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Does the Landowner's Gender Affect Self-Cultivation and Farm Productivity? An Analysis for India

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ABSTRACT *Land ownership has long been argued to enhance farm productivity by improving tenure security. But would this hold for female and male owners alike? The relationship between land ownership and productivity has been investigated relatively little from a gender perspective in most regions, with work on Asia being especially sparse. Even less explored are gender differences in the likelihood of landowners self-cultivating as vs. leasing out their land. This paper uses a unique household-level dataset for nine states of India to first assess gender differences in the likelihood of landowners self-cultivating or renting out their land. It then analyses differences in farm productivity between female and male owners who self-cultivate. The effect of caste disadvantage is also explored. We find that women owners are significantly less likely than male owners to self-cultivate their land. This is linked especially to family labour constraints and regional opportunities. However, among those who do self-cultivate, the annual farm productivity per hectare does not differ significantly by the gender of the owner-cultivator. This holds true with or without controlling for other factors. Caste matters, however: Scheduled Caste owner-cultivators of both genders have significantly lower productivity than upper-caste ones.*

KEYWORDS: Gender differences; land ownership; farm productivity; leasing out; caste; India

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1. Introduction

In 2011, the Food and Agriculture Organization's (FAO) *State of Food and Agriculture* Report focused particular attention on the relative productivity of male and female farmers, arguing that reducing the production constraints faced by women could help raise their farm yields by 20–30 per cent and agricultural output in developing countries by 2.4–4.0 per cent (FAO, 2011).

This focus on the productivity potential of women farmers is of central importance since it has implications for the income and food security of rural women and their families; for the efficient use of land, a scarce productive resource; and for a country's agricultural growth, as agriculture gets increasingly feminised, worldwide (Agarwal, 2014).

However, studies on the gender gap in farm productivity and factors underlying the gap are relatively few, and those for Asia are exceedingly sparse. The 2011 FAO report drew on 24 empirical studies, 22 relating to Sub-Saharan Africa and two to Asia. Further work since then gave us 30 studies to date, but the vast majority were still on Africa, covering 14 countries, and only six were on Asia, covering five countries.[1] Moreover, even for Africa, only nine studies had land ownership data by gender which could help asses productivity differences by gendered ownership,[2] with most of them treating land ownership as an incidental variable.[3] In Asia, only one study – that by Shandal, Mohapatra, and Veettil (2022) for India – has examined the productivity effect of women *owning* land, and even this is based on problematic assumptions discussed later. This leaves a notable research gap for Asia.

Ownership is expected to confer tenure security. However, tenure security itself is a complex issue, since the nature of land rights can vary from full rights of management, use and alienation, to subsets of rights (Schlager & Ostrom, 1992). We would expect a formal title to confer the strongest security, bringing with it the entire gamut of rights, including of alienation. To a lesser extent, security can be conferred through land certification and registration which could provide, say, usufruct rights, without the right of alienation, as undertaken in Ethiopia and Vietnam (Bezabih, Holden, & Mannberg, 2012; Cantu & Morando, 2020; Deininger, Ali, & Alemu, 2011; Holden, Deininger, & Ghebru, 2011). But strong legal rights supported by a social recognition of claims can also confer security to an extent, even if the land is not registered formally in individual names. For example, coparcenary joint family property in India is legally recognised as jointly owned across generations, even when it has not been partitioned individually (Agarwal, 1994; Agarwal, Anthwal, & Mahesh, 2021). Moreover, there can be gender differences in *perceptions* of tenure security: a recent review for 33 countries found that men were more likely to feel insecure due to external factors, such as a risk of government expropriation, while women were more likely to feel insecure because of intra-family dynamics and limits on their duration of tenure (Feyertag, Childress, Langdown, Locke, & Nizalov, 2021).

Tenure security, in turn, can have other implications. It has long been argued globally, for instance, that owning the land a farmer cultivates, especially if s/he holds the title, can increase farm productivity through at least two routes: (i) enhancing the incentive to make long-term investments in the land, and (ii) improving access to financial and non-financial inputs. Ownership, for example, is found to be linked to farmers investing in improving soil quality, terracing, bunding, creating irrigation channels, purchasing irrigation equipment, fallowing, and so on (Deininger & Chamorro, 2004; Deininger & Jin, 2006; Fort, 2007; Goldstein & Udry, 2008; Ma, 2013; Maravi & Navarro, 2019; Schweigert, 2006). Similarly, having a land title can improve access to credit, in terms of sources, amounts and terms, since land can serve as collateral (Binswanger, 1986), although the possibilities vary by context (Deininger & Feder, 2009). Owner-cultivators also typically have better access than tenants to technical information via agricultural extension agents (Sugden, 2010). Moreover, government subsidies tend to be directed to owners rather than lessor-cultivators, especially where leases are oral and lessors cannot provide documents to prove that they are the actual cultivators (Agarwal, 2018).

Although most studies on the benefits of tenure security via land ownership lack a gender analysis, some existing work points in that direction, through observing the negative effects of women's lack of land ownership or the positive effects of strengthening their rights. The absence of titles, for example, is found to reduce women's access to credit and agricultural extension (Saito, Mekonnen, & Spurling, 1994) as also government subsidies (Agarwal, 2018; Sugden et al., 2021). Women usually need to be landowners to capture the attention of extension agents and gain information for adopting new technologies (Meinzen-Dick et al., 2011). On the positive side, some Africa-related studies point to women's improved access to informal credit and other outcomes via land certification (Persha, Greif, & Huntington, 2017).

Of course, even with titles women can face hurdles. Improving land quality, for instance, may require supplementary finances and command over labour, especially male labour, that women farmers often lack. Similarly, women's access to extension services and technical training tends to be limited in conservative cultures in the absence of female extension agents, due to social norms that discourage male–female public interactions (Berger, DeLancey, & Mellencamp, 1984; FAO, 2011). And to use land as collateral for credit women may have to negotiate with male family members. In other words, while we expect owning land to enhance women's productivity, there can still be gendered barriers to realising the full benefits of ownership. These subtle gender constraints are difficult to capture quantitatively, but need to be kept in mind when interpreting the results, as we have sought to do. A second qualifier is that women owners, due to production constraints, may simply lease out their land rather than self-cultivate it.[4] This gendered aspect of land use has been little examined in the Indian context, and studies for other regions are also few.[5]

Overall, therefore, empirical work on gender differences in agricultural productivity in Asia (as opposed to Sub-Saharan Africa) is extremely scarce, and that on differences in productivity, or in decisions to self-cultivate by the landowner's gender, is ever scarcer.

