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# Female Labor Outcomes and Large-scale Land Investments in Tanzania

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## Abstract

The current transformation of the agricultural sector in many African countries has been perceived to be connected to land resources and the quest to advance agriculture as a commercial enterprise. The main expectations in this agricultural transformation include increased productivity, job creation, and rural development. This paper examines to what extent this alleged transformation has delivered on its promises, particularly for rural women. We conduct comparative analyses using the Living Standards Measurement Study-Integrated Surveys on Agriculture (LSMS-ISA) dataset, complemented with a survey from two case studies of large-scale land investments (LLIs) in Kilombero district, Morogoro region, Tanzania. The finding from the study shows that the LLIs have no significant effect on agricultural wage. However, the results show that LLIs have a negative effect on the welfare of female-headed households located in communities with LLIs. Looking at the case studies, however, we find that female-headed households working in the LLIs earned slightly lower agricultural wage compared to those not working in the LLIs. This implies that the use of LLIs in Tanzania to drive agricultural transformation requires better targeting of potential beneficiaries.

## Résumé

La transformation actuelle du secteur agricole dans de nombreux pays africains a été perçue comme étant liée aux ressources foncières et à la recherche pour faire avancer l'agriculture en tant qu'entreprise commerciale. Les principales attentes de cette transformation agricole sont l'augmentation de la productivité, la création d'emplois et le développement rural. Cet article examine dans quelle mesure cette transformation supposée a tenu ses promesses, en particulier pour les femmes rurales. Nous procédons à des analyses comparatives à l'aide de l'ensemble des données de l'Enquête sur les conditions de vie des ménages - Enquêtes intégrées sur l'agriculture (LSMS-ISA), complétées par deux études de cas d'investissements fonciers à grande échelle (LLIs) dans le district de Kilombero, dans la région de Morogoro, en Tanzanie. Les conclusions de l'étude montrent que les LLIs n'ont pas d'effet significatif sur les salaires agricoles. Cependant, les résultats montrent que les LLIs ont un effet négatif sur le bien-être des ménages dirigés par des femmes situés dans des communautés avec LLIs. En ce qui concerne les études de cas, nous constatons cependant que les ménages dirigés par des femmes travaillant dans les LLIs gagnaient un salaire agricole légèrement inférieur à ceux qui ne travaillaient pas dans les LLIs. Cela implique que l'utilisation des LLIs en Tanzanie pour stimuler la transformation agricole nécessite un meilleur ciblage des bénéficiaires potentiels.

## 1. Introduction

Africa accounts for more than 65 percent of the world's large-scale land investments (LLIs), with more than 80 percent of these concentrated in the agricultural sector (Anseeuw et al, 2013). The vastness and low cost nature of Africa's arable land area, the availability of cheap labor, and the region's weak institutional framework have all been identified as the principal factors attracting investors to African countries (Cotula et al, 2009; Deininger et al, 2011; Osabuohien et al, 2015). The upsurge of land investors in Africa can also be linked to the current agricultural transformation agenda in Africa, which aims to advance agriculture from the subsistence level to a more viable commercial level (Osabuohien, 2014; Hermann and Grote, 2015).

The significance of LLIs increased in the wake of the new millennium and particularly after 2007-2008 global financial and economic crises, driven by investors seeking a more stable investment platform and by the desire of many African governments to revitalize their countries' agricultural sectors (Wolter, 2009; Osabuohien et al, 2015). Employment opportunities, rural development and integration, and provision of social amenities are the promised benefits of such agriculture revitalization. However, the extent to which LLIs have delivered on their promises of increased incomes and employment creation, particularly for rural women who are highly vulnerable to socio-economic shocks, remains unexplored.

Similar to agriculture in other developing countries, Tanzania's agricultural sector plays a prominent role in enhancing food security, income generation and employment creation. The sector employs more than 70 percent of the country's population; over 80 percent of Tanzania's female population is involved in the main-stream agricultural production process, making women particularly vulnerable to changes in agricultural and land-related activities (Tanzanian National Bureau of Statistics -TNBS, 2015). Tanzania has received sizeable LLIs in terms of both number of investments and acreage. Available statistics show that the country is among the top 20 recipients of LLIs globally, as well as among the top 10 LLI destinations in Africa (see Figure A1 in the Appendix).

Tanzania's rate of unemployment and underemployment remains high and is especially skewed for women; the unemployment rate for females is 3 percent above the national average. For instance, although women in Tanzania own more than 47 percent of non-agricultural enterprises (which are mainly informal), they account for only 35 percent of wage employment (World Bank, 2014). Women also face some discrimination in terms of salary structure and business profit.

The pattern of LLIs in Tanzania exhibits some variation across regions (districts), purposes (intentions), sizes, and crops cultivated. Most of the land investments in the country are targeted at the agricultural sector, including bio-fuel production (Abdallah et al, 2014). Therefore, these investments are expected to have significant effect on women, who have higher participation in agricultural activities.

Consequently, the main argument of this study is that although most Tanzanian women eke out their livelihood from the agricultural sector, women's economic gains from LLIs may not be substantial compared to that of men. This presupposes that when there are issues of land displacement emanating

from the occurrence of LLIs, the effects on women might be higher. We seek to provide empirical insight into three important questions: a) to what extent is the welfare of female-headed households in communities with LLIs affected compared to those living in communities without LLIs?; b) how does the presence of LLIs impact the agricultural wage income of female-headed households?; and c) how does the occurrence of LLIs affect the agricultural labor allocation of female-headed households? We use the Living Standards Measurement Study-Integrated Surveys on Agriculture (LSMS-ISA) dataset and complement it with a survey from two case studies of LLIs in Kilombero district in Morogoro region.

The results show that LLIs have a negative effect on the welfare of female-headed households located in communities with LLIs. Further, there is a decline in welfare (total consumption) for female-headed households working in LLI enterprises. However, households whose head is working in the out-grower[1] scheme have higher welfare. The results show a non-significant effect on agricultural wages, while the findings from the case study show that female-headed households working in LLIs earned slightly lower agricultural wages compared to those in the out-grower scheme and those not working in LLIs. For the agricultural hour allocation, results using the national dataset show that women working in the LLIs allocate more hours to agricultural activities than those working outside the LLIs[2].

The remainder of the paper is organized as follows. Section two discusses the stylized facts, where background data is used to situate the agricultural and labor condition of Tanzania in relation to women. Section three presents the literature review. The research method is included in the fourth section; discussion of results is presented in the fifth section, and section six concludes.

## 2. The Agricultural Sector and Labor Market in Tanzania

Agriculture remains a dominant sector in most developing countries, especially in rural areas. In Tanzania, more than 70 percent of women earn their livelihoods from agricultural activities (TNBS, 2015). Over the last decade, Tanzania has recorded high economic growth; the GDP per capita has more than doubled, from US$348 in 2004 to US$955 in 2014. Although the share of agricultural value added to GDP has been stagnant at about 29 percent, agriculture's contribution to the country's economic growth has increased slightly. Despite Tanzania's high growth rates (an average of 7 percent in the last five years), however, it seems that limited benefits have been derived by low-income populations.

Tanzania has good climatic conditions for agricultural cultivation. The coastal region is characterized by tropical conditions suitable for rice cultivation, while along the highlands, temperate conditions are suitable for coffee production. In addition, Tanzania is home to three of the major lakes in Africa; this is important, as the country's agricultural sector is dependent on natural water supplies, with limited

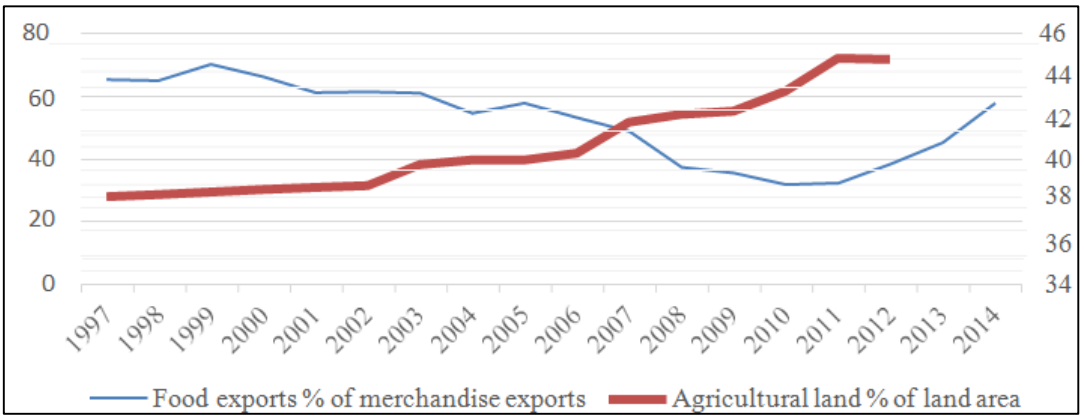
[1] The out-grower scheme is a contractual agreement between investors and individuals/associations that involves the production of agricultural products. The scheme varies depending on the extent of the inputs costs, risks, and benefits that are shared between the two parties.

[2] We could not confirm this using the case study because of limited data occurring from missing values.

mechanized farming or irrigation systems. The main cash crop is coffee, followed by sisal, cashews, cotton, tobacco, tea, and oil seeds (The Oakland Institute, 2011).

Over 80 percent of Tanzania's poor and extreme poor live in rural areas. These rural areas, which are mainly dependent on the agricultural sector, remain largely underdeveloped with poor infrastructure and limited access to public amenities (Headey and Jayne, 2014), as well as limited opportunities to establish links with productive value chains and higher value crops. Most of the agricultural activities in these areas are undertaken by women, who are constrained by family obligations, low education and skills, limited access to finance, and limited ownership of productive resources. Therefore, the poor state of rural economies affects women adversely.

