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Gender, Control, and Crop Choice in Northern Mozambique

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ABSTRACT

Women play an important role in the agricultural production process in developing countries, yet their role in making decisions about what to grow and the resulting implications for household welfare remain poorly understood. This paper studies women's empowerment in northern Mozambique as it relates to agriculture, considering in particular the factors that lead to women's managing the plots that they nominally control. Women control about 30 percent of the plots in the data but manage only about 70 percent of those plots. Using a unique panel dataset, the study finds that women are more likely to manage plots when households have historically had access to off-farm labor, typically completed by men. When women manage plots, they tend to grow crops with less complicated production techniques and are less likely to grow the area's main cash crop. However, conditional on historical access to off-farm labor, their farm incomes are the same as those among men.

Keywords: gender, crop choice, agriculture, Mozambique

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1. INTRODUCTION

Women play an important role in the agricultural production process in developing countries (for example, Duflo 2012). The role women play in the rural and agricultural economy is context specific and depends upon a myriad of factors that cannot be easily controlled, say, in a randomized experiment. Legal frameworks, specific ethnic customs, and inheritance norms all affect women's empowerment and status, and all are difficult to disentangle. Because improvements in gender equality are strongly linked to improvements in children's welfare (for example, World Bank 2011) and suggestively linked to improved economic efficiency, understanding the position of women in specific societies can help researchers and policymakers develop better programs to attempt to enhance women's welfare.

Northern Mozambique is a particularly interesting context in which to study women's positions in the rural economy, for both cultural and legal reasons. First, much of northern Mozambique is matrilineal and matrilocal, so men traditionally move to their wife's village when they get married. This system is not matriarchal, but it does mean that a woman's access to land is through her parents, as opposed to patrilineal societies, where access is obtained through the husband (Gawaya 2008). Consequently, women may have some additional control over some parcels of land. Second, the Mozambique Land Law, passed in 1997, allows both men and women access to land and, perhaps more importantly, allows both genders to participate in any community land demarcation processes. At least in theory, the Land Law provides women with additional claims on land, though more work is likely needed to make women aware of their rights in disputes (Kaarhus and Martins 2012). Consequently, in northern Mozambique one may expect to observe some variation in women's status related to agriculture potentially both between and within households.

To study the role of women's empowerment in agriculture, it is worthwhile to first define how women's empowerment will be conceptualized in this paper. The paper is somewhat narrowly concerned with the agency over specific decisions related to what crops are grown, given the general lack of use of inputs in northern Mozambique (Mather, Cunguara, and Boughton 2008). The study considers the ability to make choices about how to use resources, as women's empowerment, particularly those resources that women nominally own or control. This definition is consistent with several broader definitions of women's empowerment found in the literature (for example, Alsop and Heinsohn 2005; Kabeer 2008; World Bank 2011).

This paper provides an account of the factors that shape women's empowerment as it applies to farm management among households in Zambézia. Province of northern Mozambique. The paper is somewhat unique in that many of the sample households have been followed over a period of six years (from 2006 to 2012) because they participated in a cluster-randomized trial introducing orange sweet potatoes (OSP) to the area in an effort to reduce vitamin A deficiency. In the final round, which was conducted as a medium term impact evaluation survey, a series of questions were added to the survey specifically asking about the control of land, crop choices, proceeds from crop sales, and similar questions about livestock.

The dataset includes a panel of households followed over three surveys between 2006 and 2012. As each of the later surveys includes a large replenishment sample, additional information is available within the same communities. Therefore, cross-sectionally each survey provides more information than just the panel that can be tracked for all three rounds. As the data include both measures of control and decisionmaking at the plot level in 2012, as well as data collected in the past, it is informative about the factors that are associated with women's empowerment in decisionmaking around agriculture. In general the data described in this paper presents a unique look at decisionmaking in a set of households that is young relative to the general population.[1]

[1]The sampling frame for the paper was not random, as each household at baseline was required to have a resident child under 3 years old.

The objectives of this paper are as follows. The primary objective is to describe the conditions under which women can make decisions about what to grow on plots they control, and the implications of those decisions for household welfare. Given the relative lack of evidence in northern Mozambique about general issues around land control or management by gender, to meet this objective the paper initially describes plot-level data by gender, focusing on who manages and who controls plots. It also aggregates data to the household level to understand whether management leads to different farm outcomes by gender, focusing on the role of off-farm labor as a potential catalyst for differences in management.

The paper will proceed to meet these objectives as follows. The next section describes how women's empowerment interacts with agricultural production and well-being in general, and how women's empowerment specifically may relate to agricultural production in northern Mozambique. The following section introduces the dataset used in the analysis, including its important limitations. Here, I specifically discuss attrition in the panel component of the sample. The fourth section describes the plot-level data and determinants of female management when women have control, or use rights, over specific plots. The fifth section aggregates up to the household level to measure cropping and farm income differences between households in which women and men differentially control or manage the land. Among households in which women have some use rights, it also tries to explain income differences from households in which men make all cropping decisions. The final section concludes with a discussion of program design implications from the results, which are suggestive of a role for off-farm work in explaining decisionmaking power and income differences. The paper concludes by discussing some program design implications if a development goal is to improve women's status in agriculture in rural Mozambique.

2. WOMEN'S EMPOWERMENT AND AGRICULTURAL PRODUCTION

In a recent literature review, Duflo (2012) considered the bi-directional relationship between women's empowerment and economic development. She found evidence that economic development is not sufficient for women's empowerment to improve, though it can play a role. She also found that women's empowerment can also improve economic development; in particular, conditional cash transfer programs have been effective at increasing women's decisionmaking power (Benhassine et al. 2011; de Brauw and Liu 2013). However, it is important to take stock of measures of women's empowerment because endowments even at the beginning of relationships between men and women can continue to affect their relative bargaining power in the present, even controlling for present resources (Thomas, Contreras, and Frankenberg 2002). In a review of agricultural projects that seek specifically to empower women in agriculture, Doss, Bockius-Suwyn, and D'Souza (2012) found that an important element of successful projects is the targeting of women as members of the household and community. Along these lines they described several projects that seek to increase women's role in decisionmaking processes from the household to the farm and then the political levels.

