INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE
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Led by IFPRI

IFPRI Discussion Paper 01847

June 2019

Landownership and the Gender Gap in Agriculture

Disappointing Insights from Northern Ghana

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Abstract

Land provides the basis for food production and is an indispensable input for economic livelihoods in rural areas. Landownership is strongly associated with social and economic power, not only across communities and households, but also within households. The link between landownership and women's empowerment has been relatively well documented in general, but not specifically in relation to agriculture. This paper aims to fill this gap by analyzing how ownership of land is associated with agency and achievements in agriculture among female and male farmers in northern Ghana, a region transitioning from customary land tenure without individual ownership rights towards a more individualized and market-based tenure system. We use a recursive bivariate probit model and focus on eight different indicators in four distinct domains: decisions on agricultural cultivation, decisions on farm income, agricultural association membership, and time allocation. Our empirical estimates indicate that landownership is positively correlated with men's and women's agency in agriculture, namely in decisions on agricultural cultivation and membership in agricultural association. Yet, we also find that the gender gaps in participation in cultivation decisions, the use of agricultural earnings, and in agricultural workload continue to persist among those who own land. While the results underscore the importance of land as a resource that can enhance women's agency, they also point out that policies aiming to solely advance land rights may not be sufficient to eradicate or even reduce gender inequality in agriculture.

Keywords: land tenure, gender, women empowerment in agriculture, agricultural decision making, Ghana

Highlights

- We study the association of landownership with agency and achievements in agriculture in northern Ghana.
- Landownership is positively associated with women and men's agency in input purchasing and crop decisions and participation in agricultural groups.
- However, male landowners are significantly more likely to have agency and achievement in agriculture than female landowners.
- Landownership alone is insufficient to close the gender gap in agency and achievement in agriculture.

Acknowledgements

We would like to thank our anonymous reviewers for their valuable suggestions and feedback. We are also grateful to Maria Floro, Ruth Meinzen-Dick, Natalia Radchenko, Laura Meinzen-Dick, Andrew Mason, Sang-Hyop Lee, and Sumeet Saksena who provided valuable comments and suggestions to earlier versions of this article. Special thanks to Caren Grown and Hazel Malapit for the provision of the data, Greg Seymour for sharing cleaned GIS variables, Mekamu Kedir Jemal for GIS support, and Jerilyn Sumida for research support. This work was undertaken as part of the East-West Center's Research Program and of the CGIAR Research Program on Policies, Institutions, and Markets (PIM) led by the International Food Policy Research Institute (IFPRI). The opinions expressed here belong to the authors, and do not necessarily reflect those of the East-West Center, PIM, IFPRI, or CGIAR.

1. Introduction

Land provides the basis for food production and most income-generating activities and is an indispensable input for economic livelihoods in developing countries (Meinzen-Dick et al., 2019). Equally, if not more important, however, are the strong linkages between landownership and social and economic power (Agarwal, 1997; Kabeer, 1999; Goldstein and Udry, 2008). The direct and indirect pathways of landownership to power and empowerment have been documented at macro-level, across and within societies and communities (Binswanger et al., 1995; Goldstein and Udry, 2008). More recently, the connection between landownership and empowerment also received increasing attention at a micro-level, specifically focusing on gender relations within communities and households (Kabeer, 1999).

Landownership can help promote women's empowerment and enhance their well-being (Panda and Agarwal, 2005; Mishra and Sam, 2016). More specifically, research indicates that land access and secured land rights can increase women's economic security and bargaining power at the household level (Agarwal, 1997; Kabeer, 1999; Quisumbing and Briere, 2000; Anderson and Eswaran, 2009; Wigg, 2013). The improvement in women's bargaining positions, in turn, strengthens women's influence in household decisions, enabling women to reallocate household resources towards their preferences and contributing to an improvement in own and household well-being (Panda and Agarwal, 2005; Allendorf, 2007; Mishra and Sam, 2016). Allendorf (2007) and Mishra and Sam (2016), for example, show that landownership has a positive association with women's ability to make decisions concerning their own health care, large household purchases, purchases for daily needs, and visits to family, friends, and relatives in Nepal. With regards to women's empowerment in agriculture, Wiig (2013) finds that joint property rights considerably increase women's participation in household-decision-making on agricultural production and

land-related investment in Peru. Santos et al. (2014) find that women whose names are included on land titles in India are more likely to participate in decisions concerning how to use the land, what to grow on it, and whether to sell the produce from that plot. Doss et al. (2014) shows that women who own land in Malawi, Mali, and Tanzania participate into a greater number of agricultural decisions.

Given that land is a key asset for economic livelihoods and that agriculture remains the main income source for many rural households in developing countries, given that improving 'women's empowerment in agriculture' has become a target for many projects, and given that land rights are a key entry point for gender advocacy, it is surprising that so few studies look at the association between landownership and women's agricultural decision making or participation in agriculture. The assumption that each landowner makes all decisions regarding his or her plot alone is likely incorrect in many parts of the world (Twyman et al. 2015), and ownership of resources, such as land, does not necessarily translate into agency and achievements in any given domain (Kabeer, 1999).

This paper examines the relationships between landownership and consequent agency and achievements in agriculture for farmers in northern Ghana, and how this differs for men and women. We focus on four different domains that are directly related to agriculture: decisions about agricultural production, decision about earnings from agriculture, membership in agricultural associations, and workload in farm and non-farm activities. Ghana provides a relevant case study setting as agriculture is still the main source of income for rural households (World Bank, 2017). Especially in the north of the country, land rights are predominately governed by customary law where kinship and lineage are key determinants of land access (Higgins and Fenrich, 2011). Traditionally, customary law does not grant exclusive control and ownership to an individual

(Higgins and Fenrich, 2011; Doss et al., 2019), yet there is an ongoing transition towards increasingly more and stronger individual-held land rights and land markets are developing (Lambrecht and Asare, 2016). As in many other countries, reforming land law is high on Ghana's policy agenda (Bruce, 2014; Narh et al., 2016). Furthermore, Ghana performs poorly in terms of gender equality, and gender discrepancies are more prominent in the north compared to the southern part of the country (Apusigah, 2009; Osei-Assibey, 2014).

This study contains three features that distinguish this research from other existing studies. First, this paper extends the empirical evidence on the relationships between landownership and women's empowerment (Allendorf, 2007; Deere and Twyman, 2012; Wiig, 2013; Deere et al., 2013; Santos et al., 2014; Doss et al., 2014; Twyman et al., 2015; Mishra and Sam, 2016). We specifically focus on empowerment in agriculture and use a variety of decision-making and participation measures in agriculture that have received scant attention in the landownership literature. Other studies (Wiig, 2013; Santos et al., 2014; Doss et al., 2014; Twyman et al., 2015) include empowerment measures that capture household decision-making in agriculture but focus predominately on decisions regarding agricultural production, such as types of crops to grow for consumption and sale, and agricultural input purchases. While these are fundamental agricultural decisions and are included in our analysis, other decisions, namely agency over the use of income generated from food and cash crop farming, membership in agricultural groups, and workloads in agricultural activities, are equally critical for agrarian households. These are related yet distinct dimensions in agricultural decision-making, and their association with landownership may differ.

Second, our study takes place in a very different setting compared to previous studies on land and women's empowerment in agriculture. Wiig (2013) and Santos et al. (2014), for example, focus specifically on land titling efforts. This analysis, on the other hand, focuses on a setting in

which land tenure systems are gradually changing from customary tenure where no one owns the land to a statutory market-based system that allows women and men to acquire ownership rights.

Third, we focus not only on women, but we also include men in our analysis. A large number of studies on landownership and women's empowerment, such as Panda and Agarwal, (2005), Doss (2006), Allendorf (2007), Doss et al. (2014), Santos et al. (2014), and Mishra and Sam (2016), focus solely on women. As a result, their studies are unable to recognize the potential gender differences in the connections between landownership and decision-making roles. Critical insights are likely to be gained by understanding how these linkages between landownership and empowerment differ between men and women.

The remainder of the paper is organized as follows. The next section presents a brief conceptual framework. Section 3 provides a detailed discussion on how traditional gender norms govern landownership in Ghana. Section 4 discusses the data, and section 5 explains the empirical models. Section 6 reports the results, and section 7 concludes.

2. Conceptual framework

The conceptual framework for this analysis is based on Kabeer's (1999) definition of empowerment but relies on indicators developed as part of the women's empowerment in agriculture index (WEAI), developed by Alkire and co-authors (2013). In a paper that has shaped much of the current thinking on measuring empowerment, Kabeer (1999) defined empowerment as "*the process by which those who have been denied the ability to make strategic life choices acquire such an ability."* This process entails three dimensions: resources, agency, and achievements, which are essentially interrelated and to some extent indivisible. Resources are defined as access and rights to material, human, and social resources, which serve to enhance the

ability to exercise choice. Agency is the ability to take action in decision-making that would ultimately result in desired achievements or outcomes.

