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Contract farming in Mozambique

Implications on gender inequalities within and across
rural households

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Abstract: This paper analyses the implication of contract farming on gender inequalities in rural Mozambique. Contract farming is often considered one of the major tools of agribusiness development: it broadly includes those arrangements under which producers commit to provide a pre-defined quantity of crop to a buyer firm. This paper exploits a panel dataset (2002–05) collected by the Mozambican Ministry of Agriculture among a nationally representative sample of rural households to explore contracts' implications for gender equality, both across and within households. We look both at the participation of female-headed households in contracts, and at the impact of establishing a contract on a set of intra-household women empowerment indicators. Concerning the first, our results confirm a selection out of contracts in rural households where a woman is the household's head. With regard to the second, we may expect contrasting effects to be at work: on the one hand, the consequences of increased income relaxing the budget constraint, while, on the other, the effects of an intra-household shift towards men's control over assets. We find different results according to the indicator used: after controlling for selection bias, we find no effect on control over land, but a negative effect on women's access to extension services.

Keywords: contract farming, gender inequalities, women empowerment, Mozambique, propensity score matching

JEL classification: O13, J16, C21, C23

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1 Introduction

This paper focuses on gender inequalities in access to markets and in control over resources for agrarian production in rural Mozambique. To this purpose, we analyse contract farming arrangements, both with respect to gender-based inequalities in the access to them, and with respect to their impact on women's empowerment. Contract farming arrangements are contracts whereby producers commit to provide a pre-defined quantity of crop to a firm that buys it at an agreed price; according to the types of contract, firms may provide inputs and technical assistance to the producers. They have been considered in the last ten years as a way in which agribusiness systems could benefit smallholders (WB, 2007), and the Mozambican PEDSA - *Plano Estratégico Para o Desenvolvimento do Sector Agrário* (RoM, 2011) - considers them as tools to market integration and to push a switch from subsistence production to commercial farming.

Addressing gender-based inequalities in Mozambican rural contexts is particularly relevant since there is abundant evidence that rural women play an important role in production, but have little control over resources (Morgado and Salvucci, 2016; Arndt et al, 2011). This work attempts to address the issue in both an intra-households' and between-households' perspective. Concerning the latter, we adopt a quite consolidated approach, that is to compare female-headed households and male-headed households. There is a significant proportion of households with a woman as household head in rural Mozambique: in 2005 they were about 25 per cent, but this share may have increased in the last decade (Morgado and Salvucci, 2016). We analyse whether we find a systematic difference in access to contracts between these and male-headed households. With reference to intra-households dynamics, the impact of being in a contract farming arrangement is analysed with respect to a number of indicators capturing access of women to productive assets and agrarian services. Methodologically, the main issue to address in order to analyse the consequences of being in such agreements, is the effect of selection into contracts. We cannot claim that the evidence of a correlation means a causal effect, because households that enter into contracts plausibly differ significantly from households that do not.

Both Mozambican and international policy documents identify a women empowerment potential in contract farming agreements. The PEDSA (RoM, 2011) makes reference to the Gender Strategy of the Agricultural Sector (2005), which has the strategic objective of 'establishing partnerships between the public and private sectors to increase investment in support to small farmers and women in particular, sharing the costs and risks of assistance in adopting new technologies and new cash crops through programs aimed at food security and poverty reduction' (RoM 2005: 20).

In the first section we identify the possible mechanisms at work through a brief literature review. Section 2 provides some background elements on rural Mozambique, describes the data used and presents descriptive statistics. Section 3 and 4 develop the two main analyses of the paper: gender inequalities across-households in access to contract farming, and gender inequalities within-households, i.e. the impact of entering into contract farming on women empowerment measures. In section 5 we discuss the results and section 6 concludes.

2 The possible contrasting effects at work

The effect of increased commercial agriculture –of which contract farming is a possible tool- on gender inequalities is debated in both scholar and policy literature. The two main mechanisms that can be at work are, on the one hand, the increased income and thus the relaxed budget constraint on the household, and, on the other hand, the shift of control over resources and income towards men.

In the debate around the need to ‘close the gender gap’ in agriculture (FAO, 2011), it is highlighted that value chain development can have a positive impact on rural women empowerment if the private sector invests in value chains that can integrate women, and if governments ‘create a good investment climate through strengthening property rights’ as well as customary land right (Hill, 2011).

At the same time, the literature analysing the impact of the shift toward commercial production stresses the risks of reducing output controlled by women and of marginalization of their labour. Women may face greater constraints in accessing profitable markets, since men might take over crops from them as they become profitable (e.g. Njuki et al. 2011). Some authors have argued that increased incentives to turn to cash crops have raised women’s workload (Evers and Walters, 2001) and cash income controlled by men (Warner and Campbell, 2000). Darity (1995) proposes a two-sector model with men maximizing income on the cash crop sector and women working both in the cash crop and in the subsistence sector; an increase in prices implies that women are requested to put extra-time in the cash crop sector, under the assumption that the time devoted to reproductive work doesn’t decrease. Evers and Walters (2001) introduce a bargaining framework and Warner and Campbell (2000) a duopoly model: both papers rely on the fact that cash income is appropriated by men rather than women and therefore that an increase in cash crop production compared to food-based crops may result in an increased bargaining power of men within households.