From an agricultural perspective, land rights are often thought to be correlated with women's empowerment. One might be concerned that women who are divorced or widowed might have poor access to land. If they do, we might observe higher poverty among female-headed households directly related to their access to land. Women might also lack access to land within households. If so, women may not have strong bargaining power over household resource allocations or how income is spent. Women may retain access to land that they brought into a marriage, which can increase their bargaining power (Doss 1996). Quisumbing et al. (2013) found that access to, control over, and ownership of assets such as land affect the ways in which individuals can engage in value chains, and that these factors are influenced by gender roles. Furthermore, in area of Africa south of the Sahara, women and men continue to farm separate plots after marriage (for example, Udry 1996; Goldstein and Udry 2005). And if other resources within the household are not equally shared, then even with access to land women's status may not be equal to that of men.

For example, women may not have the same access to inputs as men, reducing their productivity (World Bank 2011). Peterman, Behrman, and Quisumbing (2010) reviewed 24 papers that measured relative access to inputs, and found that women typically lack the same access as men have to technological inputs.[2] Women have also been found to be disadvantaged in terms of extension services in many settings in Africa (for example, Gilbert, Sakala, and Benson 2002). However, Peterman, Behman, and Quisumbing (2010) found that in the majority of cases, if one controls for input access, productivity does not differ between male and female farmers.[3]

Women's Empowerment and Agriculture in Matrilineal Societies

As discussed in the introduction, northern Mozambique is predominantly matrilineal. Matrilineal marriage systems imply that children belong to the kin group of the mother. Land is also typically passed on from mothers to daughters, and women are given a plot of land to farm upon marriage or the birth of a child (Kishindo 2010). Many matrilineal marriages are also uxorilocal, meaning that upon marriage, the husband moves to his wife's village. It is important to note that matriliny does not mean matriarchy; for example, as Kishindo (1994) explained, in matrilineal Malawi reproductive decisions are often controlled by a woman's husband and her brother, who fulfills the role of guardian in her life. Studies from various parts of Mozambique and neighboring Malawi show that even within the matrilineal system, the main unit of production is the conjugal household (Peters 1997; Pitcher 1996; and Davison 1993).

[2]It is worth noting that 12 of the 24 studies had sample sizes of fewer than 200 households and therefore should be considered somewhat suspect.

[3]The major exceptions are Burkina Faso, where Udry (1996) finds that the allocation of resources within households is not Pareto efficient, and China, where de Brauw et al. (2013) find that women are unconditionally as productive as men.

In studying Mozambique, Pitcher (1996) found that women have control over income incases where the land is from their own kin. Hansen et al. (2005) suggested that in matrilineal regions of Malawi, men and women both reduce investment in their land in the form of tree planting relative to patrilineal regions of the country. However, this difference could also be due to other unobservable differences between villages, as the study was limited to two villages. In northern Mozambique, women do not choose to dedicate labor to cash crops on land that has been obtained outside of the matrilineal system because they lack secure tenure over that land and do not want to decrease their investment in and hold over their own land (Pitcher 1996). Men may also avoid investing in land when their tenure is insecure, such as in the case in which the wife's brother may force her husband to leave (Phiri 1983).

The implications of matriliny for women's well-being are unclear. On one hand, if matriliny gives women increased control over the income from their land, as suggested by Pitcher (1996), then this control could positively affect women's well-being. Extensive literature has shown that when women control income, women and children benefit in terms of food and nonfood expenditures (for example, Thomas 1990 and Duflo 2003). On the other hand, if matriliny negatively affects investment in agriculture, it could have the effect of reducing overall household well-being, including that of women. However, as Lastaria-Cornhiel (1997) argues, a shift from customary land arrangements to a market system is risky for women because private property arrangements are often biased against women.

Women's Empowerment and Agriculture in Mozambique

In Mozambique, much of the current literature focuses on differences between male- and female-headed households, rather than plots owned by men and by women within households. Walker et al. (2004) used the 2002 round of the *Trabalho de Inquerito Agricola* (TIA) survey to find that female-headed households are poorer than male-headed households, and widowed household heads are poorer still. Cunguara and Kelly (2009) also found that male-headed households have higher incomes than their female-headed counterparts; they suggested that education, the number of dependents, or cultural reasons lead to less off-farm opportunity among women, all of which help explain the income gap. Boughton et al. (2007) suggested that the difference in incomes is due to disadvantages among women in access to markets for cash crops. In contrast, in setting up their simulations, Giesbert and Schindler (2012) suggested that male-and female-headed households have similarly poor access to agricultural markets. All of these papers used various rounds of the TIA and did not attempt to differentiate by region, so some of these differences may not apply to households in Zambézia. In fact, a much older study using a different data source suggested that farmers are nearly self-sufficient and face limited markets, so access to markets is undifferentiated by gender (Brück 2004). Since markets were historically damaged significantly in Zambézia during Mozambique's long civil war (Domingues and Barre 2013), the market- based argument in Boughton et al.(2007) might not apply to Zambézia.

The TIA regularly asked about the person *responsible* for each plot within a household, but this information appears not to have been analyzed by gender.[4] Consequently, information about plot ownership and control in Mozambique is scarce. The major exception is a study by Aalerud (2010), who conducted a small survey in Lioma, an area in the north of Zambézia Province. She used a similar question to assess bargaining power among women, considering women to have bargaining power if they were individually responsible for at least one plot. She finds that defined this way, women have more bargaining power when they have access to more land or schooling.

[4]In Portuguese, the question asked was "Quem e´ a pessoa respons´avel por esta machamba?" ("Who is the person responsible for this plot"). The enumerator then coded the answer with the ID code of the individual responsible. Enumerators were taught to ask the question in the local language if the respondent did not speak Portuguese, and the enumeration team was specifically distributed so that enumerators always went to households where they could speak the local language.