Theory and common sense suggest that, in societies where arable land is the most critical form of property for livelihoods, any sustained improvements in women's well-being are tied to improvements in women's land rights (Agarwal, 1997). The literature on women's empowerment therefore interprets land mostly as a resource influencing women's empowerment (e.g. Mason, 1996; Agarwal, 1997; Allendorf, 2007; Wiig, 2013; Mishra and Sam, 2016), whereas many others use land as an indicator for women's empowerment as such (e.g. Roy and Tisdell, 2002).

Yet, individual or joint agricultural landownership does not necessarily translate into agency and achievements in agriculture (Kabeer, 1999). Agricultural households in developing countries are often both production and consumption units, where farm and household decisions are essentially interrelated and intertwined (Bardhan and Udry, 1999). The assumption that each household member makes decisions regarding his or her plot alone, or no agricultural decisions in the absence of having individual or joint ownership of a plot, is likely false in many households (Twyman et al. 2015). Rather, household members provide labor on others' plots and may consult one another regarding strategic choices (Doss & Meinzen-Dick, 2015). Whether women's landownership, as opposed to men's landownership, could effectively increase their agency and achievements in agriculture will depend to a large extent on the pervasiveness of customary norms, beliefs and values that characterize the gendered roles of men and women in agriculture (Agarwal, 1997; Kabeer 2016).

In line with Kabeer (1999)'s understanding of empowerment, we ask the following questions: (i) *is ownership of land associated with the ability of individuals make strategic choices in agriculture?*; and, *(ii) does this association differ for men and women?* Even though the three

dimensions of empowerment are essentially intertwined, we consider self-reported ownership of land to reflect mostly upon the resources (pre-conditions) domain. This encompasses both the more conventional economic meaning as well as the institutional aspect enabling ownership rights. Decision-making in agricultural production and earnings, and membership in agricultural groups are considered as signs of agency, whereas agricultural workload and total (farm and non-farm) workload are considered as (negative) achievements.

3. Background: Landownership and Gender Norms in Ghana

Ghana experienced rapid economic growth over the past 20 years, and by the end of 2010, the country obtained the status of a lower middle-income country (McKay et al., 2016). Yet, the overall reduction in poverty has come at a cost of rising inequality, with the northern part of the country lagging behind (McKay et al., 2016). Agriculture remains the backbone of the Ghanaian economy (African Development Bank, 2019) and subsistence agriculture continues to be the main economic activity for rural households (Lanz et al., 2018; World bank, 2017). Nevertheless, poverty is also higher among those working in agriculture (McKay et al., 2016).

The government of Ghana recognizes both statutory and customary laws of access to agricultural land. This has led to an essentially pluralistic setting of overlapping, and often also contradicting laws, with customary as well as state-established laws defining inheritance and property rights (Lanz et al., 2018). Ghana's statutory laws are, in theory, gender-equal. However, they do not align with prevailing customary laws on land rights that are still commonly practiced, and access to, inheritance and ownership of land is rarely gender-equal (Kutsoati and Morck, 2016; Lambrecht, 2016).

Roughly 80 percent of the land in Ghana is under customary tenure (Pande and Udry, 2005). Customary land is controlled by either the family head or the traditional head of the lineage or clan (Lambrecht, 2016). Under the customary practices, individuals are allocated a piece of land that they may use either temporarily or permanently, but whether the individual has the right to sell, rent, sharecrop, borrow, or bequeath the land rests on the community and the specific situation (Lambrecht and Asare, 2016). In some, typically more remote communities, land can still only be accessed through nonmarket transactions such as borrowing, allocation of customary land, gifts, or inheritance, and farmers consider themselves as users rather than owners of the land (Bakang and Garforth, 1998; Lambrecht and Asare, 2016; Doss et al., 2019).

Similar to other countries in West Africa, men and women within the same household cultivate separate plots (Doss, 2002), and joint ownership or landholding is rare in Ghana (Lambrecht, 2016). Social norms and customary practices have a considerable influence on women's and men's access to land because they define who is and who is not part of the family or community and what is acceptable in the community (Lambrecht, 2016). Customary access to land is mainly organized through family or kinship that follows maternal or paternal bloodlines, known as matrilineal or patrilineal systems, respectively (La Ferrara, 2007). The Akan ethnicity is the matrilineal ethnic group in Ghana, whereas there are several other patrilineal ethnic groups in the country (Ickowitz and Mohanty, 2015). Most women, especially those belonging to the patrilineal groups, do not inherit their fathers' land because their families do not want the land to be transferred to another family upon marriage (Oduro et al., 2011). Yet, as men are traditionally assigned primary responsibility for providing the main necessities for the households, women's land rights are regarded as secondary and are subject to the primary rights of their male relatives in both matrilineal and patrilineal communities (Lambrecht, 2016). As a result, in rural farm

households in Ghana, most or all of the farmland and thus agricultural earnings are under the husband's control (Lambrecht, 2016). Nevertheless, Akan women are reported to have greater decision-making power compared to women in patrilineal ethnic groups (Oduro et al., 2012). The gradual change of customary tenure towards more individualization of land rights and the emergence of land markets provides new opportunities and challenges for men and women to access land, possibly affecting gender relations in households and communities (Bruce, 2014; Doss et al., 2019).

4. Data

The study makes use of Ghana's Feed the Future (FtF) Baseline Dataset. The data was collected from June to August 2012 in the Northern Brong Ahafo, Upper West, Upper East, and Northern Regions to monitor impact of FtF-supported activities (USAID, 2013). A two-staged probability sampling methodology was adopted in the selection of the survey sample. Using the probability proportional to size method, a total of 230 enumeration areas (EAs) were selected from all the EAs within the zone of influence in the first stage. In stage two, 20 households were randomly selected from each of the selected EAs. Probability weights were created to take into account differential probabilities of selection and non-responses from the households, allowing the data to be representative of the population in northern Ghana. A total of 4,410 households were surveyed.

Aside from relevant modules on household demography and socio-economic characteristics, the survey contains a module that allows for an estimation of the WEAI. Developed as a measure to evaluate empowerment and inclusion of women in the agriculture sector, the WEAI contains individual-level data collected from both primary male and female decision makers in

each household[1] (Alkire et al., 2013). In particular, it contains information on primary male and female decision makers' access to productive capital, influence over agricultural production decisions, decision-making roles over the uses of earnings generated from various income-generating activities, membership in economic and social groups, and time allocation.

This paper restricts its attention to households with married men and women who were interviewed for the WEAI and engage in at least one agricultural activity. Households living in communities in which no one reports owning land are eliminated.[2] These restrictions reduce the number of observations for our main analyses to 3,468 individuals from 1,734 households.

5. Methodology

5.1. Main analyses

The aim of the analysis is to provide insights in the relationship between landownership on the one hand, and agency and achievements in agriculture on the other hand. Evidently, such analysis is plagued by concerns about endogeneity. Self-reported ownership of land is endogenous to different indicators of agency and achievements in agriculture, as they are driven by similar observed and unobserved factors, such as social network, farming experience and skills, intrinsic agency, and prevailing customary practices and gender norms. In other words, land ownership could lead to empowerment, but more empowered individuals are also are more likely to claim

[1] In polygamous households, the wife who has the most decision-making authority in absence of the husband was chosen to be interviewed.

[2] We dropped these communities because we are interested in the relationship between self-reported landownership and decision-making in agriculture in settings where landownership is feasible. In several communities in Ghana, customary tenure dominates to the extent that it prohibits anyone from claiming landownership. Inclusion of these communities in the analysis prevents us from distinguishing between the influence of living in a traditional setting that complies with customary rules (as a result, no one reports to own land regardless of the strength of potential claims to using the land) and with the influence of not owning land in a setting where landownership is effectively possible.

landownership. Thus, we expect a significant upward bias in the coefficient for landownership when an ordinary probit model is used (probit estimates can be found in appendix Table A1).

In our main analyses, we model the association between self-reported landownership and agency and achievements in agriculture by using recursive bivariate probit models[3] proposed by Maddala (1986). This model is recursive because the first dependent variable, landownership, appears on the right-hand side of the second equation, making this a recursive, simultaneous-equation model (Greene, 2011).

The model can be mathematically written as follows:

$$L^*_{ijk} = \delta + \gamma F_{ijk} + \zeta X_{ijk} + \mu_{ijk},$$

$$L_{ijk} = 1 \; if \; L^*_{ijk} > 0, L_{ijk} = 0 \text{ otherwise}$$

$$V^*_{ijk} = \alpha + \beta F_{ijk} + \lambda L_{ijk} + \psi \, L_{ijk} * F_{ijk} + \kappa \, C_{ijk} + \varepsilon_{ijk}$$

$$V_{ijk} = 1 \; if \; V^*_{ijk} > 0, V_{ijk} = 0 \text{ otherwise;}$$

L^*_{ijk} and V^*_{ijk} are latent continuous variables for person i in household j and community k, respectively for landownership and agency and achievement indicators. However, only the binary variables, L_{ijk} and V_{ijk} are observed. F_{ijk} is a dummy variable equal to 1 if the respondent is female. X_{ijk} and C_{ijk} are vectors of individual- and household-level control variables including district-level fixed effects, that affect landownership along with agency and achievements in agriculture, respectively. Although not explicitly shown in the above equations, several relevant control variables are also interacted with the gender of the respondent.[4] The two equations are interrelated through the error terms, μ_{ijk} and ε_{ijk} (Greene, 2011) and are estimated with a

[3] While many papers model endogenous binary outcome variables using a bivariate probit model, Filippini et al. (2018) demonstrated that the correlation parameter in a bivariate probit estimation may mask the presence of a recursive bivariate process.