Data limitations are one factor contributing to this regional research gap, but another factor is the joint nature of cultivation in Asia, where all family members typically work on all family plots, which makes gender comparisons difficult, whereas in Sub-Saharan Africa women often cultivate separate plots. Of the two India studies, Mahajan (2019) examines gender differentials in farm productivity between women and men as farm managers but not as owners, while Shandal et al. (2022) do focus on ownership, but the analysis is for one crop, rice, in four states; and some of their assumptions, such as spouses within the same household managing their plots separately, are problematic (see Section 2). In the Indian context, it is also important to factor in caste hierarchies.

Our paper breaks new ground in all these respects. It uses a unique dataset collected by the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) to examine farm productivity, by taking into account the landowner's gender. It also demarcates the effect of caste and regional differences (since the data cover nine states). Moreover, there is a logical sequence to land use, with landowners first deciding whether to self-cultivate or lease out their land, and then making production decisions if they decide to cultivate. We therefore first examine gender differences in the likelihood of owners self-cultivating and then compare productivity differences between female and male owner-cultivators. Hence, although the ICRISAT sample is not representative of the whole country, it enables us to cover key aspects that remain unexplored by earlier studies.

Section 2 below discusses past studies and gives details of the data we have used. Section 3 explores the characteristics of self-cultivators vs. lessors by gender, and possible factors underlying the likelihood of landowners self-cultivating, using logistic regressions. Section 4 then describes the characteristics of owner-cultivators, the inputs they use, and their patterns of decision-making in production. Section 5 presents the model and regression results for our productivity analysis, and Section 6 contains concluding comments.

2. Past studies and current data used

2.1. Past studies

We found only two studies – by Holden et al. (2011) for Ethiopia, and Cantu and Morando (2020) for Vietnam – on the likelihood by self-cultivating vs leasing out the land by the landowner's gender. Both studies focus on land certification, which, they find, increases the ability of female household heads to lease out their land. The studies also highlight the disadvantage women face in accessing labour and capital which can compel them to lease out rather than self-cultivate.

The vast majority of studies, however, focus on differences in agricultural productivity between male and female cultivators – whether or not they own the land – and relate predominantly to Sub-Saharan Africa. Their results vary: some find significant differences in productivity between male-managed and female-managed plots. The differences disappear or decline after controlling for other factors, especially input use. Other studies find no significant gender differences in productivity. Most of these studies focus on the gender of the farm manager (or presume that the household head is the manager). Of the nine studies we located which took into account whether the farm managers were also landowners, four found no significant productivity difference attributable to the landowner's gender (Aguilar, Carranza, Goldstein, Kilic, & Oseni, 2015; Kilic, Palacios-Lopez, and Goldstein, 2015; Palacios-López & López, 2015; Quisumbing, Payongayong, Aidoo, & Otsuka, 2001); two noted a positive effect of owning land for male farm managers but an insignificant effect for women (Backiny-Yetna & McGee, 2015; Saito et al., 1994); and three found lower productivity in female-owned plots/farms (Alene et al., 2008; Peterman, Quisumbing, Behrman, & Nkonya, 2011; Gebre, Isoda, Rahut, Amekawa, and Nomura, 2021).

Among the six Asia-related studies, again, five focused on the gender of the manager rather than the owner. Of these, two (for China and Nepal) found no significant differences between male- and female-managed farms (Thapa, 2008; Zhang, de Brauw, & Rozelle, 2004), one (for the Philippines) found lower productivity among female-managed farms (Mishra, Khanal, & Mohanty, 2017), and two – for South Korea and India – observed mixed effects: Jamison and Lau (1982), who studied South Korea, found no significant difference for non-mechanised farms but higher productivity under male management in mechanised farms, while Mahajan (2019), on India, found significantly lower productivity but no significant difference in profitability between female-managed and male-managed farms. Notably, too, the China and South Korea papers only measure the effect of the gender of the household head.

Shandal et al.'s (2022) study for India is the only one in Asia that compares productivity by gendered land ownership. They compare female-owned and male-owned rice plots within the same household and find that women's plots have lower yields compared to their spouse's plots, after controlling for some attributes but not controlling for inputs such as fertilisers, pesticides, or labour. The authors do not provide information on actual decision-making but mention that 'women decision makers are identified through land titles that give them sole ownership over the plot of land that is farmed'. This suggests that owners are *assumed* to be the main decision-makers, and plot-management is assumed to be individual rather than joint within the same household. This is contrary to our findings that there is considerable joint gender decision-making, with a fair degree of participation by non-owners within both male landowner and female landowner households (see Section 4.2). In addition, our follow-up discussion in March 2022 with one of the authors of the Shandal et al. paper points to the need to qualify their findings on some counts: (a) owners were identified largely on the basis of self-reporting and not, as indicated, by comprehensively checking their titles; and (b) households with only female owners or only male owners were excluded, as were co-owned plots. Different-sex siblings also appear to have been excluded, since the paper only mentions comparisons between spouses. These selections could have biased their results.

Most importantly, as noted earlier, in Indian farms, spouses living together do not normally manage their plots separately (see also Mahajan, 2019). Also, Shandal et al. focus specifically

on rice. This is a crop in which women are found in other studies to be specially disadvantaged, due to their lack of access to good quality paddy land (Agarwal, 2018). Moreover, in measuring productivity, what also matters is the annual value of output per hectare: cultivators whose land is less suited to foodcrops can make up by growing more commercial crops (Agarwal, 2018). A focus on one crop obscures this possibility.

Many unaddressed questions thus remain on the effect of gendered land ownership on farm productivity. Our study fills many of these gaps. It also captures the effect of region and caste.

2.1. Data

We use the Village Dynamics in South Asia (VDSA) data collected by ICRISAT in India. This dataset covers eight states for 2010–2013. Subsequently, Andhra Pradesh state was bifurcated into Telangana and Andhra Pradesh, giving us 9 states in 2014. Detailed gender-wise information on land owned was collected specifically for this period, based on directed funding received by ICRISAT.

