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Large-Scale Agricultural Investments and Smallholder Welfare: A Comparison of Wage Labor and Outgrower Channels in Tanzania

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Summary. — This article evaluates household welfare effects of large-scale agricultural investments in Tanzania, one of the main recipients of such investments in Africa. Specifically, the article compares households participating in sugar and rice investments through outgrower schemes or as agro-industry workers with non-participants in terms of household income and income poverty. Building on primary household data, it is one of the first studies to empirically analyze ex-post impacts of large-scale agricultural investments in Africa. The analysis draws on cross-section survey data of 516 households collected in Kilombero District, a priority cluster for the Southern Agricultural Growth Corridor of Tanzania (SAGCOT). The results show overall positive household welfare differences between participants of the investments and the respective counterfactual. However, there are large differences between arrangements and subsectors. Estimated effects for outgrowers are largest, yet for land-rich outgrowers more so than for land-poor. Effects for agro-industry workers in the sugar investment are significantly larger than for those in the rice investment, though in both investments land-poor workers seem to benefit. Hence, the study results suggest potential benefits of outgrower schemes and potentials of agro-industry wage employment for the land-poor to escape extreme poverty. Yet, it also stresses particularly the need to address the constraints of land-poor outgrowers. Qualitative interviews, for example, pointed to growing risks for land-poor outgrowers in the context of rising elite capture by larger outgrowers.

Key words — large-scale agricultural investments, impact evaluation, contract farming, wage employment, Africa, Tanzania

1. INTRODUCTION

The biofuels boom and sharply rising global food prices led to a massive surge in foreign investors attempting to acquire agricultural lands in developing countries since the mid-2000s (Deininger *et al.*, 2011). Sub-Saharan Africa (SSA) has received a major share of proposals for such large-scale agricultural investments (LSAI) (Cotula, Vermeulen, Leonard, & Keeley, 2009).[1] Recent estimates by Schoeneveld (2014) suggest 563 large-scale land deals during 2005–13 in 37 countries, covering nearly 23 million hectares. However, past experiences in SSA provide plenty of examples of failures of such investments (Collier & Dercon, 2009; Deininger & Byerlee, 2012). Many of the more recent LSAIs have also been abandoned, especially those targeting biofuels (Maltsoglou, Koizumi, & Felix, 2013; Singh, Singh, Vermaa, & Patraa, 2014), or have not yet materialized (Land Matrix Global Observatory—LMGO, 2015). Still, the share of large-scale farming and investments in SSA is likely to rise in future, given the new technologies to manage large farms, growing demand for standardized products and Governments' motivations to expand into uncultivated areas (Deininger & Byerlee, 2012).

The potential implications of LSAIs have been highly controversial. On the one hand, there are widespread concerns of substantial social and ecological risks of such investments that threaten the very livelihoods of poor farming households (Cotula *et al.*, 2009; German, Schoneveld, & Mwangi, 2013; Hall, 2011). Previous experiences in SSA also show that LSAIs were often associated with substantial social conflicts with negative long-term repercussions (Deininger & Byerlee, 2012). Research by Arezki, Deininger, and Selod (2015) about the drivers of more recent LSAIs likewise shows that LASI have so far often targeted countries with weak governance systems and protection of poor people's land rights, reinforcing such concerns. On the other hand, LSAIs may contribute to economic development and poverty reduction by generating rural employment, enabling local farmers to access high-value markets, modern knowledge and technologies or by contributing to investments in infrastructure, schools, and hospitals as part of Corporate Social Responsibility commitments or through tax revenues (Deininger & Byerlee, 2012; Deininger *et al.*, 2011). At the international level, policy guidelines have been developed in recent years to encourage such responsible agricultural investments that contribute to poverty reduction and economic development (e.g., Committee on Food Security—CFS, 2014). The type of institutional arrangement is considered an important parameter in this context (Vermeulen & Cotula, 2010), with arrangements that create linkages with smallholder farmers, such as contract farming or outgrower schemes,[2] often considered most effective (Arndt, Benfica, Tarp, *et al.*, 2010; Deininger *et al.*, 2011).

In spite of the relevance for development and policy making, there is a paucity of empirical evidence on the welfare and poverty effects of LSAIs (Deininger & Byerlee, 2012; Oya, 2013a). Existing studies have used ex-ante simulations to measure potential impacts, with Arndt *et al.* (2010) simulating large-scale biofuel expansions through jatropha or sugarcane production in Mozambique and Baumgartner *et al.* (2015) assessing the expansion of a rice investment in Ethiopia. Both studies suggest positive welfare effects, but more pro-poor effects if smallholders are integrated in the supply-chains. Deininger and Xia (2016) have recently used survey data of large-scale and small-scale farmers in Mozambique to study spillover effects. The authors find evidence of some spillovers to small-scale farmers in terms of adoption of farming practices, fertilizer and pesticides, but also negative impacts on farmers' subjective well-being.

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Hardly any empirical evidence exists on actual impacts through the most relevant direct participation channels, i.e., labor market channels via plantations and large-scale farming or product market channels via outgrower schemes. Research on labor market channels has focused so far on less land-intensive high-value horticulture export sectors in SSA, with some viewing these jobs critically because of their low quality and wages (e.g., Barrientos & Kritzinger, 2004; Barrientos, Kritzinger, Opondo, & Smith, 2005). The only study applying a more rigorous approach using a control-group comparison (Maertens, Colen, & Swinnen, 2011, on horticulture exports in Senegal), however, finds positive household welfare effects, with benefits especially occurring to poorer households. The existing literature on contract farming comes to rather mixed conclusions regarding household welfare effects. Whereas authors have noted the risk of exploitation of farmers (e.g., Little & Watts, 1994) and exclusionary processes (e.g., Porter & Phillips-Howard, 1997), a number of more recent impact evaluations mostly find positive household welfare effects for contract farmers (Bellemare, 2012; Bolwig *et al.*, 2009; Herrmann & Grote, 2015; Maertens & Swinnen, 2009; Rao and Qaim, 2011; Vaeth & Kirk, 2014; Warning & Key, 2002). The only two studies that analyze contract farming as part of a LSAI (nucleus-estate outgrower models) are Vaeth and Kirk (2014) on palm oil in Ghana and Herrmann and Grote (2015) on sugar in Malawi. In addition, only two studies compare the effectiveness of different participation channels, namely Maertens and Swinnen (2009) and Herrmann and Grote (2015), evaluating contract farming and wage employment in Senegal and Malawi, respectively.

The aim of this study is to contribute to the literature on the welfare effects of LSAIs by evaluating the household income and income poverty implications of outgrower schemes and estate/plantation and factory employment in large-scale rice and sugar investments in Tanzania. The analysis is based on cross-section data of sugarcane outgrowers, agro-industry workers (sugar and rice) and non-participants in villages surrounding two LSAIs in Kilombero District, Morogoro Region. The article is among the first that attempts to measure actual ex-post impacts of LSAIs, thus, contributing to filling the literature gap identified by Deininger and Byerlee (2012) and Oya (2013a). Moreover, it attempts to contribute to a better understanding of the heterogenous effects of LSAIs because of differences in sub-sectors and institutional arrangements.

Rice and sugar in Tanzania are very interesting cases. Demand for rice and sugar has been increasing within and outside the region amid rising incomes and urbanization (Johnson & Seebaluck, 2012; Larson, Otsuka, Kajisa, Estudillo, & Diagne 2010). Both subsectors have been among the main targeted crops under LSAI proposals in SSA (LMGO, 2015), with Tanzania among the top three recipient countries, apart from Ethiopia and Mozambique (LMGO, 2015). Sugar and rice are considered priority sub-sectors in Tanzania's national strategies to develop commercial agriculture (United Republic of Tanzania—URT, 2013; Southern Agricultural Growth Corridor of Tanzania—SAGCOT, 2011). The case study area is within SAGCOT, a major public–private partnership initiative to attract agribusiness investments. The two investments have been referred to as best-practice cases for future SAGCOT investments (SAGCOT, 2011).

The article is structured as follows. Section 2 discusses the literature. Section 3 describes the context of agro-industry investments in Tanzania. Section 4 explains the data source and methodology, before Sections 5 and 6 present and discusses descriptive and econometric results. Section 7 concludes.

2. LITERATURE REVIEW

This chapter summarizes existing literature on the effects of contract farming or outgrower schemes and employment linked to LSAIs. Contract farming may help smallholder farmers overcome their previous lack of access to credit, quality inputs, high-value output markets or know-how (Barrett *et al.*, 2012). Input market access, for example, can be facilitated if either (a) farmers use their output-contracts as collateral, (b) the output-contracts have inbuilt credit schemes (e.g., tri-partite arrangements with commercial banks) or (c) cash earnings are sufficient to buy inputs (Govereh, Jayne, & Nyoro, 1999; Grosh, 1994). As a result of improved access to quality inputs, extension, and high-value output markets, producer prices and/or quantity may increase, leading to overall higher incomes. Yet negative welfare effects may also arise due to increased exposure to production and marketing risks from adopting a new crop and accessing previously unknown markets (Eaton & Shepherd, 2001; Simmons, Winters, & Patrick, 2005). Most problematic may be situations in which farmers face a single buyer, and relationship-specific investments are undertaken, potentially locking them in (Sivramkrishna & Jyotishi, 2008). Sugar, for instance, is an extreme case of monopsonic market relations, where usually a single processor sources from a large number of outgrowers with no alternative market outlet. Side-selling is made difficult due to the bulkiness and perishability of the crop, as well as legislation, which often creates regional monopolies.[3] At the same time, outgrowers may benefit from the processor's output market security if it creates incentives for the processor to invest in the outgrowers productive capacity, as side-selling risks are reduced (Glover, 1990; Tiffen & Mortimore, 1990). Some recent studies find positive participation effects of contract farming in terms of household welfare (Bellemare, 2012; Miyata, Minot, & Hu, 2009; Warning & Key, 2002), although there are a few exceptions (Narayanan, 2014; Simmons *et al.*, 2005).

