share of their farmland to food crops (Table 4). On the other hand, the majority of the control households (66%) have participated in irrigated production dedicating a sizeable share of their land for high-value crops. The irrigated farming, which used to be a crucial source of livelihoods for the displaced households, is no more within reach due to the displacement.

Crop yield was assessed for the four rain-fed and commonly grown food crops in the study area. Crop harvest data for the 2019 production season was considered for the yield estimation. The result indicates lower yield performance among the displaced households for all of the assessed crops (Table 4). Compared to the control group, the displaced group has 31% less maize yield, 50% less wheat yield, 65% less Teff yield, and 74% less haricot bean. The yield difference is statistically significant at 1% for Maize and Wheat, and 5% for Teff. Similarly, the displaced households’ yield from irrigated crops is very limited or none; while the non-displaced households have enjoyed significant yield from irrigated crops. This implies the displaced households have limited opportunity for cash crops production because they have lost their fertile, irrigated and more suitable land to the LSAI, and currently struggling to sustain on marginal and less productive rain-fed lands.

Access to improved farm inputs, tools and services are crucial to enhance farm yield and production. Access to improved seeds, fertilizer, and productive tools was assessed. The result indicates the displaced households have applied less quantity of improved inputs as compared to the control groups. For instance, the displaced households have utilized a

| Variable | Displaced HHs | Control HHs | Level of significance |
|----------|--------------|-------------|----------------------|
| Percent of household by land ownership | | | |
| Own land | % 97 | 100 | $(X^2 = 8.475)** |
| Landless | % 3 | 0 | |
| Participate in irrigated farming | | | |
| Percentage | % 3 | 66.2 | $(X^2 = 226.402)** |
| Average landholding size | | | |
| Total | ha 1.35 | 1.42 | t = -0.728 |
| Rain-fed | ha 1.3 | 0.9 | t = -4.590** |
| Irrigated | ha 0.02 | 0.50 | t = -10.81)** |
| Less than 0.5ha | % 22.7 | 25.2 | $X^2 = 0.919 |
| 0.51–0.99ha | % 29.8 | 26.3 | |
| ≥ 1 ha | % 47.5 | 48.5 | |
| Average land lost to LSAIs by the displaced households | | | |
| Total | ha 1.7 | | |
| Rain-fed | ha 1.1 | | |
| Irrigated | ha 0.6 | | |
| Proportion of displaced households that were compensated | | | |
| HH compensated | % 69 | | |
| HH not compensated | % 31 | | |
| Compensation size | ETB/ha | 228,629 | |
| Proportion of households by displacement period | | | |
| Before 2000 | % 20 | | |
| 2000–2010 | % 8 | | |
| 2011–2017 | % 72 | | |

Note: *Significance at 10%; ** significance at 5%; *** significance at 1%. Source: Survey data.
Table 4. Crops produced and yield by household type.

| Crops produced and yield by household type | HHs engaged, % | Area, ha | Yield, Ton/ha |
|-------------------------------------------|----------------|---------|--------------|
| Displaced HHs                             | Control HHs    | Displaced HHs | Control HHs | Level of signif | Displaced HHs | Control HHs | Level of signif |
| Rain-fed crop production (mainly food crops) |                |         |              |               |               |            |               |
| Maize                                     | 97             | 97      | 1.0          | 0.6           | (t = -7.208)*** | 1.6         | 5.2           | (t = -20.773)** |
| Tef                                       | 22             | 60      | 0.1          | 0.2           | t = 1.267      | 0.7         | 1.1           | (t = -2.951)** |
| Wheat                                     | 25             | 57      | 0.2          | 0.2           | t = -0.451     | 1.2         | 2.4           | (t = -5.776)** |
| Haricot bean                              | 27             | 46      | 0.2          | 0.03          | (t = -5.185)** | 1.0         | 1.3           | t = -0.721     |
| Irrigated crop production (mainly cash crops) |                |         |              |               |               |            |               |
| Beet-root                                 | 37             | -       | -            | 0.1           | -              | -           | 13.3          |
| Potato                                    | 37             | -       | -            | 0.3           | -              | -           | 20.0          |
| Kale                                      | 33             | -       | -            | 0.1           | -              | -           | 16.6          |
| Cabbage                                   | 26             | 26      | -            | -            | 0.3           | -           | 22.0          |
| Onion                                     | 13             | -       | -            | 0.04          | -              | -           | 22.4          |
| Tomato                                    | 10             | 10      | -            | -            | 1              | -           | 32.7          |

Note: *** refers to significance at 1%; ** significance at 5%; * significance at 10%. Source: Survey data.

