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Changing gender roles in agriculture? Evidence from 20 years of data in Ghana

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Abstract:

Many stylized facts about women in agriculture have been repeated for decades. Did nothing really change? Is some of this conventional wisdom simply maintained over time, or has it always been inaccurate? We use four rounds of cross-sectional data from Ghana to assess some of the facts and to evaluate whether gender patterns have changed over time. We focus on five main themes: land, cropping patterns, market participation, agricultural inputs, and employment. We add to the literature by showing new facts and evidence for more than 20 years. Results show that stylized facts do not always hold, and that some of these 'facts' change over time. We find significant variation in the extent of (changes in) gender discrepancies across themes, different agroecological zones, ethnicities, household types and women's role in the household.

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Many stylized facts about women in agriculture have been repeated for decades. Did nothing really change? Is some of this conventional wisdom simply maintained over time, or has it always been inaccurate? We use four rounds of cross-sectional data from Ghana to assess some of the facts and to evaluate whether gender patterns have changed over time. We focus on five main themes: land, cropping patterns, market participation, agricultural inputs, and employment. We add to the literature by showing new facts and evidence for more than 20 years. Results show that stylized facts do not always hold, and that some of these ‘facts’ change over time. We find significant variation in the extent of (changes in) gender discrepancies across themes, different agroecological zones, ethnicities, household types and women’s role in the household.

1. Introduction

Concerns about gender inequality were already voiced in the 1980s. Still today, these same concerns are expressed with respect to gender differences, women’s access to and control over resources, and women’s empowerment. Hasn’t there been any progress in closing the gender gap in agriculture? Or are common understandings of an (eventually overcome) reality maintained over time?

Several researchers have voiced concerns about the use of stylized but often inaccurate facts about gender, commonly referred to as “gender myths” (e.g. Doss 2014; Doss et al. 2015; Palacios-Lopez et al. 2017). Gender myths are effective in mobilizing for gender action, but are less efficient in tackling the real issue, as they lead to the inability to accurately design and monitor intervention outcomes. Recently, researchers have tried to bridge the evidence gap by underpinning common claims about gender in agriculture with new data (for example the 2015 special issue of *Agricultural Economics*, or some articles in the 2017 special issue of *Food Policy* on myths and facts in African agriculture). They provide insights into prevailing beliefs about gender in agriculture, but they are not able to account for time trends. Yet, gender roles are dynamic and respond to changing economic

circumstances (Doss 2001). Studies based on reliable time data are fundamental to indicate whether reality still corresponds to the common wisdom as well as to inform policy makers about drivers of and obstacles to development (Doss et al. 2015; Christiaensen 2017; Deininger et al. 2017).

The objective of this paper is to revisit five conventional wisdoms about gender in agriculture, and analyze whether ‘facts’ change over time: (i) Women have limited access to land; (ii) Crops can be classified as men’s crops or women’s crops, whereby the former are usually cash and the latter subsistence crops; (iii) Participation in market activities by female farmers is low; (iv) Men have more access to modern agricultural inputs compared to women; and, (v) Rural women’s occupations are mainly limited to unpaid on-farm labor and household work, while men engage in remunerated on- and off-farm activities. We use four rounds of cross-sectional data collected under the Ghana Living Standard Survey (GLSS) and offer a quantitative perspective on changes in gender patterns in agriculture over time, which has been largely absent in previous studies (Doss et al. 2015).

The structure of the paper is as follows. In section two, we discuss five conventional wisdoms about gender and agriculture and relate them to empirical evidence from the existing literature. In section three, we describe the study background. In section four, we present the data, main indicators and methodology used in the study. Section five describes the results, and is followed by a summary and discussion of the results. We end with some concluding remarks.

2. Common wisdoms about gender

Many stylized facts circulate relating to rural women. Based on their prominence in the key literature and ongoing policy debates on the topic of women in rural areas and gender in agriculture, and given the feasibility of the existing data to address these facts, we identified five main themes in which we revisit common wisdoms on gender: land, crop production, crop commercialization, input use, and occupation.

Land

“Women have limited access to land and lose out when land becomes more commercialized.”

Commonly, women's access to land in developing countries is portrayed to be extremely low and insecure (e.g. Lastarria-Cornhiel 1997). Doss et al. (2015) find that women in Africa have less land and land of lower value compared to their male counterparts. Yet considerable variation exists across countries, regions and agroecological zones. Moreover, cultural concepts of property ownership must be clearly understood before making claims about access and disposal of land (Doss et al. 2015; Lambrecht and Asare 2016). Estimates of land held by women alone across 10 SSA countries range between 5 and 23% of total land owned, but can be misleading if not put into the perspective that an average of 39% of all plots are managed jointly by the couple (Doss et al. 2015). In Ghana and Mozambique, around 30% of all agricultural plots are under women's control (De Brauw, 2015; Doss, 2002), and 15% in Kenya (Githinji et al., 2014). Overall, the estimated access to land for women in empirical studies is not nearly as low as the alarming figures often cited by organizations promoting gender targeted interventions (Doss et al., 2015).

Land tenure systems are dynamic and change in response to rural transformation (Lambrecht and Asare, 2016). Overall, land tenure is increasingly individualized and formalized, land markets are rapidly developing, and in many places land has become scarce (Lastarria-Cornhiel 1997, Quisumbing et al. 2001). Such changes possibly affect men's and women's access to land differently, either exacerbating or reducing gender inequalities in access to land. The most commonly held view is that these processes will deteriorate women's access to land and result in transfers of land rights from women to men (e.g. Lastarria-Cornhiel 1997). Yet in a study on Ghana's cocoa-growing region, Quisumbing et al. (2001) find that individualization does not necessarily lead to weaker rights for women. As land tenure systems change over time, and can be expected to continue evolving, there is a need for more substantiated evidence at the national and regional levels whether gender patterns in access to land also change over time, and how.

Crop production

"Crops can be classified as men's crops or women's crops, whereby the former are usually cash and the latter subsistence crops."

Terms such as “men’s crops” and “women’s crops” are frequently used when talking about gender and African agriculture. If there were any distinction, clear patterns of men’s and women’s crops would considerably facilitate gender targeted policymaking and program interventions. By targeting specific crops, programs could easily reach either men or women. Yet, there are many settings where such distinctive gendered cropping patterns do not apply. This has already been shown in literature using older quantitative (Doss 2002) and qualitative data (Carr 2008) from Ghana. Recent evidence from Mozambique and Kenya however, shows that female plot managers grow fewer crops and fewer cash crops (De Brauw, 2015; Githinji et al., 2014).

Studies suggest that gendered cropping patterns change due to changing economic and social circumstances. In some cases, this is to the detriment of women’s participation in agriculture (e.g. Dey 1981, Sanginga et al. 1999). In other cases, an increased female participation and decision making power in agriculture is observed, related to population pressure, degraded agricultural land, and increasingly profitable off-farm employment opportunities that lead to intrahousehold changes in gendered crop control (Saito et al., 1994; Palacios-Lopez et al., 2017). So far, there is little quantitative evidence of changes in gender cropping patterns at national and regional level.

Crop commercialization

“Participation in market activities by female farmers is low.”

It is widely believed that the commercialization of crops is controlled mainly by men. This view is closely related to the belief that men are more likely to grow “cash crops” intended for sale, and women are more likely to grow “food crops”, also called “subsistence crops”, for household consumption (e.g. Lastarria-Cornhiel 1997). Indeed, female plot managers in Mozambique and Kenya were found to grow fewer cash crops than male plot managers (De Brauw, 2015; Githinji et al., 2014). Yet, several studies exist that contradict or nuance these claims. Female farmers in Uganda, Malawi and Tanzania are shown to participate less in market activities, but they tend to sell larger shares of their production conditional on participation (Carletto et al., 2017). Moreover, many crops cannot

be categorized as either cash or subsistence crops, with part of the production being consumed in the household and another part being sold for cash income (Carletto et al. 2017, Doss 2001).

Changes in external or socio-economic factors are expected to change commercialization patterns over time. The literature exploring crop commercialization patterns across women and men, especially over time, is limited.

Input use

“Men have more access to modern agricultural inputs compared to women.”

The gender of the plot owner is often believed to be associated with the uptake of agricultural inputs. Several studies point to men’s and women’s unequal access to inputs as a cause of lower female productivity (Djurfeldt et al., 2013). Various factors have been put forward for influencing women’s access to inputs (Saito et al., 1994; Doss and Morris, 2001). Yet, few studies have put solid figures on gender disaggregated input use and most prevailing beliefs are rooted in studies carried out more than 20 years ago. To the best of our knowledge, only Sheahan and Barrett (2017) make an effort to quantify input use in African countries and cast doubt on the role of gender in determining input adoption.

Occupation

“Rural women’s occupations are limited to unpaid on-farm labor and household work, while men engage in remunerated on- and off-farm activities.”

It is commonly assumed that much of the labor that women provide is unpaid labor on farm and non-farm enterprises in which the income is under the control of their husband or other male family members. Rural women are therefore considered less economically empowered compared to their male counterparts (e.g., Kabeer et al., 2011). However, several case studies indicate that women have widened their involvement in agriculture during the past few decades, either through participation in agricultural wage labor (Maertens and Swinnen, 2012), or through increased responsibilities in agricultural smallholder production, as principal farmers or unremunerated family workers (Katz, 2003; Lastarria-Cornhiel, 2006). This is commonly referred to as the ‘feminization of agriculture’. These trends have been related to broader social changes, such as increasing agricultural trade, the

“casualization” of agricultural work, unprofitable crop production, increasing off-farm income generating opportunities and male migration. Most studies rely on cross-sectional or anecdotal evidence for these statements, but ideally such statements are assessed comparing statistics from the same region over time.

3. Background

Ghana experienced a rapid transformation in the last decades. Poverty has consistently declined over the past 25 years, but inequality between the richer South and the poorer North in the country worsened (McKay et al., 2015). The country urbanized rapidly, and by 2009 more than half of the population lived in the country’s urban areas (Diao et al. 2017).

Women and men in rural Ghana are considered to have different functions in the household and society. Men’s primary task is providing basic necessities for the household, while women are expected to support their husband in this task. Compared to women, men therefore have priority access to agricultural inputs, including land (Lambrecht, 2016). Polygamy is still present, but decreased over the past few decades (Doss, 2005).