The direct welfare effects of participating as wage laborers in LSAIs are more uncertain. As agricultural wage employment usually involves high monitoring costs, hired labor has usually been used for only simple low-paid tasks (Otsuka & Yamano, 2006; Oya, 2013b). Agricultural wage employment is therefore often argued to be performed by those households lacking the ability to engage in better paid non-farm or on-farm jobs (Davis *et al.*, 2010). Consequently, although it may be an important coping strategy against shocks, it is usually believed to add little to lift the poor out of poverty (Otsuka & Yamano, 2006; Oya, 2013b). There is some indication, however, that jobs in large-scale investments may have more significant effects, especially if foreign capital is involved, as in the cases analyzed here. Foreign firms may bring in capital, new ideas and technologies, thereby increasing worker productivity (Harrison, 1994). Paying higher wages may also be a strategy to increase efficiency or to retain productive workers (efficiency-wage hypothesis) (Akerlof & Yellen, 1986), or be a result of exposure to global consumer scrutiny (Oya, 2013b). Te Velde and Morrissey (2003), for example, found in manufacturing industries in SSA that foreign firms tend to pay higher wages than domestic firms. Some studies on agro-industries in SSA regarding foreign-owned firms (Cramer, Oya, & Sender, 2008, for Mozambique) or food

exports (Maertens & Swinnen, 2009; McCulloch & Ota, 2002) also provide some positive evidence to this hypothesis.

3. LARGE-SCALE AGRICULTURAL INVESTMENTS IN TANZANIA

(a) *Context of LSAIs in Tanzania*

LSAIs involving large land acquisitions have been a matter of considerable debate throughout SSA (Gibbon, 2011).[4] Prior to independence, large-scale foreign estates that produced export crops were strongly promoted by governments in Tanzania and elsewhere, leaving the small-scale sector often with little support (Gibbon, 2011; Rweyemamu, 1973). Yet smallholder cash-crop production flourished in some regions (Mrema & Ndikumana 2013) and received widespread state support after independence, e.g., through cooperative development (Maghimbi, 2010) or outgrower programs linked to agro-industry investments (e.g., World Bank, 1994). After the state-led period in the 1990s, policies focused again on promoting commercial private investments as an engine for agricultural growth,[5] though recognizing small-scale farmers' central role in poverty reduction (e.g., National Growth and Poverty Reduction Strategies—MKUKUTA I and II).

Since the mid-2000s, Tanzania has experienced a rapid increase in biofuel and other agricultural investment proposals and has become one of the main destinations in Africa for LSAIs (Figure 1). By 2008, an estimated 4 million hectares had been under negotiation for biofuel projects alone (Sulle & Nelson, 2009). Most biofuel investments, however, have failed (Locher & Sulle, 2013), while numerous studies reported conflicts with local communities (e.g., Daley & Scott, 2011; Land Rights Research & Resources Institute, 2010). Although the area under negotiation declined thereafter, an estimated 1 million hectare was still negotiated in 2012, though focusing now on food crops and forestry products (Locher & Sulle, 2013). In this context, recent major investment promotion initiatives in Tanzania were formulated to attract LSAIs. The Southern Agricultural Growth Corridor of Tanzania (SAGCOT), for example, was established in 2010 at the World Economic Forum on Africa as an international public–private partnership to mobilize agribusiness investments throughout the southern transport corridor (SAGCOT, 2011). In addition, Big Results Now (BRN) was adopted in 2012 as a government initiative, complementing SAGCOT, to accelerate investments in agriculture, with the specific aim of establishing 25 large-scale commercial farming deals (URT, 2013, 2015).

Controversies around early biofuel investments have led to proposals for regulatory changes, such as Biofuels Guidelines that put a ceiling on land purchases in biofuels and incentives for implementing outgrower schemes (Ministry of Energy and Minerals, 2010). Amendments had previously been made to the Land Act to involve local communities, allowing for joint ventures between villages and private investors (Sulle & Nelson, 2009). SAGCOT and BRN have also adopted inclusive business models in their blueprints by focusing on outgrower schemes or collective farming arrangements (*block farms*) (URT, 2015). Outgrowers schemes or contract farming are also recognized in a number of government documents as a strategy to enhance input and output market access in Tanzania (e.g., Agricultural Marketing Policy of 2008; National Agricultural Policy of 2013). Yet, government support policies and legislations are still largely missing. Regarding employment on large plantations and farms, policies, laws and regulations that govern employment in general also apply (e.g., Employment and Labour Relations Act of 2004), which establish employment standards, promote unions, minimum wage rules and health and safety rules. Workers fall into one of three categories: unspecified time, specified time, and specific task. Employers must provide certain benefits to all workers, including minimum wage, sick leave etc.[6]

(b) *Development of sugar and rice sub-sectors*

Sugar and rice are priority subsectors in SAGCOT and BRN (URT, 2015; SAGCOT, 2011). Despite the potential for sugar production (FAO, 2010; SAGOCT, 2011), the industry has lacked competitiveness, with exports making up less than 5% of production (FAOSTAT, 2015). First factory and estate investments occurred in the 1930s and expanded after independence, involving state-supported outgrower schemes (World Bank, 1994). Parastatal ownership after 1967 led to financial problems of the industry (World Bank, 1994) and eventual government divesture in 1998 (Sugar Board of Tanzania—SBT, 2015). After privatization, production increased sharply by 16% annually during 2000–05, while

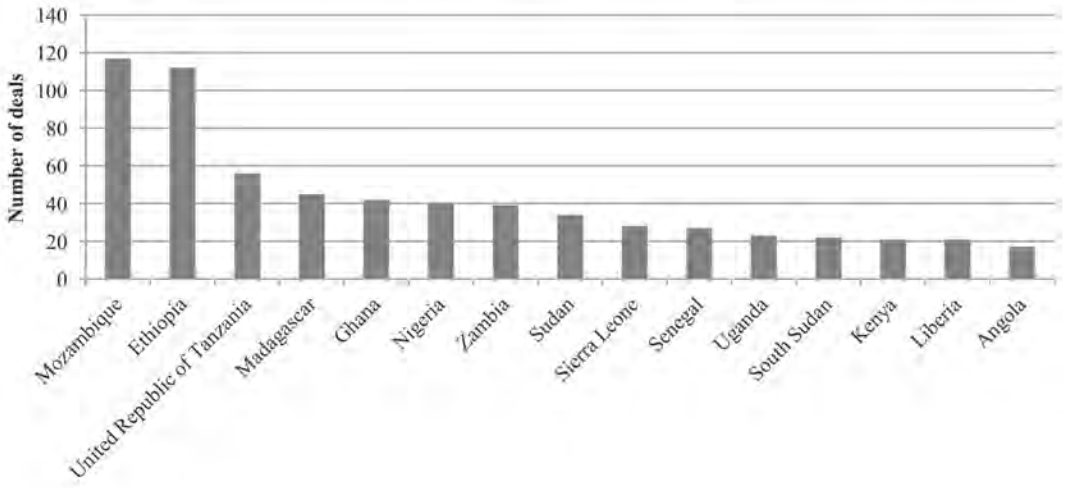


Figure 1. *Number of large-scale land deals in Sub-Saharan Africa (2014). Source: LMGO (2015).*

imports declined (FAOSTAT, 2015).[7] Outgrower area more than doubled to 20,000 ha during 2000–12 (35% of total area) (SBT, 2015), which is in contrast to many other countries, where outgrowers have played a minor role (LMC, 2004). Since mid-2000s, however, output growth has slowed, resulting in imports more than tripling and reaching more than 40% of total supply (FAOSTAT, 2015). Low factory efficiency and low farm yields are considered major production constraints (Nkonya & Barreiro-Hurle, 2012). Yet, operating under full capacity would not be sufficient to meet demand (Smalley, Sulle, & Malale, 2014). New investments are therefore given high political priority (SAGCOT, 2011).

Rice has become an important staple in SSA, with demand increasingly being met by imports from outside the region (Larson *et al.*, 2010). In contrast to the rest of SSA, imports to Tanzania have declined as production increased annually by 6% during 2000–12, making it the largest producer in East Africa (FAOSTAT, 2015). Production is dominated by smallholder farmers; more than 1.1 million households are estimated to produce rice in Tanzania (NBS, 2012a). Large commercial farms have played a minor role (NBS, 2012b). Tanzania has become a marginal exporter of rice (FAOSTAT, 2015) and could even become a major exporter to the entire region (SAGCOT, 2011). Yet, current trade policies and low rice productivity have constrained exports (Barreiro-Hurle, 2012).[8] A National Rice Sector Development Strategy was therefore formulated to increase technology adoption (Barreiro-Hurle, 2012), while large-scale rice investments are also being increasingly promoted (URT, 2013; SAGCOT, 2011).