Table 5. Access to crop inputs/services.

| Access to crop inputs/services | Unit | Displaced HHs | Control HHs | Level of significance |
|--------------------------------|------|---------------|-------------|-----------------------|
| Chemical fertilizer           | Ton/ha | 0.07       | 0.11        | (t = -2.353)**        |
| Improved seeds                | Ton/ha | 0.01       | 0.02        | (t = -2.958)**        |
| Pesticides/insecticides       | Lt/ha  | 0.2        | 2           | (t = -4.011)**        |
| Extension advice from         | %     | 16.4       | 16.4        | X² = 0.000            |
| Development agents (DAs)      |       |             |             |                       |
| Market information            | %     | 0.0        | 8.2         | (X² = 18.855)**       |
| Agricultural Loan, ETB        | ETB   | 250        | 4510        | (t = 1.090)*          |

Note: *** refers to significance at 1%; ** significance at 5%; * significance at 10%. Source: Survey data.

very limited quantity of chemical fertilizer (i.e. 0.07ton/ha), which is over 40% less as compared to the quantity applied by the control group (Table 5). Similarly, the displaced households’ consumption rate of improved seeds was limited and 0.02ton/ha, which is 50% less as compared to the control units. Moreover, the displaced households applied only 10% of the volume of crop chemicals applied by the control group. In all cases, the displaced households have a limited consumption rate of improved crop inputs as compared to the control units, and the difference is statistically significant at 1% for pesticides/insecticides and 5% for improved seeds and fertilizer.

Access to financial services such as credit or agricultural loans is crucial to boost production and productivity. However, access to these services is limited for the displaced households. According to this study finding, displaced households have received only ETB 250 cumulative agricultural loan during the two years preceding this study, while this is over ETB 4,500 for the control units (Table 5). The difference is statistically significant at 10%. The fact that the displaced households are mainly poor and have limited access to land and income explain their limited access to inputs and services. The market-oriented agricultural service provision of the government prioritizes farmers with productive lands including irrigation. The displaced households were rarely given attention because these have limited access to irrigated and productive lands. This implies the loss of land due to the LSAIs have forced the displaced households to lose essential government-supported productive inputs and services. These households also rarely rely on the market to acquire farm inputs and services due to shortage of finance.

3.1.2.3. Livestock production. Livestock husbandry is another important source of livelihood in the study areas. More than 93% of the displaced and all control households were engaged in livestock production (Table 6). The key livestock types commonly produced in the areas include cattle, small ruminants, pack animals and poultry. The livestock holding size of sample households was estimated in tropical livestock units (TLU) using the conversion factor developed by Storck et al. (1991). TLU is an approach that converts different animals into a common measurement unit using conversion factors. The result indicates the

Table 6. Livestock productions and access to inputs/services.

| Livestock productions and access to inputs/services | Unit | Quantity | Median | Coefficient of Var. | Level of significance |
|----------------------------------------------------|------|----------|--------|---------------------|----------------------|
| Average livestock holding size                      |      |          |        |                     |                      |
| Displaced                                           | TLU/HH | 4.8      | 3.68   | 0.86                | (t = 3.414)***       |
| Control                                             |       | 6.6      | 5.10   | 1.01                |                      |
| Average milk yield                                  |      |          |        |                     |                      |
| Displaced                                           | Lt/Cow/Week | 13.2      | 9.3    | 0.82                | t = -1.486           |
| Control                                             |       | 16.7     | 14     | 0.83                |                      |
| Average egg yield                                   |      |          |        |                     |                      |
| Displaced                                           | Eggs/hen/Week | 8.7      | 7      | 0.60                | (t = -2.878)***      |
| Control                                             |       | 17.7     | 14     | 0.73                |                      |
| Proportion of HHs engage in livestock production    |      |          |        |                     |                      |
| Displaced                                           | %     | 93       | 100    | (X² = 14.059)***    |
| Control                                             |       |          |        |                     |                      |
| Proportion of HHs who applied one or more           |      |          |        |                     |                      |
| improved livestock inputs                           |      |          |        |                     |                      |
| Displaced                                           | %     | 10.2     | 10.5   | X² = 0.015          |
| Control                                             |       |          |        |                     |                      |

