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ARE AGRICULTURAL SUBSIDIES GENDER SENSITIVE? HETEROGENEOUS IMPACTS OF THE FARMER INPUT SUPPORT PROGRAM IN ZAMBIA

By

Henry Machina, Hambulo Ngoma, and Auckland N. Kuteya

Food Security Policy *Research Papers*

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AUTHORS

Machina is research associate and the lead researcher in gender and youth in agriculture thematic area while Kuteya is research associate II and the lead researcher in public policy and expenditure as well as subsidy programmes in agriculture at the Indaba Agricultural Policy Research Institute (IAPRI). Ngoma is research fellow and the lead researcher in natural and climate change thematic area at IAPRI. At the time of writing, he was also postdoctoral research associate with the Department of Agricultural, Food, and Resource Economics at Michigan State University and in-country coordinator for the Innovation Lab for Food Security Policy (FSP) in Zambia.

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EXECUTIVE SUMMARY

Smallholder farmers in Sub-Saharan Africa face several challenges including low productivity, food insecurity and low agricultural diversification, which contribute to high poverty. To address these challenges, governments in the region have been implementing agricultural subsidy programs to raise productivity and promote household food security, among other things. The subsidy programs have been associated with some positive impacts on productivity but not so much on stimulating overall agricultural growth and poverty reduction. In some instances, subsidies have been found to crowd out demand for commercial fertilizer. However, there is a dearth of empirical evidence on whether subsidies can reduce the gendered productivity gaps in agriculture. This paper contributes towards filling this gap. In particular, we assess the gendered impacts of receiving FISP on productivity and assess whether these impacts are heterogeneous between female- and male-managed plots. Unlike past studies done at household level, our analysis is at the plot level and distinguishes between male- and female-managed plots.

We applied panel data methods to the two-wave Rural Agricultural Livelihoods Surveys data collected in 2012 and 2015.

The study highlights several findings as follows:

First, there were several notable differences in the main variables between female-managed and male-managed plots. The main outcome variable—the measure for agricultural productivity—yield, averaged about 1,400kg /ha. Male-managed plots had a 34kg/ha yield advantage over female-managed plots. These results are suggestive of gendered productivity gaps.

Second, there were many differences in plot-specific characteristics. Male-managed plots were on average larger than female managed plots and male household heads managed more plots than female heads. A larger proportion of female-mangers accessed more FISP and commercial fertilizers, and consequently used more basal and top dressing fertilizers than their male counterparts. The male-managers, however, used more seed. Despite the almost equal access to credit, female-managers accessed larger amounts than their male counterparts among those that accessed credit. Finally, male-plot managers were on average more educated, younger, wealthier and had more social capital more than their female counterparts.

Third, the main empirical results suggest that access to FISP does not disproportionately raise crop productivity for female-managed plots. This implies that FISP alone is not sufficient to address the gendered productivity gaps in agriculture. These results should not be understood to suggest that FISP is bad per se, but rather that FISP is insufficient to address the male-female productivity gaps. Access to FISP is associated with an average yield gain of 0.8% regardless of the gender of the plot manager.

As a way forward, the government and other stakeholders involved in promotion of FISP need to promote a more gender sensitive program that targets more female headed households to promote gender equality. There is also need to address the social-cultural norms that tip the balance of power dynamics, rights and entitlements towards men. This can be done through educational and sensitizations activities.

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LIST OF ACRONYMS AND ABBREVIATIONS

CSO	Central Statistical Office
CRE	Correlated Random Effects
FAO	Food and Agriculture Organization
FISPs	Farmer Input Support Programmes
IAPRI	Indaba Agricultural Policy Research Institute
ISPs	Input Support Programmes
MAL	Ministry of Agriculture and Livestock
MoA	Ministry of Agriculture
RALS	Rural Agricultural Livelihood Survey

1. INTRODUCTION

Smallholder farmers in Sub-Saharan Africa (SSA) face several challenges including low productivity, food insecurity and low agricultural diversification, which contribute to high poverty. To address these challenges, governments in the region have been implementing agricultural subsidy programs to raise productivity and promote household food security, among other things. The subsidy programs have been associated with some positive impacts on productivity (FAO 2015; Kato and Greeley 2016; Wossen et al. 2017) but not so much on stimulating overall agricultural growth and poverty reduction (Mason and Tembo 2015; Mason, Jayne, and van de Walle 2016; Jayne et al. 2016). In some instances, subsidies have been found to crowd out demand for commercial fertilizer (Ricker-Gilbert, Jayne, and Chirwa 2011).

There is, however, a dearth of empirical evidence on whether subsidies can reduce the gendered productivity gaps in agriculture. Most of the studies on the gendered impacts of FISP on productivity are done at household level and distinguish between male- and female-headed households without addressing intra-household dynamics and impact heterogeneity (Kanbur and Haddad, 1994; Alderman et al. 1995; Quisumbing 1996; Ghosh and Kanbur 2008; Marenya, Menale, and Emilio 2015). This deprives governments of information necessary to guide policy decisions on how best to reduce the gendered productivity gaps in agriculture. This paper contributes towards filling this gap. In particular, we assess the impact of accessing FISP on crop productivity and whether these impacts are heterogeneous between female- and male-managed plots.

1.1. Brief Background to Agricultural Subsidies in Africa

Since the 1970s, governments in SSA have used subsidy programs as the main policy instrument to address low productivity and food insecurity among smallholder farmers (Chirwa and Dorward 2013; Ricker-Gilbert, Jayne, and Shively 2013). Subsidies were phased out in the early 1990s under the structural adjustment programs (SAPs), arguing that they were inefficient and unsustainable. However, they were reintroduced in the early 2000s under the name Farmer Input Support s (FISPs) and targeted mainly smallholder farmers (Druilhe and Barreiro-Hurle 2012; Liverpool-Tasie 2012; Ricker-Gilbert, Jayne, and Chirwa 2011). The main purpose of FISP is to increase national food security and stimulate productivity among smallholder farmers and reduce overall poverty (Chirwa and Dorward 2013; Ricker-Gilbert, Jayne, and Shively 2013; Jayne et al. 2016).