(c) *Large-scale agricultural investments in the Kilombero Valley*

Kilombero District of Morogoro Region has been identified as a priority cluster for investments under SAGCOT (SAGCOT, 2011). Kilombero contains the largest low-altitude freshwater wetland of East Africa (Kangalawe & Liwenga, 2005) and provides soil and climatic conditions highly suitable for production of a variety of crops (Beck, 1964), for some of which yields are the highest in the region (NBS, 2012c).[9] Kilombero is also the largest rice producer in Morogoro (NBS, 2012c). Agriculture is the main income source, which is largely conducted by small-scale farmers, most of whom produce rice and maize (NBS, 2012c). Poor infrastructure and other factors have constrained diversification into high-value crops. Still, the area has experienced strong in-migration by farmers in previous decades (Kangalawe & Liwenga, 2005; Nindi *et al.*, 2001). Large-scale farming is not well developed, except for some teak, sugarcane and rice estates (Nindi *et al.*, 2001). Investments under SAGCOT were still in a preparatory phase when the survey started. The two investments analyzed—Kilombero Sugar Company Limited (KSCL) and Kilombero Plantation Limited (KPL)—existed already, but are considered best-practice cases for investments under (SAGCOT, 2013).

(i) *Kilombero Sugar Company Limited (KSCL)*

KSCL was established in the 1960s as the first major commercial project in Kilombero, with a concession of more than 10,000 hectares and state-promoted outgrower schemes (Beck, 1964). After near collapse during nationalization (Smalley *et al.*, 2014), it was acquired in 1998 by British–South African Illovo and ED&F Man, with the government retaining a 25% share (SBT, 2015).

KSCL is the largest sugar producer in Tanzania, accounting for more than 60% of the country's sugar output (SBT, 2015). KSCL comprises two adjacent agricultural estates and sugar factories, as well as an alcohol distillery (Illovo, 2014). Employment is created for 870 permanent staff and 2,073 seasonal workers at peak periods (Illovo, 2014).[10] In addition, more than 10,000, mostly small-scale, farmers are integrated through outgrower schemes. As estate expansion is limited due to land constraints, production increase has relied on estate yield improvements through irrigation (Illovo, 2014), as well as outgrower expansions on customary land, which more than tripled to nearly 12,000 hectares of rainfed land in 2011–12 (60% of total sugarcane area) (SBT, 2015).

The contractual relationship between outgrowers and KSCL is based on Cane Supply Agreements (CSA), which are signed between the outgrower associations and KSCL every three years. CSA spell out rights and obligations of contract partners, including division of proceeds with farmers receiving 57% and KSCL 43% of the proceeds (Smalley *et al.*, 2014). Farmers do not have individual contracts with KSCL. An indicative price is negotiated before the harvesting season and adjusted depending on the sucrose level and overall seasonal proceeds. The CSA specifies aspects of sugarcane cultivation, including required varieties and cultivation practices, obligations on cane delivery and payment schedule. Service provision changed over the years. After privatization, KSCL and donors supported outgrowers to access credit, bulk inputs, transport, and training. In 2005, service provision was devolved to the associations, who are now in charge of overseeing production and services provided (Smalley *et al.*, 2014). Today, outgrowers buy inputs either themselves or their associations assign external contractors, especially for harvesting, loading and transportation. The associations are also involved in linking farmers to credit institutions through the CSA. KSCL merely continues to monitor the burning of cane (Smalley *et al.*, 2014).[11] Yet, service provision and credit access has deteriorated (Smalley *et al.*, 2014). In addition, there have been problems of oversupply, leading to situations with some farmers being unable to sell during some years. As a result, sucrose levels among outgrowers have declined and outgrower yields average only 35–40 tons per hectare compared to 80-ton estate yields (Illovo, 2014). Recent government and donor support has therefore aimed at raising outgrower yields by promoting *block farms* (European Commission—EC, 2012; URT, 2013).

(ii) *Kilombero Plantation Limited (KPL)*

KPL is a recent rice joint venture between the British company Agrica and RUBADA, a Tanzanian parastatal organization mandated to promote agricultural investments in the Rufiji Basin. In 2008, Agrica purchased a 5,800-ha government property, which began as a Tanzanian–North Korean joint venture in 1986, but which was liquidated in 1993 (KPL, 2009). KPL established an industrial rice mill, warehouses, and cleaning and drying facilities (SAGCOT, 2013). At full operation, 20,000 tons of milled rice are expected to be produced, making it Tanzania's largest rice producer (KPL, 2009; SAGCOT, 2013), with employment of 180 full-time and up to 300 seasonal workers (KPL, 2009) from directly surrounding villages. As production is highly mechanized, agricultural jobs are mainly in weeding, with other jobs in processing, warehousing and support services. At the time of the survey, KPL had, at times, bought rice from smallholders, but no real contract farming scheme had been yet established. However, in partnership with USAID, a smallholder rice intensification project was installed that aimed at improving the rice production of 5,000 farm households in the area (SAGCOT, 2013).

4. DATA AND METHODOLOGY

(a) *Data*

The article is based on structured interviews from surveys conducted between April and June 2013 in villages surrounding KSCL and KPL, which focused on following groups: KSCL outgrower households, worker households at KSCL and KPL (factory and estate) and non-participating households at both KSCL and KPL. Non-participants are not involved in sugarcane production or agro-industry employment, but focus on maize and rice farming as well as non-farm activities (e.g., local brewery, trade or casual wage labor).

In the sugar survey, interviewees were selected through a two-stage sampling procedure. First, three wards (*group villages*) (Ruhembe, Mkula, and Sanje) were purposively selected since most of the sugarcane growers lived there according to information provided by KSCL extension officers. Ruhembe includes all the villages that sell sugarcane to the northern sugar factory (*K2*), except for those sugarcane growers living in urban areas. The households living in urban areas, who are usually wealthier non-farm business operators originating from other areas were not included in the survey. The other two wards are the main sugarcane-producing areas selling to the southern factory (*K1*). Almost all sugar agro-industry workers that live around the estates and factories, and are not migrant workers, come from these wards. Households were selected from all villages within the three wards. Village population lists were used to categorize households according to the three groups (outgrowers, workers, non-participants) and participants were randomly selected accordingly. For the case of workers (households with at least one member working at the estate), however, selection was more challenging since initially selected households often no longer worked at the estate. As a result, most working households that could be found were interviewed. The survey excluded the migratory workers in the sugar investment, who are mainly seasonal workers living in barracks within the estate area. The analysis is therefore limited to the effects in the villages surrounding the investments. Almost all of the participants were either outgrowers or workers, except for four sampled households who were both outgrowers and workers.

The agro-industry workers in the rice survey live in three villages directly surrounding KPL. As it was difficult to identify workers within the villages, sampling and interviews were conducted at the work place. During the days of the survey nearly 100 workers were available on the estate or the factory of which 68 were then selected for interviews. Non-participants were sampled as control groups from within 10 villages surrounding the investment based on population lists. The overall sample used for this article comprises 209 and 307 households for the rice and sugar survey respectively. As KSCL and KPL are located around 150 km from each other, there are no overlaps in the populations of the two surveys.

(b) *Methodological issues*

In order to understand the direct household welfare effects, this study estimates the average treatment effect of the treated (ATT), which is the average outcome difference between participation, $E[Y(1)|D = 1]$, and the situation had the participant not participated, $E[Y(1)|D = 0]$:

$$ATT = E[Y_{1i} - Y_{0i}|D_i = 1] = E[Y_{1i}|D_i = 1] - E[Y_{0i}|D_i = 1].$$

To overcome the problem that the outcome in absence of participation is unobservable, randomly assigning households into treatment and control groups would allow both groups to be statistically equivalent except for participation, so that $E[Y(0)|Z, D = 1] = E[Y(0)|Z, D = 0]$. Yet, participation is rarely random in observational studies and, instead, participants and non-participants usually differ before treatment, which may lead to over- or underestimating the true treatment effect (*selection bias*). Such a *selection bias* may arise from (a) project placement and selection decisions by the company as well as (b) households' self-selection into the respective channel. Companies, for instance, may prefer working with better-off farmers to reduce transaction costs (Barrett *et al.*, 2012). Farmers or households may decide to participate, depending on their expected returns, risks and capacity to participate. In the literature on agricultural market access or contract farming (e.g., Barrett *et al.*, 2012; Bellemare, 2012), participation is often influenced by the initial physical, educational and financial asset base, entrepreneurial ability, social networks, risk aversion or technical skills (Barrett *et al.*, 2012). For the case of agro-industry wage employment, the non-farm diversification literature also indicates that initial wealth status influences household-level diversification opportunities (Ellis, 2000). Poorer households may therefore rather self-select into the rural labor market due to their low agricultural earning potentials.

In the sugarcane outgrower case studied, participation has been relatively open. Smallholder outgrower participation first increased strongly at the end of 1970s. The company promoted sugarcane growing among all farmers in surrounding villages and provided infrastructure support as well as financial and agricultural assistance (Smalley *et al.*, 2014). However, during the 1980s and 1990s most outgrowers quit (Smalley *et al.*, 2014). Given the objective to increase sugar self-sufficiency after privatization, smallholders were encouraged again in the early 2000s to join through a number of public–private partnerships, involving outgrower infrastructure rehabilitation, technical assistance, micro-finance, and bulk input supply, making it easier for farmers to participate (see Smalley *et al.*, 2014). In addition, KSCL encouraged participation by improving factory efficiency and more transparent payment systems. Low rewards from alternative crops also led many farmers to join sugarcane outgrower schemes. The Sugar Industry Act of 2001 governs outgrower participation, requiring outgrowers to join an outgrower association and to register with the Sugar Board of Tanzania. There are no additional requirements, except for having minimal land available of as little as one acre and some start-up capital to pay a small association and to acquire inputs (Smalley *et al.*, 2014), which are therefore hypothesized to be the main entry barriers. Yet, farmers may also receive some inputs on credit, the costs for which are deducted from the proceeds at the end of season. Interviews with non-participants still revealed that lack of capital (85%), land (72%), and sufficient family labor (24%) were perceived to be the main factors impeding participation.