Ghana has a variety of ethnic groups and religions influencing traditional beliefs and social norms related to gender (Lentz and Nugent, 2000). A key distinction is between matrilineal and patrilineal ethnic groups. In a matrilineal system, family relations (and hence also family property) follow maternal, rather than paternal, bloodlines. Traditionally, the Akan ethnic groups followed matrilineal inheritance practices. Although customary structures are diminishing in response to modernization, the matrilineal rules are still widely present in rural areas (Quisumbing et al. 2001).

Land

The majority of land in Ghana is under customary tenure. Typically, many people have rights to the same plot of land, but at one point in time cultivation rights are held by only one specific person (Lambrecht and Asare, 2016). Once farmland is allocated to an individual, that individual has control over what is planted, what is harvested, and the crops and income generated on the land (Carr, 2008; Lambrecht and Asare, 2016). Over the past decades, there is an observed increase in individualization of land rights; landholders obtain more continuous claims to the

land, stronger land rights, and more individual decision making power rather than requiring consent of family members or traditional authorities (Otsuka et al., 2003; Quisumbing et al., 2001; Lambrecht and Asare, 2016).

Land tenure systems are relatively similar compared to other West-African countries, and across different ethnic groups. Many women in Ghana cultivate plots separate from men within the same household (Doss 2002). Joint ownership or joint holdings of land by husband and wife is rare (Lambrecht, 2016). Goldstein and Udry (2008) show that women receive lower quality land and are less likely to leave the land fallow to reduce the risk of losing their rights to land.

Crop production and commercialization

Ghana contains three agro-ecological zones: Savannah, Forest and Coast. (Nin-Pratt and McBride 2014). The northern Savannah zone is characterized by a unimodal rainfall distribution with only one growing season. The Forest and Coastal zones are characterized by a bimodal rainfall pattern with a major and a minor growing season (Doss, 2002). Whereas, traditionally, men are more heavily involved in cash crop production, men and women are active in the production and sale of all major crops (Doss, 2002; Carr, 2008). Cropping patterns mainly depend on the socio-economic situation and livelihood strategy of the household rather than a mere distinction according to the gender of the farmer or household head (Carr, 2008).

Input use

The agricultural sector in Ghana is characterized by minimal use of modern purchased inputs (Nin-Pratt and McBride 2014). Government interventions through fertilizer subsidy programs (FSP) were a key element in Ghana's agricultural policy in the 1970s and early 1980s. In 2008, a FSP was reintroduced in an attempt to increase fertilizer use and agricultural production in the country (Banful 2011). Yet, much of the increase in agricultural production over the past years has been attributed to land area expansion, rather than to agricultural intensification (Houssou et al. 2013; Ragasa and Chapoto 2017).

Occupation

Livelihood strategies in rural Ghana are mainly related to agriculture, but are diversifying over time (Davis et al., 2017). The agricultural sector experienced steady growth in the 1990s, albeit at a much slower pace compared to other sectors (McKay et al., 2015). Using data from 1992, 1998 and 2005, Davis et al. (2017) show that income from crop production among rural households in Ghana decreased from on average 66% to 49% of household income. The share of income from wage employment increased from 10% to 12%, but the highest increase is observed in the share of income from non-farm self-employment, from 16% to 26% of household income. Rural poverty is generally higher among agricultural households than nonagricultural households (Diao et al. 2017).

4. Methodology

4.1 Data

GLSS consist of nationally representative cross-sectional data for six time periods. We use the data from the four latest survey rounds - conducted in 1991/1992 (GLSS3), 1998/ 1999 (GLSS4), 2005/2006 (GLSS5) and 2012/2013 (GLSS6)-, which allow for disaggregate analyses at plot and plotholder level. Each GLSS survey round is conducted on a nationwide basis and is nationally representative. We limit the sample to households and individuals in rural areas. Furthermore, we limit the individual-level analyses to an economically active population in the age range of 16 to 65 years.

Our analyses related to plotheholdings, cropping patterns and commercialization rely on the distinction between plots held by men and plots held by women. The questionnaire asks about the main plotholder rather than the owner of an agricultural plot. In Ghana, the majority of the land is still under customary tenure based on use rights rather than ownership of land. Asking for the plotholder is therefore more appropriate than a definition based on plot ownership (Lambrecht and Asare, 2016). This is in line with definitions of plotheholdings used in recent literature on gendered cropping patterns (Doss 2002, De Brauw 2015, Githinji et al., 2014).

4.2 Key indicators

Indicators for each of the five themes are selected based on comparability with characteristics commonly presented in the gender literature, ease of interpretation, and feasibility given the variables present in the dataset.

Land. For each of the four time periods corresponding to the survey rounds, we calculate three indicators: i) The incidence of female and male plottolders among respectively all women and all men in rural areas; ii) The share of plottolders who are women, among all female and male plottolders; and, iii) the mean size of land held by female and male plottolders. These indicators are frequently presented as descriptive statistics in papers on gender and land tenure (e.g. Doss 2002, Doss et al. 2015, Kieran et al. 2015, Kieran et al. 2017).

Crop production. We adopt an approach similar to Doss (2002). A plottolder is considered to be growing a crop if s/he has harvested the crop in the 12 months prior to the interview. First, we calculate the number of different crops cultivated by male and female plottolders in each time period, and test whether this is significantly different. Second, for all crops, we calculate the share of female (male) plottolders who grow a crop i at time t . We test whether the share of female plottolders growing the crop is significantly different from the share of male plottolders growing the crop. Third, we calculate the share of plottolders who grow a crop i at time t who are female and test whether this is significantly different from the total share of plottolders who are female at time t . If the null hypothesis of equality is rejected, we say that the crop is disproportionally grown by either male or female plottolders.

Crop commercialization. We follow Carletto et al. (2017) and construct a Crop Commercialization Index (CCI):

$$CCI_{ijt} = \frac{\text{Gross value of crop } i \text{ sales}_{jt}}{\text{Gross value of crop } i \text{ produced}_{jt}} \quad \text{if } Sales_{ijt} > 0 \quad (1)$$

We restrict the sample to plottolders j who reported any sales of a specific crop i at time t (eq. 1). A CCI close to 0 indicates very little sales, whereas a CCI of 1 occurs when the plottolder commercializes the entire production. The data on harvest and sales in GLSS are recorded for a 12-month period for crops with a single harvest period (i.e. beans, cocoa, coconut, coffee, cotton, groundnut, kenef, maize, millet, rice, rubber, sorghum, sugarcane, and wood), and for a two-week period for crops that are repeatedly harvested (avocado, banana, cassava, cocoyam,

colanut, garden egg, leafy vegetables, mango, oil palm, okra, other fruit, other vegetables, orange, pawpaw, pepper, pineapple, plantain, potato, tomato, onion, and yam). Due to difficulties in aggregating data from these different time records, we calculate two separate aggregate measures for CCI.

Input use. We distinguish six input categories: (1) inorganic fertilizer, (2) pesticides (incl. insecticides, weedicides and fungicides), (3) purchased seeds, (4) hired labor, (5) renting of animals and equipment, and (6) purchased hand tools. A first variable indicates whether the household bought any input or any type of the above inputs. A second variable refers to the monetary value of input spent per acre of land held, conditional on having purchased the inputs. Due to data limitations, input use is calculated only at the household level.

Occupation. We split the primary occupation of individual household members in six categories: (1) agricultural self-employment, (2) agricultural contributing family worker, (3) non-agricultural self-employment, (4) non-agricultural contributing family worker, (5) paid employment, and (6) no work. Paid employment includes both agricultural and non-agricultural wage employment.

To establish a measure of occupational segregation by gender, we use the Duncan Index (Duncan, 1955):

$$D_t = \frac{1}{2} \sum_{k=1}^N |m_{kt} - w_{kt}| \quad (2)$$

where m_{kt} represents the percentage of rural men in occupation k at time t and w_{kt} represents the percentage of rural women in occupation k at time t . The Duncan Index can range from 0 to 1 and measures the relative separation of gender across occupations. A value equal to 0 signifies an even distribution of occupations between men and women, whereas 1 occurs when occupations are completely segregated.

4.3 Multivariate regression analysis

We complement the descriptive analyses with regression analyses. The primary aim is to obtain a more robust understanding of trends over time, across agro-ecological zones, and across women with different roles in the household, rather than to draw causal inferences. We estimate regressions of the following type:

$$KeyIndicator_{jt} = \beta_0 + \beta_1 Female_{jt} + \beta_2 GLSS_t + \beta_3 AEZ + \beta_4 X_{jt} + \Pi_R + \varepsilon_{jt} \quad (3)$$

Where $KeyIndicator_{jt}$ for plotholder j at time t is alternatively the propensity of holding at least one plot (dummy variable), the size of the plot, the number of crops grown, market participation (dummy variable on whether the farmer sells at least one crop), CCI, the propensity to purchase different types of inputs (dummy variable), the amount spent on inputs, as well as the primary employment choice of the plotholder. $Female_{jt}$ is a dummy variable, which is equal to 1 if the plotholder is a woman. $GLSS_t$ are survey round dummies and AEZ are agro-ecological zone dummies. The vector X_{jt} is a set of observable socio-economic characteristics of the plotholder and household of the plotholder (described in section 5.1). The plotholder and household covariates are expected to have a direct effect on the key indicators and are included to reduce potential spurious correlations between the gender of the plotholder and the key outcome indicators of interest. For the regressions on the crop commercialization indicators, we additionally include four non-mutually exclusive dummy variables for growing specific groups of crops. Regional dummies (Π_R) are included, and ε_{jt} is the unobservable error term.

We estimate an ordinary least square model (OLS) for the continuous outcome indicator ‘number of crops grown’. The occupation choice of the plotholder is modeled with a probit model. The remaining regression analyses are estimated as the first or second stage of a Heckman selection model (Cameron and Trivedi 2005). The first step of the Heckman procedure is a probit equation (selection equation), respectively for land holding, market participation and input purchase. In the second step, we estimate linear regression models for respectively land size held, share of crop commercialized and the value of inputs purchased. In addition to the explanatory variables included in equation (3), we add different exclusion restrictions to the selection equation. We use the plotters’ father’s and mother’s occupation in farming as exclusion restriction variable for land holding; the ‘share of other plotters in community that commercialize’ for market participation; and the ‘share of other plotters in community who buy any type of input’ for input purchase.

