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RESEARCH PAPER

Unmasking gender disparities in cocoa farming: the case of female land ownership in the Ashanti and Western North regions of Ghana

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Abstract
Ghana's economy relies heavily on agriculture, with subsistence farming being the primary source of income for rural households. Over 50% of the food grown worldwide is produced by women. Land ownership is paramount to be recognized as a cocoa farmer in Ghana, as most land is owned by men following traditional inheritance. This gives men access to, and control over, land for agriculture, thus creating structural gender inequalities. Thereby, women's contribution to agriculture is minimized and roles undermined. This study analyses the challenges faced by women cocoa farmers in the context of land ownership and how they are influenced by social and demographic factors. We focus on ownership including sole ownership. The study, conducted in seven communities across the Ashanti and Western North regions of Ghana, comprises 160 females and 40 males. Results indicate that ownership of cocoa plots, in general, is mostly male dominated, but when female farmers make farmland decisions, they are likely to be sole owners. Marital status and the mode of acquiring lands are very important factors that dictate ownership and sole ownership of land. While the results show the importance of land as a resource that can enhance women's agricultural productivity, it also highlights that policies to reduce gender inequality in agriculture by advancing land rights are needed.

Keywords Land ownership · Female decision-making · Gender equality · Cocoa production · Small-holder farmers · Agricultural productivity

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Introduction

According to Sen and Östlin (2008), gender is a complex social construct that characterizes systematic distinctions in power dynamics and social hierarchies. In addition to experiencing disparities in income, social hierarchy, division of labour, decision-making ability, access to resources, and agency, women also frequently occupy disempowered and disadvantaged gendered power roles and social hierarchies (Birks et al. 2013). The UN Sustainable Development Goals (SDGs), adopted in 2015, acknowledge that equal rights to land ownership and management as well as equal rights to inherit productive resources are crucial for achieving Goal 1 of ending poverty (target 1.4). Further, the SDGs suggest that policy and legal changes should grant women equal rights alongside access to ownership and control over land and other economic resources (target 5a) to achieve gender equality and empower all women and girls (Goal 5). Africa's land sector reflects a diverse and complex array of land governance and administration systems (Simbizi et al. 2014). Land is critical for the livelihoods of Ghanaians. With 69% going towards agriculture, it is the nation's principal source of production (Yokying and Lambrecht 2019). Significant population expansion is putting more strain on the land (Codjoe 2007), including increased urbanization. Significant land use changes have occurred in peri-urban regions, resulting in conflicts due to competing needs for cultivated and residential land (Ubink 2008; Spichiger and Stacey 2014). Women have less access to land than males in the Global South, even as many people in the region lack secure property rights and access to adequate resources (Raney et al. 2011). Sociocultural factors typically restrict women's rights and access to resources. Men, often household heads in patriarchal countries, make most decisions regarding resources in both the household and the community, meaning women have fewer rights to land and property (Doss 2013). Secure land rights not only mean access but also the ability to manage and control it. For many women, access to land and property—essential for producing food and maintaining long-term well-being—depends on their natal and marital ties. In many other countries that produce cocoa like Ghana, being recognized as a cocoa farmer is linked to land ownership. The majority ethnic group in Ghana, the Akans, practice the matrilineal inheritance. In this system, the recognition of women's entitlement to ancestral property occurs in instances of non-marriage, marriage, divorce, or widowhood (Kaunza-Nu-Dem et al. 2016). Thus, women are more vulnerable when their marital status changes due to a divorce or a spouse's passing (Grover et al. 2007). Under patrilineal systems, women's land rights are also affected by their relationships with male family members or spouses. In this system, women nevertheless have fewer inheritance rights than their brothers, even if they can inherit land from their fathers. Women among the Anlos in southern Ghana do not inherit as much land as men do, and women cannot pass land on to their offspring (Abubakari et al. 2021). However, with social networks that provide women the chance to easily get land, women in matrilineal communities have more access to, and control over, land than women in patrilineal societies (Quan 2007). The customary land tenure system is not the only approach to accessing land; one can acquire land through purchase, lease, or tenancy from the government, skin or stool, or families. There are financial constraints, even though these methods of acquisition could be the most secure means of women owning land. According to Dowuona-Hammond (2003), women have not just lower rates of access to, and utilization of, productive resources but also greater burdens, thus experiencing higher levels of poverty. Research indicates that land access and secured land rights can increase women's economic security and bargaining power at the household level (Anderson and Eswaran 2009; Wiig 2013). In the context of expanding cultivation of

tree crops, like cocoa, oil palm, and coconut, notably in southern Ghana, women's usufructuary privileges have been restricted, accompanied by modifications in inheritance customs that favour men (Scheiterle and Birner 2023). This study analyses the challenges faced by women cocoa farmers in the context of land ownership, including its variations, and how social and demographic factors influence it. The research was conducted in Ghana, which produces about 18% of the world's cocoa while employing an estimated 800,000 smallholder farmers (Essegbey and MacCarthy 2020). Underlying this research objective, two research questions guide the study: (1) What are the key barriers preventing female cocoa farmers from accessing land for cocoa farming? (2) To what extent do sociodemographic factors like gender, marital status, and level of education affect women's access to land? The study not only focuses on women but also includes men to recognize potential gender differences. We use gender to define male and female, but in general, gender is more diverse and is a social elaboration of biological sex.