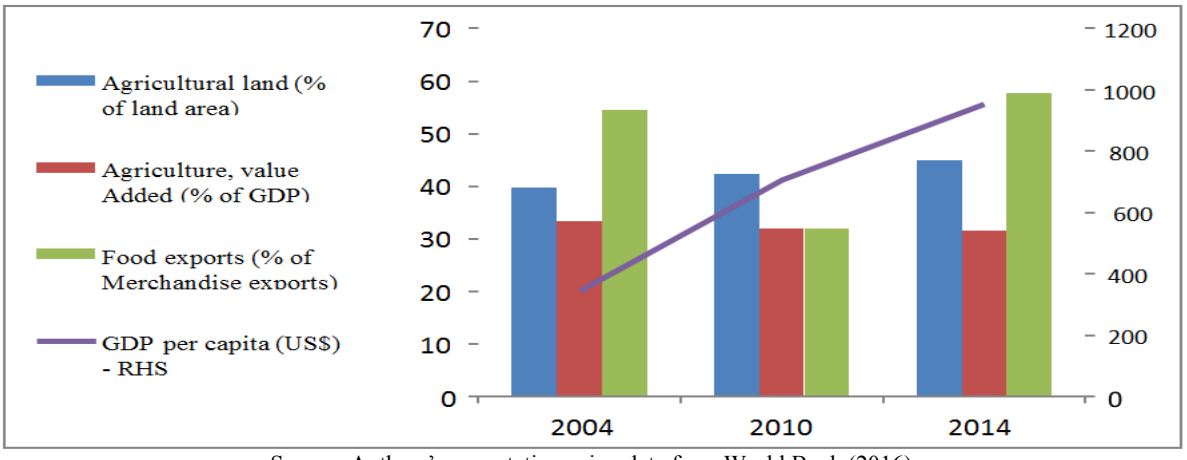
*Figure 2.1a: Agricultural Land and Food Export in Tanzania*




Source: Authors' computation using data from World Bank (2016)

Note: the right axis represents the figures for food exports % of merchandise exports, while the right axis represents agricultural land as % of land area,

*Figure 2:1b: Agricultural Sector and Economic Performance in Tanzania*




Source: Authors' computation using data from World Bank (2016)

Table 2.1 shows that the agricultural sector of Tanzania has remained buoyant in the absorption of the working population. In 2006, the agricultural sector employed a total of 75.1 percent of Tanzanian youth and adults. More women worked in this sector during this period, accounting for 40.8 percent; only 34.3

percent of men worked in the sector. In 2014, the trend was not much different - agricultural sector employed about 61 percent of the total youth and adult population. This trend reinforces the relevance of the agricultural sector in employment generation in Tanzania.

*Table 2.1: Percentage of Total Employment across Sector (Age 15+)*

| | 2006 | | | 2014 | | |
|---|---|---|---|---|---|---|
| **Sector** | **Total** | **Male** | **Female** | **Total** | **Male** | **Female** |
| Central and Local Government Parastatal | 2.6 | 1.8 | 0.9 | 3.2 | 1.8 | 1.3 |
| Organization | 0.4 | 0.3 | 0.1 | 0.4 | 0.3 | 0.1 |
| Agriculture | 75.1 | 34.3 | 40.8 | 60.7 | 30 | 30.7 |
| Private Informal Sector | 10.1 | 5.6 | 4.5 | 18.6 | 9.7 | 8.9 |
| Private Other Sector | 8.6 | 6.1 | 2.5 | 9.5 | 6.3 | 3.3 |
| Household Duties | 3.1 | 0.5 | 2.6 | 7.7 | 2.5 | 5.1 |

Source: Tanzanian National Bureau of Statistics-TNBS (2015)

The employment statistics show that approximately 94 percent of households in rural areas have at least one member working in the agricultural sector (see Table 2.2). In addition, approximately 93 percent of these households have a household head who is not well-educated (only primary education or less). In Dar es Salaam (the capital city), about 7 percent of households report having at least one person involved in the agricultural sector, and approximately 54 percent of the households have at least one member engaged in wage employment, compared to 15 percent in rural areas.

*Table 2.2: Other Employment Statistics and Educational Attainment of Household Head*

| | **Dar es Salaam** | **Other Urban** | **Rural** | **Total** |
|---|---|---|---|---|
| At least one Person in Household Engaged in Wage Employment | 53.99 | 39.50 | 14.81 | 35.73 |
| At least one Person in Household Engaged in Agricultural Sector | 6.87 | 54.78 | 94.28 | 72.80 |
| Household Heads with Primary Education and Less | 65.23 | 74.81 | 93.22 | 84.78 |

Source: Authors' computation from TNBS (2015)

To realize economic growth and development, land is a crucial resource. Tanzania's Land Act of 1999 indicates that all land belongs to the public but is vested in the President as a trustee for and on behalf of all citizens of Tanzania. For the purposes of management only, all land is classified as General land, Village land (about 71 percent of total land), and Reserve/public land. The President has powers to transfer land from one category to another. In order to accommodate the growing foreign interest in Tanzania's land, some land reforms have been implemented recently and have changed the land tenure system. Specifically, the Land Act of 1999 and the amendment of the Land Act in 2004 allowed for land marketing and mortgaging (Abdallah, et al, 2014; Massay, 2015). The dynamics of resource ownership is a major factor in determining income generation, and so these changes have had significant impacts in rural areas, where much of the land was organized under customary law.

A report by The Oakland Institute (2011) highlights three important policy themes that underline land policy in Tanzania: the state ownership of land; the right to land depending on what the land is used for;

and the administrative, rather than judicial, control of land. These themes, among others, mean that land access for foreigners comes through the government, not individuals. The government office responsible for land acquisition is the Tanzania Investment Centre (TIC); this agency has the sole right to allocate land to investors on the basis of a derivative title for the period and purpose of the investment (Cotula et al, 2008). The TIC has the right to reclaim the land once the investors' project ends.

The LLIs are mainly located in rural areas, which means that they have significant impact on the majority of Tanzania's poor and on how these poor populations earn their livelihoods. The trend of LLIs in Tanzania suggests strong interest in foreign land investment in the agricultural sector. More than 95 percent of foreign investors have agriculture as their main motive for land acquisition in Tanzania (Land Matrix Global Observatory, 2016). With this rising interest in LLIs in Tanzania, this study analyses whether these investments translate into improved household in communities where they are situated. We focus on three important issues – consumption, agricultural wages, and the labor hour input in the agricultural sector, especially for women.

## 3. Brief Insights from Recent Literature

The modernization and/or commercialization of agriculture across the globe have led to an increase in agricultural productivity and have stimulated employment creation and economic growth in most countries. However, attempts to transform the agricultural sector in developing countries (especially Africa) have not translated to such economic gains. The recent trend of LLIs[3] attempts to bring about rural poverty eradication and inclusive growth through increased productivity, employment opportunities, and improved infrastructure. In Tanzania, the Agricultural Sector Development Strategies (ASDS), developed in 2001 and 2006, and the Kilimo Kwanza Strategies, developed in 2009; aim to attract increased foreign investment in the agricultural sector (Abdallah et al, 2014; Massay, 2015).

The main drivers of LLIs in developing countries include cheap labor, availability of idle arable land, and weak property rights that ease the process of land acquisitions. The downside to this is that the interests of the local communities are not always incorporated in such land deals, resulting in substantial grievances by the local community and, in some extreme cases, to violence. Often, LLIs involve the displacement and resettlement of local populations with the promise of employment opportunities, wage income, and public amenities. Some of LLIs have failed to take off or have closed down after a few years of operation, which affects the community and the government expected revenues (Abdallah et

[3] Large-scale land investments (LLIs) are those investments (mainly in agriculture) that involve the acquisition of land above 200 hectares of land (Land Matrix Global Observatory-LMGO, 2016). Others such as Cotula et al (2009) use the benchmark of 1000 hectares and above to classify LLIs. For this study, the LMGO (200) typology is employed as it is widely used in the literature. In most cases, such LLIs are used for direct agricultural activities like crop planting or for other non-planting activities like food processing.

al, 2014; Osabuohien et al, 2015). These economic and institutional nuances of the investment models embedded in LLIs are often overlooked in the analysis of impact of LLIs (Anseeuw et al, 2013).

Most small-scale subsistence farming activities are inherently gendered in Tanzania. As in many other developing countries, women take on the core duties of food production and processing; hence they shoulder the burden of maintaining food security at the household level (Doss et al, 2014). The resettlement and giving up of land as a result of land acquisitions adversely affects women's role as primary providers for their households. Dancer and Sulle (2015) suggest that gendered impacts of land commercialization need to be addressed in order to reduce women's vulnerability in Tanzania. Women's cultural family obligations limit the time they can commit to non-farm activities and also restricts their mobility (Doss et al, 2014; Isaksson, 2015). The lower likelihood of women being employed in non-farm activities in the LLIs, due to both family obligations and women's lower educational attainment, reduces the magnitude of benefits that women gain from LLIs compared to men.

The existing literature indicates less favorable outcomes for women compared to men in Zimbabwe (Mutopo, Chiweshe, and Mubaya, 2015). Women's weak negotiating power, a labor structure that favors men over women, and women's low level of education are the major contributing factors to this biased outcome. In India, LLIs have adverse impacts on women following displacements from ancestral land (Agarwal, 2015). Maertens, Colen, and Swinnen (2011) found that the presence of LLIs in the horticulture industry of Senegal improved welfare and employment, but without gender disaggregation. Mutopo et al (2015) confirm that although there LLIs have both positive and negative impacts, the whole process has had more negative effects, mainly because women depend on land for their economic entrepreneurial activities. In Zambia, FAO (2013) finds that the LLIs create seasonal employment but that these effects are differential between men and women.

Although it is commonly understood that land ownership and use affects men and women differently, much of the literature focuses on the overall implications of LLIs; gendered analysis is limited. Women's marginalization in land-related issues requires specific policy interventions that regulate land tenure for women; however according to FAO (2013), gender issues have largely been neglected in agricultural investment research. Some of the few studies that have considered gendered effects of land related matters include Ali, Deininger and Goldstein (2014), Doss, Meinzen-Dick and Bomuhangi (2014), who studied land ownership and rural household structures in Uganda and Rwanda. These studies demonstrate the differentiated effects of the LLI model across gender in these countries.

The transformation in the agricultural sector is expected to have significant impacts on women and female-headed households. In this present study, we add to the literature by considering Tanzanian households (using a national dataset) and case studies from two regions to examine the implication of LLIs on women in Tanzania.