5. Findings

5.1 Plotholder, household and community characteristics

Socio-demographic characteristics of the plotholders are relatively constant over time (table 1). Throughout the years, about one third of the plotholders are female, and 16-22% are both female and household head. Plotholders are, on average, 42 years old and 59%-74% of them are married. More than half of all respondents did not finalize primary school. Around 30% have completed Junior High school. Only between 2% and 7% of plotholders completed Senior High school or Tertiary education. Barely half of all plotholders belong to the matrilineal ethnic group and the large majority follow a Christian religion. The plotholders' father or mother were farmers in four out of five cases.

[Table 1 here]

Plot cultivating households typically have one to two plotholders. They are headed by women in about one out of five households. Polygamy is encountered in 6% to 10% of all plot cultivating households. While the household size is relatively constant around 3.5 members, household welfare – as measured through the asset index – has increased over time. At community level, around 70% of all plotholders in a community commercialize at least part of their produce and around 90% buy any type of external input, including inorganic fertilizers, pesticides, seeds, labor, animal and equipment, or handtools.

5.2 Key indicators

Land: Figure 1 plots the average share of male and female plotholders in the population, their respective land size and the average share of plotholders that are women. Men are more often plotholders and hold larger acreages of land compared to women. Over time, we find a significant decrease in the incidence of male adults in a rural area with a plot, from 61% to 49%. The incidence of female plotholders remains constant around 25% of all plotholders in the first three survey rounds, but significantly decreases to 21% in GLSS6. The mean plot size held by all plotholders slightly increases between GLSS3 and GLSS5; the increase is significant for both men and women

between GLSS3 and GLSS4, but only significant for men between GLSS4 and GLSS5. Women’s landsize significantly decreases between the last two survey rounds.

[Figure 1 here]

Crop production: Men cultivate on average 1.2 to 1.5 more crops than women (table 2). There are no crops that are exclusively grown on men’s or women’s plots. Most crops are significantly more likely to occur on men’s than on women’s plots throughout the years. The average number of crops per plotholder decreases over time for both men and women, but the gender gap in the number of crops grown remains. The frequency of occurrence of all crops diminishes over time for both men and women, with the exception of cocoa, groundnut, maize, rice, and sorghum, millet.

[Table 2 here]

In figure 2 we show the share of plotholders who grow a crop who are women. No crop is primarily grown by women. When we compare the share of women growing a specific crop with the overall share of female plotholders, we see that most crops are disproportionally grown by men, but these discrepancies slightly decrease over time (15 out of 22 crops in GLSS3 and GLSS4, 12 crops in GLSS6). Cocoa is Ghana’s main agricultural export and cash crop. Although men are slightly more likely to be involved in cocoa production, female plotholders also play an important role.

[Figure 2 here]

Crop commercialization: Table 3 gives an overview of the average market participation and the degree of crop commercialization (CCI) of plotholders. Both male and female farmers regularly sell some of their produce to the market, for both crops with a single harvest (12-month period) and repeatedly harvested crops (2-week period). Male plotholders are more likely than female plotholders to sell some of their produce.

[Table 3 here]

When conditioning on sales, the proportion of produce sold of the single-harvest crop is larger for female than for male farmers, but is not significantly different between men and women for repeatedly harvested crops. Among sellers, female farmers seem to be more commercially oriented for both ‘cash crops’ (cocoa, oil palm) and crops that are popularly considered to be ‘food crops’, such as maize, yam, groundnut, rice and onion.

Input use: Figure 3 shows input use data disaggregated by the gender of the household head. The value of inputs spent per acre of land cultivated has rapidly increased in the past 20 years. The steepest increase is found in the use of inorganic fertilizers and pesticides. Female headed households are less likely to buy inputs compared to male headed households, except for hired labor. Differences are largest for inorganic fertilizers, pesticides and rental of animals and equipment. Conditional on having bought the input, we find that the amount spent per acre does not significantly differ among male- and female headed households for most inputs.

[Figure 3 here]

Occupation: In Table 4 we report the share of men and women in rural areas in different primary occupations over time, and the respective Duncan Index. The index is highest for agricultural self-employment and agricultural contributing family work, which indicates that these occupations have the highest level of gender segregation. Women and men are equally likely to have a primary occupation in agriculture, but men are more likely than women to be self-employed farmers and women are more likely than men to be contributing family farm workers. This is consistent with the patterns of land control we reported above. The gender gap in contributing family work is decreasing over time: the share of women who are primarily agricultural family workers dropped from 41.5% in GLSS3 to 34.2% in GLSS6.

[Table 4 here]

Albeit the frequency of occurrence is lower, inequalities in terms of paid and non-agricultural self-employment increase over time. While in GLSS3 paid employment was rarely observed for neither men nor women, by GLSS6 12% of all men, but only 4% of all women consider wage employment their primary employment. At the same

time, an equal share of women and men were self-employed in non-agricultural activities as their primary job in GLSS3 (around 20%) but men exit the sector over time and by GLSS6, only 8% of all men, but 17.6% of all women consider non-farm self-employment their main occupation.

5.3. Regression results

Land

Table 5 reports Heckman model regression results on the likelihood of holding land and on land size, conditional on holding land. Being a woman, instead of a man, is correlated with a 42 percentage points lower likelihood of holding land and the effect is significantly larger in the Forest and Savannah compared to Coast. No clear pattern appears in all rural adults' access to land over time. Gender inequalities in land access yet have decreased as compared to GLSS3, as indicated by the positive and significant coefficients of the interaction terms between gender and survey round dummies. Over time, women have increased their landholding more than men. These effects are mainly driven by the Coast and Savannah. Women's position within the household matters for access to land: female household heads are on average 39 percentage points more likely to hold land as compared to women with another position in the household (such as female spouses, daughters, daughters in law etc.); this makes them more similar to men than to their female non-head counterparts.

[Table 5 here]

The size of land held (2nd step Heckman) is not significantly affected by the gender of the plotholder, neither at national level, nor at the level of the agroecological zones. The land size held by plotholders yet increases on average over time. The increase is larger for men than for women, as indicated by the negative and significant coefficients of the interaction terms between gender and survey round.

The ethnic group and polygamous household structure are also associated with female land holding. In line with the inheritance rules, women from matrilineal ethnic groups are more likely to hold land than women from patrilineal ethnic groups. Plotholders belonging to matrilineal ethnic groups hold more land on average, but

female plottolders in matrilineal groups hold smaller plots than women in patrilineal ethnic groups. Women in polygamous households hold on average 2.2 acres less land than women from monogamous households.

Crop production

The regression results in table 6 show that the number of crops grown by plottolders significantly decreases over time and that women grow on average 1.7 less types of crops than men. Gender-related inequalities are more outspoken in the Savannah and Forest, compared to the Coast. We find that the number of crops grown by female plottolders decreases less rapidly than for male plottolders, where results are driven mainly by the Forest and Savannah. This points to a reduction in the gender gap of number of crops cultivated over time, especially in regions with higher gender discrepancies. Female plottolders who are household heads cultivate 1.5 crops more than female non-heads. Similar to our findings on land holdings, cropping patterns of female heads are more similar to male cropping patterns than that of other women in the household. Matrilineal plottolders cultivate 0.7 more crops on average. No clear gender pattern emerges for female plottolders who belong to matrilineal versus patrilineal ethnic groups. Being a female plottolder in polygamous households further decreases the number of crops cultivated by 0.5; effects are driven by the Savannah region. Unsurprisingly, an additional acre of land increases the number of crops cultivated by around 0.04.

[Table 6 here]

Crop commercialization

The likelihood of market participation is larger by 6 and 5 percentage points in GLSS4 and GLSS5 compared to GLSS3 (table 7). The gender of the plottolder does not affect market participation, but women's likelihood to participate in the market over time decreases more than that for men. Effects are mainly driven by the Coast and are significant for GLSS4 and GLSS5 compared to GLSS3. When the female plottolder is the household head, her likelihood to participate in the market is 5.2 percentage points lower than that of other women in the household; effects are driven by the Forest and Savannah.

[Table 7 here]

At the national level, the proportion of crops that is sold (CCI) is smaller in GLSS4 versus GLSS3, but is unchanged after that. Being a female plotholder is associated with a 0.04 higher share of produce sold. Effects differ by agro-ecological zone: the share of total harvest sold decreases compared to GLSS3 in the Forest, but increases in the Savannah. In both the Forest and Savannah female plotholders are more likely to sell a higher share of their harvest than in the Coast. Women from matrilineal ethnic groups are associated with selling slightly less of their harvest than women from patrilineal ethnic groups. Women in polygamous households commercialize larger shares of their harvest.

Input use

Female-headed households are less likely than male-headed households to buy inorganic fertilizers, pesticides, seeds, and hand tools. In turn, female headed households predicted probability of relying on hired labor and renting animals or equipment is greater than that for men.

Over time for all households, the average likelihood of buying fertilizers, pesticides, and equipment increases by respectively 21, 54 and 12 percentage points in GLSS6 versus in GLSS3. To the contrary, the purchase of seed, labor and hand tools decreases by respectively 16, 8 and 32 percentage points in GLSS6 versus GLSS3. The decrease in the purchase of seeds and hand tools over time is smaller for female- than for male-headed households, as indicated by the positive and significant coefficient of the interaction term of female household head and survey round. Female headed households in matrilineal groups are less likely to buy pesticides or spend on animals or equipment.

[Table 8 here]

Conditional on buying an input, households significantly increase their spending on fertilizers, pesticides, labor and animals or equipment over time. The gender of the household head is not significantly associated with the value of inputs purchased. With time, we find that households with female headship spend higher amounts on seed, labor, and hand tools than male-headed households. Significant variation exists in input use and amount spent on inputs across the different agroecological zones.

Occupation

In the regression results in table 9 we see an increase in agricultural self-employment in rural areas and a large decrease in non-agricultural self-employment over time. A smaller decrease is observed for non-agricultural family employment. Paid employment is significantly more frequent in GLSS5 and GLSS6 versus GLSS4¹.