Note: *** refers to significance at 1%; ** significance at 5%; * significance at 10%. Source: Survey data.
displaced households have far less livestock holding size (5 TLU) as compared to the control group (7 TLU). The variation is statistically significant at 1%. The control households have better access to private pastureland and crop residues to keep more animals as compared to the displaced households. Similarly, the displaced households earn less milk yield (13LT/week/cow) as compared to the control units (17LT/week/cow) though the difference between the two groups is insignificant. This implies the displaced households earn less income from livestock production as compared to the control households.

3.1.3. Non-farm sources of livelihoods

From the above discussion, one can note that displaced households have limited farm yield and production mainly due to loss of farmland, poor land quality and limited access to productive inputs and services. As a result, these households are increasingly dependent on non-farm livelihood sources for survival that include wage works and small family businesses. This assessment result indicates sizeable proportion of displaced households (46%) were pursuing one or more of these sources of earnings to compensate for the farm income lost due to the LSAs (Table 7). While the number of control households engaged in any of these sources of income is limited and less than 30%. In this regard, the difference between the two groups is significant at 1%. Within the households, the number of family members engaged in non-farm activities also varies between the displaced and control units. On average, two family members have engaged in non-farm sources from the displaced households, however, this is limited and only one member from the control households. The difference is still statistically significant at 1%. This implies non-farm livelihood sources are a priority means of survival that are pursued by the displaced rural poor with limited earning from agricultural activities.

The LSAs that have created the displacement are supposed to create employment opportunities for the local communities, at least casual work, for the displaced people that are capable of working. Surprisingly, the LSAs are reluctant to create such opportunities for the local communities in general and the displaced households in particular. According to this study finding, only 11% of the displaced households (27 cases) have one family member employed as casual workers in the LSAs. The key informant interviews in the study area indicate LSAs often preferred to attract labor-force outside the affected communities due to mistrust with the host communities. The mistrust was mainly due to the limited involvement of communities during the displacement process and the low government compensation paid to the affected households. According to this study finding, the displaced households are not happy with the low-rated government compensation paid to them and are pursuing legal cases against the LSAs at district, zonal and regional levels with no definite response from the government so far.

3.1.4. Household income

This section summarizes the household gross annual income earnings from different sources – crop, livestock and non-farm sources. The result indicates a significant difference between the annual income of the displaced and control households (Table 8). According to this finding, the annual household income of the displaced household is only ETB 31,091, while the control households annual earning is four times higher than this (ETB 137,162). The difference is statistically significant at 1%. The displaced households earn less income from farm sources, but more income from non-farm sources that are considered as a low priority by the control group.

3.1.5. Access to productive farm assets

Household access to productive farm equipment and tools (i.e. such as irrigation pumps, water pipes, donkey carts) was analyzed for the displaced and non-displaced households. The result indicates a significant difference between the two comparison groups (Table 9). On average, the displaced households’ ownership of these assets is equivalent to ETB 10,981. While the control household’s ownership over similar assets amounts to ETB 27,913 and this is significantly higher than the former at 1%. The shortage of productive assets means the displaced households have limited ability to increase and diversify their income.

3.2. Empirical result

3.2.1. Estimated propensity score and balancing

Theoretical assumptions (i.e. that the covariates should not be affected by the treatment itself; and that the covariates simultaneously affect both the treatment and the outcome of interest), as well as context specific factors driving the displacement, were used to identify the covariates for estimating propensity scores and matching (Imbens, 2004; Ho et al., 2007). According to the survey result, households that have irrigated/irrigable land and within the command areas of the LSAs were experienced forced displacement. This means irrigated/irrigable land ownership has been affected by the treatment and cannot be used as a matching variable. The existing body of knowledge and this research finding indicates access to land is a key input for several sources of household income such as farming. Access to farmland is also often used as eligibility criteria to access productive assets and inputs such as improved seeds or irrigation tools (Wondimu et al., 2015). As a result, landholding, own land-based farm earnings, as well as access to productive inputs, are all excluded from covariate selection because these are affected by the treatment itself (i.e. displacement in our case). As a result, only five variables that are related to pre-treatment household characteristics and found to satisfy the balancing test were selected. These include the age of head of households, sex of household heads, marital status, household size and access to DAs advice. The propensity score of forced participation in displacement is estimated using these covariates and the Logit model for each of the displaced and non-displaced observations.