Contributions of the study

The study differentiates between sole and joint ownership, which is not yet considered within the scope of the topic; this enables the identification of specific challenges encountered by women cocoa farmers within each ownership framework. Secondly, we employ a well-established gender analysis framework, specifically the Capabilities and Vulnerabilities Assessment Framework, to inform the design of the questionnaire utilized during data collection, thus ensuring a comprehensive examination of gender dynamics that identifies both the capacities and vulnerabilities experienced by women cocoa farmers regarding land ownership. Thirdly, we consider the influence of female decision-making and its impact on access to agricultural land. By focusing on female decision-making, the study delves deeper into the gender dynamics at play within land access in cocoa farming communities. Finally, we not only focus on women, like other studies (Panda and Agarwal 2005; Doss 2006, Doss et al. 2014; Santos et al. 2014; Mishra and Sam 2016), but include men in our analysis.

Background and conceptual framework

Land tenure systems in Ghana

In Ghana, three types of lands exist: state, private, and public (Agyeman-Yeboah 2015). The state holds almost 20% of the land (Asaaga 2017). Customary tenure covers around 75% of the land (Pande and Udry 2005). Either the head of the family or the traditional head of the lineage controls customary land (Lambrecht 2016). Under customary practices, each person is given a plot of land that they are free to use for as long as they want. However, depending on the community and the circumstances, the individual's ability to sell, rent, sharecrop, borrow, or will this land varies (Lambrecht and Asare 2016). In addition to inherited land ownership, there is an expanding unofficial land market for sales and rents (Aryeetey and Udry 2010) alongside long-standing sharecropping and other tenancy arrangements. According to Sarpong (2006), individuals who possess such lands in some regions of Ghana have the option to give up their ownership through a sale, lease, mortgage, pledge, or the granting of agricultural tenancies or shareholder agreements. The two most popular sharecropping agreements are Abusa and Abunu. Under Abunu, tenant

farmers normally receive half of the produce, while under Abusa, they receive a third. This practice, which takes many different forms, is increasingly common in agricultural communities as a means of securing access to limited land (Amanor 2010).

Land rights and registration

Ghana launched an ambitious land reform programme in 1999, adopting a National Land Policy. The strategy was implemented through a Land Administration Project (LAP), which was supported by the World Bank and many other donors; it was expected to run for around 20 years. The project's goals were to enhance land administration institutions and increase landholders' security of tenure. The registration of rights was a primary objective of the reform. The concept is not entirely new; immediately after independence, the deeds registration law was revoked and reinstituted after being in place since 1843 (Alhassan and Manuh 2005). The Land Title Registration Law introduced in 1986 focused on two areas: Greater Accra and Kumasi Metropolis. It was a more effective system of land titling and registration that included a gender strategy (Agyeman-Yeboah 2015). The gender strategy sought to raise gender awareness and mainstream gender in land-related institutions (customary and state) as well as activities and projects. Despite a legal framework allowing for equal ownership of land, considerable disparities between different groups still exist. Theoretically, gender equality in land ownership is guaranteed under Ghana's statutory laws. However, statutory law conflicts with current customary laws on land rights, which seldom grant equal access to, inheritance of, and ownership of land to men and women (Lambrecht 2016). While these practices are likely to differ among regions and ethnic groups, consistently women, migrants, and herders are less likely to own land, thus facing barriers to access. This demonstrates how social and ethnic identities are important in determining how resources are distributed and used to support ownership claims while discounting those of others (Berry 2002). Men and women in the same household farm different plots, as in other West African nations (Doss 2002); joint ownership or landholding is uncommon in Ghana (Lambrecht 2016). Social norms and customs define who is and is not a member of the family or community and what is acceptable in the community; hence, these significantly affect both men's and women's access to land (Lambrecht 2016). Gender relations in households and communities will be affected as land tenure progressively shifts to more individualized land rights and the rise of land markets, which present both new possibilities and obstacles for men and women to acquire land (Doss et al. 2019).

Conceptual framework

This study uses the capacities and vulnerabilities assessment framework (CVA). The CVA was designed specifically for use in humanitarian interventions and disaster preparedness; it critically considers gender and its associated roles, responsibilities, and power dynamics in a particular community by seeking to meet their social needs (Turnbull and Turvill 2012; Birks et al. 2013). CVA is an essential component of disaster risk analysis, designed to identify vulnerable groups, those factors making them vulnerable, as well as assessing their needs and capacities. CVA aims to ensure that projects and policies address these needs, through targeted interventions. In development projects, it provides analytical data supporting project design and planning decisions, particularly in ensuring that risks to vulnerable people are reduced as a result of the project (Consortium 2007). CVA offers two key tools: (1) categories of capacities and vulnerabilities; and (2) additional dimensions

of complex reality. For this paper, only the first tool is used as it distinguishes between the different categories of capacities and vulnerabilities, specifically including key components of this paper: land, household, access to resources, community, and family systems, and, most importantly, cultural factors. CVA is selected because it breaks down various capacities and vulnerabilities that are assumed to be different for men and women (Birks et al. 2013). CVA is used to determine whether the assumed difference is true and how much it affects the Ghanaian cocoa sector in terms of land ownership. Gender analysis is crucial here because women's and men's roles in these various forms differ widely. Women may be excluded from social group decision-making processes or may have sophisticated labour and resource exchange networks. The tool was created because of the potential for divisions based on gender, race, class, or ethnicity to erode a group's social cohesion and increase their vulnerability (March et al. 1999).