Various studies show that FISP has had positive impacts on land productivity (yield) of staple crops - maize and rice (FAO 2015; Kato and Greeley 2016; Wossen et al. 2017). However, several challenges including inefficient targeting and political interference beset FISP implementation. FISP has also crowded out demand for commercial fertilizer, with only marginal effects on reducing poverty in the region (Ellis, Devereux, and White 2009; Sitko et al. 2012; FAO 2015; Mason and Tembo 2015; Mason, Jayne, and van de Walle 2016; Jayne et al. 2016). Inefficient targeting results in problems of exclusion and inclusion: wealthier and more powerful, undeserving farmers benefit from the programs at the expense of the most deserving poor. This calls for smart targeting to ensure that the intended beneficiaries are reached by the program.

Like in most SSA countries, agricultural subsidies have been implemented in Zambia since the 1970s. The Zambian government has been providing fertiliser and seed mainly for the staple crop maize under the conventional FISP where government sources and distributes the inputs directly to the farmers. During the 2015/2016 season, the government piloted an electronic voucher (e-voucher) based FISP delivery system in 13 districts[1]. In the e-voucher based FISP, government co-finances inputs with smallholder farmers. Farmers are then free to redeem inputs of their choice from participating private agro-dealers using electronic cards (Kuteya et al. 2016). The e-voucher system is meant to increase private sector participation, promote timely access to inputs and improve beneficiary targeting as well as promoting agriculture diversification.

[1] Chibombo, Kabwe, Kapiri Mposhi, Mumbwa and Chisamba in Central Province; Ndola District on the Copperbelt Province; Chongwe district in Lusaka Province; and Chikankata, Choma, Kalomo, Mazabuka, Monze, and Pemba Districts in Southern Province.

2. CONCEPTUAL FRAMEWORK

The main objective of this paper is to assess the gendered heterogeneous impacts of receiving FISP on productivity. At the core is the question whether accessing FISP has differential impacts on productivity between females and males. Unequal access to farming inputs such as improved seeds, inorganic fertilizers and non-input factors like social capital are the often cited reason for agricultural productivity differences between females and males (Quisumbing et al. 2014; Namonje-Kapembwa and Chapoto 2016).

There are several reasons why gendered productivity gaps persist. Although unitary household models project households as single entities reliant on pooled resources and able to make joint and collective resource allocation decisions to maximize a common utility or welfare function, the social fabric and individual preferences suggest otherwise. Individuals within a household have different preferences and societies, especially in SSA are patriarchal, and therefore biased in favour of male household members (Smith et al. 2003; Farnworth, Akamandisa, and Hichaambwa 2011; Quisumbing et al. 2014). This inadvertently tips the balance of power, rights and entitlements towards males, and engenders unequal access to productive resources, which leads to gendered outcomes.

Women often cultivate crops requiring less commercial inputs—also known as less masculine crops such as groundnuts—and bear much of the burden of providing agricultural labour both on their own plots and on those of their husbands. However, these power dynamics dictate that although women can (be coerced) and do provide labour input on their husbands' plots, they mostly cannot assign their husbands to work on their (women's) plots. In addition to this disproportionate agricultural production burden, women are socially expected to care for the homestead and children, the sick and elderly, fetch water and cooking fuel, and to prepare food for the family. This creates *de facto* gendered inefficiencies in agricultural productivity not because females are bad at farming, but mainly because males allocate to themselves the best available plots and requisite inputs.

Different household types embody different power dynamics. So far, the foregoing discussions present the case of a female farmer in a male-headed household. While females in female-headed households would have more leverage to decide on resource allocations, the cultural and societal norms may still be repugnant constraints. In some societies, regardless of their household structure, female farmers still face challenges to own land, secure land tenure, access credit, extension and market information (Doss 2010; Chirwa at al. 2011; Farnworth, Akamandisa, and Hichaambwa 2011; Karamba and Winters 2015). These women-specific disadvantages in turn stifle on-farm investments and productivity growth on female farms and leads to a larger proportion female-headed households being poor. An observation also called 'feminization of poverty'.

Agricultural productivity enhancing programs such as FISP can have significan impacts on gendered productivity gaps in Agriculture. The direction of the effect is however, ambiguous. By construction, FISP should help reduce gender productivity gaps by making available improved inputs to both female and male farmers. According to World Bank (2012), if women are given the same access as men to improved agricultural inputs such as fertilizer and seed, maize yields would increase by as much as 16% in Malawi, 17% in Ghana, and 19% in western Kenya. FISP can, however, worsen the productivity gaps if female farmers face disproportionately more non-input production constraints and if program targeting discriminates against women and/or suffers from problems of exclusion and inclusion. In the latter case, FISP may exclude female farmers who are eligible to participate in the program. The central focus of FISP on maize-seed and fertilizer (for the period covered in this study) in Zambia suggests that the program could disadvantage female farmers who cultivate other crops. (Better targeting can help iron out this problem).