We focus on 2014, the latest year for which these data were available and which also had the largest number of female landowners. It covers 30 villages located in 15 districts of the nine states: Andhra Pradesh 'new',[6] Telangana and Karnataka in south India; Gujarat, Maharashtra and Madhya Pradesh in western and central India; and Bihar, Jharkhand and Odisha in eastern India. ICRISAT selected the original states (some go back to the 1970s) based on agro-ecological conditions. Within each state the selected districts cover different agro-ecological zones, and within each district two villages were selected randomly, subject to replacement if certain criteria were not met. Forty households were selected in each village, with a slightly larger number in three districts (http://vdsa.icrisat.ac.in/vdsa-desgImplementation.aspx). Thirty of those households were of cultivators, stratified into three categories by size of land owned, and 10 households were of agricultural labourers (Singh, Binswanger, & Jodha, 1985; Rao, Chand, Kiresur, & Bantilan, 2011).

The land ownership data for 2014 enables us to identify individually-owned and jointly-owned plots by gender; gender differences in the amount and quality of land owned; and the demographic characteristics of landowners. The landowner is the person so reported by the (typically male) respondent; land registration information was not collected (personal communication ICRISAT staff). Asset data were collected annually but production data were collected every 3–4 weeks by investigators living in the village (Rao, Chand, Kiresur, & Bantilan, 2011).[7] The ICRISAT staff we consulted also indicated that input data are not always plot-specific, since farmers often report average input use across plots growing the same crop. Hence, aggregating input use by household rather than per plot was deemed advisable.[8]

For our analysis, we merged the ownership and production data. This is the first time that India's ICRISAT data have been used for tracing the impact of women's land ownership on farm productivity, although this data source has been used widely for other agricultural analysis (Mullen, 2016). We also built on Agarwal et al.'s (2021) work based on the same dataset. They measured the gender gap in ownership of landed property. We examine differences between the male and female landowners so identified, in their decisions to self-cultivate and the relative productivity of those that do so.

Among the 1114 landowning rural households across the nine states studied by Agarwal et al. (2021), 1025 (92%) had single-sex owners: 89 had only female owners and 936 had only male owners, while a few had more than one female or male owner. The remaining 89 households had owners of both sexes, many with women co-owning plots with spouses, sons, or siblings, and some with both women and men owning separate plots within the household. It is not possible to separate gender effects on co-owned plots. Moreover, in Asian farming systems, as noted, women's and men's plots in the same household are not usually managed as distinct entities in terms of input acquisition or other decisions (see also, Mahajan, 2019).[9] Hence, to better assess the effect of the landowner's gender on productivity, we compare households with

only female landowners and those with only male landowners, omitting the 8 per cent of households with owners or co-owners of both sexes. Some of these households also had incomplete production data.

Of the 1025 landowning households with single sex owners in 2014, we found complete data on land use for 937. Of these, 93 were leasing out their land and 10 were growing only perennial crops, leaving 834 that were growing annual crops (Table 1). Notably, 69 per cent of the female landowner households relative to 91 per cent of the male landowner households were self-cultivating annual crops. Hence 31 per cent of the female owners were leasing out their land relative to only 9 per cent of the male owners. The decision to lease out one's own land can also indicate female disadvantage in terms of the production constraints they face.

To understand the factors underlying these gender differences in land use we probed further, comparing self-cultivators with lessors-out. We then focused on the 834 self-cultivating households (56 with female owners and 778 with male owners) for our productivity analysis.

Table 1. Household land use by gender of landowners.

	All landowner households		Female landowner households		Male landowner households	
Land use	No.	%	No.	%	No.	%
Total self-cultivators	834	89.01	56	69.14	778	90.89
• Self-cultivating all own land	811	86.55	54	66.67	757	88.43
• Self-cultivating part of own land plus leased-in land; leasing out part of own land	23	2.45	2	2.47	21	2.45
Total leasing out all land	93	9.93	25[b]	30.86	68	7.94
• Leasing out all owned land	62	6.62	21	25.93	41	4.79
• Leasing out part of owned land and leaving rest fallow	31	3.31	4	4.94	27	3.15
Growing only perennials[a]	10	1.07	0	0.00	10	1.17
Complete information	937	100.0	81	100.0	856	100.0
Incomplete information	88	–	8	–	80	–
Total owners	**1025**		**89**		**936**	

Notes: [a]Perennials include tree crops such as coconut, sugarcane and fruit trees. [b]17 are in the south, 7 in the east, and 1 in the west + central region.

3. Self-cultivation versus leasing out

Gender differences between landowners can come into play in decisions on whether to cultivate the land oneself, lease it out, or keep it fallow. What underlies this decision? We can only capture the supply side factors, since our data do not cover the demand side of the rental market.

3.1. Characteristics of owner-cultivators and lessors

Potentially, several types of factors can impinge on the decision to self-cultivate or lease out. (i) Land-related factors, such as area owned and whether it is irrigated. (ii) Labour concerns, such as the availability of family labour, especially male. (iii) Owner characteristics, such as their age, literacy, marital status (older people and widows tend to be more challenged), and caste.[10] (iv) Regional location which can affect social norms and demand for leased land.

On most counts, women self-cultivators and lessors-out are largely similar, as in age, literacy and marital status (over 80 per cent are widows),[11] while differences in the

amount of land owned or the percentage owning irrigation pumps are not statistically significant by the *t*-tests (Table 2). The notable differences lie in access to family labour and regional location. Women leasing out, for example, have fewer family members aged ≥15: in fact, 32 per cent have no males aged 15 or above in their household, relative to only 5 per cent of the self-cultivators. In addition, lessors are located substantially in the southern states.

Among male landowners, differences between self-cultivators and lessors are more pronounced. Those leasing out are more likely to be older, literate, and upper-caste, and have fewer family members aged ≥15. They are also less likely to own an irrigation machine. These factors are examined further in our regression analysis.