These observations may apply to contract farming too. The literature on contract farming highlights moreover that the cost-reducing strategies enacted by rural households to be competitive in value chains may entail substantial negative consequences for women (Key and Runsten, 1999), since the use of cheap or unpaid family labour may be a strategy for smallholders to be competitive. A study on Senegal (Maertens and Swinnen, 2012) underlined that women benefit more from vertical integration when they are workers rather than contract farmers. On the other hand, cases where women started demanding wages for previously unpaid tasks, when these entered into formal value chains, are also reported and indicated as empowering (e.g. Reynolds, 2002, on tomato production in the Dominican Republic).

Abundant literature indicates that women have historically been excluded from contractual arrangements with private investors due to their limited direct access to land and control over productive resources (Schneider and Gugerty, 2010). Many researches find gender-based differences by comparing participation among male and female-headed households: the latter generally participate less in contract farming with private investors and get smaller increases in income from crop selling (Benfica et al, 2006 and Boughton et al., 2007 on the Mozambican case). The second of these studies find lower participation of female-headed households both in tobacco and cotton growing schemes (after controlling for asset endowment); the first doesn’t find lower participation (controlling for assets), but finds lower revenues.

Widening the focus, we find evidence of lower access to cash crop production of female-headed households in and out of contracts; according to Evers and Walters (2000) this is due to a number of gender-specific constraints in access to markets: transport costs, security of property rights (namely on what concerns land) and the disruption of some ways to organize production that were favorable to women (e.g. cooperatives). In the Mozambican case, Daniel (2001) argues that women who are household head lack access to labour force and to cumulated savings that are needed to begin cash crop production.

3 Context, data and descriptive statistics

In this paper, we explore these research questions in the context of Mozambique, exploiting the rich panel dataset offered by the *Trabalho de Inquérito Agrícola* (TIA), collected by the Mozambican Ministry of Agriculture (MINAG) in collaboration with Michigan State University (MSU). Panel waves are in 2002 and 2005 and—selecting observations in order to obtain a balanced panel—we end up with 4,014 households¹. The sample is exclusively rural.

The 2000s have been years of important growth rates for the Mozambican economy, but with limited results in terms of poverty reduction, especially in rural areas (Cunguara and Hanlon, 2010). The structure of land ownership is characterized by very small landholdings: according to Hanlon and Smart (2014) the median size of a plot of land in Mozambique is 1 ha.

In Mozambique, households where the household head is a woman are, according to TIA data, 22.98 per cent of the sample in 2002 and 26.75 per cent in 2005. According to the National Statistical Institute, in 2011 they are a bigger share, i.e. 36 per cent, (Morgado and Salvucci, 2016). They are on average poorer households (Arndt et al., 2011), with smaller plots and less access to inputs (FAO, 2005). There is evidence of a gender divide in agricultural productivity: Morgado and Salvucci (2016) find a 20 per cent productivity gap in the centre and north of Mozambique (while non-significant differences in the south). Female-headed households have smaller plots: because of an inverse relationship between size and productivity, they appear more productive, but this difference disappears when controlling for land size. In their study, Morgado and Salvucci find that between 10 and 20 per cent of the productivity gap is explained by factor endowment, while the rest should be ascribed to other factors, i.e. technical efficiency, pure discrimination and unobservable characteristics.

In this paper we aim at studying also within-household inequalities, with special attention to access to productive resources and services. The Mozambican context is characterized by important work of women in the family plots, but there is evidence of a lower access to markets (Boughton, 2007). According to Arndt et al. (2011), women farmers allocate similar time to agrarian work as men, but relatively more time on food crops than on cash crops. In a study on Zambezia, De Brauw (2015) shows that women are less likely than men to manage the plots that they control, but there is no evidence that women manage lower quality plots.

The descriptive statistics of the TIA balanced panel 2002-2005 are displayed in Table 1.

¹ In the survey, attrition was relatively low (17,3 per cent, i.e. 804 households were not tracked). These are dropped from the analysis (Mather et al, 2008).

Table 1: Descriptive statistics (standard deviation in parenthesis)