## 4. Data Sources and Method of Analysis

### *4.1 The Sources of Data*

Two main data sources are applied in this study: a national survey (Living Standards Measurement Study-Integrated Surveys on Agriculture, LSMS-ISA) and a field survey carried out in Kilombero district in Morogoro region in 2013. The choice of the case study districts was informed by the significant share of LLIs that have been in operation for a long period, as is the case of rice and sugarcane plantations in these districts. The combination of these two datasets provides a national perspective as well as an in-depth case-specific perspective.

The LSMS – ISA dataset includes data on household- and community-related variables. The LSMS–ISA for Tanzania is currently conducted in three waves, forming a pseudo-panel dataset. The first wave (2009-2010) constitutes a representative sample of 3,265 households. In the second wave (2010-2011), the original households were revisited; all adults who had relocated were tracked down and re-interviewed. The sample size for the second wave expanded to 3,924, and the Global Positioning System (GPS) coordinates for the households were recorded. The third wave (2012-2013) sample size was 3,924.

The case study data involve quantitative data collected through two main surveys that were conducted between April and June 2013, in villages within a 50 km radius of two case study investments in the Kilombero region. The area is situated in low-altitude freshwater wetland, the largest in East Africa. The area is very conducive for crop production as it has both access to water and favorable climatic conditions. This region has experienced significant migration in recent decades, with farmers migrating with the aim of cultivating different crops, mostly rice. The Kilombero region is currently the largest rice producer in Tanzania. Most rice farmers in this region are engaged in small-scale farming.

The Kilombero Cluster has been identified as one of the first development clusters within the Southern Agricultural Growth Corridor of Tanzania (SAGCOT), where 330,000 hectares were identified within the Kilombero Valley Zone as a suitable location for large-scale investments in irrigated sugarcane and rice production/processing. However, at the time of this study, there have been no commercial investments implemented as part of the SAGCOT initiative. The two investments analyzed in this study are Kilombero Sugar Company Limited (KSCL) and Kilombero Plantation Limited (KPL). These two investments are considered as a reference for future projects due to their inclusive business models.

Kilombero Sugar Company Limited (KSCL), located in the northern part of the Kilombero Valley, was established in the early 1960s as the first major commercial project in Kilombero, with a total concession of about 10,117 hectares. It was acquired in 1998 by a British- South African consortium that holds 75 percent of shares, with the remaining shares held by the Tanzanian Government. KSCL produces more than 60 percent of Tanzania's sugar. It comprises of two adjacent agricultural estates and sugar factories as well as an alcohol distillery; all of these parts are treated as one company under

KSCL, employing 870 permanent staff and 2,073 seasonal workers at peak periods (Illovo Sugar Ltd, 2015).

In addition, more than 10,000 small and large sugarcane farmers are integrated in an out-grower scheme. The out-growers are integrated in the supply chain throughout-grower associations, which have sugarcane supply agreements with KCSL. Harvesting and transportation is organized by these associations.

Kilombero Plantation Limited (KPL) is a recent rice investment, which is a joint venture between a private foreign company (Agrica) and RUBADA (Rufiji Basin Development Authority), a parastatal company mandated to promote agricultural investments in the Rufiji Basin. In 2008, Agrica purchased 5,818 hectares from a government property by the name of Mngeta Rice Farm, which began as a Tanzanian-North Korean government joint venture (KOTACO) in 1986. An industrial rice mill, a large warehouse, and an automated cleaning and drying facility have since been established by KPL (Herrmann, 2016). At full operation, the investment produces rice on 5,000 hectares of estate land and creates employment for approximately 180 full-time staff and up to 300 part-time workers. Employment on the estate and within the factory is open mainly to the residents of the villages neighbouring the estate. As estate processes are highly mechanized, agricultural jobs mainly involve weeding, with other jobs available in the processing facilities, warehouses, and support services.

### *4.2 LLIs Identification and Matching*

The first step in the data analysis was to track the presence of LLIs using both the Land Matrix Global Observatory (LMGO) data and the LSMS_ISA data. The LMGO data allows for the identification of communities with LLIs at the time that the LSMS_ISA data was collected in 2012-2013[4]. The communities identified to host LLIs are categorized as 1 and the communities that do not have any LLIs are categorized as 0. Only those LLIs that have been established and are currently operational are considered for our matching process. This approach was used by Osabuohien (2014), in which the author tracked LLIs in Nigeria using LMGO data and LSMS_ISA data.

### *4.3 The Outcome Variables*

The three outcome variables of interest include: household consumption, household agricultural wages, and agricultural hour allocation per month. These three outcome variables capture diverse mechanisms through which LLIs can influence household welfare. Household consumption is measured as the sum of all household food and non-food consumption per month. For household agricultural wages, the computation is based on the total wage per month that is received by the household from agricultural activities, such as agricultural labor input. The third outcome variable is measured as the total average hour spent on agricultural activities per month.

[4]This effort was also complemented by a visit to the Tanzania Investment Centre-TIC (a kind of investment clearing house), as well as by confirmation from researchers based on recent research activities relating to LLIs in Tanzania.

### *4.4 Estimation Technique*

To examine the data for comprehensiveness and expected relationships, we employed descriptive statistics and kernel density plots[5]. The objective of this empirical approach is to compare the estimated mean effect on households between communities with LLIs and communities without LLIs with respect to our three outcome variables. The main advantage of this empirical strategy is its ability to generate a comparison group of households with a similar distribution of characteristics in communities both with and without LLIs. The comparison captures the effect of LLIs on households in communities with LLIs (the treatment group), controlling for household characteristics. The treatment effect is therefore calculated as the difference of the mean outcomes.

To explain this process in mathematical terms, we assume that there are two groups of female-headed households indexed by their location, such that P=0/1, where 1 (0) indicates that a household is (not) located in a community with LLIs. The presence of LLIs is expected to yield gains to households, where:

$Y^1_i$: is the consumption, income, or agricultural labor allocation for a household in communities with LLIs (i.e. P=1) and $Y^0_i$: is the consumption, income, or agricultural labor allocation for a household in communities without LLIs (i.e. P=0).

Therefore, the Average Treatment on the Treated Effect (ATT) will be such that:

$$ATT = E(Y^1 - Y_i^0 | P = 1_i) \quad (1)$$

Equation 1 can be simplified as:

$$ATT = E[(Y^1{}_i | P_i = 1) - (Y^0{}_i | P_i = 1)] \quad (2)$$

Where: $E(.)$ represents the average (or the *expected value*). This equation attempts to capture the consumption, income, or agricultural labor allocation of the household in a community with LLIs compared to what that household would have experienced without LLIs.

The data on $(Y^1|P = 1)$ is available in the national survey dataset. However, the data on $(Y^0|P = 1)$ is missing. To mine this date, we apply the matching process. This approach compares the effect of the presence of LLIs on a household's main outcomes with those of matched non-participants (those households located in communities without LLIs). The matches are chosen on the basis of similarity in observed household characteristics. The household characteristics considered include: household location, number of individuals in the household, age and education of the household head, household credit access, number of assets owned by the household, whether the household owns a plot of land, and whether the household cultivates that land. Rosenbaum and Rubin (1983) advance this approach by proposing the use of Propensity Score Matching (PSM) as a reliable technique to derive the equivalent non-participant data.

[5] The Double Difference (DD) approach was equally used as a robustness check. We only report highlights of the result in Section 5 and do not give details regarding the technique due to space considerations.

The underlining assumptions guiding the PSM analysis are (i) the conditional independence assumption and (ii) the common support condition. The conditional independence assumption assumes that the potential outcomes for households in communities without LLIs are independent of their status of being located in these communities, given a set of observable covariates "X".

$$i.e\ Y_i^0 \perp P_i | X \tag{3}$$

Hence, after adjusting for observable differences, the mean of the outcome variable is the same for both households in communities with LLIs and households in communities without LLIs. This condition allows us to use matched households in communities without LLIs as a control group when measuring the effect of LLIs on household welfare. Hence, equation (2) can be represented as:

$$((Y^1{}_i | P = 1, X) = (Y^0{}_i P = 0, X)) \tag{4}$$

The second assumption, common support condition, is based on the expectation that for each value of "X", there is a positive probability of either being located in communities with LLIs or not located in communities with LLIs. This assumption supports the overlap condition such that the proportion of these two categories of households must be greater than "0" for every possible value of "X". Hence, it ensures that there is a sufficient overlap in the characteristics of the two groups of households to find adequate matches. Once these two conditions are satisfied, the treatment assignment is said to be efficient (Rosenbaum and Rubin, 1983). This approach has been used in recent studies such as Nkhata, Jumbe and Mwabumba (2014).

There are different matching algorithms that are applied when using the PSM approach. This study uses the Nearest Neighbor Matching (NNM) and Kernel Matching (KM) algorithm, as they are deemed sufficient for our analysis. The NNM algorithm compares the outcome of households in communities with LLIs with the closest and most similar households in communities without LLIs, using propensity scores. This approach minimizes the distance between the propensity score of the two groups of households. Thus, it is expressed as:

$$i.e.\ min\ ||P_i - P_j|| \tag{5}$$

The KM algorithm produces more efficient results and is better suitable for dealing with large, asymmetrically distributed dataset (Baser, 2006). The KM is structured such that each household in locations with LLIs "i" are matched (using propensity scores) with other control observations that have weights that are inversely proportional to the distance between them and those households in locations without LLIs. The weight is computed as:

$$w_{ij} = \frac{H(P_i - P_j)/h}{\sum_{j=1}^{n} (P_i - P_j)/h} \tag{6}$$

Where: *h* is the bandwidth. Households located in communities with (and without) LLIs are indicated as 'i' (and j').