In the case of agro-industry workers, the participation process and barriers are not as clear. As far as sugar investment is concerned, during the early years of the investment, employment of migrant laborers was common (World Bank, 1994), many of whom later on stayed in the region and acquired farm land (Smalley *et al.*, 2014). With privatization, many workers quit their jobs at the estates due to declining salaries and fewer additional benefits, but were replaced by other workers on seasonal contracts with lower wages (Smalley *et al.*, 2014). Although it may suggest that households lacking alternative income sources would mainly work in these jobs, qualitative

interviews still suggested an overall very high demand among households for this work, which is understandable, especially given the high youth underemployment. In the rice case, qualitative interviews suggested that participants and non-participants view employment on the estates as inferior to other jobs. Yet, demand for factory as well as estate jobs is also very high. Some even noted the need to pay bribes to access these jobs.

(c) *Evaluation approach*

In order to address potential *selection bias*, the article uses propensity score matching (PSM) (Caliendo & Kopeinig, 2008; Rosenbaum & Rubin, 1983). PSM compares outcome means of participants and non-participants with similar *propensity scores*, i.e., their probability of participating P ($D_i = 1|Z$) given a vector of household characteristics Z. Using a probit model, the treatment effect is derived for those participants and non-participants overlapping in *propensity scores* using different matching algorithms. The random sample of non-participants is used as counterfactual for the participants as most would likely continue to pursue the traditional livelihood strategies in the absence of these investments. [12]

PSM's validity depends on two major assumptions (Caliendo & Kopeinig, 2008; Rosenbaum & Rubin, 1983): First, all factors influencing participation and outcomes can be accounted for (selection of observables). Second, there is sufficient similarity of participants and non-participants (overlap condition). Selection on observable characteristics only, however, is highly unlikely in practice. PSM is therefore considered a second-best approach to randomized experiments or difference-in-difference methods (Barrett *et al.*, 2012) and estimates have to be seen as suggestive rather than conclusive.

To ensure comparability, only units within a common support area in terms of propensity scores are matched. A number of tests are performed to check whether the distribution of variables in the group of participants and non-participants is balanced (Caliendo & Kopeinig, 2008).

The probit model control variables are based on the discussions in the previous section. Human capital variables of the household head (age, gender and educational level) were included, which are likely to affect a household's capacity to overcome access barriers to outgrower schemes or to access agro-industry jobs. The household size (male and female working members, number of dependants) may determine whether the household can take up labor-intensive on-farm jobs or join the labor market. Land ownership is an important physical capital when adopting a new crop and is used as a wealth proxy. Membership of local organizations and migratory background (place of birth of household head) are further included as social-capital variables.

Endogeneity may be a problem in the model due to reverse causality problem of some variables (land, assets, and liquidity constraints). The outgrower model therefore includes lagged formulations for some variables (land ownership, livestock) through retrospective questions about the situation in 2003. [13] The 67 outgrowers who had already participated before that time were excluded for the main model. Some potentially endogenous variables for which baseline information is missing (especially credit access) were excluded. For the outgrower case, the probit model was estimated in all villages. The worker probit model was only estimated in the participating villages to derive estimates for households assumed to have an actual chance to participate. [14] The worker model results were then extrapolated to estimate propensity scores for the entire group of non-participants (see e.g., Bernard, Taffesse, & Gabre-Madhina, 2008, for a similar approach). Lagged explanatory variables, however, may introduce further endogeneity problems through recall bias (Raphael, 1987) and unobserved heterogeneity (Bellemare, Masaki, & Pepinsky, 2015). As a robustness test, the model was therefore re-estimated without using lagged variables. Although there still may be difficulties measuring confounders (e.g., risk perception, entrepreneurial behavior or social capital), the model results were cross-checked with alternative sub-samples and using alternative model formulations. In addition, Rosenbaum-bounds were estimated to test how strong unobserved factors would need to be in order to alter the inferences drawn from the model (Rosenbaum, 2005). In order to cross-check the quantitative information, qualitative information was integrated in the analysis from subjective well-being questions in the questionnaires, expert interviews and four group interviews with participants and non-participants during pre-testing, and individual discussions with participants following the survey.

5. DESCRIPTIVE RESULTS

(a) *Sample characteristics*

The relevancy of LSAIs for rural poverty reduction depends on the entry barriers, particularly for poorer household groups. Table 1 therefore compares household characteristics of the groups analyzed in the study: (1) agro-industry workers in the rice and sugar sectors, which are households with at least one member employed at the estate or factory of KPL or KSCL in 2011–12; (2) outgrowers, which are sugarcane farmers selling to KSCL; (3) groups of non-participants living in the vicinity of KPL and KSCL, but neither involved in group (1) or (2). Sugarcane outgrowers are significantly better equipped in terms of human and physical capital than non-participants: they have larger areas of land, are better educated and own more livestock and other assets than non-participants. Land ownership among outgrowers averages 4.8 acres, almost twice the area owned by workers and non-participants, but which is still small compared to mean farm sizes in Tanzania and other land-abundant countries in SSA (e.g., Jayne, Chamberlin, & Headey, 2014). Moreover, outgrowers are on average older than non-participants, which may suggest difficulties experienced by younger households in accessing land, or other factors preventing them from participating. Agro-industry workers in both sub-sectors tend to have younger heads and fewer household members than non-participants. In terms of land ownership, workers are similar to non-participants in the sugarcane survey, but have significantly less land than non-participants in the rice survey. Credit access is low among all groups, but significantly higher for outgrowers (38% have access to credit) than for the other groups (8%–10%), which may suggest some benefits from participating in outgrower schemes in terms of lower credit-access barriers.

The importance of participating as a worker or outgrower in the LSAIs for overall household income varies between groups. Agro-industry workers in the rice survey continue to rely largely on agricultural income sources, but with wage income already making up 44%. Agro-industry workers in the sugar survey generate 64% of overall income from wages. Sugarcane outgrowers instead specialize in agriculture, from which they derive nearly 80% of their income.

Table 1. *Characteristics of outgrowers, agro-industry workers and non-participants*

	Rice sample		Sugar sample		
	Agro-industry worker ($N = 61$)	Non-participants ($N = 148$)	Outgrowers ($N = 144$)	Agro-industry worker ($N = 63$)	Non-participants ($N = 100$)
Average age of household (hh) head (yrs.)	38.8*	42.02	49.2***	39.8*	42.4
Female hh head (Female = 1)	7%	7%	8%**	5%***	18%
Hh head with some primary education	75%	89%	88%	92%	86%
Hh head with at least secondary education	59%	47%	48%***	28%	28%
Number of hh members	4.3*	4.8	4.8***	4.7	4.4
No. of women in hh > 16 years	1.19	1.29	1.56***	1.33	1.26
No. of men in hh > 16 years	1.43	1.38	1.39**	1.18	1.15
Dependants	1.7**	2.3	1.81	1.78	1.91
Farming household (binary)	98.4%	99.5%	100%	90%	98%
Average land holding (acre)	2.2***	3.6	4.82***	2.5	2.66
Total asset ownership (PCA)	1.38*	1.43	1.20***	0.97	0.95
Livestock (log of TLU)	0.33	0.22	0.31***	0.16	0.13
Credit access	9%	10%	38%***	10%	9%
Access to non-farm self-employment	33%**	46%	33%	25%	38%
Access to wage employment	100%	30%	36%	100%	62%
Organizational membership	41%	39%	94%***	38%	27%
Hh head born in the village	54%	44%	57%**	67%	67%
Income shares:					
Total agricultural income	45%***	74%	79%***	27%***	54%
Total hh wage income	44%***	5%	6%***	64%***	24%
Other non-agricultural income	11%***	21%	15%**	9%***	21%

Notes: Agro-industry workers are households of which at least one member has worked in 2011–12 at the estate or factory of KPL or KSCL. *Outgrowers* are households producing sugarcane and selling it to KSCL. Non-participants are households neither involved as agro-industry workers nor outgrower schemes. The significance tests are *t*-tests comparing the participant (outgrowers or agro-industry workers) with the non-participant groups: *, ** and *** indicate significance at 10%, 5%, and 1%, respectively.

Table 2. *Technology adoption and gross margin analysis (sugar survey)*

	Sugarcane production ($N = 144$)	Rice production ($N = 262$)	Maize production ($N = 107$)
Area allocated to crop (acre)	2.67	2.0	1.18
Fertilizer use (binary)	78%	30%	3%
Pesticide use (binary)	65%	46%	1%
Labor hiring for weeding (binary)	66%	51%	14%
Total production (*t*)	62.3	1.6	0.8
Total yields (*t*/acre)	21.1	0.85	1.57
Percentage sold (%)	100%	38%	16%
Value of gross revenue per acre	1,424,295	537,999	360,448
Total costs per acre	467,249	161,344	47,027
Value of net revenue per acre	953,561	361,256	299,082
Block farm profits (per acre)[a]	951,711		
Total value of net revenue	2,826,091	672,236	346,077

Notes: The rice and maize production figures include both sugarcane and non-sugarcane farmers.
[a] 49 of the interviewed sugarcane farmers reported receiving additional income from having plots in the collective farming schemes (block farms).

(b) *Gross margin, wage and household income comparisons*

Participating as agro-industry wage worker or outgrower is hypothesized to directly influence wages or agricultural incomes (intermediate outcomes), respectively. Yet, in order to capture intra-household substitution and spillover effects—not captured by crop gross margins or wages—and to compare welfare effects for different groups, the article focuses on annual per capita household income as the main impact indicator. Household income is the sum of marketed, subsistence and in-kind farm and non-farm income. In addition, income poverty is calculated following the National Bureau of Statistics' methodology for the national poverty line, but using income instead of expenditure data.[15] Table 2 reports intermediate outcomes for the outgrow channel in terms of technology use and gross margins of sugarcane outgrowers compared to the most common alternative crops, rice and maize. Sugarcane gross margins are calculated as the difference between sugarcane revenues and all field and off-field production costs.[16] Initial investment costs are converted to annual figures. Rice and maize gross revenue is the total production valued at market prices received by the households for the sold produce. Although adoption of sugarcane is associated with higher costs, overall income from sugarcane production per acre still exceeds the alternatives by a factor of three. Participation in the sugarcane outgrower scheme is also associated with a higher adoption rate of fertilizer (80%) and pesticides (65%), most of which is financed through own savings (90%).