| | 2002 | 2005 |
|----------------------------------------------------|----------------|-----------------|
| <i>Income²</i> | | |
| Total income | 9,220 (24,500) | 10,760 (25,999) |
| Farm income | 5,051 (11,423) | 6,207 (16,970) |
| Non-farm income | 4,106 (20,938) | 4,517 (18,631) |
| <i>Household characteristics</i> | | |
| Female-headed h | 0.23 (0.42) | 0.27 (0.44) |
| Age h head | 44 (15) | 46.64 (14.89) |
| Education of h head | 2.78 (3.93) | 3.12 (3.90) |
| Size of h | 5.76 (3.51) | 7.18 (4.24) |
| <i>Assets</i> | | |
| Land (ha) | 2.46 (5.54) | 2.94 (4.20) |
| Land (number of plots) | 2.53 (1.39) | 2.02 (1.18) |
| Non farm workers | 0.23 (0.59) | 0.26 (0.59) |
| Has lamp | 0.55 (0.50) | 0.50 (0.50) |
| Has radio | 0.54 (0.50) | 0.56 (0.50) |
| Has wc | 0.42 (0.49) | 0.46 (0.50) |
| Has irrigation | 0.16 (0.37) | 0.08 (0.27) |
| <i>Inputs</i> | | |
| Hires workers? | 0.23 (0.42) | 0.23 (0.42) |
| Uses animal traction | 0.21 (0.41) | 0.18 (0.38) |
| Uses fertilizers | 0.05 (0.22) | 0.05 (0.22) |
| <i>Market participation</i> | | |
| Association member | 0.05 (0.22) | 0.09 (0.29) |
| Received extension | 0.15 (0.36) | 0.19 (0.39) |
| Received info prices | 0.31 (0.46) | 0.39 (0.49) |
| Cultivates cash crops | 0.40 (0.49) | 0.23 (0.42) |
| <i>Women empowerment measures</i> | | |
| At least one plot managed by a woman | 0.50 (0.50) | 0.44 (0.50) |
| Number of plots managed by a woman | 1.06 (1.37) | 0.82 (1.16) |
| At least one plot managed by a woman (incl. sales) | NA | 0.11 (0.31) |
| Number of plots managed by a woman (incl. sales) | NA | 0.15 (0.49) |
| Does a woman in the hh receive extension services? | NA | 0.11 (0.31) |
| Is a woman in the hh member of association? | 0.034 (0.18) | 0.053 (0.226) |

Source: Author's calculations based on the Trabalho de Inquérito Agrícola 2002-2005 (TIA) panel dataset.

Contract farming in Mozambique is especially relevant in cotton and tobacco growing, that are productions concentrated in the centre/north of the country. Contract farming in these two main cash crops is based on a concession system: it entails an exclusive sale agreement that binds smallholders to sell to that company and in principle requires that the company supports smallholders in the production process.

A first step is to identify who are the farmers who participate in contract farming agreements. We know, for each cultivated crop, which is the main sale outlet, among which one can be *companhia fomentadora* (the supporting company, which is the way the buyer company is defined). A household

² Constant 2002 prices

that has a contract farming agreement is a household who has a ‘supporting company’ as main outlet for at least one cultivated crop. The number of households that are in a contract is 254 in 2002 (6.19 per cent of the sample) and 323 in 2005 (7.87 per cent of the sample). The most represented crops are indeed cotton and tobacco: 32 per cent of cotton growers and 53 per cent of tobacco growers have a contract.

Households that are part of contract farming agreements significantly differ from households that are not; these differences are significant in an important set of variables (Table 2), especially asset endowment, access to inputs and access to services.

Table 2: Household characteristics for participants and non-participants in contract farming arrangements. Data at baseline (2002).

| | Non contract farming | Contract farming | Difference |
|----------------------------------------|----------------------|------------------|------------|
| Female-headed household | 0.24 | 0.11 | *** |
| Age household head | 44.42 | 43.28 | |
| Education household head | 2.75 | 3.17 | |
| size of the household | 5.76 | 5.80 | |
| land size (ha) | 2.38 | 3.75 | *** |
| number of plots | 2.49 | 3.15 | *** |
| number of non-farm workers | 0.24 | 0.13 | ** |
| owns a lamp? | 0.55 | 0.55 | |
| owns a radio? | 0.54 | 0.69 | *** |
| owns a wc? | 0.41 | 0.56 | *** |
| has irrigation (at least on one plot)? | 0.15 | 0.25 | *** |
| hires workers? | 0.21 | 0.44 | *** |
| uses animal traction? | 0.21 | 0.25 | |
| uses fertilizers? | 0.03 | 0.34 | *** |
| is association member? | 0.05 | 0.11 | *** |
| receives extension services? | 0.14 | 0.30 | *** |
| received information on prices? | 0.30 | 0.46 | *** |
| produces cash crops? | 0.37 | 0.85 | *** |
| N | 3850 | 254 | |

Notes: *** p<0.01, ** p<0.05, * p<0.1

Source: Author’s calculations based on the Trabalho de Inquérito Agrícola 2002-2005 (TIA) panel dataset.

4 Female-headed households and selection into (and out of) contracts

The first part of our analysis focuses on inequalities across households and especially between female-headed and male-headed households. Female-headed households are 23 per cent of the sample in 2002 and 27 per cent in 2005 (Table 1).

There is evidence of a negative correlation between being a female-headed household and participating in contracts, both looking at Table 2 (first row) and to Table 3. If among male-headed household, on average 7,2 per cent are in contract farming arrangements, this share decreases to 2,9 per cent among female-headed households.