Drawing from the framework, the existing strengths that people and social groupings possess are their capacities. This involves people's social, material, and physical resources alongside their attitudes and beliefs. People's capacities, which develop over time, dictate their capacity to handle and emerge from a crisis. Long-term conditions—vulnerabilities—make people less able to handle catastrophes or the rapid advent of disasters. They also increase a person's susceptibility to calamities. According to (March et al. 1999), vulnerabilities predispose people to disasters, exacerbating their severity, complicating disaster response, and persisting beyond the disaster. The tool, categories of capacities and vulnerabilities, is subdivided into three separate, but complementary, components (Orru et al. 2022). The three components intersect in unique ways, creating synergies and balancing each other depending on the specific crisis situation (Kuran et al. 2020). The groups comprise (1) physical or material capacities and vulnerabilities, which address aspects of the land, climate, and environment in which people live, or lived before a crisis; housing, technologies, water, and food supply; and access to capital and other assets; (2) social or organizational capacities and vulnerabilities, which considers community social fabric, including the formal political structures and the informal systems through which people establish leadership, make decisions, or organize various social and economic activities; and (3) motivational and attitudinal capacities and vulnerabilities, including cultural and psychological factors that may be based on religion, on the community's past crises, and how they anticipate emergency relief (March et al. 1999). Overall, while the three components and related indicators are well suited to study factors that influence women's access to land, rather than applying the CVA to its original context of humanitarian disaster and disaster preparedness, we prioritized social differentiations, such as marital status, level of education, and access to land as a primary concern that is heavily influenced by gender roles and power relations in these communities, hence the adoption of the first tool of the CVA framework.

Methodology

Study sites

The study was conducted in seven communities, all in the Western North and Ashanti Regions of Ghana. Study sites were selected based on the gradient, as suggested by Bunn et al. (2019). To support efficient adaptation, Bunn et al. (2019) develop a cocoa-specific gradient for assessing anticipated changes and changes in cocoa-related activities. This

comprises three impact zones: Cope, Adjust, and Transform. The "Transform zone" experiences extremely hotter temperatures and drier conditions, making it unsuitable for cocoa cultivation in the future. The Adjust zones encounter higher annual average temperatures, weak and dry seasons with similarly higher precipitation and, in the driest quarter, higher yearly precipitation. The Cope zone has unpredictable climate impact trajectories and, as indicated by climatic circumstances, is positive for cocoa production. Based on this, "Cope" and "Adjust" in the Western North and Ashanti Regions of Ghana, respectively, were selected for this study. These regions are significant for their present and past cocoa production histories. The Ashanti Region is one of the earliest cocoa frontiers, and the Western North Region is the newest frontier. In the Western North Region, the study was conducted in Enchi, Akontombra, and Bonso Nkwanta communities, which are classified as "Adjust" in terms of their climate suitability for cocoa production. In the Ashanti Region, Antoakrom, Bekwai, Agona, and New Edubiase are communities classified as "Cope" (Dalaa et al. 2021), which is even more suitable for cocoa production. Different zones were chosen for zone-specific and cross-zone analysis following the understanding that gender issues and ethnic or cultural views related to land ownership differ between zones (Apusigah 2009) (Fig. 1).

Methods

Data were collected from February through April 2022. Selection of the survey sample followed a two-staged probability sampling methodology, including stratified and disproportionate sampling. This approach was chosen to cater for the strata in the population of