## 5. Results and Discussions

### *5.1 Results from the Kernel Density Plots*

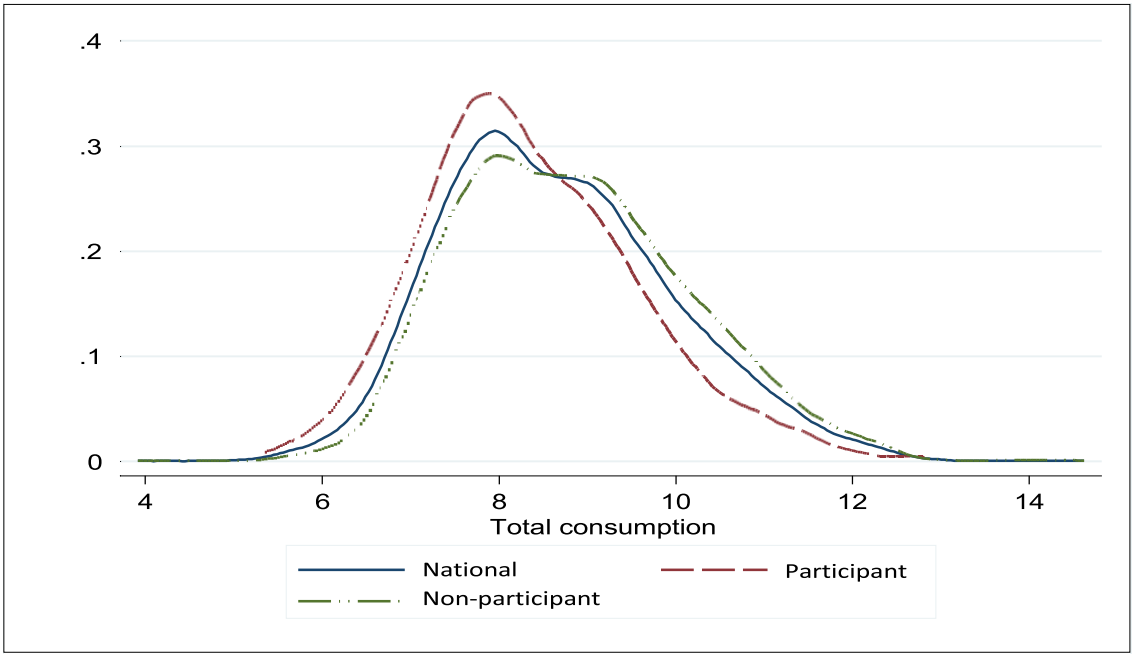
The kernel density plots are presented for the household's consumption, income, and labor allocation. The objective is to approximate the density function of the outcome variables and compare their trends. The kernel density plots are derived from the LSMS_ISA data.

The kernel density plot for household consumption is shown in Figure 5.1. The results indicate that the kernel plot for the total household consumption in communities without LLIs (the comparison group) falls to the right compared to the density plot of the households in communities with LLIs. This difference is significant at the 1 percent Kolmogorov-Smirnov test for equality of distribution, connoting that households in communities without LLIs tend to have higher total consumption expenditure in terms of the total food and non-food expenditure. On average, these households spend about Tsh. 18,000 (equivalent to US$11.4)[6] in a week on household consumption, compared to the households located in communities with LLIs, which spend about Tsh. 10, 000 (US$6.3).

Figure 5.2 shows the kernel density plot for household income, measured as average monthly household wages. The income density plot of households in communities with LLI falls to the left, while that of households in communities without LLIs falls to the right. The difference between the two density plots is significant at 1 percent based on the Kolmogorov-Smirnov test. This suggests that households in communities where the LLIs are located possibly earn less than households in communities without the LLIs. On average, while households in communities without LLIs earn a monthly wage of over Tsh. 98,000, (US$61.8), households in communities with LLI earn about Tsh 51,000 (US$32.2).

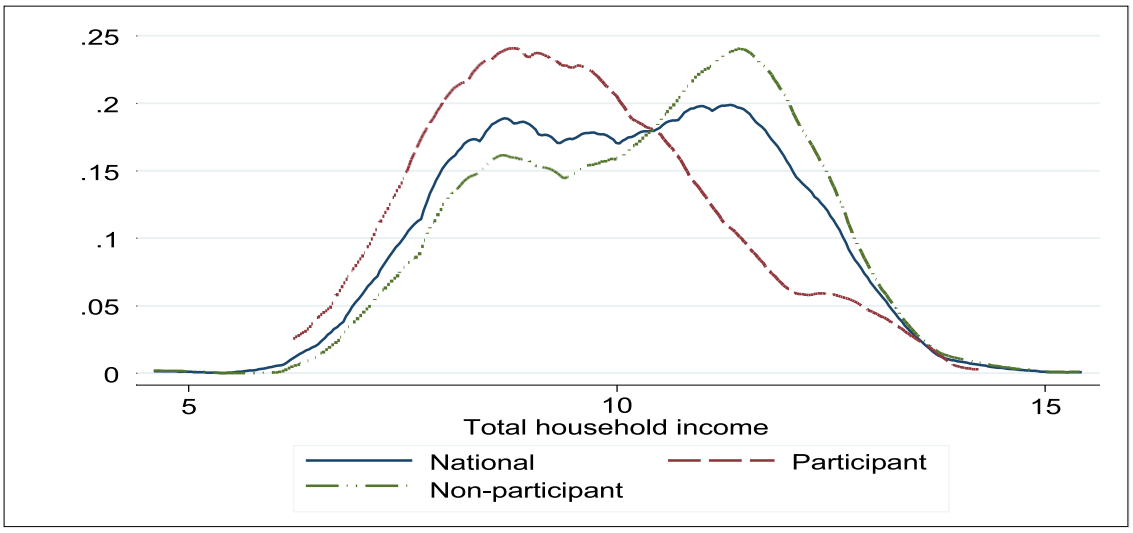
[6]The average exchange rate used is Tanzania shilling (Tsh,) 1586 to US$ 1. This was the approximate average of exchange rate in 2012 and 2013.

*Figure 5.1: Kernel Density Plot of Households' Total Consumption*




Authors' Computation

*Figure 5.2: Kernel Density Plot of Total Household Income*

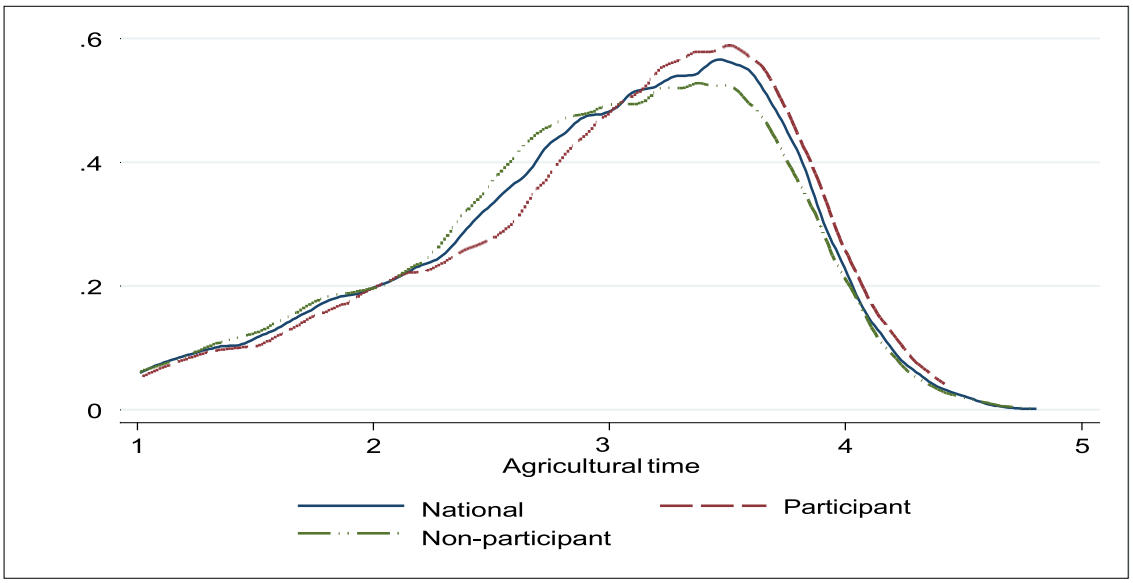



Authors' Computations

The kernel density plot of households' agricultural labor allocation is shown in Figure 5.3. The results depict that households in communities with LLIs allocate more time to agricultural activities than households in communities without LLIs. The density plot for households in communities with LLIs falls to the right compared to that of households in communities without LLIs. This difference is significant at 1 percent, implying that households in communities with LLIs tend to spend more time on agricultural activities than households in communities without LLIs. It is worth noting that households located in communities with LLIs allocate more labor time for agricultural activities but have less consumption

and lower income than households in communities without LLIs, which allocate less time to agricultural labor.

*Figure 5.3: Kernel Density Agricultural Labor Allocation*

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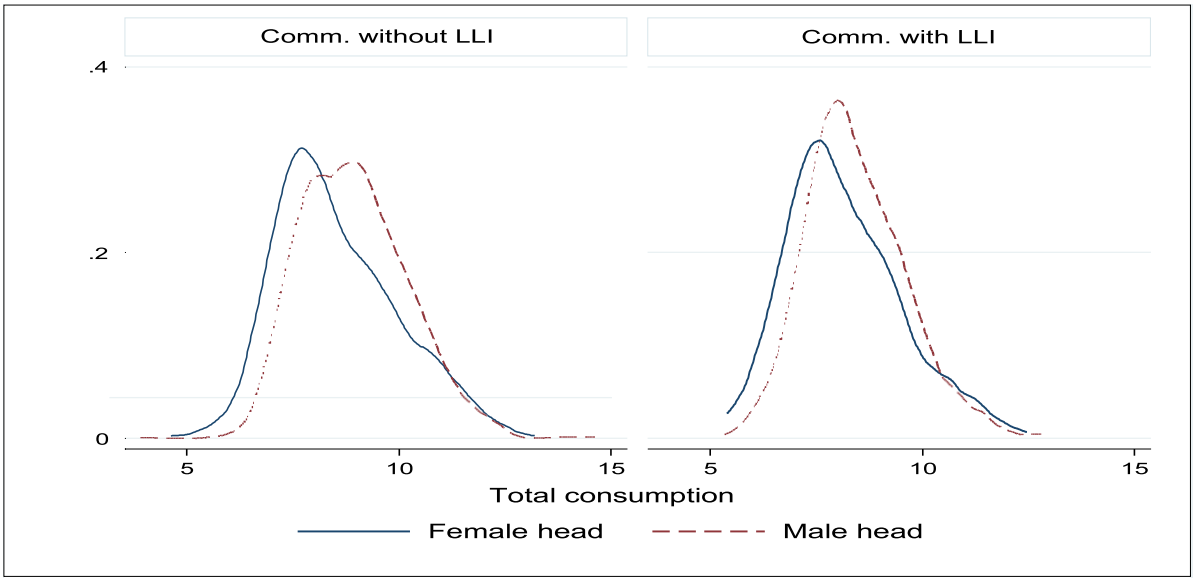
One plausible explanation for these results is that households located in communities with LLIs spend more household time in agricultural activities (where they earn relatively lower income), such that they do not have adequate time to be involved in other non-farm, revenue-generating activities. Further, the displacements that occur with LLIs might mean that households in communities with LLIs do not own private land on which they can cultivate for their own consumption or to generate income. This might affect overall household income and even households' total food and non-food consumption.