To analyze balancing, PSM and inverse probability treatment weighting (IPTW) methods were applied to the propensity score of selected covariates. The existing source emphasized these methods are commonly applied comparison strategies (Austin, 2009). In matching, the treated observation is compared with the control observation based on the closeness of propensity score (e.g. nearest neighbor) or with some level of caliper. In this case, observations that are outside common support (i.e. unmatched ones) are excluded from the analysis. On the other hand, with the weighting approach, all observations in the treatment and comparison groups are maintained and used for analysis. The weighting approach improves precision without worsening biases (Imbens, 2000; DuGoff et al., 2014).

Table 7. Frequency of HHs engaged in non-farm sources.

| HHs engaged in non-farm sources: | Unit | Household type | Level of significance |
|---------------------------------|------|----------------|----------------------|
|                                 |      | Displaced | Control | (X² – 20.789)***     |
| Family members engaged in non-farm sources per HH | N | 1.7 | 1.1 | (t = 3.295)*** |
| HHs involved in wage works: | % | 30 | 14 | (X² = 19.364)*** |
| Family members involved in wage works per HH | N | 1.9 | 1.1 | (t = 2.693)*** |
| HHs benefiting from the LSAs wage work opportunity: | % | 11 | 1 | (X² = 21.472)*** |
| Number of labor work participation in LSAs per HH | N | 1.2 | 1.0 | t = 0.894 |
| Engaged in self-employment/family business | % | 9 | 11 | X² = 0.488 |

Note: *** refers to significance at 1%; ** significance at 5%; * significance at 10%. Source: Survey data.
The nearest neighbor matching method is a commonly applied technique to match the treated and control units without replacement. Based on this technique, 510 observations were matched out of the 521 total surveyed units (Table 10). Mean standard error and variance ratio were estimated for each covariate to analyze their distribution. Existing sources indicate, for each covariate, the balance between the comparison groups is best when the difference in mean standard error between the treated and control group is close to zero, and variance ratio is close to one (Rubin, 2001). Our analysis of balancing using the PSM and IPTW is well aligned with this guiding principle. According to the findings, the difference in mean standard error between the displaced and non-displaced households is close to zero, and the variance ratio is close to one for all covariates of matched observations (Table 10). Similarly, using all of the 521 observations, the difference in weighted standard error between the groups is close to zero, and the variance ratio is close to one for each covariate under the IPTW implying consistency of findings. The distribution of covariates is consistent and balanced between the displaced and non-displaced households based on the PSM and IPTW analysis, implying that the propensity scores are properly specified and estimated.

The balance between the displaced and non-displaced groups can also be assessed using graphs constructed based on the propensity scores of the two groups. Our analysis indicates that the balanced plot constructed based on the propensity score of the covariates for the matched treatment and comparison groups (i.e. 510 displaced and non-displaced observations) fully overlaps implying that the common support assumption is satisfied (Figure 2). Similarly, for the weighted data, the density function of covariates graphed together for the displaced and non-displaced households below indicates a good balance between the two groups (Figure 3).

### Table 8. Summary of household annual income (ETB).

| Household type       | Mean (ETB) | Std. Error Mean | Median | Coefficient of Var. | Level of significance |
|----------------------|------------|-----------------|--------|---------------------|----------------------|
| Crop income          |            |                 |        |                     |                      |
| Displaced HHs        | 15,478     | 1,435           | 10,000 | 1.47                | (t = -4.509)*****    |
| Control HHs          | 122,712    | 23,286          | 40,200 | 3.08                |                      |
| Livestock income     |            |                 |        |                     |                      |
| Displaced HHs        | 6,026      | 615             | 1,000  | 1.63                | (t = -3.826)*****    |
| Control HHs          | 10,631     | 1,021           | 3,012  | 1.57                |                      |
| Non-farm income      |            |                 |        |                     |                      |
| Displaced HHs        | 9,587      | 1,323           | 0      | 2.2                 | (t = -3.717)*****    |
| Control HHs          | 3,819      | 835             | 0      | 3.56                |                      |
| Gross household annual income | | | | | (t = -4.425)***** |
| Displaced HHs        | 31,091     | 2,159           | 21,780 | 1.11                |                      |
| Control HHs          | 137,162    | 23,417          | 54,400 | 2.77                |                      |

Note: *** refers to significance at 1%; ** significance at 5%; * significance at 10%. Source: Survey data.