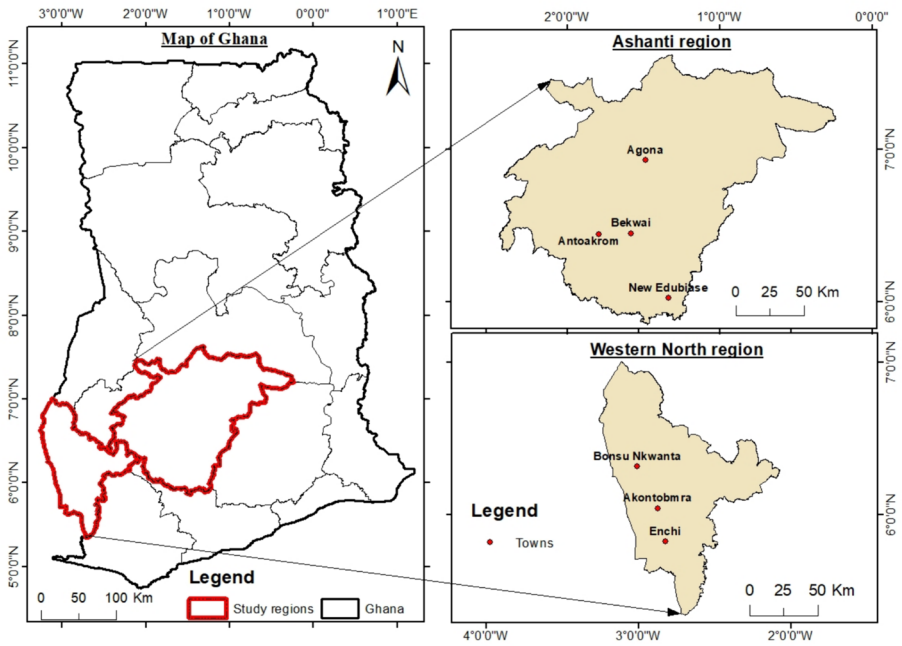

Fig. 1 Location map of the study area (Source: own map)

interest that are quite small but very important (women farmers), which may not be adequately represented in a survey if other sampling approaches were used. The population was grouped into three strata, namely gender, age, and climate impact zones. This paper draws a baseline dataset of the CocoaSoils Consortium for cocoa farmers in Ghana (Dalaa et al. 2021). The survey of 200 respondents samples married and widowed women to assess their differing experiences. The 160 female respondents comprise 80% of the sample; the 40 males represented 20%. The survey focused primarily on ownership and sole ownership of agricultural land alongside decision-making and other sociodemographic factors.

Data analysis

Data were analysed using various statistical tools, including frequencies and percentages, as well as quantitatively by running regression models. As we seek to examine the challenges faced by women cocoa farmers in the context of land ownership and how social and demographic factors influence this, we performed a probit analysis to provide insights into the relationship between sociodemographic factors including gender, marital status, level of education, and land ownership. We employed a probit analysis as a simple method for computing maximum likelihood estimates, as proposed by (Washington et al. 2020). In our study, the target variable (land ownership) is binary (with two unique values 1 and 0), where 1 represents "ownership of land" and 0 "non-ownership of land." In this scenario, we employed the Probit regression as:

$$\Pr(Y = 1|X) = \phi\left(X^1\beta\right),$$

where Pr denotes probability and ϕ is the cumulative distribution function (CDF) of the standard normal distribution. β are the coefficients of the explanatory values, which here are estimated using the maximum likelihood function. X is a vector of the explanatory variables, i.e. gender, age, household size, marital status, types of marriage, level of education, ownership, sole ownership, land title, and time spent on farm. Our study envisages multiple series of determinants that influence land ownership in Ghana, such that $\left\{Y_i, X_i\right\}_{i=1}^{n}$. Hence their joint log-likelihood function is $\ln L(\beta) = \sum_{i=1}^{n}(y_i \ln\phi\left(x_i^1\beta\right) + \left(1 - y_1\right) \ln(1 - \phi(\left(x_i^1\beta\right)))$. The estimator β follows the regression assumptions of consistency, asymptotically normally distributed and efficient if $E[XX^1]$ exists and it is not singular. The log-likelihood function ensures that β is concave, and hence, standard numerical algorithms for optimization will converge rapidly to the unique maximum.

Variables

The variables section focuses on identifying the dependent and independent variables needed for investigating the dynamics of agricultural land ownership among cocoa farmers. The ownership categories—including both sole and joint ownership of agricultural land—are the dependent variables. Here, "ownership" refers to group or joint ownership, whereas "sole ownership" refers to individual or singular ownership. In contrast, independent variables encompass a range of sociodemographic characteristics that define the participating farmers. Further information on the variables alongside their accompanying coding and description is provided in Table 1.

Table 1 Unit of measurement of the variables. Source: Field survey data (February–April 2022)

Variable	Description	Coding
Age	Chronological age of farmers	Continuous
Gender	Biological sex of farmers	Binary
		Male = 0,
		Female = 1
Marital status	Marital status of farmers	Categorical
		Single/ Widow/Widower/ Separated/Divorced = 0,
		Married = 1
Type of marriage	Nature of marital partnership	Categorical
		Monogamous = 1
		Polygamous = 2
		Non-legal, Unregistered = 3
Level of education	Educational attainment	Categorical
		No formal education = 0,
		Primary School and lower = 1,
		Junior High School = 2,
		Senior High School = 3,
		University = 4
Household size	Number of household members	Continuous
Number of plots	Number of agricultural land parcels owned	Continuous
Time on the farm	Time spent on farm activities	Continuous
Land access mode	Means of land acquisition	Categorical
		Unsure = 0,
		Purchase = 1,
		Inheritance = 2
		Borrowed = 3,
		Allocated customary land = 4,
		Gift = 5
Land title	Legal owner of land title	Categorical
		Not known/Undocumented = 0
		Wife = 1
		Husband = 2
		Others = 3
Work on farm	Main person working on the farm	Categorical
		Yourself = 1
		Spouse = 2
		Others = 3
General decision-making	General decision-making on farm operations	Categorical
		Yourself = 1
		Spouse = 2
		Both = 3
		Others = 4
Male decision-making	Male-centric decision-making on farm operations	Binary
		Male = 1
		Others = 0