[4] Although most control variables potentially affect men's and women's outcomes differently, we limit the number of interaction terms to facilitate interpretation of the main results as well as to allow the model to converge. Only a relatively small number of women in our sample report to own land.

recursive bivariate probit model via the full-information maximum likelihood estimator in Stata using the cmp command developed by Roodman (2009).

Given that the recursive bivariate probit model allows for joint estimation of landownership with the outcome variables of interest with correlated error terms, we expect that the association between landownership and measures of agency and achievements will be smaller in a bivariate probit model compared to a simple probit model. However, the absence of a strong exclusion variable for landownership precludes us from making causal statements.

Additionally, one could advocate to employ ordered probit models rather than binary probit models since the original responses are a scale of input into decision-making. Yet, a Brant test (Brant, 1990) shows that the proportional odds assumption was violated for the data used in our analysis and therefore the use of ordered probit models is not appropriate (Fu, 1998). Below, we discuss the key variables in our analysis.

Landownership

Our variable on women's and men's ownership of land is derived from the WEAI module on access to and decision-making power over productive resources. The survey asks the following questions to each male and female respondent individually: *"Does anyone in your household currently have agricultural land?"* And if so, *"who would you say owns most of the land?"*.[5] Based on these questions, we construct a dichotomous variable capturing each respondent's ownership of land. Individuals who report that they own most of the land, either solely or jointly, are considered as landowners in our analysis.[6]

[5] Although this module contains four follow-up questions regarding who makes decisions on whether to sell, give away, rent, or purchase a piece of land, we rely on the answers of the ownership question solely because the answers to the ownership question and other subsequent questions are largely identical. 92% of all individuals answered all five questions identically.

[6] In this analysis, distinguishing between sole and joint ownership may not be meaningful for two main reasons. First, from a statistical point of view, too few women (2.3%) in our sample report to be sole landowners in a

This measure of landownership comes with two main caveats. First, the survey asks about agricultural landownership at the household-level rather than at the parcel-level. Consequently, one cannot distinguish between cases of joint ownership of land compared to different individuals of the same household owning different parcels of land. In Ghana, joint landownership is rare (Deere et al. 2013, Lambrecht 2016, and section 3 above). We therefore interpret responses of 'joint' landownership as if the respondent is the individual owner of at least one plot, whereas at the same time, another household member owns at least one other agricultural plot.

Second, we use a subjective and self-reported measure of landownership. In places where land access is at least partly governed by customary tenure arrangements and where land markets have not fully developed, the notion of landownership does not necessarily align with legally recognized ownership and is not easily captured in a dichotomous fashion. In northern Ghana, land is rarely rented or sharecropped. Based on the authors' calculations using the data from the 2012 Ghana Living Standard Survey (GLSS6) for parcels in the Upper-West, Upper-East and Northern Regions, agricultural parcels are seldom bought, rented or sharecropped in, respectively 0.43%, 0.37% and 0.15% of parcels. Rather, parcels are mainly distributed by the family or community (73%) or used free of charge (26%), providing evidence that land in northern Ghana is still mainly accessed through non-market based, customary land tenure systems.[7] All households in our analysis sample cultivate land, and none of them is therefore *de facto* landless. However, landownership indicates having land rights that go beyond mere use rights, including the rights to

household. Second, from a contextual point of view, the distinction may not be meaningful as explained later in this section.

[7] These are similar also to the authors' estimations using the baseline survey from the EGC-ISSER Ghana Socio-Economic Panel dataset collected in 2009-2010. Based on those data, we find that only 0.43%, 0.74% and 0.83% of agricultural parcels are respectively purchased, rented or sharecropped in the Northern, Upper-East and Upper-West Regions of Ghana.

decide whether to sell or give away the land. Hence, landownership is not only a resource in the narrow economic sense but also refers to a bundle of rights from an institutional point of view.

Agency and achievements in agriculture

We focus on farmers' agency and achievements in agriculture using eight different indicators in four domains: agricultural production decisions, agricultural income decisions, participation in farmers' associations, and time allocation. The first three indicators capture agricultural production decisions: agricultural production, agricultural input purchases, and types of crops to grow. In this module, respondents are asked: *"When decisions are made regarding each of these indicators, who is it that normally takes the decisions?"* If the respondent indicates that s/he is the sole decision maker, the questionnaire asks "*And to which extent do you feel you can make your own personal decisions if you wanted to?"* For each of these decisions, respondents who normally and individually make the decision or feel that they can make personal decisions to at least a medium extent are considered to be adequately empowered in that decision. This threshold is identical to the thresholds used for the WEAI sub-components (Alkire et al., 2013).[8]

The fourth and fifth measures focus on decisions regarding the use of food and cash crop income and are derived from the module capturing household decision-making around production and income generation. The questionnaire of this module first asks: "*Did you participate in [ACTIVITY] in the past 12 months?"* Conditional on participating, it then asks: "*How much input did you have in making decisions about income from [ACTIVITY]?"* Agricultural activities included in this module are food crop farming (crops that are grown primary for household food consumption) and cash crop farming (crops that are cultivated largely for sale in the market). Response options are the following: no input, input into very few decisions, input into some

[8] Respondents who did not make decisions regarding the specific activity and did not answer the second questions are coded as missing.

decisions, input into most decisions, and input into all decisions. For each agricultural activity, individuals who report that they participate in the activity and have input into at least some decisions are considered to have an adequate say in each of these two decision-making outcomes. Again, this threshold is the same as is used for the WEAI (Alkire et al., 2013).[9]

Similar to the landownership indicator, a key caveat of these five indicators is that these questions are asked at household-level rather than plot-level. Hence, joint decision-making could either mean that decisions on at least one plot are taken jointly, or it could mean that different individuals decide separately on different plots. Another caveat related to decision-making on income from food and cash crop farming is that the survey limits this question to only those who participate in the activity. In practice, some respondents probably still join in decision making on income from an activity that they do not participate in and therefore we cannot automatically code their answer to zero. Hence, our sample is limited to those who participate in the activity.

The next indicator captures membership in agriculture-related groups and is drawn from the group membership module. This module reflects the existence of a variety of groups in each respondent's community and whether the respondent is an active member of each group. Given that agriculture/livestock/fisheries producer's groups, water and forest users' groups, and trade and business associations play an important role in agriculture and in expanding agricultural producers' networks, respondents who report that they are active members of at least one of these groups are considered to have membership in agricultural-related groups in their communities.

The final two measures reflect workloads in agricultural work and in productive and reproductive work, respectively, and are based on the time allocation module. This module

[9] Respondents who did not participate in the activity and did not answer the second question as well as those who did participate in the activity but did not answer the second question are coded as missing.

provides information on time spent on primary and secondary activities[10] during each 15-minute interval of a 24-hour period. In this analysis, agricultural work includes time allocated towards farming, livestock raising, and fishing. Respondents are considered to have a high workload in agriculture if the number of hours spent on agricultural work in the previous 24 hours is higher than the 75th percentile. The total workload captures time spent on all farm and non-farm work as well as domestic and care tasks. Similar to the previous measure, individuals are considered to have a high total workload if the time spent in farm and non-farm work exceeds the 75th percentile.

Aside from technical difficulties in administering and responding to time use surveys, another caveat of the time use indicators for our analysis is that they are based on only one 24-hour recall period. If we expect large fluctuations in time use allocations of each respondent across different time periods, indicators derived from a short recall period may be too noisy to pick up any associations that potentially do exist.

Control variables

At individual level, we control for age and education. Age reflects a person's maturity, experience and authority (Allendorf, 2007; Mishra and Sam, 2016). As individuals become older and thus more experienced or mature, their propensity to own agrarian land and influence decision-making is expected to increase. We include age squared to account for a diminishing or eventually reversing effect of ageing on landownership or agency and achievements in agriculture. Educational attainment is proxied by a binary variable equal to zero if a respondent did not complete primary education and one if the individual has completed primary education. Education can empower farmers by allowing them to be more informed and have stronger sense of self-worth,

[10] Secondary activities are not included in the estimation of workload in agricultural and non-agricultural activities due to the fact that many respondents (96.53%) do not report any time in agricultural activities performed as secondary work activities.

thereby enhancing their social status (Kabeer, 1999; Goldstein and Udry, 2008). Thus, education is another essential factor associated with both landownership and decision-making in agriculture.

At household-level, we control for religion, ethnicity, household type and composition, household wealth, and distance to the nearest secondary road. Moreover, we include interaction terms for religion, ethnicity and household type with gender of the respondent. Muslim households typically grant greater land rights and household autonomy to men than women (Sait and Lim, 2006), whereas matrilineal ethnic groups, such as the Akan ethnic group, may give women greater access to land and autonomy compared to the patrilineal ethnic groups (Duncan, 2010). Living in polygamous households has also been documented to affect individuals' landownership along with decision-making roles (Ghebru and Lambrecht, 2017; Ichowitz and Mohanty, 2015). Through a number of pathways, the household composition, such as the number of men and women of similar, older or younger age categories, can affect whether one is able to cultivate land and an individual's agency and achievements in agriculture (Wiig, 2013; Quisumbing et al., 2001).