3.2. Regression model

To compare self-cultivating households with those leasing out, we ran logistic regressions. Equation 1, as specified below, relates to the pooled sample. In addition, we computed separate equations (Equations 1a and 1b in Table 3) for female and male landowner households, using the same specification as in Equation 1, except for omitting the gender dummy.

$$d_{self-c} = \beta_0 + \beta_1 d_{gowner} + \beta_2 X_{land} + \beta_3 X_{irr} + \beta_4 d_{irrM} + \beta_5 X_{HH\ persons} + \beta_6 X_{age} + \beta_7 d_{lit} + \beta_8 d_{uc} + \beta_9 d_{obc} + \beta_{10} d_{south} + \varepsilon \quad (1)$$

Where $d_{self\text{-}c}$ = cultivating dummy (self-cultivating household = 1, leasing out = 0)
d_{gowner} = gender of landowner dummy (female landowner household = 1)
X_{land} = area owned (ha)
X_{irr} = percentage area owned that is irrigable
d_{irrM} = dummy for irrigation machinery owned (if owned = 1)
HH persons = number of persons in the household ≥15 years of age
X_{age} = age of landowner in years
d_{lit} = dummy for literacy (if owner is literate = 1)
d_{uc}, d_{obc} = caste dummies (uc = upper caste; obc = other backward classes; reference category is scheduled caste (SC))
d_{south} = regional dummy (south = 1, other regions = 0)

We have not included marital status, given the very few married women landowners, and (similarly) the very few widowed male landowners. Regionally, 68 per cent of female owners who leased out their land were located in south India with only one case in west + central India. We therefore clubbed the non-southern states to create one regional dummy, as the reference category. In all the equations, robust standard errors clustered at the village level were computed.

We recognise the limitations of small sample size in the regressions relating to women landowners. However, they help supplement the results of our pooled sample. Also we conducted additional verification tests.[12]

3.3. Regression results

Overall, for all landowning households pooled together, the marginal effects (ME) show that the probability of women landowners self-cultivating their land is 16.5 percentage points lower than for male owners (Table 3, Equation 1; for descriptive statistics see Table SM1 in the supplementary material online). In fact, gender is the most important factor explaining leasing out, along with regional location. Landowner households based in the south are 11.4 percentage points less likely to self-cultivate that those in other regions. In addition, lessors are more likely

Table 2. Self-cultivators versus lessors: characteristics.

Characteristics	All landowner households			Female landowner households			Male landowner households			Comparing F and M self-cultivators
	Self-cultivate (834)	Lease out (93)	*t*-Values col. 1–2	Self-cultivate (56)	Lease out (25)	*t*-Values col. 4–5	Self-cultivate (778)	Lease out (68)	*t*-Values col. 7–8	*t*-Values col. 4–7
Column number	1	2	3	4	5	6	7	8	9	10
Land owned (ha)										
All castes land owned	1.66	1.94	−1.14	1.44	1.74	−0.42	1.68	2.01	−1.23	−0.82
• Upper-caste	2.11	2.18	−0.15	1.74	1.96	−0.28	2.13	2.23	−0.20	−0.48
• OBC	1.75	3.16	−2.26**	2.44	5.38	−0.89	1.72	2.57	−0.40	0.16
• SC and others	1.32	1.21	0.45	0.85	0.69	0.96	1.37	1.49	−0.37	−1.75*
Irrigation										
% owned area irrigable[a]	51.33	54.65	−0.70	47.6	41.40	0.56	51.59	59.52	−1.47	−0.67
% Own irrigation machine[b]	51.20	33.33	3.28***	28.57	36.00	−0.66	52.83	32.35	3.26**	−3.53***
Demographic features										
Age of owner (years) [c]	51.79	55.38	−2.59**	52.29	52.64	−0.13	51.76	56.38	−2.86**	0.30
% literate[c]	70.14	70.97	−0.16	37.50	36.00	0.13	72.49	83.82	−2.03**	−5.62***
Marital status dummy (widowed or single = 1)[d]	10.19	31.18	−5.95***	80.36	84.00	−0.38	5.14	11.76	−2.27**	22.93***
Number of household members ≥ 15 years	4.14	3.35	3.98***	3.93	2.40	3.66***	4.15	3.71	1.97**	−0.91
Number of male members ≥ 15 years	2.13	1.59	4.64***	1.66	0.76	3.70***	2.17	1.90	2.02**	−3.44***
% HHs with no male members ≥ 15 years	0.36	8.60	−7.14***	5.36	32.0	−3.42***	0.00	0.00	0.00	6.63***
% Upper-caste	23.26	34.40	−2.38**	17.86	24.00	−0.64	23.65	38.24	−2.68**	−0.99
% OBC	36.93	20.43	3.17***	26.79	16.00	1.05	37.66	22.06	2.57**	−1.63
% SC and others	39.81	45.16	−1.00	55.36	60.00	−0.38	38.69	39.70	−0.16	2.47**
Regional location										
% in south	20.38	44.08	−5.24***	19.64	68.00	−4.73***	20.44	35.29	−2.86**	−0.14
% in west + central	40.17	18.28	4.15***	32.14	4.00	2.86**	40.74	23.53	2.80**	−1.27
% in east	39.44	37.63	0.34	48.21	28.00	1.71*	38.82	41.18	−0.38	1.39

Notes: *t*-values are taken from *t*-tests of difference in means of specified variables. [a]The irrigable area tends to be higher than the area actually irrigated. [b]The machines include electric or diesel pumps, submersion pumps and drip irrigation equipment. [c]In households with more than one owner, we took these characteristics for the person who was both owner and household head. [d]The female landowners are all widows, while male landowners include widowers and 0.9 per cent unmarried or separated males. Significance: *10 per cent; **5 per cent; ***1 per cent.

to be owners with more land, more irrigable area, older, and literate. In contrast, OBCs are much more likely to self-cultivate than upper castes or scheduled castes, as are those with more family members aged ≥15 and those owning irrigation equipment.

For female landowner households the number of household members aged ≥15 is the most important factor increasing the probability of self-cultivation, apart from being located in the non-southern states. Every additional member aged ≥15 increases the likelihood of self-cultivation by 16.7 percentage points. In other words, access to family labour is key and its absence can be a major constraint. In fact, some 13.6 per cent of the female landowner households have no male members aged ≥15 and most of them are leasing out their land.

Table 3. Likelihood of self-cultivation vs leasing out owned land by gender of landowner, 2014 (logistic regressions, marginal effects).