3. DATA

The data for this paper were collected in 36 village-level organizations from four districts of Zambézia Province: Milange, Guru´e, Nicoadala, and Mopeia, which are illustrated on the map of Zambézia (Figure 3.1).[5] Socioeconomic surveys took place in each community in 2006, 2009, and 2012.[6]

Figure 3.1 Sample districts: Zambézia, Mozambique

Source: Author's creation.

The communities initially selected for the sample were selected for an intervention introducing OSP, called the HarvestPlus Reaching End Users (REU) program. Because the overall objective of the project was to reduce vitamin A deficiency among women of childbearing age and young children, households selected for the baseline survey in late 2006 were required to have a resident child between the ages of 6 and 35 months. Consequently, the original sample is not a random sample of the community or of the organization selected for the intervention. The baseline survey strove to enumerate 20 households in each community; it could not locate enough households in some communities with children younger than three years old, so the resulting baseline sample was 703 households, reaching 20 households in most communities. The 36 communities were randomized into two different treatment arms and a control group, with 12 communities in each group.

In 2009, within each community, households were added to the original sample to study outcomes in a repeated cross section among children younger than 3 years old, and to study adoption outcomes among a larger set of households within the treatment groups (24 communities). Around 3 households were added in each community (a total of 104 households), and within the 24 treatment communities between another 10 and 12 households were added, totaling 256 households; therefore, a total of 360 households were added in 2009 (Table 3.1). Of the original 703 households, 630 were found in 2009, for an attrition rate of 10.4 percent.

[5] 18 of the organizations are located in Milange, 9 in Gurué, and the remaining 9 organizations are split between Nicoadala (5 organizations) and Mopeia (4 organizations). Organizations in Nicoadala and Mopeia districts were selected from a single stratum.

[6] An additional survey took place in 2008, but it is not used in this paper.

Table 3.1 Sample, by survey round: Zambézia, Mozambique

Sample round	2006	2009	2012
Original sample (2006)	703	630	552
Added in 2009		360	190
Added in 2012			159
Total sample	703	990	901

Source: REU survey data (2006, 2009, and 2012).
Note: Households added in 2009 were not all included in the sample in 2012. We could not discern the household head in four cases in 2012 (all new households).

In 2012, an attempt was made to go back to the 630 households surveyed in 2006 as well as households with young children in them in 2009. Between 5 and 10 households were added in each community to account for attrition and to attempt to measure diffusion of OSP; some of these households came from the additional households included in 2009. The 2012 sample therefore included a total of 901 households, of which 552 were originally in the sample and 190 were also surveyed in 2009. From the 630 households surveyed in 2009, we observe further attrition of 12.4 percent.

Available Measures: Agricultural Variables

Each survey round included both demographic and agricultural information that will be helpful for this study, although there are some limitations. First, from a demographic perspective, households were asked to list all household members, separating adults and children who were initially younger than five when the household was surveyed. When households were revisited, enumerators carried a prefilled list of all household members present in previous rounds, which included identifying information, including the relationship to the household head. Therefore the survey was able to track whether individuals could be found in later rounds.

Although it is not a primary indicator in this paper, one can measure female headship using the data. Female household heads were primarily defined as the household head identified by the primary survey respondent. In the few cases where headship was not clear from the collected data in later rounds, if a male adult was present in the household and did some work, he was coded as the head, whereas if no male was present (for example, a previously present male head had moved away or died), a female head was coded. The proportion of female-headed households is slightly lower than reports from the TIA in Zambézia (Table 3.2). Given the structure of the sample, this finding is not surprising; households are younger and more likely to include nuclear families than the general rural population. In the baseline, only 7.7 percent of households were female headed; the percentage increased to 11.7 percent in 2009 and dropped to 10.4 percent in 2012.

Table 3.2 Overall sample, by gender of household head: REU surveys, Mozambique

Year	Male-headed	Female-headed
2006	649	54
	92.3	*7.7*
2009	874	116
	88.3	*11.7*
2012	803	94
	89.6	*10.4*

Source: REU survey data (2006, 2009, and 2012).
Note: Percent of sample in *italics*.

From an agricultural perspective, the survey form included both a plot-by-plot enumeration and an enumeration of crops grown by the household.[7] In 2009, a question was added to ask which household member had decided to grow each crop; the answers were coded as the household head, spouse, both together, or another household member. In 2012, further questions were added to the plot- and crop-level modules. In the plot-level module, a question was asked about which household member controlled each plot, and a second question was asked about which household member decided what to grow on each plot.[8] In the crop-level module, a question was asked about who decided to grow each crop, and if any of the crop was sold, then who controlled the income from sales.[9] The coding was changed to be individual ID numbers, with special codes given for different types of joint decisions.

The change in the way responses were coded about who made choices to grow specific crops drastically changed the answers and would change the conclusions drawn. In 2009, 42 percent of households stated that the decision was "joint" between the household head and spouse to grow maize, 43 percent stated the decision was joint to grow pigeon peas (the most commonly grown legume), and 25 percent stated that the decision to grow sunflowers was a joint one. In 2012, when the enumerators were asked to enter the ID code of the decisionmaker, the answers changed dramatically. Only 2–3 percent stated the decision to grow any of the three aforementioned crops was joint. In all years, the survey asked a specific set of questions of the mother of the reference child to learn about vitamin A knowledge and sources of information. In 2012, we asked a set of questions at the end of this section about who, generally, makes decisions about crops to plant, to get indications from both husband and; although women were more likely to state both husband and wife, they did so in only 8 percent of cases. It therefore seems likely that the coding in 2009 led answers; consequently, the paper uses variables on the control of production and land computed in 2012.