Household wealth is proxied by household asset terciles.[11] Wealthy individuals are less credit constrained and experience greater land tenure security (Goldstein and Udry, 2008), and they often have greater access to information and productive resources (Mishra and Sam, 2016). Lastly, distance to the nearest secondary road is likely to affect self-reported landownership. More accessible locations are more likely to be integrated in more market-oriented land tenure systems, as opposed to customary systems with little individual landownership (Ghebru and Lambrecht, 2017), yet there may be more competition for land (Kleemann et al., 2017). Moreover, communities in more remote areas are often observed to have more traditional gender attitudes,

[11] The asset terciles are based on the household asset index. The household asset index is constructed using a principal component analysis (Filmer and Pritchett, 1999) and includes information on the material of the floor, wall and roof, type of toilet, source of household cooking fuel, access to electricity and water, and ownership of dwelling, large and small livestock, fishing equipment, non-farm business equipment, vehicles, and large and small electronic devices.

potentially reducing women's landownership compared to men (Fenrich and Higgins, 2001). Finally, district-level dummies are included to account for localized differences in gender norms and perceptions.

5.2. Sensitivity analyses

An important shortcoming of our analysis is that we do not control for the landowning status at household-level, which is impractical in the context of a recursive bivariate probit model. Hence, there is a risk of confounding individual ownership of land with household-level ownership of land. We conduct additional analyses to verify the interpretation of our findings from the main analyses by (i) using a household-, rather than individual-, level landownership variable, and (ii) limiting the sample to only landowning households. In the first set of alternative analyses, the landownership variable is not based on individual landownership, but on household-level self-reported landownership.[12] The rationale for this analysis is to verify whether the observed coefficients in our main analysis are truly driven by individual-level reported ownership. In interpreting the results, one should remember that women generally have secondary land rights in Ghana. In practice, when only one person owns land in the household, this is generally a man. Hence, especially for female farmers, we expect that coefficients will be different.

The second set of additional analyses maintains the individual-level landownership variable as in the main regressions, but it restricts the sample to landowning households. More specifically, we limit the sample to households where either the husband or the wife (or both) report that they own land. The aim of this sample restriction is to focus particularly on the role of individual landownership within landowning households. We expect individual landownership to be of primary importance as compared to household-level landownership. In this case, these results

[12] This variable is based on the respondent's answer to whether anyone in his or her household currently owns land.

should not be significantly different from the main results. Yet, minor changes are to be expected given that this concerns a subsample of the main sample. Similar to the former sensitivity analyses, the relatively small share of men who do not report to own land while living in a landowning household provides an important caveat for the estimations and the interpretation of the results.

6. Results

6.1 Descriptive Statistics

Table 1 reports gender differences in self-reported landownership and indicators for agency and achievements in agriculture. About two thirds of men in our sample (69%) report that they own land, which is more than five times the amount of women who report owning land (12%). In line with the prevailing customary norms, a significantly greater proportion of men report that they have input into decision-making in agriculture compared to women, respectively about 96-98% versus 41%-44%. These discrepancies are less stark when looking at decisions related to income from agriculture, yet there are still significantly more men than women who have influence over the use of these sources of income. In particular, 97% of men indicate that they are able to influence the use of income generated from food crop farming and cash crop farming, compared to 64% and 58% of women, respectively. As hypothesized, men are more likely to be members of agriculture-related groups than women; 32% of men are members in agricultural groups, compared to 17% of women.

In terms of involvement in work activities, men are more likely to have a high agricultural workload than women. In particular, 38% of men are overworked in agricultural activities, compared to 10% of women. Taking into account all types of work activities, however, women are more likely to have high total workload than men, respectively 35% compared to 15%.

Table 1: Self-reported landownership and agency and achievements in agriculture by gender and land ownership status (percent)

	Full sample		Do not own land		Own land	
	Men	Women [a.]	Men	Women [a.]	Men [b.]	Women [a.; b]
Land ownership	68.84	11.52***	0.00	0.00	100.00	100.00
Respondent has at least medium input in decision making on …						
… agricultural production	97.54	40.82***	95.16	37.83***	**97.94**	**57.97***
…. agricultural input purchases	96.33	41.55***	91.05	38.58***	**97.21**	**58.38***
… types of crops to grow	96.05	44.36***	89.36	41.37***	**97.15**	**61.42***
Respondent has at least some input in decision making on income from …						
… food crop farming	97.08	63.83***	94.15	61.17***	**97.53**	**78.05***
… cash crop income	97.21	58.40***	98.04	55.88***	97.07	**74.30***
Member in agricultural groups	31.92	16.87***	13.33	15.22	**40.34**	**29.53****
High agricultural workload	37.52	9.76***	38.49	9.13***	37.28	**13.84***
High total workload	14.60	34.63***	16.71	34.58***	14.09	34.97***
No. of observations	1,734	1,734	423	1,525	1,311	209

[a.] Stars denote significant gender differences in a two-sided *t*-test using clustered standard errors by the enumeration area at * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$. [b.] Bold denotes significant differences between men (resp. women) who do and do not own land in a two-sided t-test using clustered standard errors by the enumeration area at $p<0.05$. All estimates are calculated using sampling weights.

Table 1 also compares agricultural agency and achievements of men and women who do not own land with men and women who own land. Three key observations can be made. First, men and women who own land are significantly more likely to have agency in agriculture compared to those who do not own land. Nevertheless, those who do not own land are still engaged in agriculture to a relatively large degree. Second, we find a sizeable gender gap not only when comparing men and women who do not own land, but also when comparing men and women who

own land. Third, non-landowning men still have significantly more agency and achievements in agriculture compared to landowning women except for membership in agricultural groups.

Table 2 provides summary statistics on relevant individual and household characteristics by landownership status and gender. Regardless of their landownership status, men are more likely to be older than their female counterparts. Overall, very few respondents completed primary school, but women did so to a significantly lower extent than men, respectively 5% and 14%. There are, however, no differences in educational attainment between women (men) who own land and women (men) who do not own land. While there is no significant difference in the proportion of male respondents who are Muslim among both landowning categories, we do find that significantly fewer female landowners are of Islam religion. Interestingly, the share of women in polygamous marriages is not significantly different across both landowning categories (around 17%), but we find significantly more men in polygamous marriage arrangements among those who own land, respectively 20% compared to 10% among those who do not own land. Women who own land are also more likely to belong to the Akan when compared to male landowners and to women who do not own land, but there is no significant difference when we compare men and women who do not own land. We observe no significant differences in household composition between women and men with and without landownership. One exception is for the number of female and male elderly, who are more numerous in households of landowning compared to households of non-landowning respondents.

Table 2 also sheds light on the gender differences in the relationship between landownership and household wealth. A majority of men (72%) who do not own land live in households that belong to the lowest wealth tercile, whereas a significantly lower proportion of landowning men are in the lowest wealth tercile (19%). Consequently, a significantly larger

proportion of men who own land belong to the highest wealth tercile. These patterns are similar, but less pronounced among female respondents. Finally, we find no significant difference in the distance to the secondary road for men who own and men who do not own land, but women who own land live significantly closer to the secondary road, suggesting that proximity to a road relates positively to women's land rights.

Table 2: Socio-economic characteristics of men and women in agricultural households by gender

Characteristics	Do not own land		Own land	
	Men	Women [a.]	Men [b.]	Women [a.; b]
Age (years)	43.32	36.28***	**46.32**	**40.40*** **
Completion of primary education (%)	13.10	4.22***	14.33	4.75***
Islam (%)	51.11	50.77	46.95	**31.23*** **
Polygamous (%)	10.12	17.26***	**20.30**	16.27
Akan (%)	4.68	3.73	4.30	**13.27*** **
# men 0-15 y/o	1.79	1.71	1.65	1.60
# women 0-15 y/o	1.39	1.44	1.47	1.46
# men 16-65 y/o	1.39	1.45	1.45	1.41
# women 16-65 y/o	1.59	1.58	1.57	1.59
# men 66 y/o and older	0.08	0.13***	**0.16**	**0.19**
# women 66 y/o and older	0.05	0.08***	**0.09**	0.06**
1st asset tercile (%)	71.80	41.43***	**18.95**	**32.70*** **
2nd asset tercile (%)	13.84	29.15***	**39.07**	34.84
3rd asset tercile (%)	14.36	29.42***	**41.98**	32.46**
Distance to a secondary road (meters)	13,535	15,099**	14,942	**12,259*** **
Number of observations	423	1,525	1,311	209

[a.] Stars denote significant gender differences in a two-sided *t*-test using clustered standard errors by the enumeration area at * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$. [b.] Bold denotes significant differences between men (resp. women) who do and do not own land in a two-sided t-test using clustered standard errors by the enumeration area at $p<0.05$. All estimates are calculated using sampling weights.