Table 3: Share of contract farmers among male-headed and female-headed households

| | Male-headed household | Female-headed household | Difference |
|------------------|-----------------------|-------------------------|------------|
| Contract farming | 0.072 (0.0046) | 0.029 (0.0054) | *** |

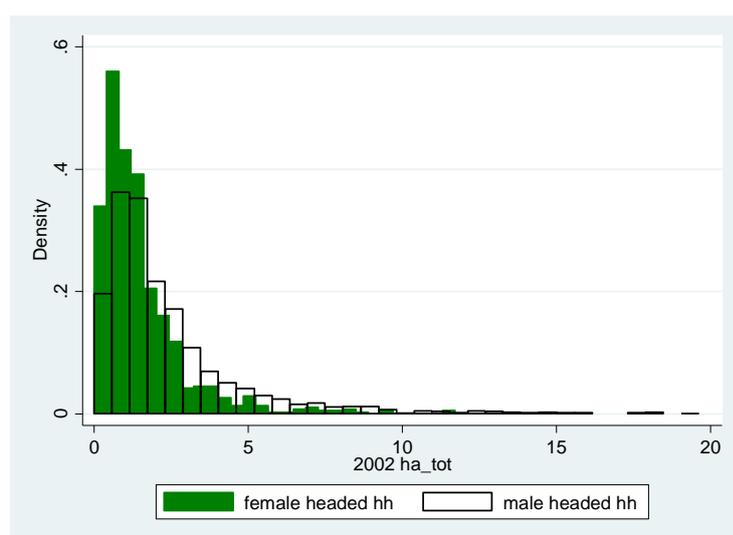
Notes: *** p<0.01, ** p<0.05, * p<0.1

Source: Author's calculations based on the Trabalho de Inquérito Agrícola 2002-2005 (TIA) panel dataset.

As discussed in the literature review, female-headed households share a number of characteristics (that may be themselves the product of unequal distribution of resources and entitlements) that may explain their limited access to contract farming arrangements. They display significant lower access to extension services, to inputs such as fertilizers, and to the possibility of hiring workers. They moreover display significantly lower levels of education. Especially, they have systematically poorer outcomes in terms of food security and food production, which are among the determinants of access to contracts (Navarra, 2017).

Our data confirms what is highlighted in previous works in terms of income and land: households where a woman is the household head have smaller landholdings and are poorer. We focus on these two dimensions in Figures 1 and 2.

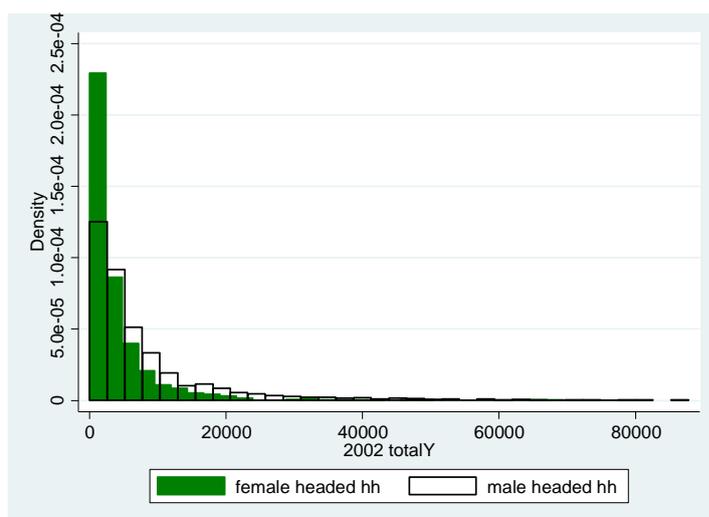
Figure 1: Land size in 2002 (baseline)³



Source: Author's illustration based on the Trabalho de Inquérito Agrícola 2002-2005 (TIA) panel dataset.

³ Excludes observation with more than 20 ha.

Figure 2: Total income in 2002 (baseline)⁴



Source: Author's illustration based on the Trabalho de Inquérito Agrícola 2002-2005 (TIA) panel dataset.

If we compare participation in contract farming across both land and income quartiles, nevertheless, we still find significant gender-related differences (Table 4). We observe lower participation of female-headed households in contracts in all land quartiles⁵ and in the first three income quartiles. Only in the richer quartile, the difference disappears.

Table 4: Differences in participation in contract farming between male and female-headed households across land and income quartiles (standard deviations in parenthesis). Data at baseline.⁶

| | Share of male-headed households in contract farming | Share of female-headed households in contract farming | Difference |
|---------------------------|-----------------------------------------------------|-------------------------------------------------------|------------|
| Total | | | |
| Quartiles of land size | | | |
| I | 0.022 (0.006) | 0.009 (0.005) | * |
| II | 0.059 (0.009) | 0.027 (0.010) | ** |
| III | 0.086 (0.010) | 0.053 (0.015) | * |
| IV | 0.108 (0.010) | 0.049 (0.020) | ** |
| Quartiles of total income | | | |
| I | 0.021 (0.006) | 0.008 (0.004) | ** |
| II | 0.046 (0.008) | 0.016 (0.008) | ** |
| III | 0.075 (0.009) | 0.038 (0.014) | ** |
| IV | 0.129 (0.011) | 0.110 (0.029) | |

Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Source: Author's calculations based on the Trabalho de Inquérito Agrícola 2002-2005 (TIA) panel dataset.

We then turn to a multivariate framework and look at the determinants of participation in contract farming in 2005 (Table 5), through a Probit model. We control for a number of household characteristics: lagged asset endowment (land, fixed assets, land title, irrigation), lagged access to services (extension, association), lagged access to inputs (fertilizers, pesticides, etc.). We include a dummy capturing the fact of being in contract farming in 2002⁷. Among these, the dummy

⁴ Exclude top 1 per cent observations.

⁵ The same exclusion of outliers as in the previous graphs applies.