Table 3 compares agro-industry wage workers with households reported to work in other wage jobs, most of which

Table 3. *Agro-industry vs. other agricultural wage employment (median values)*

Variables	Rice investment		Sugar investment	
	Agro-industry employment	Other agric. wage labor	Agro-industry employment	Other agric. wage labor
Years working in this job	2	6	4	10
Number of months per year	7	3	10	4
Number of days per month	25	11	26	12
Number of person days per year	162	31	243	56
Average income per month in Tsh	90,500	45,000	151,233	50,000
Average income per day in Tsh	3,673	4,000	5,833	5,000
Annual income from this job in Tsh	612,500	142,500	1,440,000	205,000
Total number of observations	61	74	63	132

Notes: Most of the wages in the agro-industry are paid bi-weekly or monthly. We therefore used the self-reported information on average number of days to calculate daily wages. The exchange rate in 31 December 2011 was 1580 Tanzanian Shilling to USD.

(85% in the sugarcane survey) is casual wage employment in the smallholder sector (rice and maize). Around 50% of workers mentioned working for other farmers. In the sugar survey, 35% specified working for sugarcane outgrower farmers, an indication of potential indirect effects of the investment. Nearly 80% of sugar workers are seasonally employed; the rest are divided equally into casual and permanent staff. On average, employment is for 9 months per year, which is also the length of the harvesting season. Thus, although most employment is seasonal, it still covers three-quarters of the year, mainly during the dry season. In the rice survey, 45% of workers in the investment were casual workers, 27% seasonal and 28% permanent staff. Workers were employed for an average of 7 months, but this may overstate the situation, as more factory workers were employed during data collection. Agricultural work in the rice industry, instead, is often through more short-term contracts. Average daily wages do not differ significantly between the agro-industry and local sectors, which may come as a surprise, but which could also suggest that the higher agro-industry wages exert upward pressure on local wages. But given that annual employment duration is almost twice as high in the agro-industry compared to local jobs, monthly wages and annual incomes differ by factor two and three compared to local jobs in the two sectors respectively.

Table 4 shows that differences in wage and crop income are also reflected in household income differences. Sugarcane outgrowers have the highest per capita incomes, which are more than twice the income of non-participants. Incomes of agro-industry workers are also higher than those of non-participants in both surveys, but differences are small in the rice survey. On the one hand, this is because per-capita average incomes of agro-industry workers in the two investments differ slightly, i.e., sugar workers have 20% higher incomes than rice workers on average. On the other hand, non-participants seem to be better-off in the vicinity of the rice investment site, compared to non-participants around the sugar investment (18% richer). Relative differences in the two investments compared to the respective groups of non-participants are therefore substantial—76% in sugar and 24% in rice. Average poverty rates of all participant groups are also significantly lower than those of non-participants.

6. HOUSEHOLD WELFARE EFFECTS OF LARGE-SCALE AGRICULTURAL INVESTMENTS

(a) *Probit model and balancing tests*

Table 5 shows the probit model results to derive the *propensity scores*. In the rice wage-labor case, education, number of male household members in working age, total number of dependants and land ownership are significantly associated with participation. The correlation with household members and land ownership is expected: households with less land but sufficient family labor rely more often on wage labor. The significant education coefficient may be linked to the fact that many younger, even educated, families may lack land and therefore have to rely on wage employment. But better-educated families may also more easily get a job at the company as they may be expected to be better workers.

In both sugar sector models, land is not a significant predictor of participation. Although the variable may suffer from measurement problems more than other variables, it could suggest that the outgrower schemes have lower land-based entry barriers than qualitative interviews suggested (see Section 4).[17] Yet, more educated households as well as male-headed households have a higher likelihood of participating. For agro-industry wage employment, participation is negatively correlated with the age of the household head, but pos-

Table 4. *Total household income and income poverty comparisons*

	Rice		Sugar		
	Agro-industry employment	Non-participants	Sugarcane outgrowers	Agro-industry employment	Non-participants
Total agricultural income	1,291,891	1,697,674	3,520,426	1,010,704	930,294
Total hh wage income	966,137	108,116	271,672	1,575,381	346,110
Other non-agricultural income	464,019	586,925	776,745	705,812	544,602
Total household income	2,722,046	2,416,484	4,568,842	3,291,897	1,811,621
Per capita hh income	811,145	651,974	1,217,941	974,790	552,779
Below food poverty line	15%	34%	6%	6%	43%
Below basic poverty line	20%	48%	23%	18%	53%
Observations	61	148	144	63	100

Table 5. *Probit model*

	Rice investment (worker) Coeff	Sugar investment (worker) Coeff	Sugar investment (outgrower) Coeff
Age head (years)	0.004 (0.015)	−0.041** (0.018)	0.001 (0.013)
Female-headed household (1 = yes)			−0.866*** (0.276)
Education head (1 = at least secondary)	0.739*** (0.085)	0.182 (0.210)	0.583*** (0.153)
Male working members (number)	0.293** (0.120)	0.240 (0.262)	−0.132 (0.163)
Female working members (number)	−0.236 (0.225)	0.187* (0.113)	0.007 (0.186)
Dependents (number)	0.179** (0.083)	−0.011 (0.124)	−0.085 (0.141)
Land ownership (acre) (log)*	−1.537*** (0.261)	−0.200 (0.229)	0.125 (0.154)
Group membership*	0.073 (0.227)	0.509* (0.268)	0.113 (0.352)
Born in village (1 = yes)	−0.287 (0.247)	−0.284 (0.401)	0.225 (0.305)
Village fixed effects	No	No	Yes
Constant	0.887 (0.739)	1.341** (0.632)	0.274 (0.431)
Observations	115	134	175
Pseudo R^2	0.21	0.08	0.16
Sensitivity	66.04	58.73	65.33
Specificity	82.26	59.15	73.00
Correctly classified	74.78	58.96	69.71

Notes: (a) lagged variables using retrospective questions for the outgrower model about the situation in 2002–03. *, **, and *** indicate significance at 10%, 5%, and 1%, respectively. Participants in the probit models comprise only households living in the same villages: 61 workers and 54 non-participants in the rice model, 63 workers and 71 non-participants in the sugar worker model, and 75 outgrowers and 100 non-participants in the outgrower model.

itively with group membership, which could suggest the importance of social capital. The main intention for estimating the models is, however, to balance the differences in observable characteristics between the groups.

Results of the balancing quality checks are reported in Figure 2, Tables 6 and 10. Figure 2 shows the histograms of the predicted *propensity scores* of treated and control groups. For the sugar outgrower and worker models they are within a similar range, whereas treated and control groups differ more in the rice case, though substantial overlap in the *propensity scores* remains. In all channels, the common support area includes most of the participating households, which is important for the matched participant sample to be representative of the initial sample (Blundell & Dias, 2000).[18] The mean comparisons of the model covariates (Table 10) suggest good balancing for all the three models. There is, however, some heterogeneity between different measures and matching algorithms—kernel (KM), radius (RM) and nearest neighbor matching (NNM)[19]—when comparing the pseudo-R^2 and likelihood ratio tests as well as absolute mean and median bias test before and after matching (Table 6). Good matches (cf., Caliendo & Kopeinig, 2008) are reached with KM and RM, whereas NNM leads to weaker matches, especially in the rice worker case, requiring some caution with interpreting the results.[20]

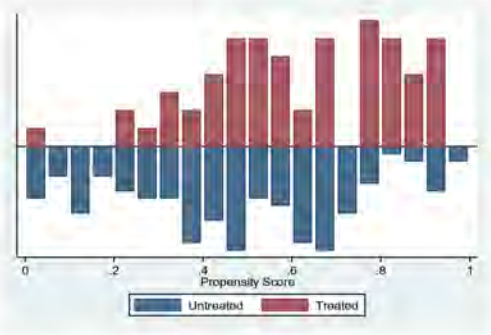
(b) *Matching results*

The estimation results for the ATT of the different channels are reported in Tables 7a and 7b, including the different PSM matching algorithms as well as ordinary least squares (OLS) estimation results. ATTs are estimated for agricultural income, total household income, per-capita household income and basic needs poverty with bootstrapped standard errors in all PSM models. For all the analyzed cases, OLS results are similar to PSM, yet with some differences in the size of the ATTs. For the case of sugarcane outgrowers (Table 7a), the models predict ATTs for agricultural income of 1.3 million to 1.5 million Tanzanian Shilling (Tsh), which are between 150% and 215%. In terms of total household income and per-capita income, outgrowers' ATTs are also between 120% (2.2–2.5 million Tsh) and 151% (530–590,000 Tsh), respectively. Income poverty is around 40% lower compared to the control group.[21]

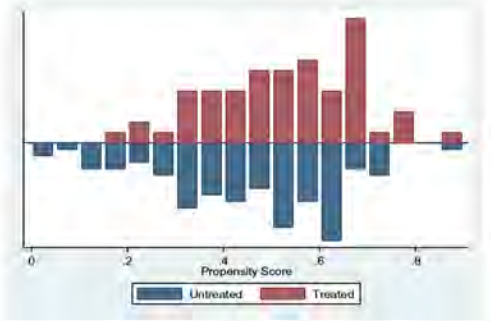
For the agro-industry employment cases (Table 7b), results differ between both sectors. Participation in the rice investment as worker is associated with lower agricultural incomes compared to the counterfactual situation, which suggest some negative household-level substitution effects, while the ATT is positive in the sugar case; yet in both cases the ATT is not statistically significant. In terms of per capita household income, participation as agro-industry worker in the sugar sector is associated with ATTs of 84% and 99% (450–490,000 Tsh), which are lower than in the outgrower case, but still very substantial. For the case of rice workers, ATTs for total household income are positive, although the models fail to predict statistically significant ATTs, but do so for per-capita income of around 50%. Differences between sectors may reflect different lengths of harvesting seasons as well as the differences in control groups' income level, as discussed in Section 4. Yet, while average income differences may be lower, around the poverty line differences are significant in both cases: income poverty is 24%–28% lower in the rice case and 40% lower in the sugar labor channel. This result may suggest that while participation in the rice investments may not contribute to large income improvements, it could provide protection against extreme poverty. In the sugar case, estimating both models with and without using the households engaged in both treatments does not change the results significantly.