[Table 9 here]

Women are less likely than men to be self-employed in agriculture and more frequently consider contributing family work in agriculture or non-agriculture as primary employment. Women are also less likely to engage in paid employment and are more often unemployed. Yet this gap is closing, and over time women become more likely to be involved in agricultural and non-agricultural self-employment and less in agricultural family work compared to their female counterparts in GLSS3. This hints at an increase in economic empowerment of women. For paid employment, the gap between men and women is larger in GLSS5 but smaller in GLSS6 as compared to GLSS4, but a longer time period is necessary to detect an overall trend. Primary occupations in agriculture are more prevalent in the Forest and Savannah than in the Coast. This is likely related to the broader set of economic opportunities in the relatively more developed coastal zone of Ghana. Women in the Forest and Savannah are less likely to be self-employed in agriculture, and more likely to be family workers in agriculture compared to women in the Coast.

We find some heterogeneity across women with different roles in the household and in different household types. Women who are household heads, who live in polygamous households, or who belong to a matrilineal ethnic group are more likely to be self-employed in agriculture compared to other women. Women who are household heads and women in polygamous households are less likely to consider themselves an agricultural contributing family worker. Women who are household heads are also more likely to hold a non-agricultural business or paid employment.

6. Summary and Discussion of Results

¹ GLSS4 is now the comparison group, given the few individuals engaged in 'paid employment' in GLSS3

Results show that in Ghana, some stylized facts about gender differences in agriculture have never existed; for others, the gender gap is closing or widening, while other longstanding beliefs remain largely true. At the level of access to land and land size held, effects are mixed at both the overall and gender gap level. The incidence of male plottolders in the rural population has slightly decreased over the past 20 years but changes are far from sizeable. The incidence of female plottolders in the adult female population has decreased less than that for men. At the level of land size held, the average acreage of plottolders has increased, but the share of acreage held by women is constant at around 20% of all available land held by rural plottolders. While the existing gender gap in landholding has thus reduced over time, a new gender gap in land size held has widened. Women in matrilineal ethnic groups are more likely to hold land, but hold plots of smaller size than women in patrilineal ethnic groups. We find that gendered cropping patterns are not strong in Ghana, similar to Doss (2002) and Carr (2008). No crops are grown exclusively by men or by women. Yet, men are disproportionally involved in the harvesting of some types of crops and grow a larger number of crops. Most crops are more frequently grown by men compared to women and are grown more frequently on the land of male plottolders compared to the land of female plottolders.

When controlling for community, household, and plot characteristics, women are as likely as men to sell crops. Conditional on selling, we find evidence of an equal if not higher market orientation of women compared to men. The data do not provide evidence that men are mainly drawn to crops that can be commercialized, while women are left with crops for home consumption. The often-cited dichotomy between “men’s cash crops” and “women subsistence crops” (Lastarria-Cornhiel 1997) is likely overcome in Ghana or never existed.

When looking at input use by male- and female-headed households, we find significant differences in their likelihood of applying inputs, but not in the amounts used per acre. It seems that once an initial hurdle in accessing inputs is overcome, input usage rates are similar. This only partly confirms the myth that female-headed households use considerably fewer inputs than male-headed households. The average likelihood of buying

fertilizers, pesticides, and renting animals or equipment increases over time. In turn, it decreases for seed, labor and hand tools, indicating a higher mechanization of agriculture but a lack of successful dispersion of new varieties and certified planting material in the past 20 years. The largest gender differences are detected in the larger amounts female-headed households spend on the hiring of labor and renting of equipment. This is likely related to physical and social constraints for female farmers to perform agricultural duties that require a high amount of strength, such as land clearing and preparation or pesticide application (Lambrecht 2016).

Finally, the share of people in rural areas who depend primarily on agriculture for their livelihoods is decreasing. There are indications of increased economic empowerment of women. Women still provide more unpaid farm labor than men, but the share of women who do so as their primary employment is decreasing. Women's participation in agricultural and non-agricultural self-employment, as well as paid employment, rises over time. The decrease in land ownership probability and non-agricultural self-employment, and increase in paid employment and agricultural self-employment, is consistent with findings on rural Ghana from Davis et al. (2017). Overall, our results do not strongly support the conventional wisdom of an ongoing "feminization of agriculture" (Lastarria-Cornhiel 2006), not based on access to land, not based on a disproportional involvement in the production of some crops, and not based on information about women's primary occupations.

Considerable differences exist across agro-ecological zones, ethnic groups and household types. Whereas gender gaps are often larger in the Forest and Savannah zones, the gender gap in terms of cropping patterns reduces, but it increases in terms of land size. Being a woman of a matrilineal ethnic group attenuates gender differences for access to land and choice of occupation, but not for the other outcome indicators, and even worsens gender inequalities in the size of land held. This is in line with earlier statements on the limited impact of matrilineality on attenuating gender differences by Quisumbing et al. (2001) and Lambrecht (2016). Being a woman in a polygamous household is associated with being more likely to hold land and to indicate agricultural self-employment as primary occupation.

Finally, our results show that gender patterns in agriculture are different according to a woman's position within the household. Except for crop commercialization, agricultural cropping patterns of women who are household heads are more similar to male cropping patterns than to that of women who have another position in the household (such as spouses, daughters etc.). Female household heads often face the burden of being both the main provider of cash or in-kind income for the household and the main caretaker of the household (Lambrecht 2016). Hence, our results are supportive of the hypothesis that a person's role in the household may be a more important determinant of gender-related patterns observed than the gender of the farmer per se. This is in line with the suggestion by Kazianga and Wahhaj (2013) that the observed gender patterns in the allocation of resources may be explained by social norms and expectations regarding the role of men and women in the household rather than innate differences in preferences or power between men and women.

7. Concluding remarks

At a time when donors and governments are increasing efforts to mainstream gender in agriculture, it is critical to revisit longstanding wisdom about rural women and men. Adequate information on gender patterns is necessary to be able to more efficiently design and evaluate policy interventions. Even if they were ever assessed, the relevance of results from older data and literature is possibly questionable, given the rapid changes that have taken place in many rural areas over the past decades (Doss et al, 2015). With this paper, we provide a unique overview of changes in gender patterns in agriculture over more than 20 years in Ghana.

Our results are varied and highlight the potential pitfalls of relying on general statements about gender in agriculture. Major gender issues persevere in women's access to land as well as access to input markets. Yet once entry barriers are overcome, women seem to follow similar agricultural patterns as men. Important variations exist at the level of the agroecological zone and women's positions within households. Moreover, while gender discrepancies seem to reduce with time in some respects, they remain similar or are exacerbated over time in other respects.

This article provides a modest attempt to contribute to the overall movement to present more objective and recent facts about women and men in agriculture. Clearly, it does not come without shortcomings. The repeated cross-sectional dimension, instead of pure panel data, increases the noise in comparing the data over time, due to both slight differences in survey questions as well as in sample sizes and sampling strategies. Moreover, panel data would allow us to control for unobservable household characteristics that do not change over time. Also, many more aspects of gender patterns in agriculture remain to be addressed. Micro-data from specific case-studies often provide clear results on impacts and have the possibility to dig further into the mechanisms of some of the effects, which are more difficult to detect in a nationally representative sample. Data on input use at plot or plotholder level rather than at household level would allow a more detailed gender-disaggregated and improve insights compared to the simple comparison of male- and female-headed households.

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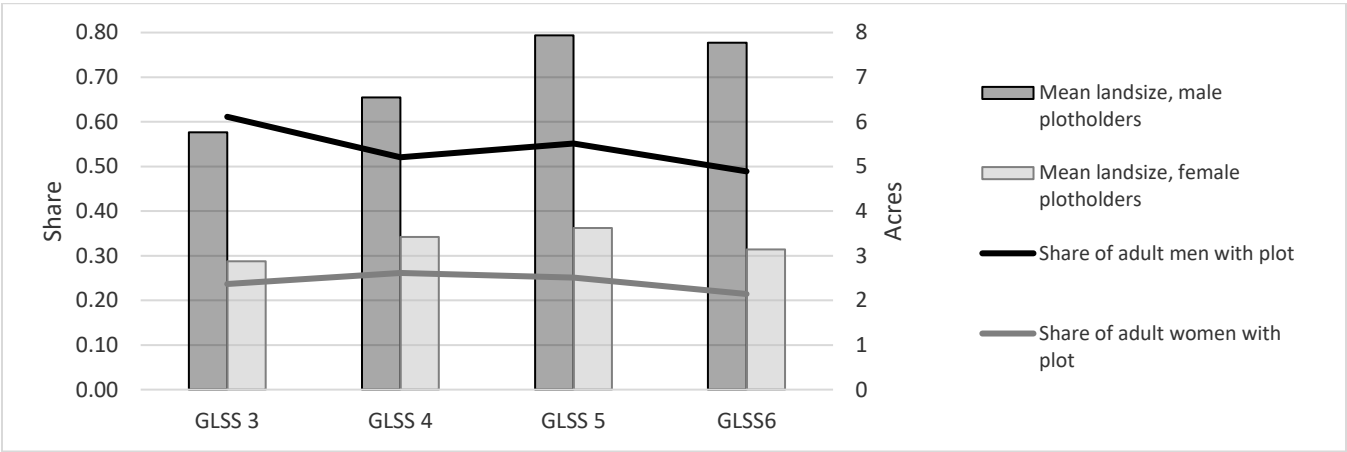
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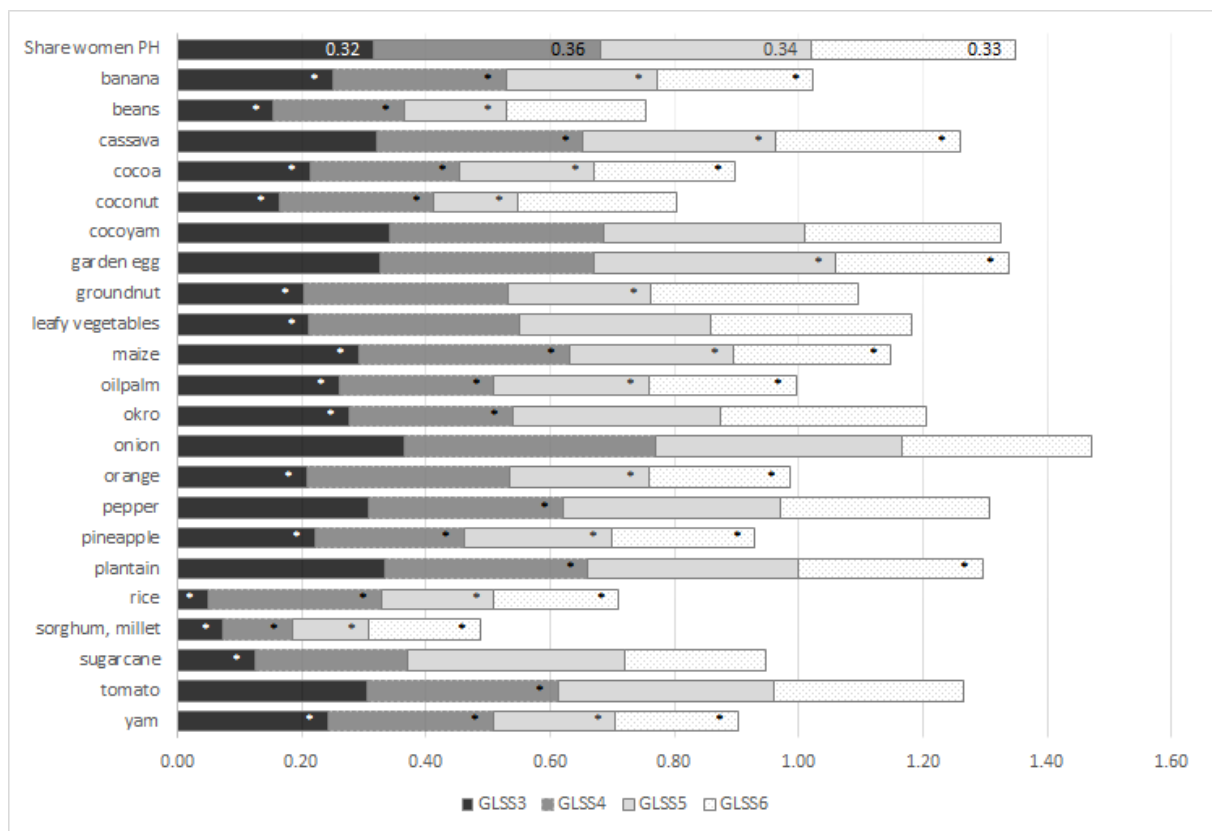
Figures