3. DATA AND METHODS

3.1. Data

The data used in this study were collected by the Central Statistical Office (CSO) in partnership with the Ministry of Agriculture and Livestock (MAL) and the Indaba Agricultural Policy Research Institute (IAPRI). We use a two-wave panel data collected in 2012 and 2015, hereafter referred to as RALS 2012 and RALS 2015, respectively. Taking the 2010/2011 farming season as the reference period for the survey, RALS 2012 interviewed a total of 8,839 households while RALS 2015 added new households and interviewed a total of 9,520 households. Both RALS 2012 and 2015 are statistically representative at the provincial and national levels and 7,254 panel households were successfully interviewed over the two-waves. Readers are referred to RALS 2012 and RALS 2015 survey reports for sampling details (CSO/MAL/IAPRI 2012, 2015). The RALS surveys collect the most comprehensive data on rural households' demographic characteristics, farm land use, crop production and input use, fruit/vegetables production and sales, livestock, prices, off-farm activities, other sources of income, household assets/implements among others, in Zambia.

We use plot-level data from 32,463 plots (16,973 and 15,490 plots 2012 and 2015, respectively owned by the 14,508 households over the two-panel waves). We arrived at this sample after dropping households without fields, with zero harvest and after accounting for missing values. Table 1 presents summary statistics of the data.

3.2. Methods

3.2.1. Empirical Model

We parametrize the conceptual ideas in section 2 using the following empirical model in the spirit of Karamba and Winters (2015):

$$\begin{aligned} y_{ijt} = \beta_o + \beta_1 \, female_{ijt} + \beta_2 FISP_{ijt} + \beta_3 \left(female_{ijt} \text{ x } FISP \right) + \boldsymbol{\beta_4 X}_{ijt} \\ + \boldsymbol{\beta_5 tillage}_{ijt} + \boldsymbol{\beta_6 Z}_{ijt} + \boldsymbol{\beta_7 C}_{ijt} + \boldsymbol{\beta_8 year} + c_i + u_{ijt} \end{aligned} \quad (1)$$

where y_{ijt}, yield in kg/ha for household *i* on plot *j* at time *t* – is the main productivity measure in this study. *Female* and *FISP* are dummies capturing, respectively, female-managed plots in a female headed household and access to the farmer input support program in the 2010/2011 and 2013/2014 seasons. $\boldsymbol{X}$ is a vector of plot specific factors such as seed and fertilizer quantities, lime and manure use, time of tillage (whether before or during the rainy season), whether the plot has title, plot size and the number of plots per household. ***tillage*** is a vector of the full range of tillage methods - rip, basin, mound, bund, plow, zero tillage, ridge and hand-hoe. $\boldsymbol{Z}$ captures household factors (age and education of head, adult equivalents, access to credit, membership to farmer organizations, wealth index). $\boldsymbol{C}$ captures exogenous factors such as rainfall and proneness to erosion. ***year*** captures survey year dummies. c_i is unobserved time invariant plot-level unobserved heterogeneity and u_{ijt} is the I.I.D idiosyncratic error term, and the $\boldsymbol{\beta}$'s are estimable parameters.[2]

The parameter β_1 captures the average effects of being a female-managed plot on productivity assuming β_3 is insignificant, while β_2 measures the average effects of FISP on productivity regardless of the gender of the plot manager, again assuming that β_3 is insignificant. A negative or positive β_2

[2] We omit square terms of all continuous regressors to simplify notation, but they are included in the estimated models.

shows negative and positive productivity effects of FISP. The interpretation changes if β_3 (the main policy measure) is significant. The overall average productivity effect of FISP (regardless of the gender of the plot-manager) is equal to $\beta_2+\beta_3$.

After controlling for the female-plot manager, and all else equal, β_3 measures the productivity effects of FISP on female-managed plots as opposed to male-managed plots. If $\beta_3 > 0$ and significant, this would suggest that FISP reduces the gender productivity gap because it would disproportionately raise productivity on female-managed plots, otherwise it reduces it. FISP has no effect on the gendered productivity gap if $\beta_3 = 0$. The estimation clustered standard errors to account for intra-cluster correlations across plots.

3.2.2. Identification Strategy

The empirical model in Eq. (1) is estimated using panel data methods. The main concern here is the endogeneity of FISP. FISP is not randomly assigned to households such that those farmers who self-select into FISP may have unobserved characteristics that also affect productivity even if they hadn't accessed FISP. For example, farmers that are more self-motivated or entrepreneurial, or are better farmers than the peers, perhaps because of good farming skills or farm management abilities may be more likely to access FISP, but such farmers would have likely higher yields than an average farmer even if they didn't access FISP.

We attempted to test and control for the endogeneity of FISP using the control function approach of Wooldridge (2010). Since FISP our main policy variable, is interacted with the gender variable, the interaction itself becomes endogenous. Addressing these endogenous regressors would require at least two instrumental variables, which we could not find in the data set used. We therefore did not pursue this approach further. However, since most of the farmer and/or plot specific factors that could cause self-selection into FISP are arguably time invariant (e.g., farmer motivation), the use of CRE to control for c_i also controls for these factors. We also controlled for several observables to account for any remaining heterogeneity even after controlling for c_i. Therefore, results in this paper should be interpreted with caution.

Because we have access to a unique two-wave panel data set, we used a Mundlak-Chamberlain correlated random effects (CRE) panel data method to control for time invariant plot-level unobserved heterogeneity (c_i) (Chamberlain 1984; Mundlak 1978; Wooldridge, 2010).[3] If we let $\boldsymbol{W}_{ijt}$ to represent all the time-varying covariates in Eq. (1), where as before, *i, j, and t* index the household, plot, and year, respectively. c_i is assumed to be a function of $\overline{\boldsymbol{W}}_j$ - the plot-level averages (across all time periods) of the time-varying covariates, which are included as additional regressors in Eq. (1). Readers are referred to Wooldridge (2010) for further details on the use of the CRE approach and to Ngoma, Mason, and Sitko (2015) for a recent and similar application.