Dependent variable	Landowning households (dummy: self-cultivator = 1)		
	All landowner households	Female landowner households	Male landowner households
Equation number	1	1a	1b
No of observations	927	81	846
Pseudo R^2	0.1896	0.3656	0.1444
Explanatory variables	**ME**	**ME**	**ME**
Gender of owner (female = 1)	−0.165***	–	–
	(0.006)		
Area owned (ha)	−0.007***	0.008	−0.006***
	(0.001)	(0.556)	(0.001)
% owned area that is irrigable	−0.001***	−0.001	−0.001***
	(0.009)	(0.430)	(0.000)
Irrigation machine owned dummy (machine owned = 1)	0.073***	0.047	0.083***
	(0.001)	(0.743)	(0.000)
Number of HH members aged ≥15	0.016**	0.167***	0.010*
	(0.044)	(0.000)	(0.086)
Age of owner (years)	−0.002**	−0.008*	−0.002**
	(0.012)	(0.054)	(0.012)
Literacy dummy: (owner is literate = 1)	−0.037***	−0.050	−0.036***
	(0.005)	(0.768)	(0.002)
Caste dummy 1: (upper-caste owner = 1	−0.040	−0.343	−0.028
	(0.167)	(0.207)	(0.198)
Caste dummy 2: (OBC owner = 1	0.036**	0.055	0.030**
	(0.012)	(0.525)	(0.030)
Regional dummy: south = 1	−0.114***	−0.465***	−0.074***
	(0.000)	(0.000)	(0.001)

Source: Calculated by the authors from ICRISAT data.
Notes: In all the equations, robust standard errors clustered at the village level are reported. ME: marginal effects. Numbers in brackets are p-values. Significance: *10 per cent; **5 per cent; ***1 per cent.
Differences between included dummies. Caste: In Equations 1 and 1b, OBCs are significantly more likely to self-cultivate than the upper castes (significant at 1 per cent). In Equation 1a the difference is not significant.

Male landowner households, by contrast, follow the same pattern as the pooled sample. They are more likely to lease out when they own more land, especially if irrigable, while owning irrigation pumps has the opposite effect. Leasing out irrigable land may seem surprising, since we would expect farmers to self-cultivate such land. It is likely, however, that the demand side of the land-lease market is playing a role here, with farmers more likely to find lessors for irrigable land, especially in south India where paddy cultivation dominates, and land with irrigation would be in high demand. In any case, the irrigable area variable is tempered by the ownership of irrigation equipment which reduces the likelihood of leasing out. Also older, literate, upper-caste male farmers are less likely to self-cultivate, relative to OBCs: it is possible that non-OBCs have more non-farm income sources, but we lack reliable data to check on this.

The factors that are consistently significant across gender, in terms of the probability of leasing out land, are the family labour constraint, being older, and being based in south India.

Let us now examine if there are productivity differences between the male and female landowners who choose to self-cultivate.

4. Owner-cultivators: characteristics by gender

4.1. Demographic characteristics and farm assets

Do female and male landowner-cultivators differ in their individual and household characteristics? Both sexes in our study are on average around 52 years old but differ starkly on other counts (Table 2, Column 10). The average literacy rate of female owner-cultivators, for example, is almost half that of males; and 80 per cent of the female owner-cultivators are widowed/single, relative to only 5 per cent of the males. Although none of the women owner-cultivators has very young children ($\leq$5 yrs), in general widows can be disadvantaged in farm management due to limited family support from in-laws (Kulkarni, Bhat, Pallavi, & Satpute, 2022).

Relative to male owner-cultivator households, female owner-cultivator households also have fewer persons (and fewer males) aged $\geq$15 who could work on the farm. Socially, the female owner-cultivators are predominantly Scheduled Castes, whilst the male owner-cultivators are more evenly spread across caste groups. The reason for this could lie in the much larger proportion of upper-caste female landowners relative to upper-caste male landowners leasing out their land rather than self-cultivating. SC households also own less land on average relative to other castes.

Ownership of farm implements is another facet of inequality. Women landowner households own fewer farm implements of all types (see Table SM2 online) – as also noted in other countries (FAO, 2011). This makes women farmers more dependent on hired machines than males, for key operations like land preparation, and hiring tractors involves higher transaction costs for women than men (Agarwal, 2018).

4.2. Input use

Labour remains a critical input for all the farms, but there are some observable differences in labour use by the gender of the owner-cultivator (Table 4). In aggregate, female owner-cultivators use more labour time per hectare of gross cropped area (GCA) (585 hrs/ha) than male owner-cultivators (422 hrs/ha), likely reflecting their lower ownership of farm machinery noted above. There are also gender differences in the types of labour used. Overall, women owner-cultivators use a larger proportion of female labour time than male owner-cultivators. They are also much more dependent on exchange labour (especially female exchange labour),[13] as well as female family labour, rather than on hired labour (see details in Table SM3 online).

Table 4. Output produced and inputs used in landowner cultivator households.

Variable	Cultivator households (HHs)			*t*-Values (of diff in means)
	All owner HHs	Female owner HHs	Male owner HHs	Female minus male owner HHs
Column	1	2	3	4 = 2 − 3
No of observations	834	56	778	
Total value of output /GCA (Rs/ha)	49,003.15	51,963.46	48,790.06	0.40
GCA per ha	1.97	1.97	1.97	0.01
• GCA/ha range	0.008–56.66	0.06–34.80	0.008–56.66	
Value of fertiliser/GCA (Rs/ha)	6340.17	8063.80	6216.10	2.04**
Value of pesticide/GCA(Rs/ha)	885.83	690.50	899.89	−0.75
Labour hrs/GCA	432.97	584.96	422.03	2.61**
Tractor use/GCA (in value terms: Rs/ha)[a]	3447.26	3714.40	3428.03	0.70
% GCA irrigated area	28.14	29.77	28.03	0.34
% GCA with non-problem soil	95.22	92.28	95.43	−1.21
% GCA under food grains	74.10	77.89	73.82	0.81

Notes: GCA: gross cropped area; HH: household. [a]Information on tractor hours was not collected consistently across regions, so we used the value of tractor time which was available for all regions. Significance: **5 per cent.

On inputs other than labour, Table 4 gives the values of the different inputs used by female and male owner-cultivator households. The only significant difference is the higher expenditure on fertiliser used/GCA by female cultivators. Although almost no women cultivators own tractors or power tillers, they hire the machines, so we see little difference in tractor use/GCA by the gender of the owner-cultivator.

These comparisons do not, however, capture the transaction cost of hiring machines or procuring inputs that women in general and SC women in particular can face. Agarwal's (2020, 2018) research on SC women farming in female-only groups in Telangana state, is illustrative:

> We don't get tractors, fertilisers and pesticides in time. Those who lease out tractors for ploughing only come to our land after completing the work of the big farmers. (Women's group farm members, Mahbubnagar district: Agarwal, 2020:19)

> Yes we have a problem in getting good quality seeds. To some extent, the whole village faces this problem, but women face it more. Moreover, for getting one bag of fertiliser we have to queue up in long lines for an entire day, and that is very difficult for women. (Women's group farm members, Karimnagar district: Agarwal, 2018, p. 62)

Timely completion of operations, especially land preparation, can affect productivity. Also given women's domestic work responsibilities, standing in long lines to procure inputs stretches their work day. This is usually an invisible cost, however, that may not affect actual input use.