Table 1 (continued)

Variable	Description	Coding
Female decision-making	Female-centric decision-making on farm operations	Binary Others = 0 Female = 1

Results

Summary statistics and linear correlation

Table 2 summarizes the sociodemographic characteristics of participants in the cocoa-growing communities in the Ashanti and Western North Regions. In both climatic zones, most female respondents were married. In general, male farmers had relatively higher levels of education than female farmers. However, men in the Cope zone had a slightly higher education than men in the Adjust zone, with at least three men having university education. Majority of women in both zones had at least primary school education or lower.

Table 2 Sociodemographic characteristics of farmers in the farming communities in Ashanti and Western North regions of Ghana ($n = 200$). Source: Field survey data (February–April 2022)

Variables		Climatic Impact Zone				Total
		Cope		Adjust		
Gender	Specification	Male	Female	Male	Female	
Marital Status	Married	18	40	17	54	129
	Widow/Widower	0	22	1	15	38
	Separated/Divorced	0	14	1	7	22
	Single	2	3	1	5	11
Total		20	79	20	81	200
Age	18–39	4	11	3	19	37
	40–69	15	57	15	61	148
	70 +	2	10	1	2	15
Total		21	78	19	82	
Level of Education	Primary School and Lower	3	27	10	35	75
	Junior High School	11	21	4	19	55
	Senior High School	3	6	3	2	14
	University	3	0	0	0	3
	No Formal education	1	24	2	26	53
Total		21	78	19	82	200
Number of Plots	1–2	12	51	11	48	122
	3–4	4	10	5	8	27
	5–6 +	4	13	2	10	29
	Not owning land	1	5	3	13	22
Total		21	79	21	79	200

Table 3 Land ownership modes based on gender in seven farming communities in Ashanti and Western North regions of Ghana ($n=200$). Source: Field survey data (February–April 2022)

Land ownership status					
Gender	Purchased	Inherited	Borrowed	Allocated Customary Land	Gift
Female	16	92	16	1	14
Male	8	19	3	3	3

Table 4 Land ownership types based on climate zones in Ashanti and Western North regions of Ghana ($n=200$). Source: Field survey data (February–April 2022)

Gender	Climate zones	Land ownership type	
		Ownership	Sole ownership
Female	Cope	84	65
Male		20	20
Female	Adjust	76	51
Male		16	14

Conversely, 24% of the females in Cope and 26% in Adjust zone had no formal education. In the two zones, most farmers owned at least 1–2 plots for farming; however, 11% of the female farmers did not own land. The majority of respondents report being married; this is consistent with (Gordon and Craig 2001).

Tables 3 and 4 provide summary statistics on relevant land ownership types and modes of land acquisition. The data from the Ashanti and Western North regions show that agricultural lands are mostly inherited and purchased, alongside sharecropped lands. Table 4 reports gender differences in self-reported ownership and sole ownership. Sole ownership is very common among male farmers (see Table 4). In the Cope zone, all 20 male farmers who owned land were also sole owners. A similar trend is seen among male farmers in the Adjust zone: 72.5% of the males who owned land in both zones were sole owners.

In Table 5, all variables, except male decision-making, have standard deviations less than the mean, indicating that the results are certain and not subject to fluctuations. The mean age of the respondents is 51, with 29 and 70 being the minimum and maximum ages. Households average 7 members, with 63% of respondents being married. In terms of ownership, 89% owned land and 75% of them were sole owners. The average time spent farming was 5 h, maximizing at 7. In terms of decision-making, 56% of the female farmers made decisions on farm activities.

Determinants of land ownership and sole ownership

This section presents the determinants of ownership (joint or group) and the specific case of sole ownership (singular ownership). We employed a linear regression probit model, as explained in the methodology. Results for the case of ownership (see Table 6) show that, among the variables examined, marital status, level of education, and land access mode are statistically significant predictors of land ownership and suggest notable associations with land ownership among cocoa farmers. Specifically, regarding sole ownership, the results reported in Table 7 show that gender, marital status, land access mode, work on the farm, and female decision-making are statistically significant predictors of sole ownership. The

Table 5 Summary statistics of farmers in the seven farming communities in Ashanti and Western North regions of Ghana ($n = 200$). Source: Field survey data (February–April 2022)

Variables	Mean	Std. Dev.	Min	Max
Gender	0.8	0.4010038	0	1
Age	51.315	11.35785	29	70
Household size	6.82	2.407609	2	10
Marital status	0.635	0.4826383	0	1
Type of marriage	1.585	0.8698033	1	3
Level of education	1.205	0.9631267	0	4
Ownership	0.89	0.3136749	0	1
Sole ownership	0.755	0.4311665	0	1
Land title	1.4	0.8796984	0	3
Time spent on the farm	5.23	1.210133	2	7
Land access mode	2.065	1.244394	0	5
Work on farm	1.755	0.8768233	1	3
General decision-making	1.685	1.073095	1	4
Female decision-making	0.565	0.4970011	0	1
Male decision-making	0.4	0.4911273	0	1