The estimated income difference in the outgrower scheme is largely in line with most other studies that have attempted to quantify the impact of contract farming. However, other studies find significantly lower participation effects of 30%–50% (e.g., Bellemare, 2012; Rao & Qaim, 2011; Warning & Key, 2002). Such differences may result from the fact that these studies focus on crops also produced locally by non-participating farmers. In this study, contracting is interlinked with introducing a new crop into a region not well integrated into high-value markets, which potentially results in much larger income differences between the common alternative income strategies (cf. the case of poultry in Simmons *et al.*, 2005; tomatoes in Maertens & Swinnen, 2009). For the labor

Propensity score distribution – Rice worker comparison



PS distribution – Sugar worker comparison



PS distribution – Sugar outgrower comparison

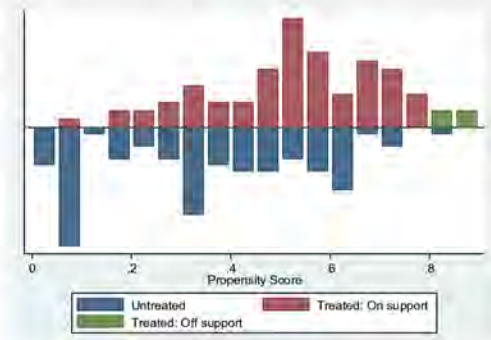


Figure 2. *Propensity score distribution.*

market cases, the significant and high positive household incomes for sugar industry workers are in line with previously cited studies in the horticultural export sector (Maertens & Swinnen, 2009; McCulloch & Ota, 2002).

(c) *Heterogeneity of effects*

As average differences may hide heterogeneity within the group of participants, Table 8 presents income differences separately for land-poor and land-rich households.[22] The results suggest that participation in sugarcane outgrower schemes has a positive and significant effect on agricultural and per capita income for both land-poorer and land-richer households, but significantly more for the latter group. Thus, whereas land-richer and land-poorer outgrowers have significantly higher agricultural and per capita incomes than non-participants, larger sugarcane outgrowers seem to benefit more than land-poorer outgrowers. For sugar workers, differences in terms of per capita income are significant and positive for both groups. Although ATTs for land-poor workers are relatively lower than for land-rich households compared to the group of non-participants, it is still positive and significant. Yet, ATTs of agricultural incomes among land-poorer workers is negative and significant, which may suggest negative effects on agricultural income, whereas the ATTs are positive for land-richer sugarcane workers. For the case of rice agro-industry workers, land-poorer households also have significantly lower agricultural production compared to non-participants, which is not the case for land-richer workers. Yet in per capita income terms land-poorer rice workers are predicted to have higher per capita incomes relative to land-rich households.

(d) *Robustness analysis*

Table 9 presents a number of robustness tests for estimating the ATT for per capita income, by adjusting some key parameters: (1) restricting matching to treatment villages only (labor market models); (2) estimating the logit model by using the entire non-participant sample (labor market models); (3) estimating the logit model using different logit specifications (labor market model), (4) estimating the logit model without using some variables that suffered from potential reverse causality (land ownership and group membership), (5) replacing lagged with current values and (6) including a lagged asset variable (2008 values) to account for differences in initial wealth status. The results highlight the robustness of the models for sugarcane outgrower and agro-industry labor; in the case of rice, the estimated differences are positive, though not statistically significant. The higher estimated effects for sugar workers when matching within worker villages (specification 1) might come as a surprise as one would expect larger positive indirect effects in the village. However, as non-worker villages are still inhabited by outgrowers there are also likely to be similar indirect effects.

In spite of the robustness checks, limitations in the data and model (small sample size, lack of baseline data, unobserved heterogeneity) preclude drawing clear causal inferences. Yet, a Rosenbaum-bounds test was also conducted to test the significant models' sensitivity to hidden bias, which suggested results for both sugarcane models to be very robust to hidden bias but less so for the rice investment.

Information about subjective well-being in the questionnaires as well as the qualitative interviews at the same time suggested a more nuanced picture of the potential effects. In spite of the high estimated income effects, only 39% of outgrowers mentioned in the questionnaire that they are satisfied with the sugarcane income they generate, which is similar to the results of Deininger and Xia (2016) for Mozambique. These results were similar for both land-richer (40%) and land-poorer outgrowers (35%). Declining overall support by outgrower associations as well as increasing production costs and low or unstable market prices were noted as some of the reasons. Nonetheless, around 80% of outgrowers would recommend their children to go into sugarcane farming, which shows the income generating potential of sugarcane in the region. Compared to others, 85% of outgrowers mentioned having slightly or much higher standards of living, whereas only 3% perceived it to be worse. Compared to before they joined, 74% noted a slight improvement, 2% a much better situation, whereas 19% felt a worsening situation. For agro-industry workers, when asked about their satisfaction regarding their labor contract, 51% of sugar workers replied that

Table 6. *Matching quality—summary measures*

		Sample	Pseudo R^2	LR chi2	$p >$ chi2	Mean Bias	Median Bias
Sugar (outgrower)							
	NNM	Raw	0.161	38.56	0.001	19.0	16.7
		Matched	0.03	5.95	0.981	9.4	8.7
	KM	Raw	0.161	38.56	0.001	19.0	16.7
		Matched	0.014	2.82	1.000	6.3	6.4
	RM	Raw	0.161	38.56	0.001	19.0	16.7
		Matched	0.005	0.93	1.000	2.8	2.3
Sugar (worker)							
Model 5	NNM	Raw	0.088	16.39	0.037	16.1	10.6
		Matched	0.039	5.07	0.750	11.5	9.9
	KM	Raw	0.088	16.39	0.037	16.1	10.6
		Matched	0.02	2.69	0.952	9.7	8.7
	RM	Raw	0.088	16.39	0.037	16.1	10.6
		Matched	0.02	2.73	0.950	8.1	6.1
Rice (worker)							
Model 4	NNM	Raw	0.196	31.15	0.000	27.5	22.7
		Matched	0.126	10.5	0.232	19.4	17.7
	KM	Raw	0.196	31.15	0.000	27.5	22.7
		Matched	0.074	6.21	0.623	16.8	13.8
	RM	Raw	0.196	31.15	0.000	27.5	22.7
		Matched	0.053	4.56	0.804	13.5	14.2

Table 7a. *ATT: sugarcane outgrower scheme*

	OLS		NNM		KM		RM	
	Coef. (SE)	%diff	ATT (SE)	%diff	ATT (SE)	%diff	ATT (SE)	%diff
Agricultural income (in '000 Tsh)	1,352*** (244)	146%	1,650*** (288)	216%	1,629*** (301)	210%	1,627*** (110)	209%
Total hh income (in '000 Tsh)	2,200*** (377)	122%	2,521*** (460)	153%	2,494*** (485)	149%	2,505*** (461)	151%
Per capita hh income (in '000 Tsh)	528** (93)	116%	596*** (106)	147%	593*** (107)	146%	595*** (110)	147%
Basic needs poverty	−0.400***	−40%	−0.397*** (0.094)	−40%	−0.406*** (0.099)	−41%	−0.400*** (0.099)	−40%

Notes: *, **, and *** indicate significance at 10%, 5%, and 1%, respectively. The OLS models comprise the entire group of participants and non-participants from all villages (209, 163, and 175 in the rice worker, sugar worker, and outgrower model, respectively). The PSM models comprise all households within the common support from all villages (209, 163, and 171 in the rice workers, sugar worker and outgrower model, respectively).