Data Limitations

Before beginning to analyze the data, it is important to point out some limitations in the data. First, though plot area was asked in each survey round, it became clear during the baseline data collection that farmers did not have a clear sense of how large each of their plots were. This sense was confirmed in the 2008 survey, in which enumerators went and measured each sweet potato plot in the treatment groups during the production season using GPS (global positioning system). They found little correlation between the stated response and the area measured by GPS. Therefore, though the study uses area measures as a control variable, we do not believe it is worthwhile computing, for example, yields per unit of area for specific crops.

Second, as discussed above the measures of control by gender are imperfect, because the questions were asked only in 2012. Therefore intrahousehold allocation issues can be studied only within the 2012 cross section. However, for at least a subset of the data, an innovation here is the ability to correlate those contemporaneous measures with past household characteristics, given the availability of previous rounds of data. Variables of specific focus are those that describe both off-farm labor participation at baseline and intense participation in the REU intervention, measured in 2009. The latter variable is primarily used as a robustness check.

Attrition

Before beginning to discuss results, it is worth studying attrition within the panel subset of households that can be measured three times. A common method for dealing with attrition is to estimate a probit (or logit) model on the original sample, predicting the ability to stay in the sample using baseline characteristics. The predicted probabilities can then be used as probability weights on the remaining

[7]In the baseline survey, crops were limited to staples, legumes, fat sources, and sources of vitamin A. The 2009 and 2012 surveys expanded the rops enumerated.surveys.

[8]In Portuguese, this question was worded: "Quem decide para cultivar esta cultura?"

[9]Note that the question on who decided to grow each crop did not change in wording; the instructions to enumerators changed.

sample to "correct"estimates for attrition (Wooldridge 2002). This study estimates a probit model using indicators for presence in 2009 and 2012, respectively, using baseline characteristics as explanatory variables (Table 3.3). The variables used in the regression include household composition, some activity indicator variables, and most importantly, whether or not the household head was male. I find that three variables predict attrition, including the gender of the household head. When the head was female in 2006, there is a relatively good chance that the survey teams were not able to find the household in later years. In 2012, the survey team took attrition particularly seriously, and supervisory notes suggested that most households that could not be found had moved away from the original village.

Table 3.3 Correlates of attrition from OSP impact evaluation sample: Zambézia, Mozambique, 2009 and 2012

Variable	2009	2012
Number of children	0.107**	0.076**
	(0.039)	(0.037)
Number, male adults	x0x044	0.011
	(0.163)	(0.131)
Number, female adults	x0x097	x0x052
	(0.111)	(0.097)
Head speaks Portuguese? (1=yes)	0.188	x0x047
	(0.206)	(0.128)
Head is female? (1=yes)	x0x606**	x0x633**
	(0.244)	(0.190)
Off-farm wage earner in household	0.144	x0x095
	(0.248)	(0.194)
Self-employed in household	x0x303**	x0x289**
	(0.138)	(0.129)

Source: REU survey data (2006, 2009, 2012).
Note: Standard errors adjusted for survey design in parentheses. **– indicates significance at the 5 percent level. Indicator for region of province also included.

There are two important consequences of these results. First, it is notable in its own right that female-headed households appear to dissolve or merge into other households. The notes taken by the 2012 survey team confirmed this point; households that could not be located generally had moved to merge with other households. Second, it is notable that the same variables predict attrition in both years, meaning the same types of households tend to move on. In the analysis, the 2012 regression will be used to create attrition probability weights to test the robustness of specific findings.

4. PLOT CONTROL AND MANAGEMENT WITHIN HOUSEHOLDS

As discussed in the introduction, there are several possible explanations for why, within households in Zambézia, women and men may control different plots. Because households are typically formed through matrilineal lines, women continue to live in the same village as their parents when they marry and therefore may specifically either bring plots into marriages or have more control over plots as new households form. Additionally, the 1997 Land Law at the very least does not discriminate against women's owning land. Because the baseline survey here specifically focused on young families (or at least families with very young children), the incidence of female landownership or control even within male-headed households is likely to be reasonably significant. We first try to understand the prevalence of female control of plots as well as what factors are correlated with the management of those plots.

We use the two questions included in the plot enumeration analysis to examine issues related to land control and crop choice. The first question asks who controls each plot in the household, and the second question asks who decides which crop to grow, or who manages the plot. Initially, we tabulate the raw data over all plots (Table 4.1, Panel A). When men control plots, decisions about what to grow are normally made by men (row 1). When women control plots, there is some interesting variation (row 2). Women make choices about what to grow on about 70 percent of plots, but men do so on 25 percent of plots. Not surprisingly, though, almost all of the men who decide what to grow on women-controlled plots live in male-headed households (Panel B). In such households, women make decisions about what to grow on 60 percent of plots, whereas men do so on 35 percent of plots. In female-headed households, women make almost all the decisions about what to grow.

Table 4.1 Plot control and decisionmaking, by gender of the household head: Zambézia Mozambique, 2012

Panel A: All households		**Decisionmaking**		
		Male	**Female**	**Both**
Plot control	Male	1269	66	22
	Female	172	470	20
	Both	7	5	32
Panel B: Male-headed households		**Decisionmaking**		
		Male	**Female**	**Both**
Plot Control	Male	1255	63	22
	Female	170	290	20
	Both	7	5	32
Panel C: Female-headed households		**Decisionmaking**		
		Male	**Female**	**Both**
Plot control	Male	5	3	0
	Female	2	178	3
	Both	0	0	0

Source: REU survey data (2006, 2009, and 2012).