### Table 9. Access to crop inputs/services.

| Ownership of assets (productive tools/equipment such as irrigation pumps), ETB | Samples | Mean | Median | Coefficient of Var. | Level of significance |
|--------------------------------------------------------------------------------|---------|------|--------|---------------------|----------------------|
| Displaced HHs                                                                  | 10,981  | 7,950| 1.0    | (t = -4.105)*****    |
| Control HHs                                                                    | 27,913  | 8,630| 2.34   |                      |

Note: *** refers to significance at 1%; ** significance at 5%; * significance at 10%. Source: Survey data.

### Table 10. Standard error and variance ratio of matching variables.

|                          | PSM-ATT (Matched) | IPTW-ATT (Matched) |
|--------------------------|-------------------|--------------------|
|                          | Stand. differences | Variance ratio     |
| Age Head                 | -0.03             | 0.91               |
| Sex Head                 | -0.08             | 1.13               |
| Married                  | -0.05             | 1.07               |
| Total AE                 | -0.01             | 1.37               |
| Access to DAs advise     | -0.04             | 0.92               |
| No. of treat. obs        | 255               | 255                |
| No. of cont. obs         | 255               | 266                |
| Total Obs.               | 510               | 521                |

Source: Survey data.

The treatment effect on income

Average treatment effect on the treated (ATT) was measured using PSM – nearest neighbor (NN); and the result checked for robustness using IPTW. As discussed earlier, both the PSM-NN and IPTW have implied optimum balance between the covariates across the displaced and non-displaced groups. Based on the PSM-NN estimator, the displaced households’ gross annual income is significantly lower than the annual...
income of the non-displaced households. On average, the displaced households’ annual income earning is less by 71.5% (ETB 97,536) as compared to the non-displaced households (Table 11). This difference is statistically significant at 1%. Similarly, the income of displaced households is significantly lower than the income of non-displaced households by 74.7% (ETB 91,000) based on the IPTW result confirming the robustness of the PSM finding. These results are consistent with the findings of other studies. For instance, Wondimu et al. (2015) have come up with over ETB 55,000 net annual income reduction of farmers whose farmland was taken by LSAIs and allocated for Sugarcane plantation in Ethiopia. Other findings (e.g. Bekele, 2016) have also found significant income reduction among the displaced households due to loss of land to LSAIs in Ethiopia.

3.2.3. Treatment effect on household asset holding

The impact of displacement on the asset holding status of displaced households was assessed. Household livestock holding size as measured in TLU, and ownership of productive farm tools and equipment as measured in ETB, were used as outcome variables and analyzed. PSM-NN was applied to assess the displacement effect on affected households. The result indicates the difference in assets of displaced and non-displaced households remained significantly negative. The average livestock holding of displaced households is lower than those who have not been displaced by about 2.8 TLU (Table 12). From this, one can generally conclude that the livestock holding size of displaced households was significantly affected by the LSAIs in the study areas. Similarly, ownership of productive farm tools and equipment was assessed using the PSM-NN for the displaced and non-displaced households. The tools and equipment considered here include ownership of several farm tools and irrigation equipment such as pumps. The result indicates the displaced households have limited ownership of these assets as compared to the non-displaced households. Under both approaches (PSM and IPTW), the difference is statistically significant at less than 1%. This implies the displaced households have limited access to productive resources to improve their production, yield and income.