6.2 Regression Estimates

Landownership

Table 3 below shows the results of the first-stage regression of the recursive biprobit model for production decisions predicting factors associated with landownership. The first-stage regression results of the bivariate probit models for the other outcome variables are nearly identical. As expected, female farmers are significantly less likely to own land compared to their male counterparts. The gender gap is strongly exacerbated in Muslim and polygamous households, given that men in these households are significantly more likely to own land compared to men in non-Islamic and monogamous households. Being of Akan ethnicity (i.e. a matrilineal ethnic group) does not significantly affect men's landownership, but we do find that women of Akan origin are more likely to own land than women of other ethnicities. However, women of Akan ethnicity are still significantly less likely to own land compared to men of Akan ethnicity. The latter confirms the persisting gender inequalities in matrilineal ethnic groups (Quisumbing et al. 2001; Lambrecht, 2016; Lambrecht et al. 2018).

Age is positively associated with landownership. We do not find a significant effect of primary school completion. The lack of variation in the education variable (less than 10% completed primary education) may mask the relationship between education and landownership. The number of male children under the age of 16 along with the number of working-age women are negatively related to landownership. As expected, respondents in households in the lowest wealth tercile are significantly less likely to own land. Distance to a secondary road is positively and significantly correlated with landownership for men. The reverse is found for women; women who live further away from a secondary road are less likely to own land. The latter is in line with

observations that land in more remote areas is governed by a more traditional interpretation of the customary law, which grants men greater land rights than women (Fenrich and Higgins, 2001).

Table 3. First-stage results of recursive bivariate probit model for production decisions predicting self-reported land ownership

Variable	Land ownership
Female	-1.557***
	(0.131)
Islam	0.100
	(0.109)
Female*Islam	-0.266*
	(0.138)
Polygamous	0.558***
	(0.149)
Polygamous*Female	-0.430**
	(0.204)
Akan	-0.084
	(0.264)
Female*Akan	0.673***
	(0.244)
Age	0.021*
	(0.011)
Age squared	-0.000
	(0.000)
Completed primary education	0.066
	(0.100)
# men 0-15 y/o	-0.044*
	(0.024)
# women 0-15 y/o	0.002
	(0.024)
# men 16-65 y/o	0.006
	(0.038)
# women 16-65 y/o	-0.115**
	(0.045)
# men 66 y/o and older	0.135
	(0.137)
# women 66 y/o and older	-0.107
	(0.077)
1st asset tercile	-1.027***
	(0.098)
2nd asset tercile	-0.040
	(0.072)
Distance to secondary road	0.000***
	(0.000)
Female*Distance to secondary road	-0.000**
	(0.000)

Constant	1.939***
	(0.442)
District-level fixed effects	Yes
Coefficient for joint effect| female=1	
Islam	-0.167
Polygamous	0.127
Akan	0.589**
Female + (Female*Islam)| Islam=1	-1.824***
Female + (Female*Polygamous)| Polygamous = 1	-1.988***
Female + (Female*Akan)| Akan = 1	-0.885***
Observations	3,468

Note: Standard errors clustered by enumeration area in parentheses; *** p<0.01, ** p<0.05, * p<0.1; all estimates are calculated using sampling weights.

Agency and Achievement in Agriculture

Table 4 reports the estimates of the recursive biprobit models for our indicators of agency and achievements. As hypothesized, the negative and statistically significant female dummies suggest that women who do not own land are less likely to participate in decisions concerning agricultural production, agricultural input purchases, types of crops to grow, and use of food and cash crop earnings compared to their male counterparts. Women who do not have landownership are, however, less likely to have high agricultural workload than men who do not own land.

For men, owning land is positively associated with decision-making in agricultural input purchases, types of crops to grow, and membership in agricultural groups. However, there is no significant association between landownership and participation in agricultural production decisions and decisions on the use of food crop income, agricultural workload, and total workload for men. The negative and statistically significant coefficient for landownership associated with the use of income generated from cash crop farming may not be meaningful since nearly all men make decisions on how cash crop earnings are used, as reported in Table 1.

Contrary to the positive association of landownership with outcome indicators in most of the domains for men, the picture is much more nuanced for women. Compared to women who do not own land, women with landownership are more likely to participate in decisions regarding

agricultural input purchases and types of crops to grow and are also more likely to be members of agricultural groups. The associations of landownership with participation in farm income decisions and with workloads do not significantly differ between women with and without landownership.

Table 4. Recursive bivariate probit regression results predicting agency and achievements in agriculture

Variable	Production decisions	Input purchase decisions	Crop cultivation decisions	Decisions on use of food crop income	Decisions on use of cash crop income	Membership in agricultural groups	High agricultural workload	High total workload
Female	-1.850***	-1.262***	-0.863**	-1.550***	-2.257***	0.054	-1.037***	0.375
	(0.383)	(0.370)	(0.338)	(0.257)	(0.324)	(0.173)	(0.262)	(0.335)
Landownership	0.735	1.276***	1.543***	-0.510	-0.967**	0.835***	0.431	-0.394
	(0.548)	(0.486)	(0.413)	(0.551)	(0.492)	(0.245)	(0.423)	(0.583)
Female*Landownership	-0.048	-0.216	-0.304	-0.193	0.388	-0.250	0.193	-0.003
	(0.228)	(0.208)	(0.197)	(0.211)	(0.336)	(0.201)	(0.221)	(0.178)
Islam	0.138	0.261	0.178	0.415	0.552**	0.084	-0.349***	-0.109
	(0.238)	(0.214)	(0.225)	(0.255)	(0.278)	(0.137)	(0.110)	(0.104)
Female*Islam	-0.384	-0.626***	-0.554**	-0.564**	-0.630**	-0.187	0.186	-0.017
	(0.267)	(0.241)	(0.251)	(0.284)	(0.288)	(0.154)	(0.135)	(0.121)
Polygamous	-0.305	-0.244	-0.165	0.265	-0.328	0.166	-0.086	-0.079
	(0.242)	(0.228)	(0.222)	(0.278)	(0.275)	(0.141)	(0.133)	(0.165)
Female*Polygamous	0.312	0.353	0.198	-0.563*	0.191	-0.189	0.190	0.203
	(0.292)	(0.278)	(0.285)	(0.290)	(0.305)	(0.163)	(0.141)	(0.177)
Akan	0.378	-0.185	0.744	-0.660*	-1.238***	0.157	-0.369	0.404
	(0.447)	(0.468)	(0.460)	(0.392)	(0.453)	(0.262)	(0.277)	(0.278)
Female*Akan	0.046	0.522	-0.322	0.674*	1.198***	-0.152	0.449*	0.083
	(0.453)	(0.409)	(0.470)	(0.380)	(0.447)	(0.306)	(0.236)	(0.243)
Age	0.065***	0.062***	0.058***	0.046***	0.033**	0.032***	0.041***	0.028***
	(0.013)	(0.013)	(0.013)	(0.014)	(0.017)	(0.010)	(0.012)	(0.011)
Age squared	-0.001***	-0.001***	-0.001***	-0.000***	-0.000*	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Completed primary education	-0.176	-0.226	-0.308*	0.251	0.083	-0.075	-0.383***	-0.142
	(0.216)	(0.198)	(0.162)	(0.161)	(0.185)	(0.108)	(0.106)	(0.154)
# men 0-15 y/o	-0.028	-0.034	0.009	-0.025	0.015	0.037	0.031	-0.036
	(0.024)	(0.027)	(0.027)	(0.027)	(0.034)	(0.023)	(0.023)	(0.023)
# women 0-15 y/o	-0.013	-0.007	0.005	0.045	0.028	-0.001	-0.000	0.003
	(0.028)	(0.027)	(0.026)	(0.035)	(0.036)	(0.024)	(0.025)	(0.028)
# men 16-65 y/o	-0.010	-0.006	-0.036	0.012	0.029	0.004	-0.087**	-0.080**
	(0.042)	(0.034)	(0.038)	(0.039)	(0.050)	(0.039)	(0.035)	(0.035)