Table 6 Demographic determinants of land ownership. Source: Field survey data (February–April 2022)

Probit regression Log pseudolikelihood = − 10.309889				Observations = 200 Wald chi2 (10) = 44.73 Prob > chi2 = 0.0000 Pseudo $R^2 = 0.8512$		
Ownership	Coef	Robust Std.Err	z	$p>\|z\|$	95% confidence interval	
Gender	− 0.0083455	0.3913727	− 0.02	0.983	0.7754218	0.7587308
Age	0.0137912	0.0127886	1.08	0.281	0.0112741	0.0388564
Household size	− 0.0904772	0.0923309	0.98	0.327	0.2714424	0.090488
Marital status	− 0.9640161	0.4470692	2.16	0.031	1.840256	− 0.0877765
Type of marriage	0.5320729	0.4053963	1.31	0.189	0.2624892	1.326635
Level of education	0.5260246	0.248951	2.11	0.035	0.0380896	1.013959
Time spent on the farm	− 0.4086146	0.2297481	1.78	0.075	0.8589126	0.0416833
Land access mode	2.912329	0.6867132	4.24	0.000	1.566396	4.258262
Work on farm	0.770456	0.3385692	2.28	0.023	0.1068725	1.434039
Female decision-making	0.5746114	0.4714274	1.22	0.223	0.3493694	1.498592
-Cons	− 1.488298	1.915459	0.78	0.437	5.242529	2.265933

results show that gender does not impact ownership. However, gender is statistically significant with sole ownership, as Table 7 shows. Marital status and land access mode are significant for both ownership and sole ownership. The negative coefficient of marital status confirms Zhllima et al. (2021), highlighting the negative effect marriage has on land ownership. The results show that the mode of land acquisition is a positive indicator of land ownership, with inherited land and purchase land being most popular (see Table 3). This trend is also seen in Spichiger and Stacey (2014), highlighting the dominance of inherited land.

Table 7 Demographic determinants of sole ownership. Source: Field survey data (February–April 2022)

Probit regression Log pseudolikelihood = − 80.622876				Observations = 200 Wald chi2 (10) = 54.00 Prob > chi2 = 0.0000 Pseudo R^2 = 0.2760		
Sole ownership	Coef/	Robust Std.Err	*z*	*p* > |z|	95% confidence interval	
Gender	− 1.36921	0.4467151	− 3.07	0.002	− 2.2444763	− .4936717
Age	0.0156013	0.0103249	1.51	0.131	− 0.0046352	0.0358378
Household size	0.0514738	0.04474447	1.08	0.278	− 0.0415161	0.1444637
Marital status	− 0.8931423	0.340408	− 2.62	0.009	− 1.56033	− 0.2259548
Type of marriage	0.2461311	0.1960596	1.26	0.209	− 0.1381387	0.6304009
Level of education	0.1740283	0.1375839	1.26	0.206	− 0.0956311	0.4436878
Time spent on the farm	0.077347	0.1105123	0.70	0.484	− 0.1392532	0.2939471
Land access mode	0.3195571	0.1012003	3.16	0.002	0.1212081	0.517906
Work on farm	0.6565165	0.1831869	3.58	0.000	0.2974768	1.015556
Female decision-making	0.8644865	0.3616931	2.39	0.017	0.1555811	1.573392
-Cons	− 1.805519	1.253296	− 1.44	0.150	− 4.261935	0.6508964

Interaction effects among the demographic determinants of land ownership and sole ownership

Tables 8 and 9 present the nonlinear probit regressions for ownership and sole ownership with interactions. In Table 8, we interacted with variables to see how they influenced other

Table 8 Interaction effects of demographic determinants of land ownership. Source: Field survey data (February–April 2022)

Probit regression Log pseudolikelihood = − 10.18175				Observations = 200 Wald chi2 (10) = 49.32 Prob > chi2 = 0.0000 Pseudo R^2 = 0.8531		
Ownership	Coef.	Robust Std.Err	*z*	*p* > |z|	95% Confidence Interval	
Gender	0.1777124	0.4159234	0.43	0.669	0.9929072	0.6374825
Age	0.0142581	0.0128904	1.11	0.269	0.0110067	0.0395229
Household size	0.4522493	0.6068923	0.75	0.456	0.7372377	1.6417360
Marital status	1.047242	0.4731568	2.21	0.027	1.974613	-0.1198722
Type of marriage	0.8276545	0.3895737	2.12	0.034	0.0641041	1.591205
Level of education	0.5192198	0.2892134	1.80	0.073	0.047628	1.086068
Time spent on the farm	0.3515	0.7385195	0.48	0.634	1.095971	1.798972
Land access type	2.892282	0.6768077	4.27	0.000	1.565763	4.218801
Work on farm	0.8060673	0.2766294	2.91	0.004	0.2638836	1.348251
Female decision-making	0.555008	0.8964371	0.62	0.536	1.201977	2.311992
Education*female decision-making	0.0518896	0.5343749	0.10	0.923	0.9954659	1.099245
Householdsize*time spent on the farm	0.1013659	0.1150934	0.88	0.378	0.3269448	0.124213
-Cons	5.773338	4.401754	1.31	0.190	14.40062	2.853941