Based on the variation in control by gender and differences in management, there are two immediately interesting questions. First, one might wonder about differences in plot characteristics that men versus women control. A few plot characteristics are available: First, the survey asked about two rough measures of quality, which are whether or not at least part of the plot is in the lowlands, and whether or not the respondent reported that the plot is of "good" quality, relative to "average" or "poor". Second, from the respondent number and a question that asked the source of the plot, one can roughly glean whether the plot was obtained from parents (for example, patrilineally or matrilineally);

alternatives are that the plot was simply being occupied by the household or that use rights had been transferred from government. Finally, one can compare the area of various plots, subject to the measurement error caveat described above.[10]

I initially estimate average characteristics by the gender of control (Table 4.2, Panel A). The two proxy variables differ somewhat in their message. Women are just as likely as men to control plots at least partially in the lowlands; however, the self-report suggests that the plots women control are slightly (7 percentage points) less likely to be rated "good" than those controlled by men. The proportion of plots matrilineally or patrilineally obtained are about equivalent; about half of the plots in the dataset are obtained administratively.[11] Finally, I find that male-controlled plots are reported to be larger than female-controlled plots. Whereas this difference may be due to reporting error, there is a substantial difference when both control the plots; jointly controlled plots are clearly smaller than other plots.

Table 4.2 Descriptive statistics and plots, by gender of control and management: Northern Mozambique, 2012

Panel A: Plot characteristics by control			
Variable	**Man controls plot**	**Woman controls plot**	**Both control plot**
Plot in lowlands?	0.404	0.427	0.667
	(0.014)	(0.021)	(0.090)
Good quality (1=yes)	0.724	0.653	0.889
	(0.015)	(0.023)	(0.046)
Patrilineally obtained	0.259	0.299	0.067
	(0.016)	(0.025)	(0.037)
Matrlineally obtained	0.245	0.238	0.111
	(0.015)	(0.022)	(0.085)
Area (hectares)	0.977	0.863	0.381
	(0.035)	(0.046)	(0.090)

Panel B: Plot characteristics by manager, women controlled plots		
	Woman manages plot	**Man manages plot**
Plot in lowlands?	0.457	0.347
	(0.024)	(0.041)
Good Quality (1=yes)	0.696	0.585
	(0.027)	(0.045)
Patrilineally obtained	0.253	0.403
	(0.027)	(0.048)
Matrlineally obtained	0.218	0.307
	(0.025)	(0.048)
Area (hectares)	0.836	0.999
	(0.056)	(0.085)

Source: REU survey data (2012).

[10]The survey also asked about irrigation, but almost no plots in the dataset were irrigated.

[11]There is some interesting regional variation; almost all of the plots in the two southern districts are administratively obtained; the plots handed down from family are more likely to be in Milange district.

The next step is to further examine plots controlled by women, to understand whether there are differences in plot characteristics when men versus women manage those plots (Table 4.2, Panel B). One might be concerned that women are left with poorer-quality plots than men (for example, Udry 1996); rather, results show that according to the self-reports, men manage crop decisions on plots that are less likely to be partially in the lowlands and less likely to be rated as good. In addition, the plots women manage are slightly more likely to be administratively allocated rather than obtained from parents of either the head or the spouse. Finally, according to the reports, the plots women manage are slightly smaller. All in all, there are clearly some differences between male- and female-managed plots when women initially hold control.

Determinants of Female Management

Given that I find plot-level differences in average plot characteristics by the gender of the manager, we next explore differences in a multivariate regression framework. We specifically regress an indicator variable for female management on various plot- and household-level characteristics (Table 4.3), among plots controlled by women. We begin by using only plot characteristics and the number of plots owned by the household as explanatory variables (column 1). Initially, the data suggest that many coefficient estimates are significantly different from zero, similar to the difference in means above. The quality variables are positively correlated with female management, and the variables indicating that the plot came from family are negatively correlated with female management. Further, when households have more plots, women are less likely to manage any specific plot. After adding a variable for female headship, we not surprisingly find the magnitudes drop on the variables for quality and number of plots (column 2). A third regression explores whether the quality differences persist when we control for all observable and unobservable household characteristics by using household fixed effects (column 3). We find that they do not remain, suggesting that apparent differences between the quality of men's and women's plots can be explained by differences in household-level perceptions of land quality.

We next return to strata fixed effects and add a set of variables measuring whether or not male and female household members had off-farm jobs as their primary employment in 2006, using the subsample of plots in households sampled in the baseline (column 4). Off-farm work was rare in the baseline, and men were six times more likely to work off-farm than women. Findings show large, positive coefficients on both variables, and the coefficient on the male members' working off-farm is quite precisely estimated; they suggest a difference of 20 percentage points. These results are consistent with a story that such households have found specialized roles for the two partners; women manage the farm while men work off-farm (typically, these jobs are as seasonal migrants). The significant lag between surveys—six years—demonstrates that such specialization may persist over a long period of time. In column 5, we add village fixed effects, and at least for the men, the coefficient remains similar in magnitude and significantly different from zero.

Table 4.3 Partial correlations of women's plot management when women control plot: Northern Mozambique, 2012

Explanatory variable	(1)	(2)	(3)	(4)	(5)
Plot characteristics					
Any part of plot	0.073**	0.061**	0.003	0.045	0.023
in the lowlands?	(0.026)	(0.025)	(0.023)	(0.025)	(0.026)
Self-reported good quality	0.103**	0.093**	0.036	0.053	0.069
	(0.043)	(0.039)	(0.025)	(0.046)	(0.048)
Plot obtained matrilineally	-0.191**	-0.091		-0.094	-0.153***
	(0.056)	(0.063)		(0.076)	(0.081)
Plot obtained patrilineally	-0.167**	-0.236**	-0.034	-0.254**	-0.205**
	(0.059)	(0.050)	(0.079)	(0.062)	(0.060)
Area (in hectares)	-0.026	-0.031*	-0.008	-0.047**	-0.045**
	(0.018)	(0.017)	(0.008)	(0.024)	(0.018)
Household characteristics					
Number of plots, 2012	-0.078**	-0.048**		-0.038	-0.049*
	(0.025)	(0.023)		(0.027)	(0.028)
Female head (2012)		0.376**		0.370**	0.289**
		(0.038)		(0.059)	(0.066)
Number off-farm males, main job (2006)				0.201**	0.262**
				(0.043)	(0.043)
Number off-farm females, main job (2006)				0.190*	0.125
				(0.101)	(0.081)
Fixed effects:	Strata	Strata	Household	Strata	Village
Number of observations	659	659	659	427	427
R^2	0.097	0.209	0.015	0.229	0.200

Source: REU survey data (2006, 2009, 2012).