# women 16-65 y/o	0.026	0.017	0.024	0.008	0.046	-0.064	0.057	0.017
	(0.047)	(0.045)	(0.044)	(0.059)	(0.067)	(0.045)	(0.048)	(0.038)
# men 66 y/o and older	-0.060	0.072	-0.022	0.034	0.198	0.066	0.027	0.031
	(0.148)	(0.144)	(0.161)	(0.178)	(0.178)	(0.145)	(0.147)	(0.114)
# women 66 y/o and older	0.100	0.041	0.083	0.004	0.130	0.157	-0.206*	0.012
	(0.164)	(0.143)	(0.132)	(0.126)	(0.155)	(0.099)	(0.109)	(0.092)
1st asset tercile	0.111	0.265**	0.252**	-0.220	-0.113	-0.724***	0.119	-0.172
	(0.144)	(0.126)	(0.118)	(0.163)	(0.173)	(0.112)	(0.141)	(0.164)
2nd asset tercile	0.038	0.137	0.068	-0.068	-0.123	-0.049	-0.111*	-0.144*
	(0.092)	(0.097)	(0.084)	(0.095)	(0.125)	(0.070)	(0.065)	(0.082)
Constant	0.041	-0.461	-1.155*	2.017***	2.988***	-1.369***	-1.843***	-1.262
	(0.830)	(0.747)	(0.673)	(0.730)	(0.688)	(0.439)	(0.637)	(0.882)
District-level fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Coefficient for joint effect| female=1								
Landownership	0.687	1.060**	1.240***	-0.704	-0.579	0.585*	0.624	-0.397
Islam	-0.246***	-0.365***	-0.375***	-0.150	-0.078	-0.103	-0.164*	-0.126
Polygamous	0.006	0.109	0.032	-0.299**	-0.137	-0.023	0.103	0.124
Akan	0.424	0.337	0.422	0.014	-0.040	0.005	0.080	0.486**
Female + (Female*landownership)| land=1	-1.898***	-1.478***	-1.167***	-1.743***	-1.869***	-0.196	-0.844**	0.372
Female + (Female*islam)| Islam=1	-2.234***	-1.887***	-1.417***	-2.114***	-2.889***	-0.134	-0.851***	0.358
Female + (Female*Polygamous)| Polygamous=1	-1.538***	-0.909*	-0.665	-2.114***	-2.066***	-0.136	-0.847***	0.578
Female + (Female*akan)| Akan=1	-1.804***	-0.740	-1.185**	-0.876**	-1.059**	-0.098	-0.587**	0.458*
Observations	3,021	2,993	3,014	2,775	2,030	3,454	3,234	3,234

Note: Standard errors clustered by enumeration area in parentheses; *** p<0.01, ** p<0.05, * p<0.10; all estimates are calculated using sampling weights.

Despite the optimistic findings above, the interaction term of being female and owning land is insignificant in all main regressions. As a consequence, the gender gap observed between men and women who do not own land is similar if we compare men and women who own land. Compared to male landowners, female landowners are less likely to be involved in cultivation and farm income decisions. Women are however less likely to have high agricultural workload.

Again, we find that religion, household type, and ethnicity have heterogeneous impacts on men and women. Muslim women have less agency than non-Muslim women in terms of production, purchase, and cropping decisions, whereas women in polygamous marriages are less likely to participate in decision on use of food crop income compared to women in monogamous marriages. Akan women are more likely to participate in decisions on use of income from food and cash crop income compared to non-Akan women, but also have a higher agricultural workload. To the contrary, men of Akan origin are less likely to participate in income decisions compared to non-Akan men.

Nevertheless, we continue to observe gender gaps in agriculture within each of these different groups. Compared to their male counterparts, Muslim women are considerably less likely to participate in decisions on agricultural production, input purchases, types of crops to grow, and the use of food and cash crop income. Similarly, women living in polygamous households are less likely to have a say in production, input purchase, and farm income decisions than men in polygamous households. Akan women are also less likely to participate in decisions on agricultural production decisions as well as on the use of income generated from farming compared to Akan men. Akan women are more likely to have high total workload than their male counterparts. Regardless of their religion, household type, and ethnicity, men are more likely to have high agricultural workload than women.

Age is positively associated with having agency and achievements in agriculture, but eventually this effect becomes negative at older age. Individuals who completed primary education are less likely to participate in decisions on the types of crops to grow. While this negative correlation may be surprising, they could reflect the fact that better-educated individuals are less likely to be involved in agricultural work than lesser-educated persons. This may also account for why better-educated individuals are less likely to have high agricultural workload.

While household composition does not have a significant association with agency and achievements in agriculture, the number of working-age men is negatively correlated with the probability of having high agricultural and total workloads. Household wealth is significantly associated with agency and achievement in agriculture. Compared to individuals belonging to the top asset tercile, those in the lowest tercile are more likely to have a say over purchases of agricultural inputs and types of crops to grow. A likely reason is that impoverished individuals are more likely to rely on agricultural activities as their main source of livelihoods; thus, they would have greater input in agricultural production decisions than wealthier persons. On the contrary, those who belong to the poorest wealth tercile are less likely to be members of agricultural associations. Individuals belonging to the middle asset tercile are less likely to have high agricultural and total workloads than those in the highest asset tercile.

6.3 Sensitivity analysis

Tables 5 and A2 presents the main regression results of the recursive bivariate probit analyses in which the landownership indicator is specified at household-level rather than individual-level (sensitivity analysis a). Three key messages emerge. First, we still observe significant gender gaps in agriculture among those living in households who do not own land for all outcomes, except for membership in agricultural groups. Second, for men, the household's

landownership is associated with significantly higher participation in input purchase and crop cultivation decisions and agricultural association membership. The relationship between household-level landownership and production decision and decisions on cash crop income is no longer statistically significant. Third, gender gaps persist for decisions on use of food crop income and workload in landowning households and are even wider compared to non-landowning households for crop cultivation decisions and agricultural group membership. This can be observed from the interaction terms, which have become negative and statistically significant for agricultural production decisions and membership in agricultural groups. Overall, women in landowning households do not have significantly more input into decision-making compared to women in non-landowning households, except in decision on the use of food crop income and participation in agricultural groups.

Tables 5 and A3 reports the regression estimates that use self-reported individual landownership as key variable of interest, but are based on the sub-sample of landowning households (sensitivity analysis b). In other words, it excludes households in which neither the husband nor wife report owning land. Again, we point at three key messages emerging from these results. First, we continue to find negative and statistically significant associations of being female with the outcome variables for farmers who do not report to own land, except for input in decisions regarding agricultural input purchases, membership in agricultural groups, and having high agricultural workload. Second, we no longer observe any significant associations between landownership and our outcome variables, except for input in decisions on food crop income and agricultural association membership. This however, may be partly due to large standard errors related to having only few male respondents who do not own land but live in a landowning household. For the same reason, the negative relationships between landownership and income

decisions may not be meaningful. Third, however, the gender gap is maintained or even larger when we consider men and women who own land within landowning households. Women who own land are significantly less likely to have agency in agriculture compared to men who own land.

7. Discussion and conclusion

Land provides the basis for food production and most income-generating activities and is the most important asset among agricultural households. Using the 2012 Feed the Future Baseline Survey data, we investigate how landownership is associated with agency and achievements in agriculture for male and female farmers. More specifically, this paper studies whether individuals with landownership are more likely to have agency and achievements in agriculture than those who do not own land, and whether landownership is associated with improvements in women's agency (i.e. participation in decisions on crop cultivation, decisions on income from agriculture, and membership in agricultural associations) and achievements (excessive workload) in agriculture relative to their male counterparts.

The results from our analyses show a large gender gap in participation in decisions surrounding agricultural cultivation (production, input purchases, and types of crops). This gap is especially large for women in Muslim households. Not surprisingly, self-reported landownership significantly increases participation in input purchase and crop decisions for both men and women. Nonetheless, we continue to observe a similar gender gap among the landowners.

Table 5. Key estimates of the sensitivity analysis a that uses a household-level landownership indicator, and sensitivity analysis b that restricts the sample to landowning households.

Variable	Production decisions	Input purchase decisions	Crop cultivation decisions	Decisions on use of food crop income	Decisions on use of cash crop income	Membership in agricultural groups	High agricultural workload	High total workload
Sensitivity analysis a:								
Female	-1.360***	-0.898***	-0.461	-1.974***	-1.727***	0.075	-1.034***	0.420**
	(0.377)	(0.313)	(0.354)	(0.569)	(0.208)	(0.202)	(0.197)	(0.181)
Household Landownership	0.669	1.229**	1.311**	0.246	-0.336	2.025***	-0.278	-0.184
	(0.532)	(0.522)	(0.514)	(0.519)	(0.447)	(0.284)	(0.354)	(0.370)
Female*Household	-0.979**	-1.263***	-1.502***	0.556		-0.609***	-0.245	0.207
Landownership	(0.419)	(0.344)	(0.383)	(0.548)		(0.198)	(0.204)	(0.181)
Sensitivity analysis b:								
Female	-2.617***	-0.882	-1.191*	-1.616***	-1.504***	0.406	-0.272	
	(0.384)	(1.210)	(0.638)	(0.259)	(0.548)	(0.288)	(0.704)	
Landownership	-0.630	1.663	1.074	-0.607**	-0.097	1.256***	1.158	
	(0.792)	(1.378)	(0.827)	(0.257)	(0.663)	(0.329)	(0.801)	
Female*Landownership	-0.456	-0.716	-0.962**	-0.809***	-0.735*	-0.219	-0.298	
	(0.335)	(0.563)	(0.382)	(0.230)	(0.432)	(0.231)	(0.309)	

Note: Standard errors clustered by enumeration area in parentheses; *** p<0.01, ** p<0.05, * p<0.10; all estimates are calculated using sampling weights. Missing value for the interaction term in the cash crop income regression because there are no men that do not have influence on decisions regarding the use of cash crop income and live in non-landowning households. Missing values for the equation predicting the probability of having high total workload in sensitivity analysis b due to lack of convergence of the regression estimates.