Introducing gender perspectives to the kernel density plots indicates that there are significant gender differences in all three outcomes. Figure 5.4 shows the kernel density plot for household consumption by gender for both communities with and without LLIs. The density plot of male-headed households falls to the right relative to that of female-headed households. This implies that male-headed households have a higher consumption than their female-headed counterparts. For communities without LLIs, the results indicate that on average, male-headed households spend about Tsh 20,000 (US$12.6) in a week on household consumption, while female-headed households spend about Tsh16,000 (US$10.1). A similar trend is observed in communities with LLIs, except for the fact that the difference in total household spending across the two groups is not significant. In effect, male-headed households in communities with LLIs spend about Tsh11,000 (US$6.9) on household consumption, while female-headed households spend about Tsh10,000 (US$6.3).

Similarly, male-headed households have higher household income compared to their female- headed counterparts, as shown in Figure 5.5. For both communities (with and without LLIs), the kernel density plots for female-headed households tilt more to the left. In communities without LLIs, male-headed

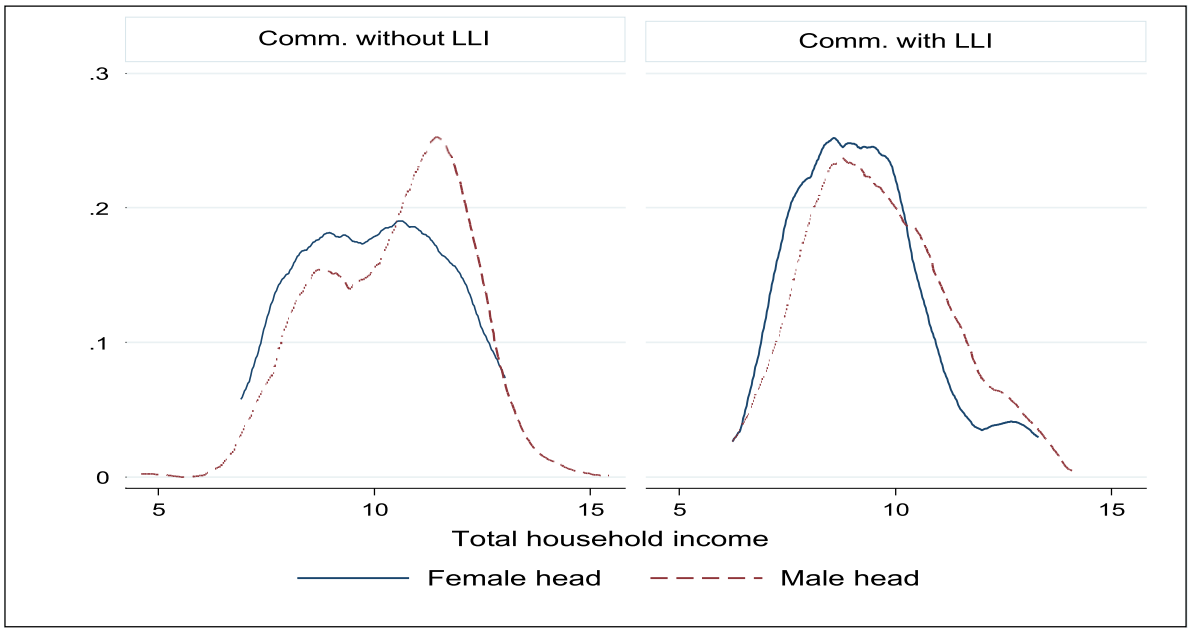
households earn about Tsh105,000 (US$66.2) compared to their female counterparts, who have an income of about Tsh 72,000 (US$45.4). This is similar for communities with LLIs, where male-headed households earn about Tsh 55,000 (US$34.7) compared to female-headed households (Tsh 38,000 (US$24)). The persistence of this income disparity across the male- and female-headed households in communities with LLIs implies that the presence of LLIs does not contribute to the alleviation of gendered income disparities.

*Figure 5.4: Kernel Density Plot of Total Consumption across Gender of Household Head*




Authors' Computations

*Figure 5.5: Kernel Density Plot of Household Income across Gender of Household Head*

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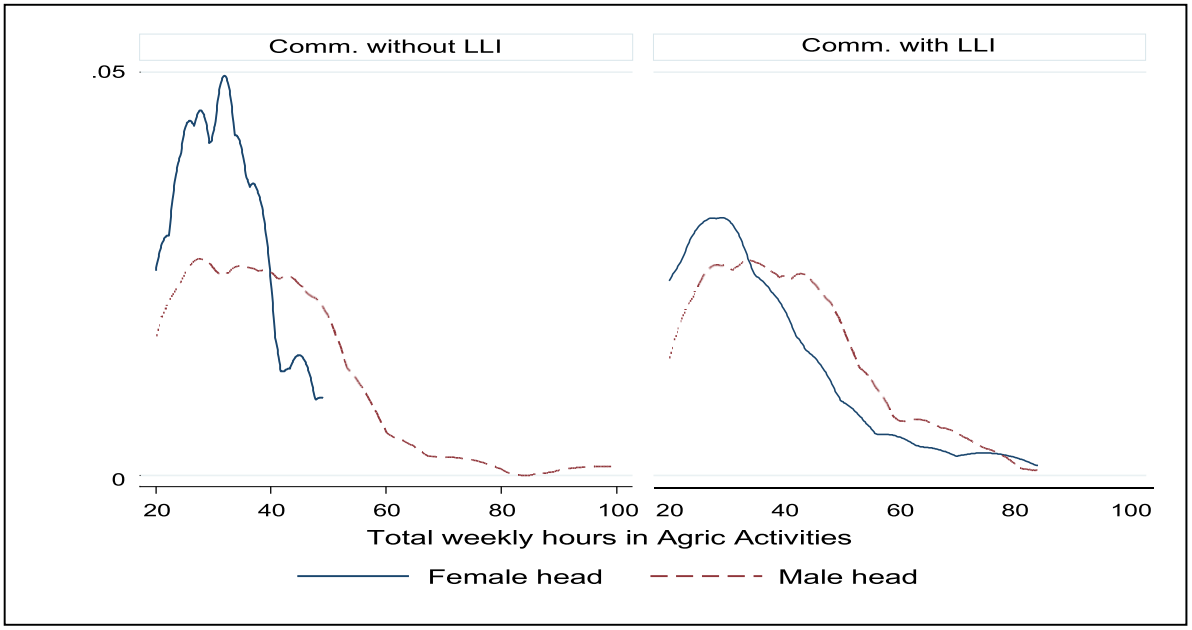
The kernel density plot for labor allocation to agricultural activities by gender is presented in Figure 5.6. For communities both with and without LLIs, the density plot for male-headed households falls to the right compared to the density plot for female-headed households. This suggests that male-headed households tend to allocate more time to agricultural activities compared to female-headed households. The PSM estimations are applied to further analyze the impact of LLIs on household consumption, income, and labor allocation to agricultural activities.

*Figure 5.6: Kernel Density Plot of Labour Allocation across Gender of Household Head*

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## *5.2 Descriptive Statistics: Overall Sample Characteristics*

The household characteristics of interest include household location (i.e. rural or urban), average age and educational attainment of household head, number of household members, total assets owned by the household, and households' credit access and land ownership. The descriptive statistics are presented in Table 5.1, which compares the sample characteristics of households in communities with and without LLIs.

*Table 5.1: Household Characteristics*

| **Communities without LLI** | | | **Communities with LLI** | | **a vs c** | **b vs d** |
|---|---|---|---|---|---|---|
| | **Total (a)** | **Female Hh(b)** | **Total (c)** | **Female Hh(d)** | **t-test** | |
| | **Mean (SD)** | **Mean (SD)** | **Mean (SD)** | **Mean (SD)** | | |
| Location (Rural==1, Urban==0) | 0.394<br>(0.020) | 0.399<br>(0.490) | 0.634<br>(0.026) | 0.583<br>(0.493) | 52.51*** | 54.19**** |
| Number in household | 3.414<br>(2.350) | 2.561<br>(1.819) | 3.489<br>(2.299) | 2.712<br>(1.667) | 0.230 | 29.73*** |
| Age of Hh head | 44.414<br>(16.813) | 47.491<br>18.914 | 48.673<br>(17.350) | 55.461<br>16.444 | 13.21*** | 81.58*** |
| Hh cultivate plot of land (No=0; Yes=1) | 0.457<br>(0.499) | 0.465<br>(0.498) | 0.111<br>(0.342) | 0.155<br>(0.434) | 156.3*** | 17.71*** |
| Hh own farmland (No=0; Yes=1) | 0.870<br>(0.336) | 0.851<br>(0.355) | 0.748<br>(0.435) | 0.667<br>(0.471) | 19.91*** | 69.80*** |
| Education Attainment | 0.222<br>(0.416) | 0.341<br>(0.474) | 0.273<br>(0.446) | 0.446<br>(0.497) | 3.01* | 17.67*** |
| [+]How much credit access (Tsh) | 1711485<br>(3459099) | 1611933<br>(3346360) | 404285.7<br>(1047596) | 121099.2<br>(197553.5) | 3.87* | 82.04*** |
| Number of asset by household | 1.621<br>(1.768) | 2.413<br>(6.081) | 2.204<br>(2.986) | 2.736<br>(8.429) | 10.65*** | 6.82*** |
| **Outcome Variables** | | | | | | |
| [+]Total Hh consumption (Tsh) | 7171.058<br>(12027.760) | 31200.7<br>(104308.7) | 3078.108<br>(6185.671) | 16538.51<br>(121331.9) | 47.05*** | 9.20*** |
| [+]Total Hh wages (Tsh) | 101223.700<br>(182169.300) | 57908.12<br>(61322.19) | 57493.930<br>(109266.800) | 87479.32<br>(185104.4) | 7.89* | 11.76*** |
| Hh labour allocation | 11.166<br>(17.410) | 8.429<br>(13.810) | 21.387<br>(32.248) | 16.866<br>(19.128) | 28.81* | 90.53* |