Note: Standard errors clustered at village level in parentheses. *-indicates significance at the 10 percent level; **- indicates significance at the 5 percent level. Off-farm employment is measured in 2006 and is measured at the household level; all other variables measured in 2012.

To test whether or not this finding is robust to the inclusion of other variables, we test three alternative specifications of this regression (Table 4.4). First, we add a variable indicating that the primary woman in the household was a nutrition promoter in the REU project. Nutrition promoters were volunteers who met with small groups of about 10 other mothers to disseminate project messages, for various reasons, promoters are slightly over-represented in the dataset. Not surprisingly, these women learned more than other beneficiaries (de Brauw et al. 2010); it might not be surprising if such knowledge was associated with additional empowerment. However, we estimate a negative coefficient on this variable, and it does not change the coefficient on the variable for men working off-farm (column 1). In column 2, we add household demographic characteristics (the head's years of schooling and the household size). Again, the coefficient on men working off-farm remains large and statistically significant. Finally, we apply probability weights to account for nonrandom attrition (column 3); the coefficient on men working off-farm remains large in magnitude and precisely estimated.

Table 4.4 Robustness checks, women's plot management when women control plot: Northern Mozambique, 2012

Explanatory variable	(1)	(2)	(3)
Plot characteristics			
Any part of plot in the lowlands?	0.015	0.004	0.044*
	(0.026)	(0.026)	(0.026)
Self-reported good quality	0.077*	0.071	0.040
	(0.047)	(0.049)	(0.045)
Plot obtained matrilineally	-0.147*	-0.137	-0.085
	(0.083)	(0.087)	(0.074)
Plot obtained patrilineally	-0.192**	-0.194**	-0.240**
	(0.058)	(0.057)	(0.062)
Area (in hectares)	-0.049**	-0.048**	-0.044**
	(0.018)	(0.018)	(0.018)
Household characteristics			
Number of plots	-0.047	-0.053**	-0.030
	(0.030)	(0.025)	(0.022)
Female head	0.305**	0.324**	0.366**
	(0.069)	(0.085)	(0.060)
Number off-farm males, main job (2006)	0.265**	0.277**	0.201**
	(0.043)	(0.043)	(0.043)
Number off-farm females, main job (2006)	0.095	0.191	0.168
	(0.076)	(0.117)	(0.104)
Nutrition promoter? (2009)	-0.148		
Head, years of schooling (2012)	(0.109)		
Household Size		-0.011	
		(0.012)	
		0.026**	
		(0.012)	
Fixed effects?	Village	Village	Strata
Number of observations	418	424	427
R^2	0.222	0.222	0.221

Source: REU survey data (2006, 2009, 2012).

Note: Standard errors are robust in columns 1 and 2 and clustered at village level in column 3. Estimates in column 3 are attrition weighted to account for attrition since 2006.

In summary, the results show that one of the strongest predictors of women deciding what to grow on the plots that they control is that the household had access to off-farm labor six years ago. The time lag is useful because the decisions about management and participation in off-farm work are not necessarily being made simultaneously, and therefore there is a stronger argument that they could be exogenous. As mentioned above, these results suggest that a small portion of households in the sample are beginning to specialize tasks among adults; potentially due to work availability, some men seasonally migrate and women in those households make decisions about what to grow on household land.

5. HOUSEHOLD-LEVEL ANALYSIS

The evidence at the plot level indicates that women manage about 70 percent of plots that they nominally control, whereas men manage more than 90 percent of plots that they control. Complete crop production and sales information is available only at the household level in the dataset, so in this section data are aggregated up to the household level. Doing so allows measurement of differences in experience of control and management, as well as consideration of crop sales and household farm income, by household type. Three types of households can be defined in both domains: households in which men, women, or both control or manage plots.

All of the households with land in the dataset can then be categorized into nine groups, by control and management (Table 5.1). Not surprisingly, households in which men control and manage all the land are the most prevalent; more than half of households fit this category. Combining rows 2 and 3, households in which females control some or all of the land, men manage all of the plots in 90 households, women do so in 196 households, and there is a split in 78 households. From the household perspective, the interesting variation in experience, then, appears to be when women control some or all of the household plots.

Table 5.1 Household types by gendered control of land and management of land: Northern Mozambique, 2012

		Gender of plot managers		
		All male	**All female**	**Both**
Gender	All male	489	11	21
of control	All female	28	183	14
of plots	Both	62	13	64

Source: REU survey data (2006, 2009, 2012).

Note: Number of total valid observations is 885. Numbers reflect the actual number of sample households fitting in each category.

The next step in the analysis is to aggregate to four variables measuring farming experience and describe them by these nine types of households. These four variables are the number of plots held by the household, the number of different crops grown by the household, the number of crops sold by the household, and the logarithm of per capita farm income.[12] By definition, households in which both men and women control or manage crops must have more than one plot, so we first drop the 140 households that recorded only one plot. We are particularly interested in studying the difference between male and female "control" households.

We initially find no differences in the number of plots held between households in which men or women control and manage the land, respectively (Table 5.2, Panel A). When both genders have control of some land within a household, the household has slightly more plots on average. Though men and women have the same amount of land, men tend to farm more crops than women when they manage plots (whether or not women control them; Panel B). Women tend to sell fewer crops than men as well when they manage crops (Panel C). Finally, when men control plots, their farm incomes are also higher, by between 0.2 and 0.4 log points (corresponding roughly to 20 to 50 percent higher; Panel D) than when women manage plots. When both men and women manage plots, average farm incomes are variable; this finding could be a function of sample sizes, which are generally small.