3.2.4. Sensitivity analysis

Matching is aimed to eliminate biases through balancing based on observable covariates. However, there could be unobserved variables (U) that cause hidden biases. Sensitivity analysis is therefore applied to check if unobservable variables are causing hidden biases and how much the effect of these biases the estimated treatment effect. Ignorability assumption is violated if confounders are causing hidden bias (Ichino et al., 2008). To address this problem, a simulation-based sensitivity technique is often preferred to assess the effect of potential confounders on the average treatment effect on the treated units (Ichino et al., 2008). According to this source, implementation of the simulation technique could be done in two ways. One way is through using a variable that is believed to confound the result, while the second method is through assigning probabilities P11, P10, P01, P00 called the ‘killer confounders’. Due to the problem of identifying potential confounding variables, we applied the ‘killer confounders’ by assigning P11 = 0.80, P10 = 0.70, P01 = 0.60 and P00 = 0.30 with mean household income level. The analysis simulates a potential confounder to assess the robustness of the estimated treatment effects for deviations from the conditional independence assumption. The baseline and simulated average treatment effect on the treated (ATT) was estimated using nearest neighbor (NN), kernel matching method (KMM), and radius matching method (RMM).

The analysis result shows that the simulation technique using the NN method has reduced the income by only 6% (from 97,500 to 90,400) due to potential confounders (Table 13). In the cases of KMM and RMM methods, the effect on income due to the confounder was increased by a

![Figure 3. Balance graph.](image)

**Table 11. Average treatment effect on gross annual income of displaced households.**

| Estimators | Outcome method | Measurement type | Treatment effect (Displaced HHs vs Control HHs) | Coef. | Standard Error | P > z |
|------------|----------------|------------------|-----------------------------------------------|-------|----------------|-------|
| PSM NN method | Matching | ATT | -97,535.9 (71.5%) | 36,255.15* | 0.007 |
| IPTW Weighted mean | ATT | -91,633.0 (74.7%) | 18,196.44 | 0.000 |

Note: * Abadie-Imbens robust standard errors (RSE) used.

**Table 12. Average treatment effect on farm productive asset holding of displaced households.**

| Estimator | Outcome model | Treatment effect | ATT - (Livestock holding size in TLU) | Coef. | Standard Error | P > z |
|-----------|---------------|------------------|-------------------------------------|-------|----------------|-------|
| PSM-NN matching | ATT | -2.8 | 0.89* | 0.002 |
| IPTW weighted mean | ATT | -2.4 | 0.51 | 0.000 |

Note: * Abadie-Imbens robust standard errors (RSE) used.

**Table 13. Sensitivity analysis.**

| Estimation | No. of treat. | No. of cont. | Baseline estimation | Simulated Estimation | Out. Eff. | Sel. Eff. |
|------------|---------------|--------------|---------------------|----------------------|-----------|-----------|
| ATT with NN method | 255 | 151 | -97, 500 | -90, 400 | 3.843 | 2.683 |
| ATT with KMM | 255 | 250 | -94, 000 | -100, 000 | 3.804 | 2.661 |
| ATT with RMM | 255 | 250 | -94, 600 | -103, 000 | 3.896 | 2.653 |

Source: Survey data.
limited proportion - 6.4% (in the case of KMM) and 8.8% (RMM). This implies the simulated confounder has limited impact on the overall estimate of treatment effect implying that the estimate is robust. The odds ratio in the last two columns was generated using the logit model to assess the effect on income and participation in displacement due to the potential confounders. The result indicates limited change in income and participation in displacement due to the confounders. The higher the numbers reported here indicate increased sensitivity and the lower the numbers reported indicate limited sensitivity of the treatment effect. In both cases, the estimated treatment effect is insensitive to potential confounders, implying the estimated ATT was robust.

4. Discussion

The empirical finding indicates displacement due to the LSAs has significantly undermined the income and asset possession of the displaced households. The annual income of displaced households has reduced by 72% as compared to the income of non-displaced households. The descriptive analysis result also indicates a significant decline in income of the displaced households. These households earn only 19% of the crop income and 57% of the livestock income earned by non-displaced households. The finding of other several studies within Ethiopia and elsewhere also indicate a substantial reduction of farm income of displaced households due to the LSAs (Wondimun et al., 2015; Bekele, 2016). This implies LSAs induced displacement has a significant and negative impact on farm and overall income of the displaced households. On the other hand, due to the loss of land to LSAI, the displaced households were forced to rely on non-farm sources including low paying casual labor works to earn livelihoods. Similar findings from other African countries indicate that the wage works available to the displaced people are often low-paying and risky health-wise (Zaehringer et al., 2018a,b). This implies displacement has forced the displaced households to engage in marginal sources of income earning for survival.