[3] While a fixed effects (FE) approach would also have been possible, we used CRE in order to preserve the many dummy variables in Eq. (1), including the main policy variable FISP. We compare CRE models with OLS as a robustness check, and across CRE models with and without endogenous input variables.

4. RESULTS AND DISCUSSION

4.1. Descriptive Statistics

Table 1 presents summary statistics for the main variables used in the analysis. The table presents statistics for the pooled sample and for 2012 and 2015 separately. These results are disaggregated by whether the plot was female- or male-managed. There are several notable differences in the main variables between female-managed and male-managed plots. The main outcome variable—the measure for agricultural productivity—yield, averaged about 1,400 kg/ha. Male-managed plots had a yield advantage over female-managed plots, especially in 2012.

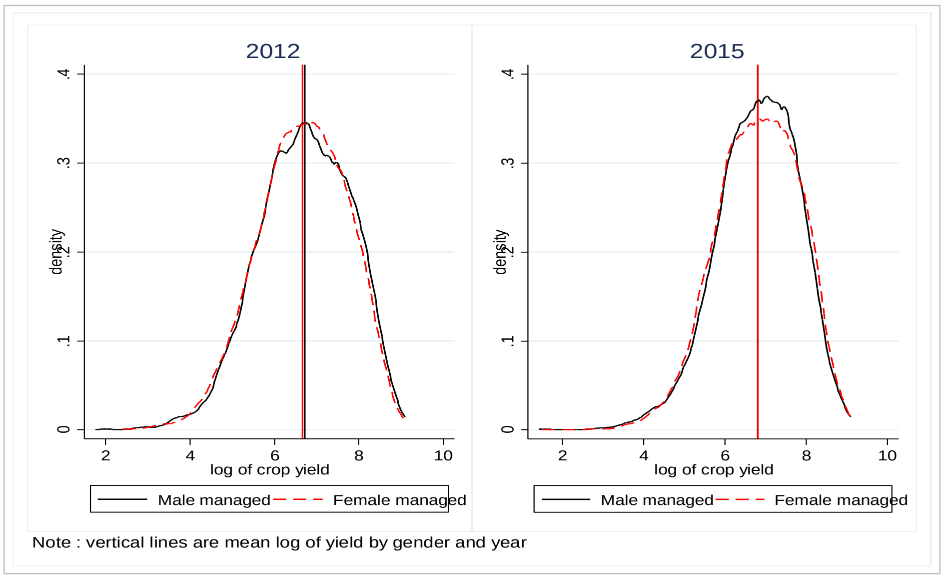
Table 1. Summary Statistics for the Main Variables

	Overall	Male mngd plot	Female mngd plot	T-Stat
Yield (kg/ha)	1375.47	1381.84	1348.30	1.74 *
Plot size (hectares)	1.29	1.36	0.99	5.49 ***
Number of plots	4.81	4.90	4.41	16.55 ***
Accessed FISP (yes =1)	0.58	0.58	0.61	-4.24 ***
Accessed com. fertilizer (yes =1)	0.89	0.89	0.90	-3.47 ***
Top dressing fertilizer (kg)	47.89	46.20	56.24	-6.61 ***
Basal dressing fertilizer (kg)	47.79	46.08	56.25	-6.64 ***
Kgs of seed used	17.30	17.64	15.82	6.23 ***
Accessed credit (yes=1)	0.23	0.23	0.23	0.7
Credit amount (ZMW) [credit > 0]	894.05	698.02	1743.02	-4.89 ***
Plot with title (yes=1)	0.08	0.08	0.07	0.96
Tillage before rains (yes=1)	0.19	0.18	0.20	-2.39 **
Applied manure (yes = 1)	0.05	0.04	0.05	-2.59 ***
Applied lime (yes = 1)	0.00	0.00	0.01	-1.06
Education level head	5.98	6.01	5.84	3.1 ***
Adult equivalent	4.82	4.82	4.81	0.42
Number of prime age adults	2.98	2.97	3.01	-1.33
Age household head	46.73	46.62	47.18	-2.64 ***
Married household head (yes =1)	0.78	0.78	0.76	2.7 ***
Bunding tillage (yes=1)	0.06	0.06	0.05	3.66 ***
Ridging tillage (yes=1)	0.29	0.29	0.31	-2.68 ***
Plowing tillage (yes=1)	0.26	0.26	0.26	-0.64
Mounding tillage (yes=1)	0.02	0.02	0.02	-0.21
Zero tillage (yes=1)	0.02	0.02	0.02	0.01
Hand Hoe tillage (yes=1)	0.32	0.32	0.31	1.93 *
Basins tillage (yes=1)	0.01	0.01	0.01	-0.48
Ripping tillage (yes=1)	0.02	0.01	0.02	-1.5
HH wealth index from PCA	-0.05	-0.03	-0.12	2.99 ***
Member to farmer group, coop (yes = 1)	0.51	0.51	0.49	2.59 ***

Source: CSO/MoA/IAPRI RALS 2012 and 2015. otes: ***, **, * imply statistically significant t-test (T-stat) at 1%, 5% and 10% respectively (these are unweighted); the table also includes access to commercial and FISP fertilizer, and credit amount that are not used in the estimations later. N=32,463, with 16,973 and 15, 490 plots 2012 and 2015, respectively owned by 14,508 households. (The average number of plots per household is 2.24).