[12]While the survey form disaggregates white and orange sweet potatoes, for this measure they are combined into one crop. Per capita farm income is computer by constructing unit values for each crop and multiplying by the amount produced, then summing up the value of production. The variable is effectively the gross value of agricultural output, computed on a per capita basis.

Table 5.2 Descriptive statistics by gender of control and management of plots, household level: Northern Mozambique, 2012

		Male	Female	Both
Panel A: Number of plots (if more than one)				
Gender of control of plots	Male	2.586	2.444	2.714
		(0.038)	(0.242)	(0.171)
	Female	2.870	2.634	2.929
		(0.202)	(0.060)	(0.195)
	Both	3.048	3.077	3.188
		(0.116)	(0.288)	(0.122)
Panel B: Number of crops grown				
		Male	**Female**	**Both**
Gender of control of plots	Male	4.252	2.889	3.619
		(0.094)	(0.423)	(0.327)
	Female	4.217	3.634	3.929
		(0.397)	(0.124)	(0.474)
	Both	3.871	3.769	4.484
		(0.232)	(0.231)	(0.234)
Panel C: Number of crops sold				
		Male	**Female**	**Both**
Gender of control of plots	Male	1.463	0.778	1.143
		(0.071)	(0.401)	(0.210)
	Female	1.130	1.069	1.500
		(0.192)	(0.094)	(0.310)
	Both	1.371	0.769	1.328
		(0.168)	(0.281)	(0.165)
Panel D: Log, per capita farm income				
		Male	**Female**	**Both**
Gender of control of plots	Male	6.634	6.278	6.570
		(0.046)	(0.314)	(0.160)
	Female	6.660	6.415	6.167
		(0.146)	(0.076)	(0.310)
	Both	6.625	6.207	6.584
		(0.114)	**(0.241)**	(0.112)

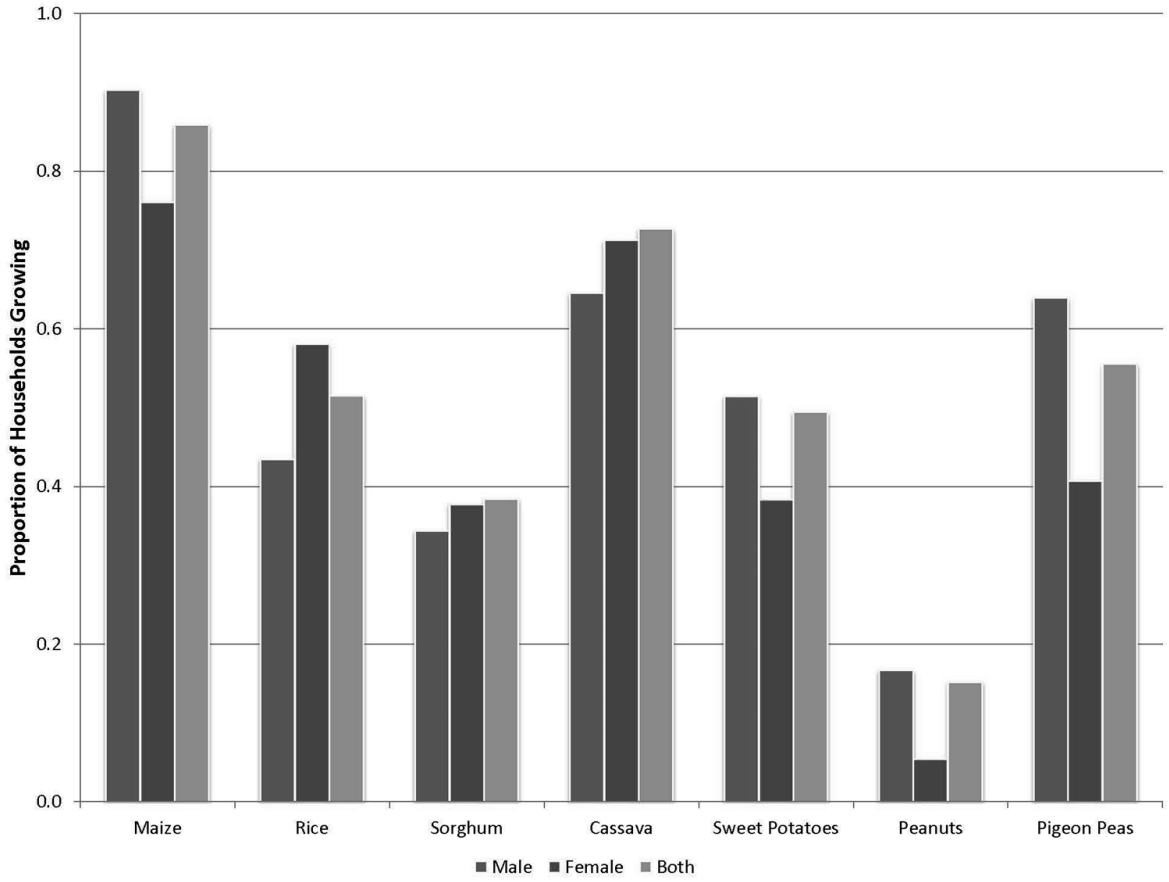
Source: REU Survey Data (2006, 2009, 2012).

Note: Standard errors clustered at the village level in parentheses. All statistics conditional on more than one plot available in the household.

Since women appear to grow fewer crops than men do when they manage plots, we next consider whether women are more or less likely to grow specific crops than men when they manage plots (Figure 5.2). We find that the propensity to grow most grain crops is similar; when women manage plots, they are slightly less likely to grow maize than men, and slightly more likely to grow rice. There are larger differences when considering sweet potatoes, peanuts, and pigeon peas, which are the main cash crop in Zambézia; when women manage all plots, they are less likely to grow all of these crops than when men control all plots or when men and women both control some plots.[13] Both sweet potatoes and peanuts are slightly more complicated to grow than other crops, so women may decide that planting these crops is not worth the effort. While it could be that women are less likely to plant pigeon peas because they are concerned they will lack a market, when women grow pigeon peas they are equally as likely to sell pigeon peas as men, so it would be impossible to demonstrate this point with the data available.