⁶ Differences are bigger in 2005 (not shown).

⁷ The result is robust also without controlling for this variable.

indicating whether the households have a woman as head is always significant, both using the lagged (Col. 1) and the contemporary variable (Col. 3). The result is robust controlling for productivity (measured as food production per hectare) as shown in Col 3, and it is robust to a specification with district fixed effects (Col. 4). It is to be noted that controlling for district fixed effects increases the difference between male- and female-headed households.

This specification highlights that female-headed households are about 4,5 per cent less likely to enter into contracts, also after controlling for other households' characteristics, such as education, assets, access to inputs and observable variables measuring market access. These differences are significant, even though they are smaller than the unconditional difference, which was about 13 per cent: the controls in fact capture the bigger part of the women's disadvantage, but do not explain all of it.

Table 5: Determinants of the probability of being in a contract farming agreement in 2005. Marginal effects after Probit.

| | (1) Marginal Effects | (2) Marginal Effects | (3) Marginal Effects | (4) Marginal Effects |
|----------------------------------------------|---------------------------|---------------------------|---------------------------|---------------------------|
| Was in a contract farming agreement in 2002? | 0.0629*** (0.0141) | 0.0628*** (0.0141) | 0.0659*** (0.0144) | 0.0952*** (0.0231) |
| Log of total income 2002 | -0.00475 (0.00498) | -0.00436 (0.00498) | -0.000300 (0.00480) | -0.0136 (0.00885) |
| Age of head of household 2005 | -0.00143*** (0.000351) | -0.00148*** (0.000353) | -0.00147*** (0.000357) | -0.00229*** (0.000568) |
| Female-headed household 2005 | | -0.0441*** (0.0127) | -0.0453*** (0.0129) | -0.0673*** (0.0204) |
| Female-headed household 2002 | -0.0436*** (0.0135) | | | |
| Size of the household 2005 | 0.00322** (0.00132) | 0.00319** (0.00132) | 0.00220* (0.00133) | 0.00376 (0.00229) |
| Household head education 1 2005 | -0.0145 (0.0106) | -0.0161 (0.0106) | -0.0155 (0.0108) | -0.0171 (0.0177) |
| Household head education 2 2005 | -0.0121 (0.0172) | -0.0149 (0.0173) | -0.0137 (0.0175) | -0.00850 (0.0286) |
| Household head education 3 2005 | -0.0377 (0.0276) | -0.0420 (0.0276) | -0.0332 (0.0280) | -0.0410 (0.0450) |
| Size of landholding (ha) 2002 | -0.00104 (0.00147) | -0.000984 (0.00146) | 0.000910 (0.00149) | 0.00238 (0.00247) |
| Number of plots 2002 | 0.00884** (0.00371) | 0.00938** (0.00372) | 0.00727* (0.00379) | 0.00768 (0.00645) |
| Owns a lamp? 2002 | -0.0229** (0.00984) | -0.0233** (0.00984) | -0.0243** (0.00998) | -0.0276* (0.0167) |
| Owns a radio? 2002 | 2.61e-06 (0.00984) | 0.000205 (0.00982) | 0.00103 (0.00996) | 0.0194 (0.0162) |
| Owns a wc? 2002 | 0.0182* (0.0103) | 0.0188* (0.0103) | 0.0200* (0.0105) | 0.0201 (0.0173) |
| Owns a granary? 2005 ⁸ | 0.0215* (0.0113) | 0.0206* (0.0113) | 0.0220* (0.0115) | 0.0287 (0.0182) |
| Has irrigation (at least on one plot)? 2002 | -0.0248 (0.0151) | -0.0241 (0.0151) | -0.0235 (0.0153) | -0.0439* (0.0242) |
| Has at least one titled plot? 2002 | 0.0138 (0.0352) | 0.0126 (0.0352) | 0.0162 (0.0353) | 0.0199 (0.0534) |
| Hires workers? 2002 | 0.00294 | 0.00346 | 0.00956 | -0.00867 |

⁸ We don't have the information whether the households owned a granary at baseline.

| | | | | |
|---------------------------------------|-----------------------|-----------------------|------------------------|-----------------------|
| Uses animal traction? 2002 | (0.0119) 0.0172 | (0.0119) 0.0153 | (0.0120) 0.0158 | (0.0192) 0.0353 |
| Uses fertilizers? 2002 | (0.0166) 0.0315* | (0.0166) 0.0299* | (0.0168) 0.0305* | (0.0275) 0.00741 |
| Uses pesticides? 2002 | (0.0166) 0.0758*** | (0.0166) 0.0754*** | (0.0171) 0.0762*** | (0.0272) 0.0659*** |
| Received extension services? 2002 | (0.0135) 0.0127 | (0.0135) 0.0123 | (0.0137) 0.0134 | (0.0221) 0.0283 |
| Member of association? 2002 | (0.0112) -0.00157 | (0.0112) -0.000405 | (0.0113) 0.00112 | (0.0186) -0.0215 |
| Has wage worker in household? 2002 | (0.0200) -0.0370** | (0.0200) -0.0360** | (0.0202) -0.0389*** | (0.0322) -0.0275 |
| Food production per capita (ton) 2002 | (0.0144) 0.0390*** | (0.0144) 0.0386*** | (0.0145) 0.0660*** | (0.0237) 0.0523** |
| Cultivates cash crops? 2002 | (0.0144) 0.0670*** | (0.0144) 0.0666*** | (0.0109) -2.25e-05* | (0.0230) 0.0727*** |
| Productivity in food production 2005 | (0.0108) | (0.0108) | (1.34e-05) | (0.0181) |
| PROVINCE FE | YES | YES | YES | NO |
| DISTRICT FE | NO | NO | NO | YES |
| Observations | 3,401 | 3,401 | 3,348 | 1,931 |

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Source: Author's calculations based on the Trabalho de Inquérito Agrícola 2002-2005 (TIA) panel dataset.