Notes: *, ** and *** indicate significant at 10, 5 and 1%, respectively.+ : The average exchange rate was between 1579.10 and 1592.20 Tanzanian Shilling (Tsh) to 1 United States Dollars (USD)as at the last quarter of 2012 and first quarter of 2013 (BOT, 2013: 32)

Authors' Computations

The choice of these variables is based on their importance in explaining household decision-making with regard to household location. For instance, older individuals, those residing in rural areas, and those who own land are likely to be located in areas where LLIs are established. The level of education is also an important predictor of being located in communities with LLIs. This is because a more educated individual will likely be located in urban communities and will not be involved in agricultural activities. Related observations have been made for Nigeria (Osabuohien, 2014) and Malawi (Herrmann and Grote, 2015). The number of individuals in a household, household assets, and household credit access are included as baseline characteristics because it is likely that households with more assets and more access to credit are likely to be wealthy and will be located in urban areas. Most LLIs are located in rural areas where there is vast available land. These variables influence household choices regarding consumption, incomes, and allocation of resources with an objective of enhancing their livelihoods.

The results in Table 5.1 indicate that the groups' means differ across all variables except the number of individuals in a household. Focusing on the outcome variables, households also differ across their weekly consumption, the average wage earned, and the time allocated to agricultural activities. Households in communities without LLIs have a higher consumption (Tsh 7,171 (US$4.5)) compared to households in communities with LLI, with an average Tsh 3,078 (US$1.9). Households in communities with LLI earn wages of about Tsh 57,493 (US$36.3) relative to Tsh 101,223 (US$63.8) for households living in communities without LLIs. Similar to the kernel density plot, households located in communities with LLIs tend to put in more time on agricultural activities than households located in communities without LLIs. The difference in hours spent on agricultural activities across the two groups is significant at the 1 percent level of significance. Disaggregating the results by gender, female-headed households show a similar trend, with households located in communities with LLIs showing lower household consumption and income but higher labor hour allocation to agricultural activities. The communities with LLIs have more households located in rural areas and larger household size. For all variables except household head age, there are significant differences across female-headed households in communities with and without LLIs.

## *5.3 Econometric Results of Household Welfare*

### *5.3.1 The Probit Model and Balancing Tests*

To design a set of variables that can match household characteristics in communities with and without LLIs, we apply the probit model. The main intention for estimating the probit regression model is to balance the differences in the observable characteristics that may be present between the groups (i.e. those located in communities with LLIs and those not located in such communities).

*Table 5.2: Probit Model for Computing the Propensity Scores*

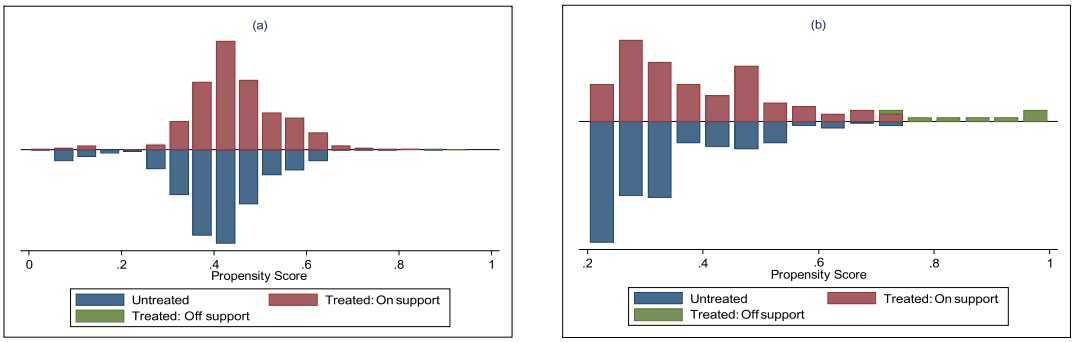
| | **Total HHs** | **Female-headed HHs** |
|---|---|---|
| Total Hh Member | -0.055*** | 0.057*** |
| | (0.000) | (0.000) |
| Hh cultivate any plot | -1.140*** | |
| | (0.000) | |
| Hh Own and Cultivate Farm Plot | -0.368*** | -0.534*** |
| | (0.000) | (0.004) |
| Age | 0.001*** | |
| | (0.780) | |
| nos_hhasset | 0.030*** | 0.163*** |
| | (0.000) | (0.005) |
| Locality | 0.025 | |
| | (0.372) | |
| Education | -0.072 | 0.207 |
| | (0.224) | (0.201) |
| Constant | 1.926*** | -0.128 |
| | (0.000) | (0.775) |
| Pseudo $R^2$ | 0.117 | 0.075 |
| Prob. Value | 0.000 | 0.000 |
| Log Likelihood | -1850.55 | -173.09 |

Probability values are in parentheses $^{*}p< 0.1$, $^{**}p< 0.05$, $^{***}p< 0.01$.
The values in parenthesis are the robust standard errors. We use different probit explanatory variables for the segregated group – female headed households.

Table 5.2 shows the probit model result, which was used to derive the propensity matching scores. For all households, household size, age of the household head, whether or not a household is cultivating land or owning and cultivating farm plots (Column 1) are found to be significantly associated with women's labor participation. The correlation of LLIs and the variables discussed earlier is as expected, since households in rural areas, with larger household size and older household heads, and with plots of land to cultivate have a higher likelihood of being located in communities with LLIs.

In Column 2, a positive coefficient is reported for having a household member who attends school; a possible explanation for this is seen in Herrmann (2016), who observes that more educated household members have alternative sources of income and hence are less inclined to own and/or cultivate land but instead rely on wage employment in some of these LLIs. Therefore, it is possible that as a result of employment opportunities, households with more educated heads may be located in communities with LLIs. Owning and cultivating farm plots and having more access to credit show a negative association with being located in communities with LLIs.

*Figure 5.7: Propensity Score Distribution*




Source: Authors' Computation

The results of the balancing quality checks are presented in Figure 5.7 and Table 5.3. The histograms of the predicted propensity scores for both the treated and the control groups are presented in Figure 5.7, Panels (a), and (b) for the total sample and the female sub-sample, respectively. From this figure, it is evident that the propensity scores are of a relatively equal distribution and are within a similar range, suggesting comparability of the treatment and control groups. The implication of the figures in the corresponding panels suggests that the common support area includes most of the sampled households. Most of the treated households have an equivalent match on the comparison sample; this is important for the matched sample in the communities with LLIs to be representative of the initial sample. Table 5.3 shows that most of the sample in the control group has a match within the treatment group.

The matching quality is also assessed using group mean and median comparisons to check the extent to which the differences in the characteristics across groups (treatment and control) are reduced as a result of the matching process.[7] The difference in pre-intervention characteristics is balanced after matching and an appropriate counterfactual outcome derived. In Table 5.3, these differences are reported as unmatched and matched for both the total sample and the sub-sample of female household members, and both the nearest neighbor with five neighbors and kernel matching algorithm (with the standard 0.06 bandwidth). In both the nearest neighbor and kernel matching technique, the pre-intervention differences between households in communities with LLI and those in communities without LLI are reduced. This is evidenced by the non-significant values of the likelihood ratio (LR) Test. More so, the mean and median absolute bias is also significantly reduced in both techniques[8].

The matching quality for the female-headed household sub-sample in the communities with (and without) LLIs is shown in Table 5.3. In both the nearest neighbor and kernel matching algorithm, the difference in the observable characteristics that exist among the two groups is reduced. For instance, the mean and median absolute bias for the models that comprise total household consumption and

[7]The standard errors are maximized by bootstrapping with (300) replications following the approach of Herrmann (2016).
[8]The mean differences t-test of the households' characteristics between the groups before and after matching are estimated but not reported for space.

household labor allocation are reduced in both matching algorithms. For the total household wages for both the NNM and KM matching algorithm for the female-headed household sub-sample, it is evident that there was no significant reduction in the mean and median differences across the sample in communities with (and without) LLI. However, a closer look at the mean and median values of the total household wages after the matching shows that these differences are somewhat reduced. Therefore, the probit model results indicate that there are comparable households to estimate the Average Treatment Effect.