Several factors explain why the displacement has contributed to a significant decline in the income of the displaced households. Loss of land particularly irrigated land lies at the core of significant decline in income of displaced households. According to this study finding, the displaced households have dispossessed their irrigated land to the LSAs. This has severely undermined their involvement in irrigated cash crops production and income there-off. This finding is well-aligned with similar studies in other countries. According to Breu et al. (2016) and Rulli et al. (2013), LSAs have often positioned themselves close to the available water sources (rivers, lakes, and other water bodies) thereby causing shortage of irrigated land and water among small-scale irrigation users and undermining their crop production. Over obstruction of water sources by LSAs in many African countries has severely affected smallholders’ production and yield (Ulrich, 2014; Dégife and Mauser, 2017). This implies LSAs’ quest for land acquisition depends on the availability of water and irrigable land thereby threatening the income of small-scale irrigation users and others living around water bodies.

Access to productive farm tools/equipment, inputs and services are crucial to boosting farm production and income. However, this study finding indicates displaced households have limited access to these sources. According to the empirical result of the study, the displaced households have limited possession of productive farm assets, close to ETB 5,000 less as compared to the non-displaced households. The consumption rate of improved seeds and fertilizer among the displaced households is significantly lower than the quantity applied by the non-displaced households –40% less for fertilizer application and 50% less for improved seeds. The community FGD result indicates the government considers access to land (including irrigated land) as key criterion to provide productive inputs and services such as improved seeds and fertilizer. Such consideration has excluded the displaced households from accessing improved tools, inputs and services. This implies the mainstream agricultural inputs and service provision marginalizes the landless and displaced households affected by the LSAs. Existing sources from other African countries also indicate LSAs rarely contributed to the modernization of farming activities of displaced households through introducing improved farm inputs, practices and technologies (Ploeg and Van der, 2010; Zaehringer et al., 2018a,b).

Moreover, the study finding indicated displacement has negatively impacted on livestock production. Shortage of land among these households means they have limited access to crop residue and pasture to feed their animals. The livestock herd size, productivity and income of the displaced household have significantly declined as a result. Experience from other sources indicated similar findings. Smallholders displaced due to LSAIs were forced to convert pastureland to farmland, reduce the stock size to cope with feed shortage, and this has negatively impacted livestock income (Zaehringer et al., 2018a,b; Mekuye et al., 2018; Bekele et al., 2021). This implies LSAs has contributed to de-accumulation of key livelihood assets, which the displaced households could count on at the time of shocks to meet their income need and other means of survival. LSAs are expected to create employment opportunities for the displaced people as part of their corporate responsibilities. However, this is rarely happening in the study area. According to the descriptive analysis result, LSAs have created very limited incoming earning opportunities including casual works for the displaced households. The community FGDs result indicates these LSAs were reluctant to attract local labor-force including casual workers mainly due to lack of trust on the local community. Rather, they prefer to attract a labor-force from outside the displaced communities. This finding is well aligned with results of other sources that indicate the presence of LSAs rarely contributed to improved livelihoods of the displaced smallholders through employment creation (Ploeg and Van der, 2010). The community discussion result also indicated there was no smooth interaction between the LSAs and local communities to ensure a win-win approach from the investments. The low wage rate, poor fulfillment of corporate responsibilities as well as associated negative health impact arising from uses of farm chemicals by the LSAs were served as a disincentive to involve in LSAs based wage works (Dégife and Mauser, 2017; Zaehringer et al., 2018a,b). This implies the LSAs while forcing the smallholders to loss their farm enterprises, however, failed to create alternative opportunities for the displaced people to ensure their survival.

According to the existing government law, displaced households are entitled to receive cash compensation and engage in alternative sources of livelihoods (Council of Ministers, 2007). However, this study result indicates several challenges in this regard. On the one hand, sizeable numbers of displaced households (over 30%) had not received any compensation from the government. Existing evidence from the past confirms similar practices. Dispossession of land with little or no compensation is often practiced in Ethiopia (Retzbuch, 2010; Araya, 2013). On the other hand, the majority of compensation recipients were dissatisfied with the compensation process and amount of cash received. The displaced households were neither involved in community consultation nor valuation/pricing of assets dispossessed due to the LSAs. Similar studies elsewhere also indicate higher dissatisfaction among the displaced people with compensation received mainly due to low asset pricing, low compensation rate compare to the market, delayed payment or limited transparency during the process (Huu TY et al., 2013; Richards, 2013). This implies the displaced households are passive recipients of compensation without having any input in the process and therefore, forced to receive a limited amount of compensation given to them or risk losing it. This contradicts the existing government regulation, which indicates the displaced people should actively participate in the process and agree with the amount of payment provided.