We also observe a significant gender gap when considering participation in decisions-making on income from cash or food crop farming for those who do not own land, and a similar gender gap among those who own land. Given that women are responsible for household food purchases and other small household expenses such as clothes or school fees (Lambrecht, 2016), women can often participate to some extent on the use of income from farming and we find that they are more likely to participate in these decision compared to cultivation decisions. Yet, men continue to be decision makers on the use of income for household food consumption and for household or agricultural investments.

We find that men are more likely to be member of agricultural associations compared to women. Yet, agricultural association membership is the only domain where we do not observe a gender gap in agricultural association membership when controlling for landownership. In other words, we do not find significant gender differences when comparing men and women who do not own land, and when comparing men and women who are landowners. Landownership is positively correlated with being members of agricultural groups for both women and men.

Women are less likely to have a high agricultural workload than men, regardless of their landowning status. To the contrary, however, our descriptive statistics show that women more often have a higher total workload compared to men. Yet these differences are not significant in our regression analyses.

These findings paint a modest picture of the association of landownership with an improvement of women's agency and achievements. They substantiate the work of Agarwal (1997) and Kabeer (1999) by showing that both women and men are more likely to participate in decisions on agricultural cultivation and in agricultural groups when they own land. However, owning land does not close the observed gender gap. In northern Ghana, as elsewhere, patriarchal

social norms and rules govern men's and women's behavior in the household and on the farm and are not easily overridden by changing notions of landownership. The image of the male breadwinners is pervasive in Ghana, and across many other cultures, and continues to dominate norms and perceptions on household organization (Kabeer, 2016; Lambrecht, 2016). In an agrarian economy, this aligns with men taking up leading roles in agriculture, and a stereotypical image of men being more knowledgeable concerning farming practices (Jost et al., 2016). These norms and perceptions seem to be maintained and applied, irrespective of landownership.

In terms of policy implications**,** the observed discrepancies in men's and women's landownership, gaps in participation in agricultural decision making as well as an unequal workload show that continued efforts to improve women's access to land and voice in agriculture are not misplaced. However, a mere focus on women's landownership may not necessarily lead to reduced inequalities in decision-making in agriculture or ensure a more equal workload for men and women. Improving women's participation in, and benefits from, decision-making in agriculture, will require gender-sensitive development strategies that go beyond advancing women's land rights in Ghana.

Although our analysis adds valuable insights to the understanding of how ownership of land is associated with agency and achievement in agriculture, it suffers from shortcomings related to the construction and interpretation of some of the key indicators as well as the lack of a causal analysis that can quantify the impact of landownership. Specifically, in a setting where there is a clear indication of individual-level user and ownership rights at plot-level, such as Ghana, we strongly recommend collecting gender-disaggregated land rights and agricultural decision making data at plot-level. Such data allows for distinction between joint and individual plot ownership or decision making processes among different household members. Much more remains to be

unpacked concerning women's empowerment in agriculture by using better and alternative indicators and methods, and by focusing on different contexts.

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APPENDIX

Table A1. Probit estimates predicting the probability of having agency and achievements in agriculture

Variable	Production decisions	Input purchase decisions	Crop cultivation decisions	Decisions on use of food crop income	Decisions on use of cash crop income	Membership in agricultural groups	High agricultural workload	High total workload
Female	-1.982***	-1.648***	-1.367***	-1.148***	-1.936***	-0.023	-1.227***	0.553***
	(0.218)	(0.171)	(0.182)	(0.227)	(0.319)	(0.149)	(0.127)	(0.109)
Landownership	0.507**	0.668***	0.775***	0.449**	-0.162	0.687***	0.078	-0.065
	(0.202)	(0.190)	(0.188)	(0.206)	(0.298)	(0.128)	(0.124)	(0.115)
Female*landownership	-0.083	-0.291	-0.397*	-0.018	0.577*	-0.278	0.115	0.050
	(0.224)	(0.217)	(0.211)	(0.225)	(0.347)	(0.189)	(0.193)	(0.156)
Islam	0.141	0.274	0.187	0.449*	0.571**	0.089	-0.343***	-0.120
	(0.241)	(0.224)	(0.239)	(0.269)	(0.277)	(0.135)	(0.114)	(0.097)
Female*Islam	-0.395	-0.668***	-0.603**	-0.584**	-0.623**	-0.196	0.169	0.004
	(0.267)	(0.245)	(0.261)	(0.297)	(0.292)	(0.153)	(0.137)	(0.109)
Polygamous	-0.277	-0.173	-0.074	0.109	-0.493*	0.188	-0.038	-0.122
	(0.230)	(0.224)	(0.223)	(0.284)	(0.252)	(0.138)	(0.129)	(0.141)
Female*Polygamous	0.287	0.293	0.119	-0.440	0.335	-0.208	0.147	0.241
	(0.279)	(0.274)	(0.287)	(0.301)	(0.292)	(0.163)	(0.138)	(0.164)
Akan	0.347	-0.269	0.692	-0.645	-1.227**	0.142	-0.402	0.444*
	(0.441)	(0.500)	(0.465)	(0.410)	(0.488)	(0.259)	(0.291)	(0.251)
Female*Akan	0.115	0.713*	-0.121	0.449	1.054**	-0.105	0.549**	-0.012
	(0.431)	(0.408)	(0.483)	(0.404)	(0.474)	(0.315)	(0.227)	(0.170)
Age	0.066***	0.066***	0.063***	0.046***	0.032*	0.033***	0.043***	0.027**
	(0.013)	(0.013)	(0.013)	(0.015)	(0.018)	(0.011)	(0.012)	(0.011)
Age squared	-0.001***	-0.001***	-0.001***	-0.000***	-0.000	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Completed primary education	-0.176	-0.231	-0.322*	0.259	0.084	-0.073	-0.382***	-0.149
	(0.216)	(0.205)	(0.169)	(0.173)	(0.195)	(0.108)	(0.106)	(0.152)
# men 0-15 y/o	-0.029	-0.040	0.004	-0.018	0.024	0.035	0.028	-0.033
	(0.024)	(0.026)	(0.028)	(0.029)	(0.034)	(0.023)	(0.022)	(0.023)
# women 0-15 y/o	-0.013	-0.008	0.004	0.046	0.029	-0.001	-0.000	0.004
	(0.027)	(0.027)	(0.027)	(0.037)	(0.038)	(0.024)	(0.025)	(0.028)
# men 16-65 y/o	-0.010	-0.005	-0.036	0.012	0.030	0.004	-0.088**	-0.081**

	(0.042)	(0.035)	(0.038)	(0.040)	(0.052)	(0.039)	(0.036)	(0.034)
# women 16-65 y/o	0.021	0.004	0.007	0.037	0.069	-0.068	0.047	0.026
	(0.047)	(0.046)	(0.044)	(0.057)	(0.066)	(0.044)	(0.050)	(0.037)
# men 66 y/o and up	-0.053	0.092	-0.001	0.010	0.175	0.069	0.035	0.021
	(0.149)	(0.148)	(0.167)	(0.195)	(0.192)	(0.146)	(0.149)	(0.115)
# women 66 y/o and up	0.093	0.025	0.062	0.023	0.166	0.153	-0.216**	0.021
	(0.165)	(0.143)	(0.135)	(0.140)	(0.165)	(0.099)	(0.108)	(0.092)
1st asset tercile	0.061	0.138	0.087	-0.005	0.072	-0.766***	0.023	-0.093
	(0.114)	(0.113)	(0.111)	(0.104)	(0.129)	(0.090)	(0.078)	(0.085)
2nd asset tercile	0.036	0.134	0.061	-0.064	-0.128	-0.050	-0.116*	-0.142*
	(0.092)	(0.095)	(0.083)	(0.108)	(0.135)	(0.070)	(0.065)	(0.081)
Constant	0.335	0.316	-0.162	0.966*	2.082***	-1.196***	-1.227***	-1.672***
	(0.520)	(0.541)	(0.503)	(0.500)	(0.647)	(0.365)	(0.127)	(0.439)
District-level fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,021	2,993	3,014	2,775	2,030	3,454	3,234	3,234

Note: Standard errors clustered by enumeration area in parentheses; *** p<0.01, ** p<0.05, * p<0.10; all estimates are calculated using sampling weights

Table A2. Recursive bivariate probit estimates with household-level landownership indicator (sensitivity analysis a)