*Table 5.3: Matching Quality*

| **Total Sample** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Matching Algorithms** | **Outcome** | **Sample** | **Pseudo R2** | **LR chi2** | **p>Chi2** | **Mean Bias** | **Median Bias** |
| 5 Nearest Neighbour | Total Hh | | | 490.40 | | | |
| Matching (NNM) | consumption | Unmatched | 0.117 | | 0.000 | 26.2 | 15.8 |
| | | Matched | 0.000 | 1.25 | 0.990 | 1.1 | 0.7 |
| | Total Hh | Unmatched | 0.164 | 282.19 | 0.000 | 31.4 | 25.2 |
| | wages | Matched | 0.009 | 10.91 | 0.143 | 6.7 | 4.0 |
| | Hh labour | Unmatched | 0.034 | 90.22 | 0.000 | 14.2 | 12.2 |
| | allocation | Matched | 0.001 | 2.80 | 0.903 | 2.3 | 2.3 |
| Kernel Matching (KM) | Total Hh | Unmatched | 0.117 | 490.40 | 0.000 | 26.2 | 15.8 |
| | consumption | Matched | 0.001 | 1.96 | 0.962 | 1.6 | 0.6 |
| | Total Hh | Unmatched | 0.164 | 282.19 | 0.000 | 31.4 | 25.2 |
| | wages | Matched | 0.007 | 8.39 | 0.299 | 4.5 | 2.1 |
| | Hh labour | Unmatched | 0.034 | 90.22 | 0.000 | 14.2 | 12.2 |
| | allocation | Matched | 0.002 | 3.78 | 0.805 | 2.8 | 3.0 |
| **Female Sub-Sample** | | | | | | | |
| 5 Nearest Neighbour | Total Hh | | | 27.86 | | | |
| Matching (NNM) | consumption | Unmatched | 0.074 | | 0.000 | 29.0 | 31.7 |
| | | Matched | 0.003 | 0.78 | 0.941 | 5.4 | 4.8 |
| | Total Hh | Unmatched | 0.128 | 13.06 | 0.011 | 49.3 | 49.5 |
| | wages | Matched | 0.006 | 0.39 | 0.983 | 6.1 | 5.6 |
| | Hh labour | Unmatched | 0.061 | 11.84 | 0.019 | 24.7 | 26.5 |
| | allocation | Matched | 0.026 | 4.60 | 0.331 | 13.3 | 9.8 |
| Kernel Matching (KM) | Total Hh | Unmatched | 0.074 | 27.86 | 0.000 | 29.0 | 31.7 |
| | consumption | Matched | 0.002 | 0.61 | 0.962 | 4.6 | 4.5 |
| | Total Hh | Unmatched | 0.175 | 17.82 | 0.013 | 49.8 | 54.2 |
| | wages | Matched | 0.063 | 4.03 | 0.776 | 16.1 | 14.2 |
| | Hh labour | Unmatched | 0.068 | 13.12 | 0.069 | 17.5 | 19.0 |
| | allocation | Matched | 0.025 | 4.38 | 0.735 | 11.3 | 10.6 |

Source: Authors' Computation

### *5.3.2 The Propensity Score Matching Results*

The average treatment effect (ATT) estimation results for the different outcome variables across the matching algorithms are reported in Table 5.4.

*Table 5.4: Estimated Average Treatment Effect*

| | OLS | %diff | NNM | %diff | KM | %diff |
|---|---|---|---|---|---|---|
| **Total Household** | | | | | | |
| Household Consumption | -678.74*** | -39.42% | -496.40* | -28.80% | -485.59*** | -28.20% |
| | 0.009 | | 0.059 | | 0.010 | |
| Wages | -25313.2 | -44.95% | -23475.9** | -41.70% | -25711.7*** | -45.70 |
| | 0.241 | | 0.042 | | 0.009 | |
| Time allow | 0.105*** | 3.46% | 0.103** | 0.03% | 0.103** | 3.40% |
| | 0.009 | | 0.043 | | 0.011 | |
| **Female Headed Household** | | | | | | |
| Household Consumption | -2933.79*** (0.010) | -20.96% | -2919.83*** (0.000) | -21.34% | -2136.57*** (0.000) | -42.45% |
| Wages | 19098.96 (0.600) | 20.88% | 339.06 (0.995) | 0.371% | 11373.34 (0.822) | 12.432% |
| Time allow | 0.295** (0.037) | 9.473% | 0.385** (0.021) | 12.364% | 0.278*(0.092) | 8.927% |

Note: Probability values are in parentheses $^{*}p< 0.1$, $^{**}p< 0.05$, $^{***}p< 0.01$.
Source: Authors' Computation

We compare the results in Table 5.4 with the Ordinary Least Squares (OLS) for sensitivity and robustness checks. The ATT for household consumption and income is negative and significant. The results suggest that the location of households in communities with LLI accounts for between 28 and 39 percent reductions in their total consumption and between 42 and 46 percent reductions in their total wages. However, the presence of LLIs has a positive and significant effect on time allocated to agricultural activities; the ATT was positive for the entire matching technique. Thus, there is an increase in the number of hours per week that households allocate to agricultural activities. This increase is between 0.03 and 3 percent.

*Table 5.5: Estimated Average Treatment Effect of only Agric Wages*

| | OLS | %diff | NNM | %diff | KM | %diff |
|---|---|---|---|---|---|---|
| **Total Household** | | | | | | |
| Wages | -4180.507 | -13.67% | -9489.846 | -31.03% | -943.769 | -3.09% |
| | 0.768 | | 0.532 | | 0.950 | |
| **Female Headed Household** | | | | | | |
| Wages | 8927.392 (0.837) | 23.40% | 16755.56 (0.500) | 43.93% | 18921.97 (0.332) | 49.60% |

Source: Authors' Computation

The female-headed household sub-sample reports different results. For household consumption, it is observed that a negative average impact still exists; the reduction in consumption is between 21 and 42 percent for the different matching algorithms. Thus, female-headed households will be affected negatively (in terms of household consumption) if they are located in communities with LLIs. Similarly, for the time allocated to agricultural activities, the ATT reveals a positive impact, ranging from 8.9 to 12.4 percent across the different matching algorithms. The analysis is further disaggregated just for agricultural wages, as presented in Table 5.5. The results do not register any significant change as in Table 5.4, especially when considering the signs of the coefficient.

### *5.4 Sensitivity Analysis*

To check the robustness of the ATT, the propensity scores are re-estimated by applying direct NNM before estimating the propensity score equation. This approach estimates the ATT on the outcome variables by using direct nearest-neighbor matching with one match per treatment (in our case, per household in communities with LLI). The rationale for this is to examine whether the ATT results change; if they do not change, this shows that they are reliable.

The results in Table 5.6 indicate that sign of the ATT coefficient for the different outcome variables remained the same for both the total sample and the sub-sample of female-headed households. For instance, there is a Tsh 217.07 reduction in consumption, an Tsh 8,027.73 reduction in the total household wages, and a 0.054 increase in the number of hours put into agricultural activities. For female-headed households, consumption remains negative, but as usual, household wages and labor input (in terms of hours put into agricultural activities) significantly increase.

*Table 5.6: Sensitivity Check using the Direct nearest Neighbor Matching*

| | | **Consumption** | **Wages** | **Labour Input** |
|---|---|---|---|---|
| | **Matched Pairs** | **ATT (Sig)** | **ATT (Sig)** | **ATT (Sig)** |
| Total Sample | 1 | -217.072<br>(0.350) | -8027.733**<br>(0.043) | 0.054**<br>(0.031) |
| Female Hh | 1 | -82.404<br>(0.882) | 6446.250*<br>(0.093) | 0.341*<br>(0.093) |

Note: Probability values are in parentheses $^{*}p< 0.1$, $^{**}p< 0.05$, $^{***}p< 0.01$.
Source: Authors' Computation

### *5.5 LLIs Impact at the Individual Level: Further Evidence*

The estimations in this study are based on the household level (in terms of female-headed households); however, we take a step further to consider the impact of LLIs at the individual level. In this section, the ATT was re-estimated, taking into consideration individual females in communities with and without LLIs. This estimation intends to show the impact of LLIs on individual females who are not the head of household. From this effort, further policy implications can be drawn.

The results (presented in Table 5.7) are similar to the earlier result seen in Table 5.4. The OLS, NNM, and KM were not different from those in Table 5.4 in terms of the signs and significance of the coefficients of the ATT; the exception is wages, which is now negative in Table 5.7. Women in the Tanzanian national survey will experience a higher labor hour input in the agricultural sector, but women's relative consumption and wages maintain a reduced value in communities with LLIs. This further asserts that the presence of LLIs in Tanzanian communities will reduce the consumption and wages of women, but the number of hours that women allocate to agricultural activities increase.

*Table 5.7: Estimated Average Treatment Effect for Entire Female Sample*

| | OLS | %diff | NNM | %diff | KM | %diff |
|---|---|---|---|---|---|---|
| **Total Household** | | | | | | |
| Household Consumption | -667.25*** | -35.59% | -1007.78*** | -46.25% | -1119.25*** | -40.30% |
| | 0.015 | | 0.010 | | 0.000 | |
| Wages | -25315.63 | -21.81% | -85085.95*** | -26.70% | -58952.77*** | -49.22 |
| | 0.241 | | 0.001 | | 0.002 | |
| Time allow | 0.073** | 2.45% | 0.108 | 3.624% | 0.060**** | 2.014% |
| | 0.020 | | 0.153 | | 0.031 | |

Note: Probability values are in parentheses $^{*}p< 0.1$, $^{**}p< 0.05$, $^{***}p< 0.01$.
Source: Authors' Computation

### *5.6 Average Treatment Effect Based on Double Difference Estimate*

The Double Difference (DD) is further estimated to examine the consistency of our estimates in terms of the ATT when controlling for the difference between the treatment and control groups. This estimation approach is valuable because it adjusts for the time-varying factors that may affect the outcome variables and because it eliminates bias that arises, assuming that these factors are not controlled for. Essentially, applying the DD approach controls for unobserved heterogeneities that may affect the outcome variables (apart from LLIs). Gertler *et al* (2011) emphasize that the DD should be included in PSM estimates for robustness. The results of the DD for both female-headed households and the female gender are presented in Table 5.8.

The ATT estimates in Table 5.8 show similar result to those in Table 5.4. Household consumption continues to have a significant negative sign, suggesting that the presence of LLIs in communities reduces the consumption of female-headed households. This result is also applicable when considering the female gender in the sample. For household wages, the results are insignificant using the DD approach. The result for the agricultural time input, however, confirms a similar result to that seen in Table 5.4. The significant value of the outcome variable was consistent both for the female-headed household and the entire female population in the sample. Therefore, we surmise that the consumption and agricultural labor hour input effects could be verified with the DD approach; however, the total wage effect could not be verified. However, this does not raise much concern, as the sign of the variable remains consistent with Table 5.7.