Table 9 Interaction effects of demographic determinants of sole ownership. Source: Field survey data (February–April 2022)

Probit regression Log pseudolikelihood = − 76.085172				Observations = 200 Wald chi2 (10) = 53.65 Prob > chi2 = 0.0000 Pseudo R^2 = 0.3167		
Sole ownership	Coef.	Robust Std.Err	z	$p>\|z\|$	95% confidence interval	
Gender	− 1.534291	0.4873299	− 3.15	0.002	2.48944	− 0.5791417
Age	0.0186293	0.0108126	1.72	0.085	0.002563	0.0398216
Household size	0.7892177	0.2268993	3.48	0.001	0.3445032	1.233932
Marital status	− 0.9694965	0.3380374	− 2.87	0.004	1.632038	0.3069554
Type of marriage	0.355396	0.2146757	1.66	0.098	0.0653607	0.7761526
Level of education	0.1716895	0.1766754	0.97	0.331	0.1745879	0.5179671
Time spent on the farm	1.078423	0.3230413	3.34	0.001	0.4452742	1.711573
Land access type	0.3468493	0.1054948	3.29	0.001	0.1400832	0.5536153
Work on farm	0.7180499	0.2030093	3.54	0.000	0.320159	1.115941
Female decision-making	0.8685009	0.4561397	1.90	0.057	0.0255164	1.762518
Education*female decision-making	0.0932133	0.2693753	0.35	0.729	0.4347526	0.6211792
Householdsize*time spent on the farm	− 0.1427057	0.0422113	− 3.38	0.001	0.2254384	0.0599731
-Cons	− 7.244976	2.14806	− 3.37	0.001	11.4551	3.034855

variables in determining the concepts of land ownership. We explored interactions between "education and female decision-making" and "household size and time spent on the farm." We find marital status, type of marriage, land access mode, and work on the farm to be statistically significant predictors of land ownership. However, the interaction models of education and female decision-making, as well as household size and time spent on the farm, are not statistically significant predictors of land ownership. We performed the same analysis for sole ownership in Table 9. However, here, with the interaction model of time spent on the farm and household size, we noticed a change to a negative relationship, but now statistically significant. Marital status, land access type, and work on the farm maintain their significance for both cases of land ownership.

Discussion

Results in Table 8, with respect to the ownership case, suggest that marital status, level of education, and land access mode are important determinants of land ownership among cocoa farmers, highlighting the significance of social and demographic factors in shaping land ownership patterns. The negative coefficient suggests that when farmers are married, they tend not to own land. This is mostly seen in the Western North of Ghana, where many male farmers prefer to not register their marriages because of the perception of losing their farms to their wives in case they divorce. Thus, marriage is seen as negatively influencing land ownership. Given that the majority of women in this study have only primary

education or less, they are at a disadvantage compared to their male counterparts. Despite a sample of only forty male farmers, three had a university education; none of the 160 women surveyed could make the same claim. Educated farmers, regardless of gender, are more likely to be adept in navigating processes and understanding land tenure laws and might be better equipped to seek out support programmes or negotiate favourable terms for land ownership. Moagi (2008) asserts that the failure of rural women to acquire vital knowledge about land reform processes and procedures leaves them vulnerable and unrepresented in their community's leadership structures. This emphasizes that poor public education affects land documentation and its processes. The positive coefficient of "land access mode" suggests that the manner in which farmers access land has a substantial impact on their likelihood of owning land, with certain types of land access modes being strongly correlated with land ownership. Based on the summary statistics in Table 5 and the modes of land ownership shown in Table 3, inherited land is dominant, thus in line with Spichiger and Stacey (2014), who acknowledge some customary systems, notably matrilineal lineages, permitting daughters to inherit land. (Toulmin 2009) highlights the possibility of women having access rights through their husbands. According to (Oduro et al. 2011), transfers of land from husbands to wives and vice versa in exchange for labour support is also common in cocoa-growing regions of Ghana.

For the case of sole ownership, results presented in Table 9 highlight the significance of gender, marital status, land access mode, work on the farm, and female decision-making in influencing sole land ownership among cocoa farmers. The results show that gender has a positive and significant relation with sole ownership, as seen in the literature, where sole ownership of agricultural land is male dominated (Deininger and Castagnini (2006), and Table 4 corroborates that assertion. The significant association between work on farm and sole ownership implies that cocoa farmers who are more actively engaged in farm work are more likely to have sole ownership of land. When farmers are actively engaged in their farm activities, investing their time, labour, and resources—this dedication can be perceived as evidence of their capability and willingness to manage the land independently, thus justifying sole ownership rights. Dos et al. (2014) highlight that making decisions on farm operations is a sign of sole ownership. The positive relationship of female decision-making on sole ownership suggests that higher involvement of females in decision-making processes is associated with higher odds of sole ownership. This implies that female involvement in decision-making regarding land is positively associated with sole land ownership among cocoa farmers, thus in line with Yokying and Lambrecht (2019). Masuku et al. (2023) also emphasize that the extension of ownership of land to women will result in increased confidence levels among rural women, thus empowering them in terms of their decision-making roles.