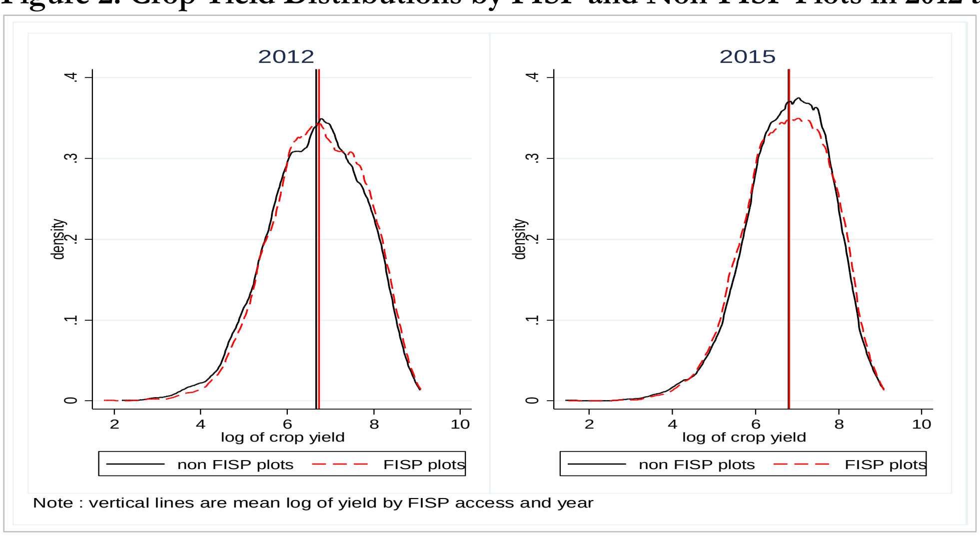
These results are depicted visually in Figures 1 and 2. Albeit small and insignificant in some instances, these results are suggestive of gendered productivity gaps. While Figure 1 compared yields between female and male-managed plots, Figure 2 makes the comparison across FISP plots, regardless of the gender of the plot manager. We do not find substantial differences in yields even between FISP and non-FISP plots (Figure 2).

Figure 1. Crop Yield Distributions by Female-managed and Male-managed Plots in 2012 and 2015



Source: CSO/MoA/IAPRI RALS 2012 and 2015.

Figure 2. Crop Yield Distributions by FISP and Non-FISP Plots in 2012 and 2015



Source: CSO/MoA/IAPRI RALS 2012 and 2015.

There were many differences in plot-specific characteristics (Table 1 and Annex Table 1). Male-managed plots were on average larger than female managed plots and male household heads managed more plots than female heads. This confirms that women are disadvantaged in terms of access to resources such as land, access to credit, extension and market information (Doss 2010; Farnworth, Akamandisa, and Hichaambwa 2011; Karamba and Winters 2015).

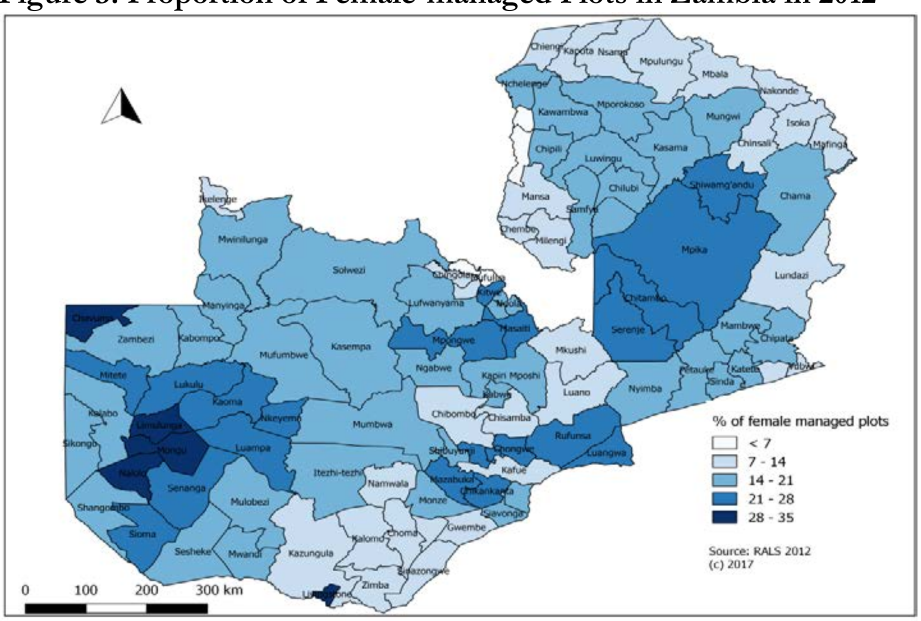
In terms of input use, a larger proportion of female-mangers accessed more FISP and commercial fertilizers, and consequently used more basal and top dressing fertilizers than their male counterparts. The male-managers, however, used more seed. Although we find almost equal access to credit, female-managers accessed larger amounts than their male counterparts among those that accessed credit.

Male-plot managers were on average more educated, younger, wealthier and had more social capital (belonged to farmer groups) more than their female counterparts. As reported by Quisumbing et al. (2014) and Namonje-Kapembwa and Chapoto (2016), this confirms the disadvantaged position of women, which contributes to their low productivity. Further, most of the differences were statistically significant suggesting, as per literature review that female-managers may be disadvantaged, but this is better assessed under multivariate models as done below.