The community FGDs result also shows the amount of cash compensation provided was too limited to enable the displaced families to establish alternative sources of income or strengthen existing ones. Along with this, existing evidence suggests that displacement of smallholders from farmland without equivalent or more compensation pay undermines their livelihoods and income, thereby leading to impoverishment (Keeley et al., 2014; Vanclay, 2017). Moreover, the displaced...
households received cash only, and no livelihoods planning support or skill training to ensure proper utilization of the compensation resource. This is so because the government compensation guideline is narrowly framed and focuses on cash compensation only without having further support and guidance on livelihoods restoration. As a result, the majority of those who have received the cash compensation were forced to use the resource for informal purchase of marginal lands to engage in agricultural livelihoods. This implies that the government compensation provision is not comprehensive enough to ensure livelihood restoration of the displaced people.

The weakness of institutions in charge of rural land, displacement and associated compensations is at the core of the problems facing the displaced smallholders. All land is under government ownership in Ethiopia. One of the key arguments for state ownership of land is to protect farmers against displacement (Lavers, 2018). Ethiopia’s FDRE Constitution (1995) and Land proclamation (2005) re-iterate that anyone who wants to make a living by farming has the right to get access to farmland free of charge. Moreover, LSAs are also expected to contribute to the local socio-economic service provision as part of their corporate responsibilities. However, this study finding indicates that displaced households were not provided with replacement land. The community FGDs result indicates only farmland lost to the LSAs and houses partly or fully demolished were compensated (with cash); other expropriated resources including perennial trees and other investments on the land were not compensated. This has contributed to the reduction of compensation payment per recipient. Furthermore, no other support was provided including services to the restoration of lost income sources. Similar studies elsewhere confirmed that the displaced people due to LSAs see their life and livelihoods worsening compared to the situation before displacement (Harris, 2015).

From the LSAs perspective, these investments rarely lived up to expectations. According to this study finding, their contribution to local employment creation, infrastructural development or farm technology transfer is insignificant. Responsible investment in agriculture that protects poor farmers and their sources of livelihoods is yet to be ensured in Ethiopia (Degife and Mauser, 2017). This implies the existing government institutions and structures are too weak to enforce standing regulations related to the LSAs, and this has significantly impacted the livelihoods and income of the displaced people.

5. Conclusions

Impacts of LSAs on the displaced smallholders depend on a specific local context. Among others, factors such as the characteristic of the displaced people, the type of local resource affected by the LSAs, and the type and level of supports provided to the displaced farmers are context-specific and therefore key drivers determining the impacts of LSAs on income and asset condition of displaced people.

In light of the above, this study concluded that the annual income and asset holding situation of the displaced households have significantly reduced due to the LSAs in the study area. The empirical findings from this study prove that the displaced households earn significantly less annual income as compared to the non-displaced households. Moreover, households affected by the LSAs have limited assets including livestock and other productive resources as compared to the non-displaced households. Several key factors underline this and these include loss of fertile and irrigated land to LSAs, inadequate compensation, limited access to productive farm inputs and services, and weak capacity of relevant actors to support the displaced people. Moreover, despite taking their land and water resources, the LSAs have rarely created alternative opportunities for the displaced people. The latter is suffering from a shortage of income and other key resources as a result.

In conclusion, this study has generated empirical results proving the worsening income and asset condition of the displaced smallholders due to the LSAs, thereby contributing to addressing the scientific information gap in this regard. However, the impacts of LSAs on the displaced people are by no means limited to these. Such impacts as household food security, vulnerability to climate change, and access to ecosystem services from the Lake Ziway, were not addressed in this study and therefore should be the subject of further researches. More importantly, LSAs may have serious implications for the nearby water bodies and deserve more attention.

Declarations

Author contribution statement

Dereje Kebede: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Girmay Tesfay; Bezabih Emanac: Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

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Data availability statement

Data will be made available on request.

Declaration of interests statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

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