Variable	Production decisions	Input purchase decisions	Crop cultivation decisions	Decisions on use of food crop income	Decisions on use of cash crop income	Membership in agricultural groups	High agricultural workload	High total workload
Female	-1.360***	-0.898***	-0.461	-1.974***	-1.727***	0.075	-1.034***	0.420**
	(0.377)	(0.313)	(0.354)	(0.569)	(0.208)	(0.202)	(0.197)	(0.181)
Household	0.669	1.229**	1.311**	0.246	-0.336	2.025***	-0.278	-0.184
landownership	(0.532)	(0.522)	(0.514)	(0.519)	(0.447)	(0.284)	(0.354)	(0.370)
Female*Hh	-0.979**	-1.263***	-1.502***	0.556		-0.609***	-0.245	0.207
landownership	(0.419)	(0.344)	(0.383)	(0.548)		(0.198)	(0.204)	(0.181)
Islam	0.187	0.304	0.238	0.486*	0.578**	0.089	-0.337***	-0.115
	(0.239)	(0.221)	(0.237)	(0.272)	(0.279)	(0.141)	(0.117)	(0.098)
Female*Islam	-0.455*	-0.718***	-0.667**	-0.636**	-0.644**	-0.245	0.159	0.000
	(0.265)	(0.245)	(0.261)	(0.298)	(0.292)	(0.149)	(0.136)	(0.110)
Polygamous	-0.215	-0.098	0.028	0.143	-0.474*	0.130	-0.010	-0.122
	(0.234)	(0.225)	(0.226)	(0.283)	(0.258)	(0.139)	(0.134)	(0.143)
Female*Polyg	0.244	0.228	0.031	-0.500*	0.328	-0.183	0.121	0.243
amous	(0.277)	(0.272)	(0.288)	(0.299)	(0.290)	(0.156)	(0.138)	(0.162)
Akan	0.226	-0.192	0.533	-0.755*	-1.258***	0.329	-0.457	0.428*
	(0.451)	(0.422)	(0.473)	(0.405)	(0.487)	(0.319)	(0.303)	(0.260)
Female*Akan	0.296	0.747*	0.127	0.636	1.125**	-0.051	0.615***	-0.010
	(0.454)	(0.383)	(0.503)	(0.400)	(0.479)	(0.312)	(0.231)	(0.176)
Age	0.070***	0.070***	0.066***	0.049***	0.036**	0.032***	0.046***	0.026**
	(0.013)	(0.014)	(0.014)	(0.014)	(0.017)	(0.011)	(0.012)	(0.011)
Age squared	-0.001***	-0.001***	-0.001***	-0.000***	-0.000*	-0.000***	-0.001***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Completed	-0.182	-0.240	-0.317*	0.220	0.090	-0.096	-0.385***	-0.140
primary	(0.211)	(0.202)	(0.168)	(0.172)	(0.196)	(0.111)	(0.105)	(0.151)
education								
# men 0-15	-0.031	-0.040	0.003	-0.016	0.019	0.052**	0.026	-0.034
y/o	(0.024)	(0.026)	(0.027)	(0.029)	(0.034)	(0.023)	(0.023)	(0.023)
# women 0-15	-0.013	-0.009	0.004	0.049	0.030	0.002	-0.001	0.003
y/o	(0.027)	(0.027)	(0.026)	(0.037)	(0.038)	(0.025)	(0.025)	(0.028)
# men 16-65	-0.014	-0.006	-0.040	0.009	0.026	-0.005	-0.087**	-0.082**
y/o	(0.042)	(0.035)	(0.038)	(0.039)	(0.050)	(0.040)	(0.037)	(0.035)
# women 16-	0.010	-0.003	-0.000	0.040	0.064	-0.052	0.041	0.026

65 y/o	(0.048)	(0.048)	(0.047)	(0.059)	(0.067)	(0.044)	(0.050)	(0.038)
# men 66 y/o	-0.043	0.092	0.001	0.007	0.198	0.027	0.051	0.021
and up	(0.151)	(0.153)	(0.170)	(0.189)	(0.185)	(0.155)	(0.151)	(0.116)
# women 66	0.070	0.011	0.051	0.004	0.136	0.151	-0.226**	0.022
y/o and up	(0.161)	(0.139)	(0.134)	(0.138)	(0.162)	(0.100)	(0.106)	(0.093)
1st asset tercile	-0.027	0.168	0.071	0.036	-0.002	-0.185	-0.172	-0.093
	(0.161)	(0.179)	(0.163)	(0.150)	(0.169)	(0.192)	(0.161)	(0.183)
2nd asset	0.034	0.146	0.073	-0.058	-0.131	-0.003	-0.129*	-0.144*
tercile	(0.087)	(0.089)	(0.081)	(0.104)	(0.138)	(0.070)	(0.067)	(0.082)
Constant	0.213	-0.391	-0.783	1.116	2.376***	-3.042***	-0.964	0.420**
	(0.792)	(0.825)	(0.749)	(0.776)	(0.744)	(0.470)	(0.671)	(0.181)
District-level fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,021	2,993	3,014	2,775	2,006	3,454	3,234	3,234

Note: Standard errors clustered by enumeration area in parentheses; *** p<0.01, ** p<0.05, * p<0.10; all estimates are calculated using sampling weights

Table A3. Recursive bivariate probit regression results based on a subsample of landowning households (sensitivity analysis b)

Variable	Production decisions	Input purchase decisions	Crop cultivation decisions	Decisions on use of food crop income	Decisions on use of cash crop income	Membership in agricultural groups	High agricultural workload
Female	-2.617***	-0.882	-1.191*	-1.616***	-1.504***	0.406	-0.272
	(0.384)	(1.210)	(0.638)	(0.259)	(0.548)	(0.288)	(0.704)
Landownership	-0.630	1.663	1.074	-0.607**	-0.097	1.256***	1.158
	(0.792)	(1.378)	(0.827)	(0.257)	(0.663)	(0.329)	(0.801)
Female*Landownership	-0.456	-0.716	-0.962**	-0.809***	-0.735*	-0.219	-0.298
	(0.335)	(0.563)	(0.382)	(0.230)	(0.432)	(0.231)	(0.309)
Islam	0.374	0.286	0.256	0.362	0.502**	0.044	-0.455***
	(0.228)	(0.224)	(0.238)	(0.230)	(0.243)	(0.153)	(0.133)
Female*Islam	-0.587**	-0.643**	-0.591**	-0.621**	-0.621**	-0.126	0.290**
	(0.240)	(0.271)	(0.257)	(0.246)	(0.265)	(0.167)	(0.144)
Polygamous	-0.257	-0.264	-0.161	0.178	-0.483*	0.060	-0.066
	(0.272)	(0.232)	(0.252)	(0.243)	(0.280)	(0.163)	(0.126)
Female*Polygamous	0.304	0.446	0.184	-0.535**	0.260	-0.154	0.121
	(0.308)	(0.284)	(0.308)	(0.261)	(0.296)	(0.170)	(0.145)
Akan	-0.137	0.665	0.630	-0.702**	-1.513***	-0.211	0.134
	(0.468)	(0.436)	(0.443)	(0.349)	(0.439)	(0.273)	(0.235)
Female*Akan	0.638	0.029	0.083	0.602	1.218**	-0.107	0.216
	(0.453)	(0.503)	(0.484)	(0.443)	(0.561)	(0.316)	(0.258)
Age	0.063***	0.066***	0.073***	0.044***	0.033*	0.033***	0.046***
	(0.018)	(0.015)	(0.014)	(0.014)	(0.019)	(0.012)	(0.013)
Age squared	-0.001***	-0.001***	-0.001***	-0.000***	-0.000	-0.000***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Completed primary education	-0.233	-0.309	-0.390*	0.083	-0.025	-0.019	-0.343***
	(0.187)	(0.230)	(0.202)	(0.171)	(0.200)	(0.118)	(0.124)
# men 0-15 y/o	-0.011	-0.017	0.005	-0.007	0.014	0.068***	0.033
	(0.025)	(0.028)	(0.036)	(0.028)	(0.038)	(0.025)	(0.027)
# women 0-15 y/o	-0.001	-0.004	0.006	0.043	0.054	0.007	0.008
	(0.026)	(0.031)	(0.030)	(0.039)	(0.047)	(0.031)	(0.025)
# men 16-65 y/o	-0.016	-0.010	-0.057	0.021	0.043	-0.021	-0.083*
	(0.050)	(0.045)	(0.048)	(0.043)	(0.055)	(0.046)	(0.043)
# women 16-65 y/o	-0.023	-0.009	0.005	0.024	0.066	-0.009	0.080

	(0.055)	(0.057)	(0.058)	(0.066)	(0.078)	(0.058)	(0.051)
# men 66 y/o and up	-0.006	0.066	0.036	-0.042	0.072	0.030	0.029
	(0.149)	(0.172)	(0.197)	(0.178)	(0.191)	(0.165)	(0.150)
# women 66 y/o and up	0.044	0.072	0.115	-0.080	0.034	0.185*	-0.248**
	(0.155)	(0.169)	(0.156)	(0.128)	(0.157)	(0.107)	(0.123)
1st asset tercile	-0.170	0.172	0.013	-0.188*	0.056	-0.563***	0.100
	(0.181)	(0.145)	(0.140)	(0.108)	(0.160)	(0.102)	(0.122)
2nd asset tercile	0.047	0.140	0.032	0.013	-0.021	-0.017	-0.110
	(0.078)	(0.108)	(0.087)	(0.089)	(0.139)	(0.072)	(0.075)
Constant	2.206*	-1.166	-0.418	2.470***	2.332***	-1.833***	-3.265***
	(1.20)	(1.70)	(1.084)	(0.638)	(0.847)	(0.624)	(0.988)
District-level fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,520	2,494	2,495	2,316	1,675	2,706	2,600

Note: Standard errors clustered by enumeration area in parentheses; *** p<0.01, ** p<0.05, * p<0.10; all estimates are calculated using sampling weights. Missing values for the equation predicting the probability of having high total workload in sensitivity analysis b due to lack of convergence of the regression estimates.

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