4.1.1. The Geography of Female-managed Plots in Zambia

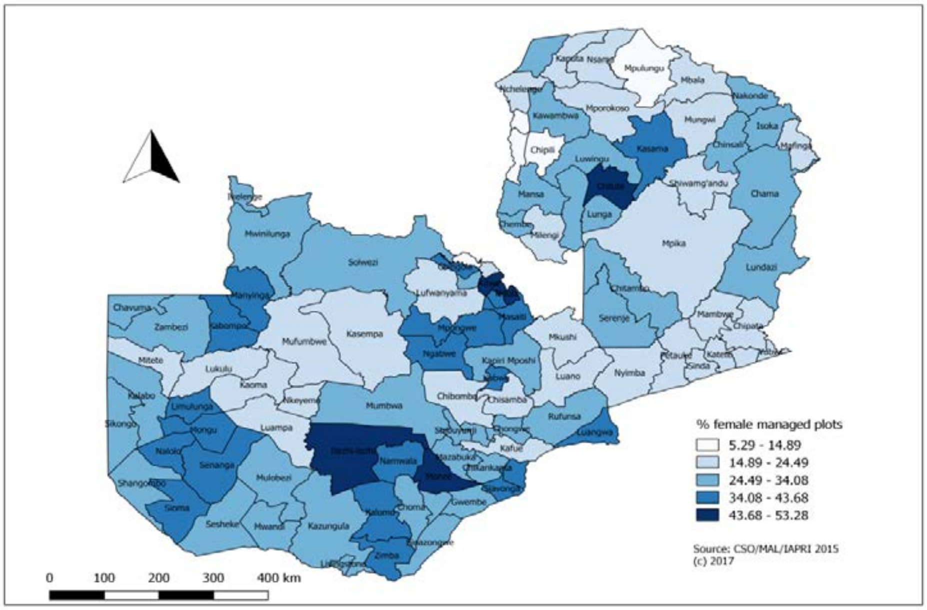
We also considered the geography of female-managed plots in Zambia. Overall, results in Figures 3 and 4 suggest that less than 20% of all plots were controlled by females in 2012 and 2015 in Zambia. While we observe some dynamics between 2012 and 2015, the loci of female-managed plots appear concentrated around the Copperbelt, Central, Lusaka, Southern and Western regions of the country. Understanding why poses a good question, but one that is beyond the scope of the current study.

Figure 3. Proportion of Female-managed Plots in Zambia in 2012



Source: CSO/MoA/IAPRI RALS 2012.

Figure 4. Proportion of Female-managed Plots in Zambia in 2015



Source: CSO/MoA/IAPRI RALS 2015.

4.2. Empirical Results

We estimated Eq. (1) using different model specifications. Using mainly the OLS estimator, results in Table 2 are for ordinary OLS in column (1), CRE in column (2) and CRE without the endogenous input variables, tillage variables and without both input and tillage variables in columns (3) – (5). We estimated the results in the last three columns to allay potential concerns that endogenous choice variables may influence our main results. Since the results are robust across specifications, unless otherwise stated, we will use the full CRE results in column (2) for interpretation.

4.2.1. The Heterogeneous Impacts of FISP on Productivity

Table 2 suggests that access to FISP on female-managed plots (*female* x *FISP*) had no statistically significant effects on crop yield. These results suggest that access to FISP alone is not sufficient to reduce the gender-productivity gaps in agriculture. The heterogeneity in access to productive inputs shown in Table 1 and the societal and cultural contexts that are biased in favor of men could partly explain these results. These findings are in line with those in Karamba and Winters (2015) who found that FISP had insignificant productivity effects for female farmers in Malawi.

Discerning the overall effects of female-manager and access to FISP on productivity requires care because our main model includes an interaction term. This is because the *female-manager* dummy is significant, but the *FISP* variable as well as their interaction (*female* x *FISP*) are insignificantly different from zero. The net effects for these variables are reported in Table 3. All else equal, access to FISP regardless of the gender of the plot manager is associated with an average yield increase of about 0.8%. This result is statistically significant at 5%. The negative coefficient on the female-manager dummy is suggestive of the existence of gendered productivity gaps in Zambia (although the net effect in Table 3 is insignificant).

Table 2. Estimates of the Impacts of FISP on the Log of Crop Yield (kg/ha)

	(1)	(2)	(3)	(4)	(5)
Variables	OLS	CRE	CRE without input variables	CRE without tillage variables	CRE without tillage and input variables
Female manager (yes =1)	-0.085***	-0.085***	-0.085***	-0.085***	-0.085***
	(0.031)	(0.031)	(0.031)	(0.031)	(0.031)
Accessed FISP (yes =1)	0.011	0.011	0.011	0.019	0.019
	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)
Female manager x FISP	0.064	0.064	0.064	0.063	0.063
	(0.039)	(0.039)	(0.039)	(0.040)	(0.040)
Plot size	0.007***	0.250***	0.540***	0.234***	0.539***
	(0.002)	(0.022)	(0.013)	(0.022)	(0.013)
Number of plots	-0.007	-0.007	-0.007	-0.007	-0.007
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Top dressing fertilizer/100	0.574***	1.418***	-	1.441***	-
	(0.086)	(0.097)	-	(0.098)	-
Basal dressing fertilizer/100	0.120	0.120	-	0.116	-
	(0.086)	(0.086)	-	(0.086)	-
Seed rate	0.008***	0.026***	-	0.024***	-
	(0.001)	(0.002)	-	(0.002)	-
Accessed credit (yes =1)	0.065***	0.066***	0.066***	0.073***	0.073***
	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)
Plot titled (yes=1)	0.068**	0.068**	0.068**	0.065**	0.066**
	(0.033)	(0.033)	(0.033)	(0.032)	(0.032)
Tillage before rains (yes=1)	0.083***	0.083***	0.083***	0.118***	0.118***
	(0.021)	(0.021)	(0.021)	(0.020)	(0.020)
Applied manure (yes = 1)	0.013	0.014	-	-0.022	-
	(0.035)	(0.035)	-	(0.036)	-
Applied lime (yes = 1)	0.068	0.069	-	0.065	-
	(0.117)	(0.117)	-	(0.115)	-
Education household head	0.001	0.001	0.001	0.002	0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Adult equivalents	-0.001	-0.001	-0.001	-0.001	-0.001
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Age household head	0.001*	0.001*	0.001*	0.001*	0.001*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Bunding tillage (yes =1)	0.133***	0.133***	0.132***	-	-
	(0.037)	(0.037)	(0.037)	-	-
Ridge tillage (yes =1)	-0.026	-0.026	-0.026	-	-
	(0.020)	(0.020)	(0.020)	-	-
Plow tillage (yes =1)	-0.141***	-0.141***	-0.140***	-	-
	(0.023)	(0.023)	(0.023)	-	-
Mound tillage (yes =1)	0.209***	0.209***	0.208***	-	-