Table 7b. *ATT: agro-industry wage employment*

	OLS		NNM		KM		RM	
	Coeff (SE)	%diff	Coeff (SE)	%diff	Coeff (SE)	%diff	Coeff (SE)	%diff
Rice sector								
Agricultural income (in '000 Tsh)	149 (204)	9%	−161 (190)	−12%	−128 (172)	−10%	−121 (175)	−9%
Total hh income (in '000 Tsh)	595* (302)	24%	502 (323)	25%	444 (291)	21%	470* (248)	23%
Per capita hh income (in '000 Tsh)	170** (70)	31%	265*** (85)	64%	240*** (77)	54%	232*** (77)	52%
Basic needs poverty	−0.30** (0.074)	−31%	−0.37*** (0.091)	−37%	−0.35*** (0.096)	−35%	−0.35*** (0.082)	−35%
Sugar sector								
Agricultural income (in '000 Tsh)	133 (223)	14%	244 (332)	24%	280 (322)	29%	267 (307)	27%
Total hh income (in '000 Tsh)	1,883*** (468)	104%	2,051 (575)	97%	2,189 (570)	109%	2,194 (561)	112%
Per capita hh income (in '000 Tsh)	449*** (118)	99%	455** (179)	84%	493*** (136)	96%	495*** (122)	96%
Basic needs poverty	−0.403*** (0.091)	−40%	−0.416*** (0.085)	−42%	−0.397*** (0.077)	−40%	−0.401*** (0.076)	−40%

Notes: *, **, and *** indicate significance at 10%, 5%, and 1%, respectively. The OLS models comprise the entire group of participants and non-participants from all villages (209, 163, and 175 in the rice worker, sugar worker, and outgrower model, respectively). The PSM models comprise all households within the common support are from all villages (209, 163, and 171 in the rice workers, sugar worker and outgrower model, respectively).

they were satisfied, whereas only 22% rice workers were satisfied. Yet, when comparing their well-being to others, 75% of sugar and 74% of rice workers felt their well-being to be higher and only 2% and 12% to be worse, respectively. Compared to before participating, 76% of sugar workers and 54% of rice workers noted an improvement, though only slightly. Still, most sugar and rice workers (67% and 75%, respectively) would not recommend their children to take up this job.

The individual and group interviews also pointed to further problems in the outgrower model that may undermine their

Table 8. *Heterogeneity of impacts (Kernel matching)*

	Treated	Untreated	ATT	SE	% change
Sugarcane outgrower scheme					
Agricultural income					
Land poorer (≤2 acres)	29	100	782,424***	240,570	101%
Land richer (>2 acres)	42	100	2,181,397***	382,767	269%
Per capita total income					
Land poorer (≤2 acres)	29	100	215,708**	112,393	64%
Land richer (>2 acres)	42	100	811,880***	143,507	201%
Sugar agro-industry worker					
Agricultural income					
Land poorer (≤2 acres)	32	100	−477,421***	168,427	−50%
Land richer (>2 acres)	30	100	1,088,385*	566,834	109%
Per capita total income					
Land poorer (≤2 acres)	32	100	346,607**	138,292	66%
Land richer (>2 acres)	30	100	648,567***	219,626	129%
Rice agro-industry worker					
Agricultural income					
Land poorer (≤3 acre)	28	156	−328,928**	127,844	−29%
Land richer (>3 acres)	25	156	324,374	359,829	21%
Per capita total income					
Land poorer (≤3 acre)	28	156	329,415***	99,674	84%
Land richer (>3 acres)	25	156	206,142	135,237	41%

Notes: *, **, and *** indicate significance at 10%, 5%, and 1%, respectively.

poverty-reducing potential. Whereas power imbalances between sellers and buyers are considered major sources of conflict in the literature (e.g., Little & Watts, 1994), they seemed less relevant here. Instead, governance issues within the outgrower associations were more problematic, as larger outgrowers seem to influence service provision (harvesting, transport) leaving resource-poorer outgrowers with less access (elite capture). Often, these smaller outgrowers are not serviced for several seasons, causing some to abandon their land, which may eventually lead to greater land concentration among larger farmers. Institutional innovations such as *block farming* (see Section 2), which could enhance smallholder competitiveness, seem to be not well supported by outgrower associations. Other factors are worsening extension support and input availability among smallholders, which keeps their yields low (cf. Smalley *et al.*, 2014). In addition, waiving of import tariffs at times is making domestic producers more vulnerable to market shocks.

7. CONCLUSIONS

This article examined the effects of large-scale agricultural investments (LSAIs) on household welfare in Tanzania, one of the main recipients of LSAIs in Sub-Saharan Africa. Building on primary household-level data, it compared income levels and income poverty of households involved in different investment schemes—large-scale factory and estates investments in rice and sugar and outgrower schemes for smallholders in the sugar sector—with those not participating in these schemes.

The empirical analysis, conducted by means of propensity score matching accompanied by several robustness and sensitivity tests, shows significant and strong positive differences in terms of income and poverty between participants in sugarcane outgrower schemes compared to the counterfactual, but more nuanced results for the agro-industry labor market channel which depend on the investment. The positive results for the outgrower channel are broadly in line with other studies on contract farming and outgrower schemes (e.g., Maertens & Swinnen, 2009; Rao & Qaim, 2011; Vaeth & Kirk, 2014). However, land-rich outgrowers seem to benefit more than land-poor in absolute and relative terms. For agro-industry workers in the sugar investment, estimated income effects are slightly lower than for outgrower farmers, but are still very large. For workers in the rice investment, predicted effects are significantly lower, but still positive and significant. In particular the results concerning the sugar industry contrast with commonly voiced concerns about this type of employment, but are in line with Maertens' *et al.* (2011) study on tomato exports in Senegal. The findings show that, in the context of few alternative market and employment opportunities, this type of employment is often an improvement compared to alternative vulnerable farming systems. Qualitative interviews conducted as a cross-check support the general results, although they also pointed to a number of challenges, especially regarding the operation of outgrower schemes, which may constrain the investments' potential to reduce poverty. Nonetheless, the results have to be seen as suggestive rather than conclusive evidence due to the data and model limitations, as is often the case in studies on contract farming (Bellemare, 2015).

In order to derive more general conclusions about the implications of the investments, however, further research would first need to account for a broader set of outcome variables to capture the multi-dimensionality of poverty (particularly nutrition, health, education). Well-implemented investments may, for example, also involve investments in schools and health facilities as part of their Corporate Social Responsibility approach, generating additional welfare benefits (Deininger

Table 9. *Robustness checks (per capita household income)*

	ATT	Bootstrap SE	*P*-value	Mean bias	Median bias	RB
(1) Agro-industry employment—Matching only with non-participants in treatment villages						
Rice sub-sector						
NNM	132,198	132,537	0.271	17.9	18.2	
KM	116,821	119,193	0.303	9.8	9.4	
RM	122,743	99,790	0.258	11.2	11.8	
Sugar sub-sector						
NNM	667,194	132,244	0.00	5.6	6.1	4–4.25
KM	674,398	128,787	0.00	4.1	4.6	4.25–4.5
RM	671,216	129,343	0.00	3.5	3.2	5.0–5.25
(2) Agro-industry wage models: Propensity scores estimated from entire group of non-participants						
Rice sub-sector						
NNM	143,974	95,742	0.137	5.6	4.3	
KM	144,664	84,880	0.119	5.9	6.3	
RM	151,949	78,449	0.05	5.0	5.4	
Sugar sub-sector						
NNM	533,088	131,436	0.00	4.8	4.3	1.1–1.2
KM	543,926	123,644	0.05	3	2	1–1.25
RM	537,707	129,685	0.00	2.4	2	1.25–1.5
(3) Agro-industry wage models: Different specification of logit model						
Rice sub-sector						
NNM	98,658	104,591	0.937	8.8	6.5	
KM	111,765	103,760	0.916	4.4	3.3	
RM	124,038	98,138	0.829	4.4	4.2	
			Sugar sub-sector			
NNM	573,424	457,561	0.00	6.2	5.6	5.25–5.5
KM	602,466	478,139	0.00	5.3	2.2	6.0–6.25
RM	565,237	484,577	0.00	3.4	3.1	5.0–5.25
(4) Sugarcane outgrower—PS estimated w/o land and group membership variable						
NNM	623,238	110,184	0.000	7.7	6.1	5–5.25
KM	627,076	103,518	0.000	7.3	5.2	5.5–5.75
RM	605,756	105,503	0.000	6.9	5.7	5.5–5.75
5) Sugarcane outgrower—Different logit model (current land holding, livestock)						
NNM	560,947	462,830	0.000	6.4	6.6	4.25–4.5
KM	549,091	461,074	0.000	6.3	5.1	3.75–4
RM	551,387	447,970	0.000	4.9	4.0	4.0–4.25
6) Sugarcane outgrower—Different logit model (including asset variable of 2008)						
NNM	516,375	102,345	0.000	5.5	5.2	2.25–2.5
KM	535,692	102,129	0.000	4.2	3.6	2.5–2.7
RM	551,146	97,704	0.000	4.1	3.7	2.75–3

Notes: *, ** and *** indicate significance at 10%, 5%, and 1%, respectively. RB = Confidence Intervals of the Rosenbaum Bounds Gamma values (log odds of differential assignment due to unobserved factors). Model 5) uses all outgrowers within the common support area; Model 4) only uses outgrowers that started sugarcane production before 2003.

& Byerlee, 2012), as was the situation for the cases analyzed. Secondly, indirect effects to other regions through migratory labor movements (not accounted for in this study) and to the non-farm and small-scale farming sector influence their development impacts. Such investments may, for example, introduce new farming methods, inducing spillovers to small-scale farmers. In one of the investments studied a partnership with USAID was initiated to support small-scale rice intensification in the region. In addition, there may also be positive effects for the entire sub-sector, when large agribusiness firms may have more influence on policies that benefit producers and processors. Lastly, industrial hubs might arise due to various inter-industrial linkages. In contrast to that, however, large-scale producers targeting the domestic market may push small-scale farmers and local processors out of market due to oversupply. Increasing land demand due to estate or outgrower expansions may also reduce land availability and cause local conflicts.