5 Impact of contract farming on within-household gender inequalities

The aim of this paper is also to introduce intra-household measures of women empowerment and gender inequalities. We focus on measures of empowerment that are related to agrarian production. This of course excludes several other possible measures; the choice is both due to data availability and to the hypothesized effects of contract farming.

We therefore look at two categories of variables, each measured by two variables:

A. Women's control over assets:

1. dummy variable indicating if at least one plot is under the responsibility of a woman both for production and sales;
2. change in the number of plots under the responsibility of a woman for production⁹.

These indicators are similar to those used by de Brauw (2015): while he has information on 'control' over plots and on the identity of the person deciding which crop to grow, here we use the information whether a woman is responsible for production on a plot, and whether she is responsible for production and sales. This is relevant since women may be responsible for a plot without managing the income deriving from it (Navarra and Pellizzoli, 2012). In 2005 (the only year in which we have information on both) 44 per cent of the households had at least one plot under the responsibility of a woman, but only 11 per cent had a plot under the responsibility of a woman both for production and sale.

B. Women's access to agrarian services:

1. dummy variable indicating if at least one women in the household is member of an association (conditional on the fact that the household has at least a member);
2. dummy variable indicating if at least one women receives extension services (conditional on the fact that the household is receiving extension services).

All these measures display significant correlations with the fact of being in contract farming arrangements. With respect to the signs, we observe that measures of women's access to assets show a positive correlation with contract farming, while measures of access to services display a negative correlation (Table 6).

⁹ Unfortunately the data does not allow us to calculate the same variable on the plots where a woman is responsible for both production and sales.

Table 6: Women empowerment measures in households with or without contract farming agreements

| | Contract farming | Non contract farming | Difference |
|---------------------------------------------------------------------------------------|------------------|----------------------|------------|
| At least one plot is under women's responsibility both for production and sale (2005) | 0.13 | 0.10 | * |
| Change in the number of plots under the responsibility of a woman for production | -0.08 | - 0.25 | *** |
| Woman is member of association (2005) (if the household is) | 0.5 | 0.64 | ** |
| Woman receives extension services (2005) (if the household does) | 0.5 | 0.62 | *** |

Notes: *** p<0.01, ** p<0.05, * p<0.1

Source: Author's calculations based on the Trabalho de Inquérito Agrícola 2002-2005 (TIA) panel dataset.

How to identify whether these correlations correspond to causality relationships? Our identification strategy uses propensity score matching in order to identify a group, among the households that are not under contract, that is comparable to the households that are under contract. We then exploit, when possible, the variation in the outcome variables in the two points in time (this is unfortunately possible only for variable A2). We use the predicted values of a Probit model to identify, for each «treated» household (participating in a contract farming agreement) the closest non-treated, on the basis of observable pre-treatment variables. This allows identifying two groups that have the same probability to be treated conditional on a set of observables. These observables are measures of income, food production, asset endowment, access to inputs, and a vector of household characteristics, all measured at baseline (2002)¹⁰.

Exploiting the panel dimensions, we can observe movements 'in' and 'out of' the contracts. This allows us to identify 4 subgroups: those who never enter into contract farming, those who are always 'in' (in both our points in time), those who were in a contract in 2002 but are not anymore in 2005, and those, on the contrary, who were not in a contract in 2002, but are in 2005 (for a more detailed description of the four groups, see Navarra, 2017). The groups and the respective magnitudes are the following:

- 1) households that are never in contract farming N=3618;
- 2) households that were not in 2002, but are in contract farming in 2005 N= 232;
- 3) households that were in contract farming in 2002, but stopped by 2005 N= 163;
- 4) households that always are in a contract farming agreement N=91.

The analysis is restricted to group 1 and 2, thus we exclude the households that were under contract in 2002 at baseline. This allows comparing, among the households that were not under contract in 2002, those who entered into a contract farming agreement and those who did not. The households that enter into contract farming between 2002 and 2005 start from a comparable income level with respect to the others, but have a greater increase between the two waves.

Dependent variables are therefore:

- (1) $y =$ is at least one plot under women's responsibility both for production and sale? (dummy in 2005);
- (2) $y = (N_{plots_{T,2005}} - N_{plots_{T,2002}}) - (N_{plots_{C,2005}} - N_{plots_{C,2002}})$;
- (3) $y =$ does a woman receive extension services, conditional on the household receiving extension? (dummy in 2005);

¹⁰ The Probit model used to estimate the propensity score is in the Appendix.