	(1)	(2)	(3)	(4)	(5)
Variables	OLS	CRE	CRE without input variables	CRE without tillage variables	CRE without tillage and input variables
	(0.060)	(0.060)	(0.060)	-	-
Zero tillage (yes =1)	0.161***	0.161***	0.161***	-	-
	(0.048)	(0.048)	(0.048)	-	-
Basin tillage (yes =1)	0.100*	0.099*	0.102*	-	-
	(0.054)	(0.054)	(0.054)	-	-
Rip tillage (yes =1)	-0.060	-0.060	-0.056	-	-
	(0.056)	(0.056)	(0.055)	-	-
Wealth index	0.011**	0.011**	1.584***	0.009**	1.579***
	(0.005)	(0.005)	(0.042)	(0.005)	(0.043)
Member farmer organization	-0.018	-0.018	-0.018	-0.026	-0.026
	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)
Seasonal rainfall /100	-0.035**	-0.036**	-1.313***	-0.034*	-1.303***
	(0.017)	(0.017)	(0.040)	(0.018)	(0.040)
Prone to erosion (yes = 1)	0.011	0.011	0.011	0.016	0.016
	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)
2015	0.134***	0.135***	0.135***	0.119***	0.119***
	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)
Constant	6.568***	6.568***	6.569***	6.531***	6.529***
	(0.093)	(0.093)	(0.093)	(0.096)	(0.097)
Observations (plots)	28,956	28,956	28,956	28,956	28,956

Notes: Clustered robust standard errors in parenthesis; ***, **, * imply statistically significant at 1%, 5% and 10% respectively; hand hoe and 2012 are base tillage and year respectively. The main results do not change even when we use the total quantity of FISP fertilizer received by households.

When considered in totality, the descriptive and empirical results in this paper are reinforcing. Access to FISP does not disproportionately raise crop productivity for female-managed plots, implying that FISP alone is not sufficient to address the gendered productivity gaps in agriculture. These results should not be understood to suggest that FISP is bad per se, but rather that FISP is insufficient to address the male-female productivity gaps. There are several reasons for this. Intra- and inter-household, as well as societal norms that shift power dynamics, rights and entitlements towards men leave women exposed to the least productive plots and/or agricultural lands.

Table 3. Overall Average Marginal Effects of Access to FISP and Female-Managed Plots on the Log of Crop Yield (Based on CRE Results in Column 2 in Table 2)

	Marginal effect	Standard Error	T-Stat
Accessed FISP (yes=1)	0.075	0.034	2.20
Female managed plot (yes=1)	-0.021	0.024	-0.85

Source: Authors' computations using CSO/MoA/IAPRI RALS 2012 and 2015.
Notes: The overall marginal effects in this table are the overall effects of accessing FISP (regardless of the gender of the plot manager) and of female-managed plots on productivity. They are net of the FISP and female-manager interaction effects in Table 3. These marginal effects should be multiplied by 100% since the dependent variable was log transformed.

Because women in African societies disproportionately shoulder much of the agricultural labor burden and tend the homesteads, children and the elderly; they have less time to work on their farms. This means, even if women had access to productive inputs as much as men—a tenet seemingly fostered in FISP—they may still have lower productivity. Addressing the male-female productivity gaps therefore requires a paradigm shift: a move beyond the obvious knee-jerk policies of only providing productive inputs to addressing the under-laying, deep-rooted socio-cultural norms that disadvantage and marginalize women. These may include improving women's access to agricultural information, land access and decision making power within the households as well as in production decisions on the main plots. It should also involve empowering men themselves to value women and accommodate women as co-managers of the household main plots.

4.2.2. Other Drivers of Crop Yield

Results on the other drivers of productivity are standard: fertilizer and seed rates, secure plot tenure, farming experience (proxied by age of household head), early tillage, zero tillage, basin tillage, as well as bund and mound tillage systems are associated with increased productivity. However, plow tillage relative to hand-hoe tillage (the base), as well as seasonal rainfall reduce productivity.

5. CONCLUSIONS AND RECOMMENDATIONS

This study assessed the heterogeneous gendered impacts of access to the Farmer Input Support Programme (FISP) on productivity. Using two-wave panel data from Zambia's Rural Agricultural Livelihoods Surveys of 2012 and 2015, the analysis was done at plot level and segregated by the gender of the plot manager. We further find that despite the heterogeneity in access to inputs, there were no significant gender differences in productivity among FISP recipients as well as between FISP and non-FISP plots. Further, male-managed plots were on average larger than female managed plots confirming the disadvantaged position of women in access to agricultural resources necessary to increase productivity.

In terms of input use, this study found that a larger proportion of female-mangers accessed FISP and commercial fertilizers, and consequently used more basal and top dressing fertilizers than their male counterparts. Male-plot managers were on average more educated, younger, wealthier and had more social capital. Most of the differences were statistically significant suggesting that female-managers may be disadvantaged.

Our overall empirical results suggest that access to FISP does not disproportionately raise crop productivity for female-managed plots, implying that FISP alone is not sufficient to address the gendered productivity gaps in agriculture. These results should not be understood to suggest that FISP is bad per se, but rather that FISP is insufficient to address the male-female productivity gaps. Female farmers face a lot more non-input constraints to production. Since productivity growth stimulates poverty reduction, this places females at a disadvantage in terms of poverty reduction possibilities as compared to males. These results suggest that addressing factors that shape power dynamics in the household such as socio-cultural norms and decision making is critical in attempts to raise productivity and close the gender gaps in agriculture. In this light we make the following recommendations.