Overall, observed gender differences in personal characteristics and access to some key inputs point to an unequal playing field for women owner-cultivators. Yet, this may not show up in productivity differences with male owner-cultivators, since some of the gender disadvantage can be overcome by the presence of male support (virtually all the female owner-cultivators have family males aged $\geq$15), and some costs, such as standing in line for procuring inputs, tend to remain hidden.

4.3. Decision making

Farm productivity also depends on management decisions. Most studies assume that the household heads are the main decision-makers in farm-related matters and are therefore the farm managers. In reality, ownership and headship may not overlap, and farm decision making is complex. Typically datasets fail to capture joint decision-making, possibly due to a prior assumption that decisions are made mainly by one person. For example, the Indian Human Development Survey used by Mahajan (2019) only asks one question: 'Who is the primary decision maker about farm matters in your house?' Joint decision-making cannot be identified on this basis.

In our sample of cultivating households, 99 per cent of male landowners and 82 per cent of women landowners are also household heads. But are they necessarily making all or most of the farm decisions? The ICRISAT data on decision making simply tell us if the decision maker is male or female but not whether the person is the landowner or the household head. This could well reflect reality, in that decision-making can be diffused between and across genders. We mapped the gender of the decision maker by household land ownership on five input-related decisions for which there were data and found that the main decision makers varied by type of input (Table 5).

Labour-related decisions were made jointly by both women and men in 58–60 per cent of both female and male owner-cultivator households. For other inputs, in male owner households decisions were made by men alone or jointly with women, but rarely by women alone, while in female owner households, although women alone made decisions in about a quarter of the cases, men were very involved in most cases as joint decision makers or even as sole decision makers.

Hence, it is difficult to categorically identify the principle decision maker for the farm as a whole. What we do know is that in male owner-cultivator households, land ownership, headship, and decision making overlap in very large part, but in female owner-cultivator households, although ownership and headship largely overlap, decision making is more gender-diverse.

We therefore created a dummy for households where the landowner was not involved in even one of the five decisions. There were only 11 such cases (seven for female owner households, four for male owner households). Given the small numbers, we did not use this variable in our main regression analysis, but have provided the runs as supplementary material for illustration.

5. Gender differences in productivity

Without controlling for input use or other factors, we find no significant difference in output per hectare of gross cropped area (GCA) between female and male owner-cultivators (see *t*-tests in Table 4).

Does this change when we control for inputs used, the cultivator's characteristics, and the household's regional location?

5.1. Regression model

We computed three productivity equations. To deal with any potential selection bias in terms of who self-cultivates, we extracted predicted values (for self-cultivating vs. leasing out) from our logistic regression in Table 3, and used these propensity scores in our productivity equations.[14]

Equation 2, as specified below, relates to the pooled sample of all landowning cultivator households, while Equations 2a and 2b in Table 6 relate respectively to only female owner-cultivator households, and only male owner-cultivator households. These separate equations

Table 5. Decision makers by inputs in landowner cultivator households.

	All owner-cultivator HHs (834)			Female owner-cultivator HHs (56)			Male owner-cultivator HHs (778)		
	Who makes the decision for given inputs?[a] Percentages								
Inputs	F	M	B	F	M	B	F	M	B
Fertilisers	3.7	65.2	31.1	23.2	33.9	42.9	2.3	67.5	30.2
	(30)	(528)	(252)	(13)	(19)	(24)	(17)	(509)	(228)
Pesticides	2.4	76.3	21.3	17.3	48.1	34.6	1.3	78.3	20.4
	(19)	(609)	(170)	(9)	(25)	(18)	(10)	(584)	(152)
Seeds	2.7	58.0	39.3	23.2	26.8	50.0	1.2	60.3	38.5
	(22)	(472)	(320)	(13)	(15)	(28)	(9)	(457)	(292)
Hired labour	7.6	31.4	61.1	24.5	17.0	58.5	6.4	32.4	61.2
	(60)	(248)	(483)	(13)	(9)	(31)	(47)	(239)	(452)
Own labour	10.3	29.5	60.1	21.8	20.0	58.2	9.5	30.2	60.3
	(85)	(243)	(495)	(12)	(11)	(32)	(73)	(232)	(463)

Notes: [a]Figures in brackets give the number of cases for which we have information; the percentages relate to these cases. HH: household; F: female only; M: male only; B: both male and female.

have the same specification as Equation 2, except for omitting the gender dummy. The basic unit of analysis is the landowning household.

$$\begin{aligned} log(Y) \;=\; & \beta_0 + \beta_1 d_{gowner} + \sum\nolimits_j \alpha_j log(W_j) + \sum\nolimits_k \gamma_k Z_k + \beta_2 X_{irr} + \beta_3 X_{soil} + \beta_4 X_{fg} \\ & + \beta_5 d_{irrM} + \beta_6 d_{lit} + \beta_7 d_{uc} + \beta_8 d_{obc} + \beta_9 d_{south} + \beta_{10} d_{west+central} + p_s + \varepsilon \end{aligned} \tag{2}$$

Where Y = annual value of output per gross cropped hectare cultivated by the household
d_{gowner} = gender of landowner dummy (female landowner household = 1; male landowner household = 0)
W_j = inputs: gross cropped area (GCA) in hectares, value of fertilisers + manure/GCA, value of pesticides/GCA, labour hrs/GCA, tractor/power-tiller use/GCA (value). Here j connotes the jth input
Z_k = labour type variables: % male labour hours; % hired labour hours. Here k connotes the kth type of labour
X_{irr} = percentage GCA irrigated
X_{soil} = percentage GCA without problem soil[15]
X_{fg} = percentage GCA under food grains
d_{irrM} = dummy for irrigation machine owned (if owned = 1; 0 otherwise)
d_{lit} = dummy for literacy (if landowner is literate = 1; 0 otherwise)
d_{uc}, d_{obc} = caste dummies (caste of the landowner). Reference category = SC and others
d_{south}, $d_{west+central}$ = regional dummies (landowner household location).
Reference category = east
p_s = propensity scores (predicted values taken from the regression runs for self-cultivation vs leasing out).