[13] Other beans are all grown with similar propensities, so they are not depicted.

Figure 5.2 Proportion of sample households growing specific crops that market at least a portion: Zambézia, Mozambique, 2006–2012



Source: REU Survey Data (2006, 2009, 2012).

The large discrepancy in per capita incomes between male- and female-managed plots, even in households in which women control all of the plots, calls for further investigation. Therefore we isolate all of the households in which women have some control over the plots, removing from consideration households in which men control all of the plots. We next define indicator variables for women managing all plots and both genders managing some plots, and we regress the logarithm of per capita farm income on those two indicator variables (Table 5.3, column 1). The result is an estimated coefficient of approximately −0.2 on the women management indicator variable, suggesting that women produce 22 percent less than men; the coefficient is significantly different from zero at the 10 percent le vel. We next add two characteristics of the household head– whether it is a female and the years of schooling (column 2)– and the coefficient estimate actually grows to 0 256. A third regression (column 3) adds variables measuring the number of plots controlled by the household and whether or not the household has access to the lowlands. While the statistical significance of the coefficient on the women management variable loses its significance, it remains near 0 2 in m agnitude. The next regression adds variables measuring the number of male and female farm workers in the household contemporaneously in 2012 (column 4). These variables again do not affect the coefficient estimate on women managing plots; the coefficient remains close to 0 2, though again it is not significant.

However, when two variables measuring the number of male and female off-farm laborers in 2006 are added at least among the panel subsample, the coefficient on female management becomes much smaller in magnitude and is truly indistinguishable from zero (Table 5.3, column 5). Meanwhile, the coefficient on the number of male workers with jobs off-farm is large (0 243) and significant at the 10 percent level. Although restricted to the panel, this regression suggests that all of the difference in incomes between households in which men and women, respectively, manage plots can be explained through off-farm labor access. These results are largely consistent with a story that when households (or men in households) can access off-farm work, women are more likely to make all cropping decisions on their plots. Moreover, given the potential for additional household income women in these households may not be as interested in growing cash crops, explaining the earlier finding about pigeon peas. Alternative explanations,ofcourse,·for this set of results are certainly plausible.

Table 5.3 Household correlates with logarithm of per capita farm income, by gender of manager when female controls plots: Northern Mozambique, 2012

Explanatory variable	(1)	(2)	(3)	(4)	(5)
Female manages all plots	-0.199***	-0.256**	-0.197	-0.189	-0.027
	(0.118)	(0.114)	(0.122)	(0.126)	(0.149)
Both genders manage plots	-0.118	-0.120	-0.132	-0.113	0.117
	(0.143)	(0.143)	(0.141)	(0.141)	(0.173)
Female head?		0.207	0.234	0.264	0.141
		(0.156)	(0.160)	(0.164)	(0.189)
Years of schooling, head		0.028	0.021	0.018	0.008
		(0.026)	(0.024)	(0.024)	(0.021)
Number of plots (2012)			0.205**	0.208**	0.146**
			(0.058)	(0.058)	(0.061)
Household has access to lowlands			-0.102	-0.072	-0.090
			(0.117)	(0.116)	(0.149)
Number male farm workers (2012)				0.001	-0.028
				(0.053)	(0.064)
Number female farm workers (2012)				-0.109**	-0.090***
				(0.048)	(0.049)
Number off-farm males, main job (2006)					-0.243***
					(0.130)
Number off-farm females, main job (2006)					-0.001
					(0.274)
Fixed effects	Strata	Strata	Strata	Strata	Strata
Number of observations	319	317	317	317	209
R^2	0.026	0.038	0.071	0.083	0.092

Source: REU Survey Data (2012).

In summary, in households where women make decisions about at least some of the plots, the variety of crops, the number of crops sold, and per capita farm incomes tend to be lower than when men solely make decisions about what to grow. In households where women manage the plots, they tend to grow either crops with less complicated basic production processes or crops that are less likely to be cash crops. These differences explain the difference in the number of crops grown. Income differentials between households in which men and women, respectively, make cropping decisions can be wholly explained through access to off-farm work among males in the baseline survey, suggesting that such households are able to specialize labor tasks.

6. DISCUSSION AND CONCLUSION

This paper, has explored how agricultural decisionmaking in northern Mozambique occurs by gender, and its implications. Based on interesting variation found in the data, the study largely focuses on the factors that appear to lead to women retaining decisionmaking over plots that they nominally control, and the implications of those decisions for the crops grown and household income.

I initially study plot management within households, finding that men control (or have use rights over) the majority of plots households control, whereas women control about 30 percent of plots. For the plots that women control, women make decisions about what to grow about 70 percent of the time. One of the strongest predictors of women managing the plots that they nominally control in 2012 is that a male member of the household worked off-farm during the baseline survey in 2006.

Among the findings in this paper, this one perhaps is the most potentially profound for policymaking, if women's empowerment in agriculture is a goal of development programs. Women appear to have more decisionmaking power when men are able to work off-farm; because in this context most of those men are seasonal migrants, a suggestion would be that programs that develop off-farm work for unskilled labor, for example, might actually boost women's empowerment in farm households left behind. It is worth noting that given the lack of a randomized controlled trial *proving* this process is occurring, these results are merely suggestive. However, the correlation is robust enough in these data that designing such a trial with the goal of increasing women's empowerment might be worthwhile.

However, it would also be worth knowing more about how matrilineal processes manifest themselves in land control in these areas. The wife's brother is an important actor in matrilineal societies; however, as with most household surveys, characteristics of family members of the nuclear couple were not collected in the REU household surveys. To understand these agricultural decisionmaking processes better, learning about more of the actors in the extended family would be particularly worthwhile in further research.

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