The Ministry of Agriculture, together with line ministries and other stakeholders involved in promotion of FISP need to promote a more gender sensitive program that targets more female headed households to promote gender equality.

FISP implementers need to incorporate educational activities that challenge social-cultural norms at household level to promote access to FISP inputs. These could include promoting women's decision making power within the household. This can further be done by facilitating access to gender sensitive agricultural information for females and their spouses, through, for example, village groups.

ANNEX

Table A 1. Full Summary Statistics of the Main Variables

	Full sample				2015			2012		
	Overall	Male managed plot	Female managed plot	T-Stat	Male managed plot	Female managed plot	T-Stat	Male managed plot	Female managed plot	T-Stat
Yield (kg/ha)	1375.47	1381.84	1348.30	1.74 *	1403.94	1400.59	0.13	1363.82	1275.23	3.01 ***
Plot size (hectares)	1.29	1.36	0.99	5.49 ***	1.56	1.06	4.34 ***	1.20	0.89	4.4 ***
Number of plots	4.81	4.90	4.41	16.55 ***	4.91	4.57	8.77 ***	4.89	4.18	15.39 ***
Accessed FISP (yes =1)	0.58	0.58	0.61	-4.24 ***	0.58	0.62	-4.01 ***	0.57	0.59	-1.54
Accessed com. fertilizer (yes =1)	0.89	0.89	0.90	-3.47 ***	0.95	0.96	-3.35 ***	0.84	0.82	2.2 **
Top dressing fertilizer (kg)	47.89	46.20	56.24	-6.61 ***	127.87	123.24	1.5	28.30	30.16	-1.25
Basal dressing fertilizer (kg)	47.79	46.08	56.25	-6.64 ***	127.00	124.87	0.68	28.39	30.19	-1.2
Kgs of seed used	17.30	17.64	15.82	6.23 ***	17.69	15.88	5.19 ***	17.61	15.73	3.86 ***
Accessed credit (yes=1)	0.23	0.23	0.23	0.7	0.24	0.22	2.3 **	0.23	0.25	-1.6
Credit amount (ZMW) [credit > 0]	894.05	698.02	1743.02	-4.89 ***	979.40	1059.46	-0.8	462.99	2587.48	-5.06 ***
Plot with title (yes=1)	0.08	0.08	0.07	0.96	0.05	0.05	-1.18	0.10	0.11	-0.52
Tillage before rains (yes=1)	0.19	0.18	0.20	-2.39 **	0.24	0.24	0.58	0.13	0.14	-0.36
Applied manure (yes = 1)	0.05	0.04	0.05	-2.59 ***	0.06	0.07	-1.4	0.03	0.03	-0.2
Applied lime (yes = 1)	0.00	0.00	0.01	-1.06	0.00	0.01	-0.91	0.00	0.01	-0.82
Education level head	5.98	6.01	5.84	3.1 ***	5.92	5.77	2.02 **	6.08	5.94	1.75 *
Adult equivalent	4.82	4.82	4.81	0.42	4.98	5.01	-0.61	4.68	4.52	3.45 ***
Number of prime age adults	2.98	2.97	3.01	-1.33	3.17	3.18	-0.25	2.81	2.76	1.45
Age household head	46.73	46.62	47.18	-2.64 ***	48.14	48.65	-1.84 *	45.39	45.11	0.86
Married household head (yes =1)	0.78	0.78	0.76	2.7 ***	0.71	0.73	-2.26 **	0.83	0.81	3.4 ***
Bunding tillage (yes=1)	0.06	0.06	0.05	3.66 ***	0.02	0.02	0.72	0.09	0.09	0.8
Ridging tillage (yes=1)	0.29	0.29	0.31	-2.68 ***	0.32	0.34	-2.32 **	0.27	0.26	0.38
Plowing tillage (yes=1)	0.26	0.26	0.26	-0.64	0.29	0.29	-0.19	0.22	0.21	1.65 *
Mounding tillage (yes=1)	0.02	0.02	0.02	-0.21	0.01	0.01	-0.97	0.03	0.03	-1.13
Zero tillage (yes=1)	0.02	0.02	0.02	0.01	0.03	0.03	1.7 *	0.01	0.01	0.07
Hand Hoe tillage (yes=1)	0.32	0.32	0.31	1.93 *	0.27	0.26	1.4	0.37	0.39	-1.68 *

Annex Table 1 Cont

Basins tillage (yes=1)	0.01	0.01	0.01	-0.48	0.02	0.02	0.82	0.01	0.01	0.38
Ripping tillage (yes=1)	0.02	0.01	0.02	-1.5	0.02	0.02	0.52	0.01	0.01	-1.51
HH wealth index from PCA	-0.05	-0.03	-0.12	2.99 ***	-0.04	-0.13	2.11 **	-0.03	-0.11	1.99 **
Member to farmer group, coop (yes = 1)	0.51	0.51	0.49	2.59 ***	0.54	0.52	2.24 **	0.49	0.45	3.09 ***

Source: CSO/MoA/IAPRI RALS 2012 and 2015

Notes: ***, **, * imply statistically significant t-test (T-stat) at 1%, 5% and 10% respectively (these are unweighted); the table also includes access to commercial and FISP fertilizer, and credit amount that are not used in the estimations later. N=32,463, with 16,973 and 15, 490 plots 2012 and 2015, respectively owned by 14,508 households. (The average number of plots per household is 2.24).

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