In all the equations, robust standard errors clustered at the village level are reported.

The dummy for the landowner's gender in Equation 2 helps us assess whether female land ownership makes a difference to overall agricultural productivity, controlling for input use, landowner and household characteristics, and the household's regional location. The separate equations for female and male owner-cultivators then help assess whether the factors that affect farm productivity differ by the landowner's gender. We expect the gender of the landowner to impinge on the cultivator's ease of procuring inputs, hiring labour, as well as exercising command over family labour.

The effect of the landowner's demographic characteristics is assessed using literacy and caste. We tested for age and marital status as well, but these were consistently insignificant across all models and have therefore not been reported in the regression tables.[16] For marital status, as noted, the vast proportion of female landowners are widows and the vast proportion of male landowners are married. In the 'SC and others' caste category, 95 per cent of households are Scheduled Caste, the remaining being largely Scheduled Tribe and Christians. Located in Jharkhand and Orissa, it is likely that the Christians too were formerly from tribal communities.

We use regional dummies to distinguish between households located in south India, west + central India and east India. These regions differ broadly in their local ecology, cropping patterns, extent of agricultural commercialisation (on this, see Agarwal & Agrawal, 2017), as well as gender norms.

5.3. *Productivity results*

Table 6 presents our regression results, while Tables SM4, SM5 and SM6 (all online) provide the descriptive statistics for farm productivity variables. In addition, Table SM7 (online) provides some illustrative results when we include the dummy for no-decision by the owner.

In the pooled sample (Equation 2) in Table 6, our variable of particular interest is the landowner's gender. We find no statistically significant productivity differences between female owner-cultivator and male owner-cultivator households. Several of the input variables are

Table 6. Factors affecting productivity by gender of landowner in landowning cultivator households, 2014.

	Landowner cultivator households		
Dependent variable	All owner-cultivators	Female owner-cultivators	Male owner-cultivators
	Log annual value of output (Rs/ha)		
Equation number	2	2a	2b
No of observations	834	56	778
R^2	0.4706	0.5563	0.4886
Explanatory variables	Coef	Coef	Coef
Gender of owner (dummy: female = 1)	−0.178	–	–
	(0.408)		
Log gross cropped area (ha)	0.038	−0.139	0.055
	(0.388)	(0.514)	(0.183)
Log fertiliser value/GCA (Rs/ha)	0.063*	−0.102	0.070**
	(0.052)	(0.507)	(0.035)
Log pesticide value /GCA (Rs/ha)	0.045	0.175**	0.035
	(0.122)	(0.026)	(0.177)
Log tractor use value /GCA (Rs/ha)	0.040	0.037	0.081†
	(0.111)	(0.577)	(0.103)
Log labour hrs/GCA (hrs/ha)	0.454***	0.594**	0.441***
	(0.000)	(0.023)	(0.000)
% Male labour	0.004	−0.012	0.004
	(0.133)	(0.353)	(0.119)
% Hired labour	−0.001	−0.009	−0.000
	(0.626)	(0.356)	(0.772)
% GCA irrigated	0.002	0.007	0.001
	(0.244)	(0.206)	(0.261)
% GCA without problem soil	0.009*	0.013	0.009*
	(0.088)	(0.127)	(0.057)
% GCA under food grains	− 0.005*	0.009	−0.006**
	(0.079)	(0.220)	(0.027)
Irrigation machine owned dummy (machine owned = 1)	0.205*	0.277	0.204*
	(0.074)	(0.449)	(0.071)
Literacy dummy (owner is literate = 1)	−0.074	−0.065	−0.059
	(0.318)	(0.908)	(0.429)
Upper caste dummy (upper–caste owner = 1)	0.301**	0.942*	0.292**
	(0.025)	(0.063)	(0.027)
OBC dummy (OBC owner = 1)	0.250*	−0.139	0.287**
	(0.059)	(0.681)	(0.027)
Regional dummy 1 (south = 1)	−0.470*	−0.040	−0.466**
	(0.061)	(0.951)	(0.047)
Regional dummy 2 (west + central = 1)	−0.486**	−0.022	−0.490**
	(0.021)	(0.971)	(0.014)
Propensity score	−0.563	0.871	−0.695
	(0.428)	(0.608)	(0.283)
Constant	6.786	4.831	6.997

Notes: Numbers in brackets are *p*-values. Significance: †close to 10 per cent; *10 per cent; **5 per cent; ***1 per cent. In all equations robust standard errors are clustered at the village level. *Reference categories:* For regions: east. For caste: SC and some others.
Differences between included dummies. Regions: No significant productivity difference between west + central and south in any equation. Caste: In Equations 2 and 2b, we found no significant productivity difference between upper castes and OBCs. In Equation 2a, upper castes had higher productivity than OBCs, significant at 5 per cent.

positive but the most notable contributor to output is labour time. A 1 per cent increase in labour time is linked to a 0.45 per cent increase in the annual value of output per hectare. Owning an irrigation machine also increases output.

In addition, and notably, caste matters: upper-caste households have the highest productivity. OBC households follow closely behind. And both do better than SC households. Regionally, the eastern states do better than both the west + central and southern states, but the latter two regions do not differ much from one another.

In the pooled sample, we also tried adding interaction terms between the gender dummy and other variables. These are not presented here, as they did not alter the main results, and only two interaction terms were significant – pesticide use (as also found in Equation 2a) and percentage area under foodgrains.

Among female owner-cultivators (Equation 2a) taken on their own, the input variable of particular note is again labour time (a 1 per cent increase in labour hours per hectare is linked with a 0.59 per cent increase in the annual value of output per hectare), followed by pesticide use. However, it is the caste variables which again warrant comment. Upper-caste women are found to have a notable advantage relative to both OBC and SC women. For example, upper-caste female owner households have a 156 per cent higher annual value of output per hectare than SC female owner households.[17]

The results for the male owner-cultivators (Equation 2b) are very close to the pooled sample, not surprisingly since they constitute a large proportion of the pool. Again the effect of labour use stands out. A 1 per cent increase in labour hours per hectare leads to a 0.44 per cent increase in the annual value of output per hectare. Owning an irrigation machine also provides a significant benefit. Farmers devoting more of their land to foodgrains, however, do worse than those focused more on non-food crops, in keeping with findings in other studies on India (Agarwal, 2018; Mahajan, 2019). And, as with female landowners, caste matters, with upper-caste and OBC male owners doing much better than SCs. Notably too, the non-eastern states perform worse than the eastern states.