Figure 1: Plotholders by gender, 1991 – 2013



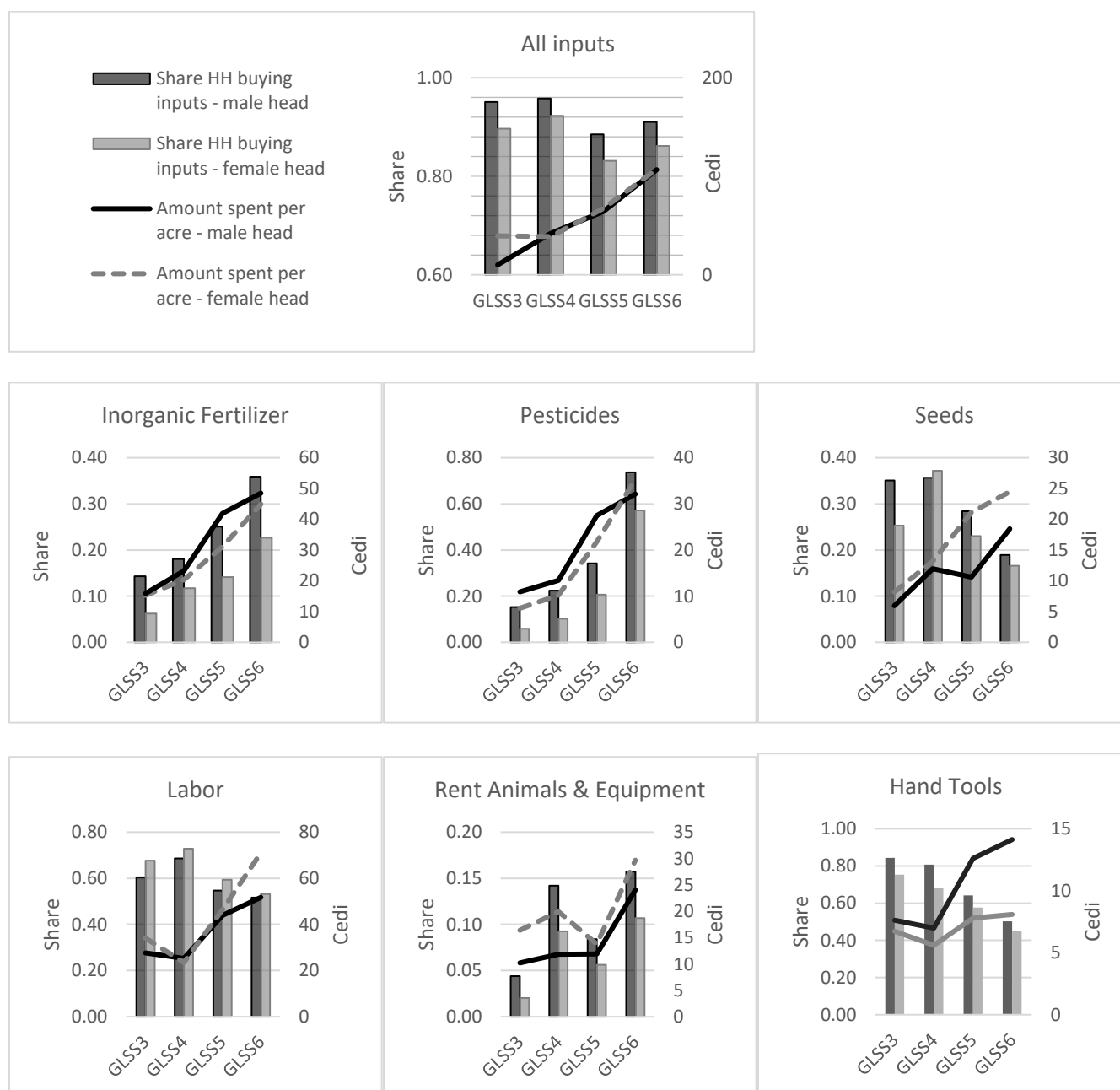
Note: The sample contains all adults (age 16 – 65 years) in rural areas

Figure 2: The proportion of farmers growing a specific crop who are women, 1991 – 2013



Note: * Share of female plottolders growing a crop is different (smaller or larger) from the share of female plottolders in the population that reference year, at the 5% significance level. The sample contains all adult plottolders (age 16- 65 years) in rural areas who grow crops. PH = plottolder.

Figure 3: Input use, 1991 – 2013



Note: values are adjusted to Ghana cedi equivalents in GLSS6 (base year 2013). The sample contains all households in rural areas that grow crops.

Tables

Table 1: Plotholder, household and community characteristics, by survey round

	GLSS3	GLSS4	GLSS5	GLSS6
<i>Plotholders (nb. obs)</i>	2,510	3,306	4,561	7,649
Number of plots cultivated by plotholder	1.41	2.21	1.79	1.87
Female	0.32	0.36	0.34	0.33
Female plotholder is HH head	0.22	0.20	0.18	0.16
Age	41.16	41.51	41.58	42.22
Marital status (=1 if married)	0.74	0.59	0.66	0.67
Education				
No education	0.57	0.50	0.54	0.50
Primary	0.12	0.13	0.14	0.15
Junior High	0.28	0.30	0.28	0.30
Senior High	0.01	0.01	0.02	0.03
Tertiary	0.01	0.06	0.02	0.03
Matrilineal ethnic group	0.45	0.48	0.44	0.40
Religion				
Catholic	0.15	0.18	0.15	0.15
Other Christian	0.44	0.46	0.46	0.50
Muslim	0.12	0.11	0.15	0.27
Traditionalist	0.25	0.12	0.12	0.00
Other	0.04	0.13	0.12	0.09
Father occupation: farming	0.82	0.79	0.81	0.80
Mother occupation: farming	0.82	0.76	0.78	0.78
<i>Plot cultivating households (nb. obs)</i>	2,306	2,799	3,886	6,555
Number of plotholders in the HH	1.19	1.39	1.43	1.56
Female HH head	0.23	0.23	0.20	0.19
Polygamous HH	0.08	0.06	0.10	0.08
HH size (in adult equivalents)	3.30	3.48	3.49	3.57
HH asset index ^(a)	0.94	1.16	1.26	1.70
<i>Communities (nb. obs)</i>	262	186	333	618
Share of other plotholders in community that commercialize	0.70	0.73	0.73	0.73
Share of other plotholders in community that buy any type of input	0.93	0.95	0.87	0.89

Note: (a) The household asset index is the first principal component of a polychoric principal component analysis on housing quality and various non-productive asset ownership indicators as a proxy for long-run household welfare. nb. Obs = Number of Observations