*Table 5.8: Double Difference Estimation of the ATT*

| | Female Hh | | | Gender=Female | | |
|---|---|---|---|---|---|---|
| | **Household Consumption** | **Wages** | **Time allow** | **Household Consumption** | **Wages** | **Time allow** |
| ATT | -4508.28** (0.045) | -1987.09 (0.981) | 3.035* (0.000) | -2526.81* (0.000) | -118376 (0.140) | 2.980* (0.000) |
| R-Squared | 0.1359 | 0.2679 | 0.8228 | 0.1042 | 0.0463 | 0.7699 |
| F-Stat | 14.89 | 10.13 | 12.06 | 66.02 | 11.4 | 6.68 |
| Prob > F | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |

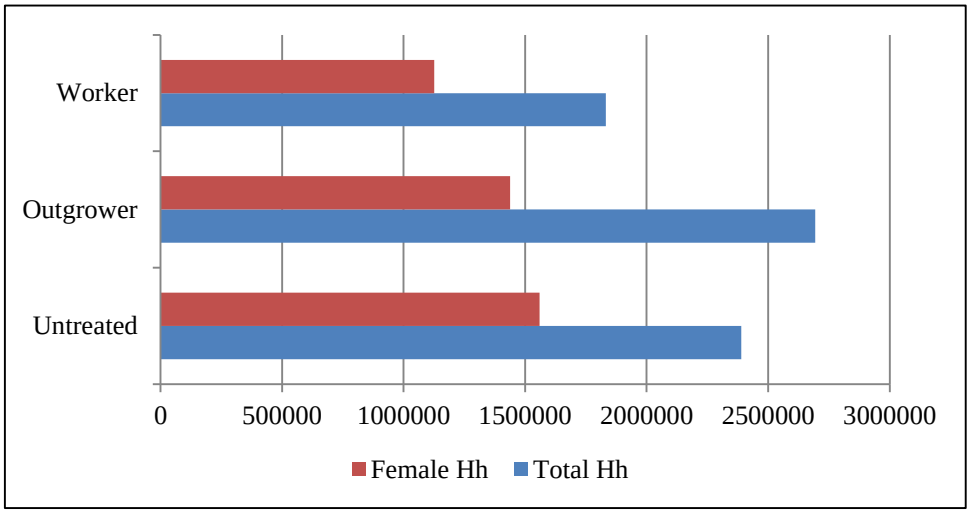
Source: Authors' Computation

## *5.7 Case Studies*

To corroborate the analysis using the LSMS-ISA dataset, two case studies were gathered from a field survey of Kilombero sugar and rice plantations. The main focus in this section is to consider our outcome variables across different categories of female-headed households using these case studies. We will further analyze the effect of LLIs in communities, especially with regards to female-headed households. The analysis in this sub-section will be restricted to descriptive statistics because the sample contains 55 women (about 8.3 percent of the sample) and may not be sufficient for rigorous econometric estimations.

The results in Figure 5.8 show that women working in LLI factories have lower total consumption compared to those who are not working in the factories and even to those participating in the out-grower scheme. Generally, workers' consumption is about Tsh155,000 (US $ 97.8) compared to those not working in the factories, who have an average consumption of about 240,000 (US $ 151.4). This trend is also applicable for the female-headed households working in the LLI factories. They have a lower consumption compared to those who are not working in the factory and those who are involved in the out-grower scheme. This trend corroborates our earlier finding that a negative relationship may exist between the presence of LLIs in communities and household consumption (either total or of female-headed households).

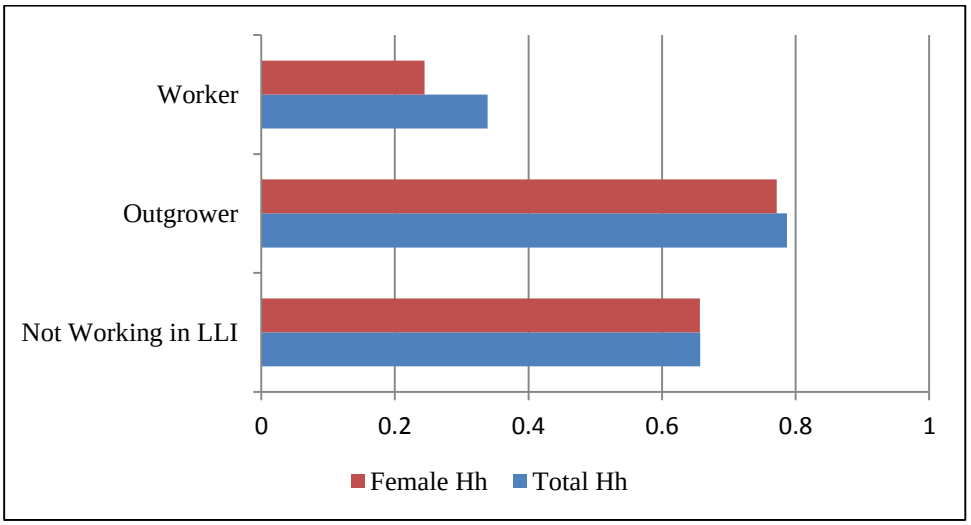
*Figure 5.8: Total Consumption across Households in Case Communities (Values are in Tsh)*




Source: Authors' Computation

Next, we consider the agricultural wage income of households that are working in the LLIs and those that are not working in the LLIs, as well as those that are in the out- grower scheme. From Figure 5.9, it is evident that workers in the LLIs have a reduced agricultural wage income as a ratio of total household income. The agricultural wages of this category of household are about half of that of households in the out- grower scheme and those not working in the LLIs. This is also applicable to female-headed households, which earn less from agricultural activities compared to those not working in the LLIs and to those in the out-grower scheme.

*Figure 5.9: Total Agricultural Income across Households in Case Communities (Values are in Tsh)*




Source: Authors' Computation

It is important to note that the LLIs that were used in our case study engage workers in agricultural activities that may not yield substantial income to the participants. Since most of these LLIs use highly mechanized processes, the agricultural jobs that are allocated to the employees include weeding and

other jobs in the processing facilities, such as warehouses and support services. It is possible that the income from these activities is incomparable to possible income that the household could have obtained if it had continued with its agricultural activities and smallholder farming. This probably explains the negative average impact of the presence of LLIs in host communities.

## 6. Conclusion

This study contributes to the understanding of the labor and welfare implications of the presence of large-scale land investments (LLIs) for female-headed households in Tanzania. We examine household consumption, agricultural income, and labor allocation to agricultural activities for those living in communities with LLIs and those living in communities without LLIs. The analysis was based on ex-post non-experimental analysis that considers the implication of the presence of LLIs after the investments are established and functional. The propensity score matching (PSM) and regression-based approach, including the treatment-effects model, were applied; this combination of different estimations corrects for potential biases.

The study finds that households located in communities with LLIs have lower consumption compared to households located in communities without LLIs. The results suggest that female-headed households are better off living in communities without LLIs.

Considering the income effect, our estimation reveals a negative and significant agricultural income effect for the entire sample; for female-headed households, a non-significant effect was observed. The female-headed households living in communities with LLIs could have a higher agricultural income (between 0.4 percent and 21 percent) compared to those living in communities without LLIs. For the entire sample and the female-headed households, the analysis reveals a positive effect on agricultural labor hour input. These results, however, should be seen only as suggestive evidence of the implications of the presence of LLIs in Tanzanian communities because of some other unobservable factors that are peculiar to the communities being observed and that are not accounted for in our empirical model. Nonetheless, the combination of national survey and case study descriptions of the household distribution across the two groups provides substantial evidence that could inform policy.

The policy implication that emanates from this study is that the agricultural sector still holds great potential for economic transformation in Tanzania; however, the drive for LLIs may not result in the desired labor outcome, particularly with regards to women. In essence, the effects of LLIs differ markedly between male- and female-headed households, which signals the need for targeted strategies to integrate small farmers into the LLI process. Based on a supplementary analysis[9] that was conducted to establish the channel through which LLIs affect female individuals and female household heads, it is evident that formal education, land

[9] Results are available on request.

ownership, and women's age are all important factors that should be considered in Tanzania in relation to the effect of LLIs on women. Our findings suggest that although the presence of LLIs results in negative consumption and agricultural wages for female-headed households, these results may not hold if the women are better educated, own land, or are older. Thus, policies should consider education and land access as channels through which to improve female outcomes in the case of rising land investors.

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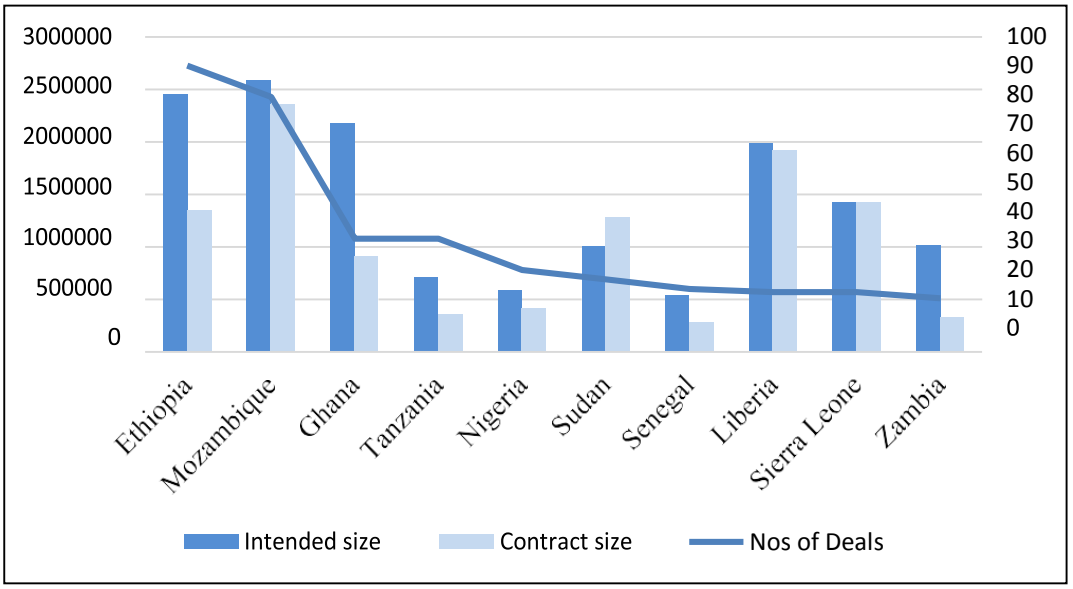
## Appendix

*Figure A1: The Top 10 Major Recipients of LLIs in Africa*




Source: Computed by the authors using data from Land Matrix Global Observatory-LMGO (2016)

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