The consistently poorer performance of SC households relative to upper-caste ones in all the equations is likely to be linked to several disadvantages faced by the SCs that cannot be measured directly from our data, but for which other studies provide substantial evidence. National-level studies find, for instance, that SCs are discriminated against when seeking agricultural credit from cooperative banks (Kumar, 2013). They also have less access to farm machinery (Agarwal, 2020) and agricultural extension information (Krishna, Aravalath, & Vikraman, 2019), and a narrower range of social networks which reduces timely access to hired labour (Nandi, 2010). These disadvantages act in tandem, in turn affecting agricultural productivity and returns (Rao, 2017).

On all these counts, women from SC households face an additional disadvantage (Agarwal, 2020; Kumar, 2013). As noted earlier, both gender and caste can affect input access, with SC women being worse off than upper-caste ones, as well as relative to men more generally. This is captured in Equation 2a, rather than via the interaction term for gender and caste that we tried (as noted) in Equation 2 of the pooled sample.

Finally a comment is warranted on the dummy variable for no-decisions by the landowner. In the equations for both all-owners and female owners (Table SM7 online), the variable is negatively significant, suggesting that the owner's non-involvement (possibly exclusion) from all five farm-related decisions could adversely affect productivity, although given the small number of cases this is only indicative, while worth examining with other datasets.

6. Concluding comments

Global evidence on gender differences in agricultural productivity is sparse, and most of it relates to the gender of the cultivator rather than that of the landowner. Also, barring a few exceptions, almost the entire body of work on both counts relates to Sub-Saharan Africa.

For Asia, not only are there very few studies on productivity differences by gender, but almost none takes into account the effect of the farmer owning the land cultivated, or the intersectionality of gender and caste. Research on landowners leasing out their land rather than self-cultivating it is even sparser. This paper breaks new ground in covering all these aspects.

Gender emerges as important in decisions to self-cultivate or lease out owned land. Women landowners are significantly more likely to lease out their land than male landowners. This signals gender disadvantage, in that women face more constraints than men in self-cultivation. In particular, the low availability of family labour is significantly and positively related to leasing out. While this affects both female and male landowners, women are found to be more disadvantaged.

Age and location also matter for both genders: older owners, male and female, have a higher tendency to lease out, as do those based in south India. It needs mention, though, that leasing out can also have a positive side. It can improve the economic efficiency of land use if rented to those who can cultivate it more effectively, and it provides the landowner an income source not available to the landless.

Among the landowners who self-cultivate, we find that gender is not a statistically significant factor in explaining differences in farm productivity, with or without controlling for input use and many other characteristics. Caste, however, emerges as important. SC farmers face a substantial disadvantage and have significantly lower per hectare output than upper-caste farmers. This holds for both female and male landowners.

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Data availability statement

The data we use are taken from the 'Village Dynamics in South Asia' database, available online from the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), India. See: http://vdsa.icrisat.ac.in/. Data specifically extracted and prepared by us for this paper can be requested.

Notes

1. The Asia studies are: Jamison and Lau (1982) for the Republic of Korea, Mahajan (2019) and Shandal et al. (2022) for India, Mishra et al. (2017) for the Philippines, Thapa (2008) for Nepal, and Zhang et al. (2004) for China.

2. The nine studies are: Adeleke, Adesiyan, Olaniyi, Adelalu, and Matanmi (2008), Aguilar et al. (2015), Backiny-Yetna and McGee (2015), Gebre, Isoda, Rahut, Amekawa, and Nomura (2021), Kilic, Palacios-Lopez, and Goldstein (2015), Palacios-López and López (2015), Peterman et al. (2011), Quisumbing et al. (2001) and Saito et al. (1994). See also Doss (1999) and Quisumbing (1996) for overviews on some aspects.
3. Tracking how land ownership affects productivity can also be challenging due to differences in reported, documented and effective ownership (Doss, Kovarik, Peterman, Quisumbing, & van den Bold, 2015).
4. Of course, it could also be argued that leasing out has a positive side, since it indicates that women have the freedom to use the land as they want, but in the Indian context women owners tend to prefer self-cultivation where possible, citing food security as a key factor and the transaction costs involved in leasing out (fieldwork by Bina Agarwal in several states; and in Maharashtra by Seema Kulkarni, Forum for Women's Land Rights).
5. These include Holden et al. (2011) for Ethiopia and Cantu and Morando (2018) for Vietnam.
6. We added 'new' to distinguish the bifurcated state from the undivided state with the same name.
7. The instruction manual was not available for the 2009-2014 survey. We thus drew on survey manuals for previous years to glean this information.
8. In 2021–2022, we consulted Dr. Kumar, former Principal Scientist ICRISAT, Hyderabad, who oversaw VDSA data collection in east India for a while; Mr. Khan, senior scientific officer, ICRISAT Hyderabad; and Mr. Sharma, a former chief investigator for this dataset in east India. We thank them for the information provided.
9. Exceptions could include widows cultivating their deceased husband's land, especially if linked to self-help groups (Kulkarni et al., 2022).
10. The division of households into Scheduled Caste (SC), other backward classes (OBC), and upper castes may be subject to small inaccuracies, since some upper caste households tend to declare themselves as being SC or OBC to gain affirmative action privileges promised by the state. One referee suggested using *jatis* instead, but jatis cannot be inferred from anonymised datasets, nor can India's 3000 plus jatis be ranked by their socio-economic status.
11. Having small children (say, under 5) could also constrain female owners, but we found only two such cases. Most were grandmothers.
12. We calculated bootstrapped standard errors to address the issue of small sample size for women owners. We found that a shortage of family labour still remained strongly significant in explaining leasing out, while there was noise on age and region.
13. Exchange labour is labour exchanged between households. Labour exchange units are often calibrated by gender.
14. We also ran the productivity equations using Inverse Mills' Ratios obtained through the Heckman method from the decision to self-cultivate equations (run as probit regressions). The results were similar to those obtained by using propensity scores.
15. ICRISAT identifies 'problem soils' in terms of the soil being acidic, saline, etc.
16. In Equation 2a we also tried adding the gender of the household head, but it was insignificant. We did not attempt this for Equation 2b since there is a high overlap between male landownership and male headship.
17. Calculated as follows: $(e^b - 1) * 100$, where b is the coefficient of the dummy variable.

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