Table 2: Male versus female plotholder growing a crop, 1991 – 2013

	GLSS3		GLSS4		GLSS5		GLSS6	
	Male	Female	Male	Female	Male	Female	Male	Female
# crops cultivated	7.84	6.46 ***	6.93	5.47 ***	6.15	4.65 ***	4.80	3.64 ***
banana	0.17	0.12 ***	0.11	0.08 ***	0.14	0.09 ***	0.11	0.07 ***
beans	0.25	0.10 ***	0.20	0.09 ***	0.19	0.07 ***	0.15	0.09 ***
cassava	0.72	0.74 ***	0.51	0.44 ***	0.69	0.60 ***	0.56	0.49 ***
cocoa	0.18	0.11 ***	0.21	0.12 ***	0.23	0.12 ***	0.28	0.17 ***
coconut	0.05	0.02 ***	0.04	0.02 **	0.04	0.01 ***	0.01	0.01
cocoyam	0.41	0.46 **	0.28	0.26	0.32	0.29	0.20	0.19
garden egg	0.21	0.22	0.13	0.12	0.12	0.15 **	0.09	0.07 **
groundnut	0.26	0.14 ***	0.25	0.21 **	0.25	0.15 ***	0.18	0.19
leafy vegetable	0.21	0.12 ***	0.22	0.20	0.19	0.17 *	0.09	0.09
maize	0.77	0.68 ***	0.85	0.76 ***	0.78	0.54 ***	0.71	0.50 ***
oil palm	0.28	0.22 ***	0.23	0.13 ***	0.26	0.17 ***	0.16	0.10 ***
okra	0.48	0.40 ***	0.35	0.22 ***	0.30	0.29	0.21	0.21
onion	0.08	0.10	0.05	0.06	0.03	0.04	0.02	0.02
orange	0.12	0.07 ***	0.11	0.09	0.12	0.07 ***	0.07	0.05 ***
pepper	0.58	0.56	0.46	0.36 ***	0.43	0.45	0.28	0.30
pineapple	0.11	0.07 ***	0.11	0.06 ***	0.11	0.07 ***	0.07	0.04 ***
plantain	0.43	0.47 *	0.32	0.27 **	0.42	0.41	0.34	0.30 ***
rice	0.14	0.02 ***	0.16	0.10 ***	0.12	0.05 ***	0.14	0.07 ***
sugarcane	0.02	0.01 ***	0.01	0.01	0.01	0.01	0.01	0.00
sorghum, millet	0.25	0.04 ***	0.25	0.05 ***	0.25	0.07 ***	0.17	0.07 ***
tomato	0.38	0.36	0.27	0.21 ***	0.28	0.29	0.16	0.14
yam	0.44	0.30 ***	0.37	0.24 ***	0.42	0.20 ***	0.36	0.18 ***

Note: * $p < .1$. ** $p < .05$. *** $p < .01$. Boldface indicates that the shares of crop cultivated are significantly larger for female than for male plotholders. The sample contains all adult plotholders (age 16 – 65 years) in rural areas.

Table 3: Plotholder agricultural commercialization by gender and type of crop over time, 1991-2013

		GLSS3		GLSS4		GLSS5		GLSS6	
		Men	Women	Men	Women	Men	Women	Men	Women
All crops - Single harvest	Sell any	0.67	0.55 ***	0.76	0.66 ***	0.74	0.53 ***	0.75	0.56 ***
	CCI	0.60	0.67 ***	0.57	0.61 ***	0.62	0.66 ***	0.66	0.71 ***
All crops - Repeated harvest	Sell any	0.28	0.31	0.21	0.17 **	0.31	0.22 ***	0.22	0.15 ***
	CCI	0.47	0.55 **	0.45	0.52	0.55	0.54	0.58	0.58
banana ^(b)	Sell any	0.35	0.40	0.30	0.26	0.43	0.35	0.44	0.41
	CCI	0.73	0.58 *	0.78	0.82	0.86	0.84	0.82	0.80
beans ^(a)	Sell any	0.39	0.36	0.41	0.45	0.56	0.55	0.47	0.43
	CCI	0.63	0.76 ***	0.58	0.61	0.61	0.63	0.61	0.58
cassava ^(b)	Sell any	0.20	0.25 **	0.20	0.20	0.24	0.23	0.19	0.20
	CCI	0.64	0.62	0.56	0.51	0.70	0.66	0.67	0.69
cocoa ^(a)	Sell any	0.96	0.91	0.98	0.98	0.94	0.94	0.95	0.95
	CCI	0.93	0.96	0.90	0.90	0.88	0.94 ***	0.89	0.95 ***
coconut ^(a)	Sell any	0.59	0.71	0.65	0.62	0.55	0.47	0.44	0.32
	CCI	0.85	0.90	0.73	0.72	0.84	0.80	0.80	0.70
cocoyam ^(b)	Sell any	0.20	0.22	0.13	0.09	0.10	0.07	0.11	0.13
	CCI	0.69	0.65	0.63	0.54	0.75	0.68	0.73	0.69
garden egg ^(b)	Sell any	0.18	0.16	0.22	0.12 *	0.27	0.20	0.14	0.22
	CCI	0.77	0.85	0.81	0.63 *	0.80	0.77	0.68	0.82
groundnut ^(a)	Sell any	0.63	0.76 ***	0.67	0.53 ***	0.76	0.79	0.67	0.61 **
	CCI	0.58	0.73 ***	0.52	0.62 ***	0.62	0.62	0.59	0.62
maize ^(a)	Sell any	0.56	0.60 *	0.55	0.56	0.60	0.57	0.54	0.47 ***
	CCI	0.62	0.65 *	0.59	0.61	0.59	0.63 ***	0.61	0.66 ***
oil palm ^(b)	Sell any	0.19	0.13	0.25	0.24	0.32	0.16 ***	0.30	0.19 **
	CCI	0.70	0.69	0.59	0.75 **	0.78	0.83	0.80	0.84
okra ^(b)	Sell any	0.15	0.20	0.15	0.14	0.20	0.15	0.17	0.15
	CCI	0.72	0.72	0.68	0.65	0.75	0.69	0.78	0.77
onion ^(b)	Sell any	0.20	0.10	0.18	0.42 **	0.30	0.28	0.20	0.21
	CCI	0.77	0.75	0.79	0.90	0.56	0.51	0.71	0.86 *
plantain ^(b)	Sell any	0.30	0.32	0.33	0.33	0.34	0.21 ***	0.33	0.31
	CCI	0.65	0.62	0.60	0.56	0.70	0.64	0.74	0.71
pepper ^(b)	Sell any	0.11	0.13	0.11	0.11	0.19	0.20	0.15	0.11
	CCI	0.79	0.78	0.69	0.79 **	0.77	0.78	0.78	0.71
pineapple ^(b)	Sell any	0.15	0.09	0.14	0.09	0.14	0.14	0.29	0.26
	CCI	0.69	1.00 ***	0.70	0.76	0.79	0.75	0.72	0.72
rice ^(a)	Sell any	0.51	0.15 ***	0.62	0.74 **	0.57	0.54	0.57	0.46 **
	CCI	0.63	0.53	0.57	0.64 **	0.60	0.56	0.59	0.62
sorghum, millet ^(a)	Sell any	0.16	0.09	0.26	0.27	0.41	0.33 *	0.30	0.17 ***
	CCI	0.46	0.57	0.42	0.48	0.55	0.61	0.55	0.47
tomato ^(b)	Sell any	0.25	0.25	0.23	0.17	0.35	0.23 ***	0.26	0.24
	CCI	0.75	0.73	0.71	0.65	0.79	0.79	0.82	0.74
yam ^(b)	Sell any	0.15	0.09 *	0.13	0.09	0.16	0.10	0.16	0.07 **
	CCI	0.57	0.67 *	0.52	0.70 ***	0.63	0.74	0.61	0.53

Note: CCI = Crop Commercialization Index conditional on selling a specific crop; Boldface indicates significant differences at the 1 percent or 5 percent level between male and female plottolders. (a) Indicators based on a 12-month period record; (b) Indicators based on a two-week period record. The sample contains all adult plottolders (age 16- 65 years) in rural areas.

Table 4: Primary occupation and Duncan index (D), 1991-2013

	GLSS3			GLSS4			GLSS5			GLSS6						
Employment category	Men	Women		D	Men	Women		D	Men	Women		D	Men	Women		D
Agric self-employed	0.514	0.272	***	12.1	0.589	0.373	***	10.8	0.519	0.266	***	12.7	0.454	0.263	***	9.6
Agric family worker	0.179	0.415	***	11.8	0.116	0.296	***	9.0	0.142	0.346	***	10.2	0.195	0.342	***	7.3
Non-agric self employed	0.195	0.198		0.2	0.127	0.279	***	7.6	0.059	0.200	***	7.0	0.084	0.176	***	4.6
Non-agric family worker	0.011	0.017	**	0.3	0.009	0.013		0.2	0.002	0.009	***	0.3	0.009	0.023	***	0.7
Paid employment	0.000	0.001		0.0	0.156	0.039	***	5.8	0.119	0.025	***	4.7	0.123	0.042	***	4.0
No work	0.091	0.087		0.2	0.003	0.000	**	0.2	0.143	0.140		0.1	0.098	0.126	***	1.4
No. of Obs.	2,820	3,362			3,004	3,714			5,342	6,090			10,420	11,569		

Note: Agric = agriculture; The sample contains all male and female adults (age 16 – 65 years) in rural areas. Share of men and women in primary occupation are significantly different at ** $p < .05$; *** $p < .01$.