Lastly, case study results have to be seen as context specific and are only to a limited extent generalizable. The case studies revealed important differences between the investments and sub-sectors, but are not representative of the sub-sectors. The investments considered have been referred to as best-practice cases in Tanzania (SAGCOT, 2013). For the outgrower case studied, for example, participants benefited considerably from substantial public–private partnership

support after privatization (see Section 5). In other cases, relationships between processors and outgrowers have been more contentious and the schemes less inclusive. At Mtibwa Sugar, another sugar investment in the same wider region, for instance, conflicts as a result of pricing policies and continuous factory breakdowns often leave large amounts of outgrower produce unprocessed (Nkonya & Barreiro-Hurle, 2012), leading many farmers to quit participation (cf. SBT, 2015). Factory efficiency in terms of capacity utilizations, for instance, is as different as 54% (Mtibwa) and 87% (Kilombero) (SBT, 2015). Outgrowers at Kilombero have also received higher prices than those at Mtibwa (38% difference) due to different pricing models, which in Kilombero includes, apart from sugar sales, molasses and biogas utilization (Nkonya & Barreiro-Hurle, 2012). Outgrowers at the investment studied make up also around 60% of the total sugarcane area. In other schemes, such as those in Malawi, Mozambique, Zimbabwe, or Zambia, outgrowers often play only a marginal role in relation to the area and production of the estate, thus limiting the schemes poverty-reducing potentials and farmers negotiation power (Gibbon, 2011; Oya, 2012).

For the case of agro-industry employment, conclusions about the overall benefits are strongly influenced by the labor intensity of the investments as it determines the potential for creating direct and indirect effects. For sugarcane, the number of workers employed per 1,000 ha may range from only 150 for mechanical harvesting in Mozambique to around 700 on irrigated plantations with manual harvesting in Tanzania (Deininger *et al.*, 2011). In addition, although the study finds improvements to the status quo, wages would need to increase in the long-term in order to lift workers out of poverty (cf. Jayne *et al.*, 2014).

Both investments analyzed were also special cases as they operate on previous government land, whereas investments targeting village land may face a multitude of legitimate claims by rural people, with a greater risk of land conflicts. Alternative models, such as joint ventures with communities, where the community retains land ownership, might be more suitable in such cases (cf. Cotula & Leonard, 2010).

NOTES

1. Large-scale land acquisitions (LSLAs) or land deals refer to transfers or their negotiations of the use of ownership rights over contiguous areas of large lands for plantation production models (Baumgartner, von Braun, Abebaw, & Müller, 2015; Schoeneveld, 2014). LSAIs are a subset of LSLAs, which involve actual investments in land (Baumgartner *et al.*, 2015).

2. Eaton and Shepherd (2001, p.2) define contract farming "as an agreement between farmers and processing and/or marketing firms for the production and supply of agricultural products under forward agreements, frequently at predetermined prices," often involving production support through advice and input provision. In this article, the terms contract farming and outgrower schemes are used interchangeably.

3. The Tanzanian Sugar Board Act of 2001, for example, effectively creates regional monopsonies by prohibiting the establishment of different sugar factories within a certain area.

4. Yet, this is in spite of their relative low importance. Gibbon (2011), for example, estimates that on average only 5%–7.5% of all cultivated land in Sub-Saharan Africa has been under plantations or large-scale farming.

5. In Tanzania, the Investment Promotion Act of 1996 provided investment incentives and led to the establishment of the Tanzanian Investment Center (TIC), which is mandated to actively promote large-scale agricultural investment.

6. However, actual working conditions are often not in line with the legal provisions, e.g., with permanent positions often declared as daily or task-based jobs to avoid legal protections for the workers, social security or protective equipment not being provided.

7. Despite sharp employment cuts, 14,000 continued to be directly employed during peak seasons (2011–12) (SBT, 2015).

8. FAOSTAT data suggests that while Tanzania is the 28th most important rice producer in the world, it is only in 99th place in terms of rice yields (2010–13 averages) (FAOSTAT, 2015).

9. At the same time, the Kilombero Valley is surrounded by sites of great biodiversity value that constrain overall agricultural expansion (Nindi, Maliti, Bakari, Kija, & Machoke, 2001).

10. Most workers are employed on the estate and within the factories, many of whom are cane cutters involved in the manual sugarcane harvesting during the 9–10-month-long harvesting season. Other estate jobs include fertilizer application, truck driving, or gap filling.

11. According to the CSA, KSCL "has no obligation or responsibility to make available to the associations, or to the association growers . . . any management, operational, extension or administrative services" (cited by Smalley *et al.*, 2014).

12. Simmons *et al.* (2005) and Narayanan (2014) follow a very similar argumentation in their studies.

13. See Maertens and Swinnen (2009), Maertens *et al.* (2011), who follow a similar approach.

14. As a robustness check we also estimated the probit models including all villages as we may another bias.

15. Total household income is converted in adult-equivalent scales (NBS, 2007) and compared to the Tanzanian national basic needs poverty line of Tsh 36,482 per adult equivalent per month in 2011–12 (NPS, 2012–13).

16. Production costs include all external inputs, including machinery rental services and hired labor costs. Family labor was recorded in the crop section, but is not accounted for.

17. Qualitative observations also partly confirmed this result. Moreover, most sugarcane outgrowers in the interviewed villages own relatively small plots, whereas the large sugarcane farmers usually come from outside the villages in urban settlements surrounding the factories and are not part of the survey, as mentioned above.

18. Only seven adopters are lost in total when applying the common support condition (three rice workers and four sugar outgrowers).

19. The default 0.06 bandwidth is used for the KM and 0.1 calipers for the RM, while five nearest neighbors are used with the NNM.

20. Caliendo and Kopeinig (2008) argue that a bias reduction below 5% is usually seen as sufficient.

21. As we do not account for family labor, the estimated effects include both return to family owned labor and entrepreneurship. If we would account for family labor, the effects for the outgrower case would be even larger, given the less intensive use of family labor among outgrowers.

22. To categorize households in land poor or land rich, the median land holding in each survey was used as cut-off points (three acres in the rice and two acres in the sugar investment)

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APPENDIX A

Table 10. *Matching quality—covariance balance (Appendix)*

	Variable	Unmatched Matched	Mean Treated	%reduct Control	*t*-test %bias	Bias	*t*	$p > t$
Rice (worker)	Average age of hh head	Unmatched	39.00	41.89	−26.9		−1.44	0.153
		Matched	39.00	39.64	−5.9	78	−0.22	0.829
	Hh head with at least secondary education	Unmatched	0.58	0.49	18.5		0.99	0.325
		Matched	0.58	0.56	4.1	77.9	0.15	0.88
	No. of men in hh > 16 years	Unmatched	1.45	1.42	3.6		0.19	0.849
		Matched	1.45	1.54	−9.7	−172.8	−0.35	0.728
	No. of women in hh > 16 years	Unmatched	1.15	1.38	−35.9		−1.93	0.056
		Matched	1.15	1.30	−23	35.8	−0.99	0.324
	Dependants	Unmatched	1.60	1.73	−11.4		−0.61	0.543
		Matched	1.60	1.54	5.4	52.7	0.2	0.841
	Average land holding (acre) (log)	Unmatched	1.02	1.43	−73.4		−3.94	0.00
		Matched	1.02	1.22	−36.3	50.6	−1.42	0.16
	Organizational membership	Unmatched	0.45	0.29	33.1		1.77	0.079
		Matched	0.45	0.30	31.8	3.9	1.15	0.253
	Hh head born in the village	Unmatched	0.53	0.62	−17.1		−0.91	0.362
		Matched	0.53	0.62	−17.8	−4.3	−0.66	0.513
Sugar (worker)	Average age of hh head	Unmatched	39.40	42.74	−30.2		−1.81	0.072
		Matched	39.40	38.68	6.5	78.6	0.41	0.685
	Hh head with at least secondary education	Unmatched	0.29	0.28	1.3		0.08	0.938
		Matched	0.29	0.31	−5.1	−304.6	−0.28	0.779
	No. of men in hh > 16 years	Unmatched	1.24	1.16	11.5		0.7	0.483
		Matched	1.24	1.11	19.1	−65.6	1.14	0.258
	No. of women in hh > 16 years	Unmatched	1.33	1.26	9.9		0.63	0.532
		Matched	1.33	1.29	6.6	34	0.37	0.713
	Dependants	Unmatched	1.79	1.90	−9.1		−0.56	0.574
		Matched	1.79	1.87	−6.1	32.3	−0.35	0.727
	Average land holding (acre) (log)	Unmatched	0.70	0.83	−18.7		−1.16	0.248
		Matched	0.70	0.69	2.2	88.5	0.12	0.901
Sugar (outgrower)	Average age of hh head	Unmatched	44.56	42.74	14.8		0.97	0.335
		Matched	44.44	43.77	5.4	63.3	0.34	0.734
	Female-headed-hh	Unmatched	0.09	0.18	−25.3		−1.62	0.106
		Matched	0.10	0.11	−3.8	84.8	−0.25	0.8
	Hh head with at least secondary education	Unmatched	0.41	0.28	28.1		1.85	0.065
		Matched	0.38	0.37	2.2	92.3	0.12	0.901
	No. of men in hh > 16 years	Unmatched	1.32	1.16	21.2		1.39	0.165
		Matched	1.30	1.27	3.1	85.5	0.19	0.852
	No. of women in hh > 16 years	Unmatched	1.32	1.26	8.4		0.55	0.582
		Matched	1.24	1.24	−0.6	93.1	−0.04	0.971
	Dependants	Unmatched	1.83	1.90	−6.4		−0.42	0.675
		Matched	1.89	1.79	8.7	−35	0.54	0.59
	Average land holding (acre) (log)	Unmatched	0.83	0.67	21.7		1.44	0.152
		Matched	0.81	0.80	0.9	95.8	0.05	0.958
	Organizational membership	Unmatched	0.27	0.27	−0.7		−0.05	0.961
		Matched	0.27	0.27	−1.4	−89.4	−0.08	0.933
	Hh head born in the village	Unmatched	0.65	0.67	−3.5		−0.23	0.819
		Matched	0.63	0.62	2.4	32.9	0.14	0.891