(4) $y = 1$ is a woman member of an association, conditional on the household having at least a member? (dummy in 2005).

In specifications 1, 2 and 3 the selection equation includes province-fixed effects¹¹, while in specification 4 this is no more the case (for lack of observations).

Table 7 displays the average treatment effect on the treated (ATT) on the outcome variables mentioned above, where by ‘treatment’ we mean the fact of being in an contract farming agreement in t_1 (2005).

$$ATT = E (y_t - y_0 \mid t=1)$$

These treatment effects are calculated with a one-to-one match and the Abadie-Imbens (Abadie and Imbens, 2016) standard error is calculated, in order to take into account that propensity scores are estimated.

Table 7: ATT of ‘being in contract farming’ 2005, after matching

| | (1) One plot under women’s control (prod and sale) | (2) Difference in the number of plots controlled by a woman | (3) Woman receive extension services | (4) Woman association member |
|-----------------------------|----------------------------------------------------------|-------------------------------------------------------------------------|--------------------------------------------|------------------------------------|
| Contract farming in 2005 | 0.0217 (0.0276) | 0.0696 (0.121) | -0.185** (0.0724) | -0.250 (0.160) |
| Observations | 3,153 | 3,114 | 605 | 332 |

Notes: Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Source: Author’s calculations based on the Trabalho de Inquérito Agrícola 2002-2005 (TIA) panel dataset.

The effect of contracts on control over land - which displayed a positive correlation in the descriptive statistics – is not significantly different from zero: we cannot claim a causality link (contract farming increasing women control over land), but correlations have probably to be ascribed to selection effects. The same is true for association membership, which in Table 6 showed a negative correlation with participation in contracts.

On the other hand, we find a significant and negative effect of entering into contract farming arrangements on the probability that –if the household receives extension services- these services are addressed to a woman within the household.

A usual critique to propensity score matching techniques is that it only allows for selection on observables. As a robustness check, we use the Abadie semi-parametric difference-in-difference (Abadie, 2005; Hounghbedji, 2016). This uses a reweighting technique to address the imbalance of characteristics between treatment and control group, in order to make the assumption of parallel trends in the outcome variables between the two groups more credible. We only focus on the outcome variable of which we know the variation over time, i.e. the change in the number of plots under the control of a woman (in the production phase). The previous result holds: the effect is again positive, but not significantly different from zero.

¹¹ This means that we had to drop the provinces where no contract farming is observed, that means dropping the observations of two southern provinces, Maputo and Inhambane.

Table 8: Abadie semi-parametric DID

| | Difference in the number of plots controlled by a woman |
|--------------------------|---------------------------------------------------------|
| Contract farming in 2005 | 0.0974 (0.0729) |
| Observations | 2,513 |

Notes: Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Source: Author's calculations based on the Trabalho de Inquérito Agrícola 2002-2005 (TIA) panel dataset.

6 Discussion

Our work is divided into two parts: the first analysing the gendered differences in access to contract farming agreements, and the second analysing the impact of contract farming on measures of within-household women empowerment.

In the first part we find that female-headed households have lower probability to enter into contract farming arrangements. This holds also after controlling for assets, access to inputs, education level, connection to the market. Female-headed households display significant disadvantages in most of these measures and this disadvantage explains most of their lower probability to enter into contract farming. Still, after controlling for these, there is a negative effect of having a woman as household head on the probability of being in contracts. This result indicates that there may be some 'pure discrimination' effect at work (Morgado and Salvucci, 2016). It is to be noted that this result doesn't change also after controlling for productivity, measured by food production per hectare, which rules out the possibility that the exclusion from contract farming depends on lower productivity of women-managed plots.

This is consistent with the qualitative evidence discussed in Navarra and Pellizzoli (2012): in the absence of specific actions devoted to women inclusion, women farmers are dropped out of contract farming agreements. This is not related to a supposed women's 'disconnection from the market': women participate in market activities and have livelihood strategies that include crop marketing, although they may display a greater attention for food production and have access to more limited markets than men. Although there is evidence of a productivity gap (Morgado and Salvucci, 2016), Navarra and Pellizzoli (2012) do not find that this is a major determinant of exclusion from contracts. In their qualitative analysis, they report interviews where private investors define women as 'excellent farmers'. These investors point at the 'traditions' as a burden that keeps women behind. At the same time, the interviewed women farmers declare that traditional gender roles are indeed a burden for them, but that 'things are changing'. They consider education as the major problem: they are often illiterate and thus have limited access to information.

The second part of the paper focuses on the impact of contract farming on some indicators of women empowerment within the household. Before controlling for selection, we find a positive correlation of contract farming with women's control over production and sales of crops, but negative correlation with women's association membership, and with women's access to extension services. After controlling for selection, the only robust result is the negative impact on the probability of women receiving extension services (conditional on the households actually receiving extension). In the literature we found both elements pointing at positive and at negative effects of contract farming on women control over assets and access to services. For most indicators, the effects seem to cancel out. In case of access to extension services, on the contrary, the negative effects seem to prevail. This is coherent with the observation that usually contracts are in the man's name (Navarra and Pellizzoli, 2012), which implies that all services provided to the households in the framework of the contract are channelled towards men. Even if we assume that providing extension services to any member of the households produces knowledge

spillovers to all active members, the identity of the recipient is likely to matter. There are reasons to think that extension could be empowering; it may define *n/ho* is the knowledgeable person in the households in terms of a specific crop or technique, thus establishing social recognition effects, and it can provide social capital, connections, and mobility opportunities.