Table 5: Regression results on plot holding and land size

	Dep Var= Plot holding dummy (Probit 1st step)				Dep Var = Land size in acres (Heckman MLE 2nd step)			
	Ghana	Coast	Forest	Savannah	Ghana	Coast	Forest	Savannah
Female	-0.417*** (0.013)	-0.381*** (0.023)	-0.405*** (0.016)	-0.531*** (0.015)	0.982 (0.815)	1.056 (0.965)	-1.368 (1.047)	0.274 (1.480)
4.GLSS	0.026*** (0.009)	-0.014 (0.022)	0.045*** (0.013)	0.022 (0.015)	0.933*** (0.329)	0.829* (0.496)	0.721 (0.475)	0.841 (0.621)
5.GLSS	-0.011 (0.008)	0.005 (0.022)	0 (0.013)	-0.017 (0.013)	1.843*** (0.308)	1.722*** (0.487)	1.359*** (0.462)	2.180*** (0.537)
6.GLSS	-0.050*** (0.008)	-0.150*** (0.021)	-0.046*** (0.012)	-0.014 (0.013)	1.657*** (0.309)	2.087*** (0.621)	0.209 (0.455)	2.313*** (0.542)
Female#4.GLSS	0.092*** (0.012)	0.099*** (0.027)	0.045** (0.018)	0.140*** (0.020)	-0.932* (0.555)	-0.258 (0.774)	-0.568 (0.727)	-1.802 (1.258)
Female#5.GLSS	0.047*** (0.012)	0.087*** (0.027)	0.009 (0.018)	0.078*** (0.018)	-1.306** (0.540)	-0.755 (0.779)	-2.126*** (0.736)	-0.832 (1.160)
Female#6.GLSS	0.069*** (0.011)	0.121*** (0.027)	-0.008 (0.017)	0.117*** (0.017)	-2.104*** (0.519)	-1.859** (0.864)	-1.158 (0.708)	-3.174*** (1.097)
Female plotholder is HH head	0.391*** (0.006)	0.262*** (0.014)	0.401*** (0.008)	0.448*** (0.010)	-0.855 (0.579)	-1.093 (0.683)	-0.08 (0.878)	-0.549 (1.093)
Matrilineal ethnic group	-0.011* (0.006)	-0.002 (0.017)	-0.030*** (0.008)	0.015 (0.015)	0.648** (0.267)	0.843* (0.477)	0.13 (0.311)	0.992 (0.780)
Female#Matrilineal ethnic	0.059*** (0.008)	0.031* (0.019)	0.044*** (0.011)	0.101*** (0.019)	-1.461*** (0.403)	-2.321*** (0.553)	-0.72 (0.503)	-2.043** (1.030)
Polygamous HH	0.013 (0.009)	0.125*** (0.043)	-0.006 (0.024)	0.017 (0.010)	3.108*** (0.366)	2.793*** (0.939)	7.534*** (0.884)	1.986*** (0.484)
Female#Polygamous HH	0.018 (0.011)	-0.088* (0.052)	0.057* (0.029)	0.019 (0.012)	-5.396*** (0.598)	-4.501*** (1.414)	-9.790*** (1.382)	-4.787*** (0.792)
Forest	0.082*** (0.007)				1.803*** (0.348)			
Savannah	0.078*** (0.009)				1.793*** (0.438)			
Female#Forest	-0.045*** (0.010)				-1.105** (0.499)			
Female#Savannah	-0.081*** (0.011)				-1.081** (0.546)			
Father occupation: farmer	0.081*** (0.004)	0.049*** (0.011)	0.052*** (0.007)	0.120*** (0.007)				
Mother occupation: farmer	0.097*** (0.004)	0.148*** (0.010)	0.095*** (0.007)	0.065*** (0.006)				
Inverse Mill's Ratio					-1.883*** (0.440)	-1.572** (0.662)	-1.078 (0.709)	-1.937*** (0.679)
Plotholder and HH controls	yes	yes	yes	yes	yes	yes	yes	yes
Region FE	yes	yes	yes	yes	yes	yes	yes	yes
No. of Obs.					45,976	6,614	18,559	20,803

Note: * $p < 0.10$, ** $p < 0.05$ or *** $p < 0.01$; Robust standard errors in parenthesis; Marginal effects from probit models are reported on the output on 'Land Holding'. Plotholder controls include age, education, marital status, religion; Household controls include HH assets and HH size. The sample contains all adults (age 16- 65 years) in rural areas. FE = fixed effects; MLE = Maximum Likelihood Estimate

Table 6: Regression results on number of crops harvested (OLS model)

	Number of crops			
	Ghana	Coast	Forest	Savannah
Female	-1.706*** (0.218)	-0.314 (0.376)	-2.732*** (0.305)	-3.129*** (0.268)
4.GLSS	-0.899*** (0.134)	-0.608* (0.340)	-0.971*** (0.233)	-1.088*** (0.165)
5.GLSS	-1.768*** (0.111)	-1.749*** (0.255)	-1.933*** (0.209)	-1.500*** (0.135)
6.GLSS	-3.073*** (0.110)	-2.762*** (0.310)	-3.868*** (0.197)	-2.229*** (0.136)
Female#4.GLSS	-0.154 (0.222)	-0.183 (0.497)	-0.193 (0.344)	0.061 (0.320)
Female#5.GLSS	0.313* (0.190)	-0.337 (0.394)	0.280 (0.312)	0.996*** (0.281)
Female#6.GLSS	0.790*** (0.180)	-0.187 (0.408)	1.366*** (0.292)	0.844*** (0.268)
Female plotholder is HH head	1.503*** (0.112)	0.393 (0.259)	1.441*** (0.182)	2.015*** (0.147)
Matrilineal ethnic group	0.722*** (0.109)	0.963*** (0.295)	0.484*** (0.136)	1.326*** (0.259)
Female#Matrilineal ethnic group	0.101 (0.151)	-0.517* (0.304)	0.336* (0.203)	0.026 (0.343)
Polygamous HH	-0.171 (0.115)	-0.639 (0.547)	-0.518 (0.429)	-0.212* (0.112)
Female#Polygamous HH	-0.497*** (0.162)	-0.878 (0.691)	-0.773 (0.638)	-0.408*** (0.153)
Land size (in acres)	0.042*** (0.009)	0.061*** (0.018)	0.059*** (0.019)	0.025*** (0.007)
Forest	1.587*** (0.130)			
Savannah	0.723*** (0.155)			
Female#Forest	-0.870*** (0.191)			
Female#Savannah	-0.851*** (0.177)			
Constant	5.957*** (0.199)	5.341*** (0.489)	7.374*** (0.301)	6.656*** (0.195)
Plotholder and HH controls	yes	yes	yes	yes
Region FE	yes	yes	yes	yes
No. of Obs.	16,177	1,983	6,981	7,213
R-Squared	0.22	0.25	0.19	0.23

Note: * p<0.1, ** p<0.05 or *** p<0.01; Robust standard errors in parenthesis; Plotholder controls include age, education, marital status; Plotholder controls include age, education, marital status, religion; Household controls include HH assets and HH size. The sample contains all adult plotholders (age 16- 65 years) in rural areas. FE = fixed effects

Table 7: Regression results on crop commercialization for crops grown and sold in the past 12 months

	Dep Var = Market Participation (Probit 1st step)				Dep Var = Crop Commercialization Index (CCI) (Heckman MLE 2nd step)			
	Ghana	Coast	Forest	Savannah	Ghana	Coast	Forest	Savannah
Female	0.037 (0.026)	0.082 (0.050)	-0.012 (0.028)	0.069 (0.044)	0.042* (0.022)	0.062 (0.043)	0.027 (0.026)	0.083** (0.034)
4.GLSS	0.061*** (0.014)	0.023 (0.035)	0.052*** (0.019)	0.090*** (0.025)	-0.062*** (0.010)	-0.04 (0.028)	-0.105*** (0.015)	-0.024 (0.018)
5.GLSS	0.054*** (0.013)	0.02 (0.034)	0.028 (0.019)	0.081*** (0.021)	-0.011 (0.010)	0.019 (0.027)	-0.069*** (0.014)	0.059*** (0.016)
6.GLSS	-0.021 (0.013)	0.036 (0.042)	0.034* (0.018)	-0.072*** (0.021)	0.008 (0.010)	-0.025 (0.032)	-0.071*** (0.014)	0.110*** (0.016)
Female#4.GLSS	-0.063*** (0.023)	-0.128** (0.054)	-0.038 (0.028)	-0.074 (0.050)	-0.002 (0.018)	-0.055 (0.043)	0.026 (0.025)	0.037 (0.038)
Female#5.GLSS	-0.062*** (0.022)	-0.133** (0.053)	-0.024 (0.029)	-0.052 (0.047)	-0.016 (0.018)	-0.085* (0.045)	0.034 (0.025)	-0.018 (0.036)
Female#6.GLSS	-0.03 (0.022)	-0.092 (0.060)	-0.035 (0.028)	-0.034 (0.043)	-0.011 (0.017)	-0.025 (0.048)	0.057** (0.024)	-0.026 (0.034)
Female plotholder is HH head	-0.052*** (0.013)	-0.031 (0.034)	-0.031* (0.017)	-0.088*** (0.025)	-0.029*** (0.011)	-0.017 (0.030)	-0.015 (0.015)	-0.049** (0.020)
Matrilineal ethnic group	0.012 (0.012)	0.085** (0.034)	-0.009 (0.013)	0.028 (0.032)	0.046*** (0.008)	-0.003 (0.027)	0.041*** (0.009)	0.050** (0.022)
Female#Matrilineal ethnic group	-0.007 (0.017)	-0.046 (0.039)	0.003 (0.020)	-0.038 (0.041)	-0.024* (0.013)	0.013 (0.033)	-0.022 (0.017)	-0.016 (0.030)
Polygamous HH	0.018 (0.015)	-0.033 (0.068)	0.032 (0.041)	0.021 (0.019)	-0.01 (0.011)	-0.046 (0.056)	-0.031 (0.026)	0.008 (0.014)
Female#Polygamous HH	0.030 (0.025)	-0.001 (0.109)	-0.020 (0.063)	0.023 (0.032)	0.057*** (0.021)	0.050 (0.105)	0.019 (0.051)	0.055** (0.025)
Land size (in acres)	0.001*** (0.000)	0.003* (0.002)	0.000 (0.001)	0.002*** (0.000)	0.001*** (0.000)	0.004*** (0.001)	0.000 (0.000)	0.001 (0.000)
Savannah	-0.018 (0.015)				-0.01 (0.012)			
Forest	-0.02 (0.018)				0.011 (0.014)			
Female#Forest	-0.031 (0.021)				0.038** (0.017)			
Female#Savannah	0.015 (0.022)				0.039** (0.019)			
Crop grown last 12 months: cereals	0.239*** (0.010)	0.331*** (0.027)	0.227*** (0.013)	0.221*** (0.018)	-0.175*** (0.009)	-0.226*** (0.030)	-0.162*** (0.011)	-0.193*** (0.018)
Crop grown last 12 months: cash crops	0.437*** (0.013)	0.414*** (0.056)	0.407*** (0.013)	0.290*** (0.041)	0.015 (0.010)	0.039 (0.029)	0.010 (0.014)	0.015 (0.021)
Crop grown last 12 months: legumes	0.189*** (0.009)	0.249*** (0.032)	0.124*** (0.017)	0.211*** (0.011)	-0.104*** (0.008)	-0.109*** (0.025)	-0.058*** (0.013)	-0.135*** (0.012)
Crop grown last 12 months: other crops	0.103*** (0.012)	0.239*** (0.027)	0.105*** (0.023)	0.050*** (0.019)	-0.072*** (0.009)	-0.109*** (0.022)	-0.058*** (0.015)	-0.085*** (0.014)
Share of other plotholders in community that commercialize	0.491*** (0.013)	0.544*** (0.035)	0.430*** (0.020)	0.513*** (0.022)				
Inverse Mill's Ratio					-0.163*** (0.013)	-0.123*** (0.034)	-0.168*** (0.021)	-0.217*** (0.021)
Plotholder and HH controls	yes	yes	yes	yes	yes	yes	yes	yes
Region FE	yes	yes	yes	yes	yes	yes	yes	yes
No. of Obs.					16,164	1,976	6,976	7,212

Note: * p<0.1, ** p<0.05 or *** p<0.01; Robust standard errors in parenthesis; Marginal effects from probit models are reported on the output on 'Market Participation'. Plotholder controls include age, education, marital status, religion; Household controls include HH assets and HH size. The sample contains all adult plotholders (age 16- 65 years) in rural areas. FE = fixed effects; MLE = Maximum Likelihood Estimate.

Table 8: Regression results on input purchase

	Dep Var = Buy any input (Probit 1st step)						Dep Var = Amount spent per acre (Heckman MLE 2nd step)					
	Inorganic Fertilizers	Pesticides	Seeds	Labor	Animal or Equipment	Hand tools	Inorganic Fertilizers	Pesticides	Seeds	Labor	Animal or Equipment	Hand tools
Female HH head	-0.070** (0.032)	-0.088*** (0.032)	-0.069*** (0.026)	0.061** (0.030)	0.052* (0.030)	-0.140*** (0.028)	-25.382 (17.776)	-2.945 (16.086)	-0.228 (4.081)	6.608 (9.336)	-2.425 (15.061)	-0.659 (1.320)
4.GLSS	0.012 (0.011)	0.037*** (0.010)	-0.029** (0.014)	0.069*** (0.014)	0.098*** (0.008)	-0.062*** (0.012)	-1.375 (6.912)	-0.447 (5.956)	2.86 (1.869)	-10.020** (4.521)	-0.823 (6.769)	-1.711*** (0.581)
5.GLSS	0.099*** (0.011)	0.172*** (0.011)	-0.071*** (0.013)	-0.018 (0.014)	0.056*** (0.007)	-0.140*** (0.012)	23.107*** (6.523)	16.998*** (5.836)	-0.607 (1.940)	10.829** (4.435)	3.319 (6.152)	0.442 (0.587)
6.GLSS	0.207*** (0.011)	0.537*** (0.010)	-0.156*** (0.013)	-0.083*** (0.014)	0.123*** (0.007)	-0.323*** (0.012)	41.859*** (7.696)	31.748*** (7.893)	1.293 (2.404)	12.310*** (4.535)	15.072** (6.866)	0.692 (0.693)
FemaleHead#4.GLSS	0.05 (0.032)	0.021 (0.030)	0.103*** (0.024)	-0.023 (0.028)	0.019 (0.030)	0.015 (0.027)	6.658 (18.135)	-0.05 (15.514)	0.807 (3.905)	-1.29 (8.133)	6.422 (15.171)	0.879 (1.160)
FemaleHead#5.GLSS	0.033 (0.031)	0.047* (0.028)	0.062** (0.024)	-0.042 (0.027)	0.050* (0.030)	0.068*** (0.026)	7.284 (16.868)	-1.352 (14.437)	8.032** (3.993)	9.125 (8.466)	6.170 (15.561)	3.799*** (1.195)
FemaleHead#6.GLSS	0.026 (0.029)	0.007 (0.027)	0.075*** (0.023)	-0.050* (0.026)	0.038 (0.028)	0.109*** (0.024)	13.857 (15.765)	7.770 (13.629)	9.748** (3.883)	26.240*** (8.071)	9.591 (14.495)	6.416*** (1.166)
Matrilineal ethnic group	-0.021** (0.010)	0.008 (0.010)	0.007 (0.010)	0.035*** (0.012)	0.006 (0.009)	0.043*** (0.011)	-7.310* (4.376)	-1.614 (2.768)	2.032 (1.664)	-2.046 (3.528)	-11.693*** (3.936)	-0.697 (0.510)
FemaleHead#Matrilineal ethnic group	-0.016 (0.019)	-0.084*** (0.017)	0.028 (0.018)	0.010 (0.020)	-0.086*** (0.015)	0.020 (0.018)	12.476 (8.263)	0.918 (5.731)	0.073 (2.982)	1.388 (5.979)	7.856 (8.145)	0.552 (0.920)
Forest	-0.058*** (0.014)	0.138*** (0.012)	-0.038*** (0.014)	0.063*** (0.014)	0.005 (0.012)	0.070*** (0.014)	-4.165 (6.161)	2.370 (4.832)	-9.756*** (2.096)	0.105 (4.877)	-18.192*** (6.433)	-3.073*** (0.677)
Savannah	0.019 (0.019)	0.053*** (0.017)	-0.037** (0.018)	0.115*** (0.019)	-0.016 (0.015)	0.101*** (0.018)	-10.484 (7.563)	8.138 (5.704)	-4.450* (2.702)	11.948* (6.261)	-19.075** (8.047)	0.188 (0.890)
FemaleHead#Forest	-0.019 (0.023)	-0.015 (0.023)	-0.044** (0.021)	0.023 (0.024)	-0.041** (0.019)	-0.036* (0.022)	18.012 (11.470)	-3.790 (9.004)	1.511 (3.460)	-5.516 (7.628)	-9.112 (9.603)	0.363 (1.105)
FemaleHead#Savannah	0.003 (0.025)	0.036 (0.025)	0.018 (0.024)	-0.02 (0.027)	-0.081*** (0.020)	-0.014 (0.025)	17.417 (11.245)	-8.925 (9.569)	-3.290 (3.922)	-12.182 (9.050)	0.653 (8.261)	-1.720 (1.344)
Share of other plottolders in community that buy any type of input	0.389*** (0.021)	0.555*** (0.020)	0.430*** (0.023)	0.698*** (0.022)	0.360*** (0.021)	0.420*** (0.021)						
Inverse Mill's Ratio							27.476*** (9.523)	8.199 (5.658)	13.208*** (3.971)	-7.889 (7.631)	0.598 (5.783)	0.216 (0.813)
HH controls	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Region FE	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
No. of Obs.							17,600	17,600	17,600	17,600	17,600	17,600

Note: * p<0.1, ** p<0.05 or *** p<0.01; Robust standard errors in parenthesis; Marginal effects from probit models are reported on the outputs on 'Buy any input'. Household controls include age, education and religion of the HH head, HH assets and HH size. The sample contains all HH in rural areas.

FE = fixed effects; MLE = Maximum Likelihood Estimate.

Note: GLSS3, GLSS4, and GLSS5 values on the amount spent are adjusted to Ghana cedi equivalents in GLSS6 (base year 2013).

Table 9: Regression results on primary employment category (Probit model)

	Dependent variable = Primary Employment					
	Agric Self	Agric Fam	NonAgr Self	NonAgr Fam	Paid Empl	No Work
Female	-0.285*** (0.015)	0.218*** (0.016)	0.016 (0.010)	0.009** (0.003)	-0.060*** (0.007)	0.044*** (0.009)
4.GLSS	0.109*** (0.010)	-0.024** (0.011)	-0.133*** (0.011)	-0.009* (0.005)		
5.GLSS	0.049*** (0.009)	-0.033*** (0.009)	-0.189*** (0.010)	-0.019*** (0.004)	0.025*** (0.003)	0.087*** (0.005)
6.GLSS	0.034*** (0.008)	0.043*** (0.009)	-0.183*** (0.010)	-0.011*** (0.004)	0.015*** (0.003)	0.043*** (0.005)
Female#4.GLSS	0.019 (0.014)	-0.028* (0.014)	0.112*** (0.010)	(0.001) (0.004)		
Female#5.GLSS	-0.019 (0.013)	-0.014 (0.012)	0.141*** (0.010)	0.008* (0.004)	-0.012* (0.006)	-0.002 (0.008)
Female#6.GLSS	0.054*** (0.012)	-0.100*** (0.011)	0.094*** (0.009)	0.004 (0.003)	0.009* (0.005)	0.015** (0.007)
Female plotholder is HH head	0.233*** (0.007)	-0.422*** (0.012)	0.091*** (0.005)	-0.010*** (0.003)	0.028*** (0.004)	-0.075*** (0.006)
Matrilineal ethnic group	-0.004 (0.007)	-0.019** (0.008)	-0.004 (0.006)	-0.005** (0.002)	-0.004 (0.003)	0.031*** (0.005)
Female#Matrilineal ethnic group	0.066*** (0.010)	-0.013 (0.010)	-0.006 (0.007)	0.003 (0.003)	-0.002 (0.005)	-0.026*** (0.006)
Polygamous HH	-0.003 (0.009)	0.000 (0.009)	-0.008 (0.011)	-0.003 (0.003)	-0.001 (0.006)	0.002 (0.007)
Female#Polygamous HH	0.062*** (0.012)	-0.036*** (0.011)	0.004 (0.013)	-0.001 (0.004)	0.009 (0.009)	-0.019** (0.008)
Forest	0.107*** (0.008)	0.038*** (0.010)	-0.033*** (0.008)	-0.004 (0.003)	-0.033*** (0.005)	-0.029*** (0.006)
Savannah	0.119*** (0.011)	0.040*** (0.012)	-0.020** (0.010)	-0.003 (0.004)	-0.047*** (0.007)	-0.032*** (0.008)
Female#Forest	-0.048*** (0.012)	0.058*** (0.013)	-0.033*** (0.008)	-0.001 (0.003)	0.006 (0.005)	0.004 (0.007)
Female#Savannah	-0.118*** (0.013)	0.090*** (0.014)	-0.032*** (0.009)	-0.001 (0.003)	0.014** (0.006)	0.006 (0.008)
Plotholder and HH controls	yes	yes	yes	yes	yes	yes
Region FE	yes	yes	yes	yes	yes	yes
No. of Obs.	46,023	46,023	46,023	46,023	46,023	46,023
Pseudo R-squared	0.26	0.25	0.15	0.15	0.26	0.21

Note: * p<0.1, ** p<0.05 or *** p<0.01; Robust standard errors in parentheses; Marginal effects from probit models are reported. Plotholder controls include age, education, marital status, religion; Household controls include HH assets and HH size. The sample contains all male and female adults (age 16 – 65 years) in rural areas. AgricSelf = Agricultural self-employment; AgricFam = Agricultural family worker; NonAgric Self = Non-agricultural self-employment; NonAgr Fam = Non-agricultural family worker; Paid Empl = Paid Employment; No Work = Not working; FE = fixed effects