Concerning access to land, the correlation is, on the contrary, to be ascribed to selection: households that display a greater women's control over land are also more likely to enter into contracts. This deserves more exploration in the future steps of the work. The fact that contract farming does not produce significant effects in control over resources is consistent with their little impact on the structure of households' production. Overall, it seems that patterns of production do not shift substantially, i.e. that households entering into contracts do not abandon food production, and that cash crop is a complement rather than a substitute for production of staple crops (Navarra, 2017).

7 Conclusions

In this paper we analyse gender inequalities both across and within households in Mozambican rural contexts. In the first part we observe the selection of households into contracts and we find systematic evidence of a negative effect associated with being a female-headed household. This is globally consistent with the existing literature, but still needs further analysis, since the result is robust to several controls: asset endowment, access to inputs, market access, productivity measures. It can relate to social norms and stereotypes in gender roles, to social capital and information network measures, or to other channels of discrimination. Since there is evidence of a positive impact of contract farming on income (Navarra, 2017), this selection pattern indicates that contracts may have had a gender-inequality-increasing effect across household.

The main contribution of this paper is nevertheless to couple this approach with an analysis of gender inequalities within households. We focus on indicators measuring women empowerment with respect to control over assets and access to services, thus focusing on the role of women as farmers. Several other indicators may be used to measure women empowerment, but our main predictions derived from the literature focused on control over resources and services. In the descriptive statistics, we observed a positive correlation of contract farming with women control over land and production, and a negative one with access to services (extension and associations). After controlling for selection bias, the positive effect on control over resources disappears, as well as the negative effect on the participation in producers' associations. Contracts, at the same time, have a negative impact on the probability that women receive extension services when their household does. This can have an inequality-increasing effect since extension services can be a source of empowerment and relative bargaining power within the household.

In terms of policy this work does not aim at reaching a conclusion on the 'pros' and 'cons' of contract farming. It simply underlines that emerging market opportunities per se do not mean that women will be necessarily included and empowered, or that gender inequalities will be reduced. Deliberate actions are likely to be needed in this direction. The analysis of possible actions is beyond the scope of this work, but is an important line of research for future works.

This analysis of course has a number of limitations. First, more investigation should be done on the mechanisms of female-headed households' exclusion patterns (and thus on possible policy implication). Second, alternative indicators of within-household women empowerment can be used. Some of them, unfortunately, show too little variation, e.g. the number of plots in the man's or woman's name that have a land title. Some other indicators cannot be constructed because of lack of appropriate data, e.g. time use patterns, that would allow to see whether the work load of women is significantly affected by contract farming agreements. Last but not least, a similar analysis with more recent data might show what changes have occurred in the last decade.

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Appendix

Table A1. Selection equation for the definition of the propensity score. Probit model. All regressors are measured at baseline (2002).

| | Contract farming in 2005 |
|---------------------------------------------|-----------------------------|
| Niassa province | 1.383*** (0.280) |
| Cabo Delgado province | 0.857*** (0.274) |
| Nampula province | 1.203*** (0.267) |
| Zambazia province | 0.480* (0.275) |
| Tete province | 0.948*** (0.247) |
| Manica province | 0.525* (0.268) |
| Sofala province | 1.249*** (0.265) |
| Female-headed household 2002 | -0.434*** (0.117) |
| Age of head of household 2002 | -0.0119*** (0.00301) |
| Household head education 1 2002 | -0.161* (0.0884) |
| Household head education 2 2002 | 0.00124 (0.153) |
| Household head education 3 2002 | -0.189 (0.287) |
| Size of the household 2002 | 0.0274** (0.0139) |
| Size of landholding 2002 | 0.00767 (0.0125) |
| Number of plots 2002 | 0.0979*** (0.0315) |
| Owns a lamp? 2002 | -0.168** (0.0831) |
| Owns a radio? 2002 | -0.0312 (0.0831) |
| Owns a wc? 2002 | 0.134 (0.0885) |
| Has irrigation (at least on one plot)? 2002 | -0.211 (0.135) |
| Hires workers? 2002 | 0.0141 (0.100) |
| Uses animal traction? 2002 | 0.234 (0.151) |
| Uses fertilizers? 2002 | 0.427** (0.174) |
| Received extension services? 2002 | 0.122 (0.0974) |
| Member of association? 2002 | -0.142 (0.190) |
| Received information on prices? 2002 | 0.211** (0.0846) |
| Has wage worker in household? 2002 | -0.272** (0.118) |
| Cultivates cash crop? 2002 | 0.566*** (0.0852) |
| Food production er capita 2002 | 0.000295** (0.000132) |
| Total income 2002 | -6.11e-06* (3.38e-06) |

| | |
|--------------|----------------------|
| Constant | -2.463*** (0.309) |
| Observations | 3,153 |

Notes: Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Source: Author's calculations based on the Trabalho de Inquérito Agrícola 2002-2005 (TIA) panel dataset.