To investigate how the variables interact among each other, we employ the interaction model of "education and female decision-making" and "household size and time spent on the farm." Given the aim to explore the interaction between variables and how they impact other determinants of ownership and sole ownership, we delved into an interaction model that looked at the nonlinearity between the two concepts. The results after the interaction suggest that marital status, type of marriage, land access type, and involvement in farm work are significant predictors of land ownership among cocoa farmers. Most significantly, the emergence of marriage type as an important indicator of land ownership implies that certain types of marriages are associated with higher odds of land ownership. Based on the summary statistics in Table 5, the type of marriage that was observed in our study ranged between monogamous and polygamous settings. This implies that majority of the respondents in our study were either in monogamous or polygamous marriages. (Ghebru and

Lambrecht 2017) reiterated that living in polygamous households is proved to affect individuals' landownership, particularly since customary inheritance practices may prioritize male heirs over female heirs in land inheritance. Thus, land may be passed to sons from the husband's multiple marriages, leaving daughters with limited or no access to land for farming. Monogamous marriages, on the other hand, are often more straightforward, with land being passed down from one generation to the next or from one spouse to the other. The matrilineal groups of the Akan tribe in Ghana are a prime example of this practice, as women are able to take advantage of their kinship networks to negotiate secure land rights and actively participate in commercial agricultural production, even in the face of opposing tendencies that restrict the allocation of land from men to women (Aryeetey 2002).

With regard to the relationship between the interaction model and sole ownership, results show household size and time spent on the farm are statistically significant, indicating that the combined effect of these variables influences sole land ownership among cocoa farmers. The negative relationship implies that while larger households and more time spent on the farm individually increase the likelihood of sole land ownership, their combined effect diminishes this likelihood. This indicates that when farmers spend more time on the farm and also have a bigger household size, they do not end up solely owning land; however, in isolation, these variables positively impact sole ownership. A likely explanation to this situation could be that the time farmers spend on their farm is shared with the responsibilities that come with having a large household size and farm-related work, and as such, this trade-off reduces the likelihood of solely owning the farm. Farmers end up resorting to labourers or exploring other tenancy agreements, such as the Abuna and Abusu, as highlighted in Introduction. Although joint ownership or landholding is rare in Ghana, according to Lambrecht (2016), this study proves that it is still prevalent in the Ashanti and Western North regions of Ghana. Additionally, gender has notable association with sole ownership, but the negative relationship suggests that being female is associated with lower odds of sole land ownership compared to being male. This implies that male cocoa farmers are more likely to have sole ownership of land than female cocoa farmers, a contrast to the case of ownership, which shows no relationship with gender. These outcomes underpin the importance of addressing gender inequalities in cocoa farming in Ghana. Dery (2015) emphasized that if gender disparities are addressed, economies dominated by agriculture would expand quicker, ensuring food security and agricultural productivity. We also reckon that the income level of farmers is an important criterion that can be included in future research, as we believe it affects land ownership status among cocoa farmers.

Conclusion

Given that land provides the basis for food production and most income-generating activities, it is an important asset among agricultural households. In exploring the challenges women cocoa farmers face when it comes to land ownership, we conclude that land ownership, in general, is male dominated, although some distinctions exist when it comes to sole ownership. From our study, marital status and land access mode maintain their significance in both cases of ownership and sole ownership, which points to the importance of governments and policy makers in designing interventions that address discriminatory practices in inheritance laws and ensuring equitable access to land for women, regardless of their marital status. Sole ownership is seen to significantly increase female decision-making for

on-farm activities. However, to determine what influences the specific concept of sole ownership, we must take into consideration household size and the time the women farmers spend on the farm. These variables, according to our study, play an important role when interacted together and not in isolation. We find that gender has a limited correlation with ownership, showing the possibility of some females being partial owners with their partners. 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 who share their lands with their husbands. Although land ownership leads to empowerment, it is evident from this study that ownership alone is insufficient to close the gender gap in cocoa farming. More attention on sole ownership of land for female cocoa farmers is crucial for bridging this gender gap and for building the capacity of female farmers to be sole owners of their agricultural land. That notwithstanding, we believe the following policy-based recommendations would help women cocoa farmers access secure land tenure systems: (1) Better support and acknowledgment for women involved in cocoa farming are needed, particularly in terms of offering incentives to source from women as producers in cocoa farming irrespective of their status with regard to land tenure; and (2) legislation that ensures rural women's equal rights to land, regardless of their marital and civil status, is also essential.

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Declarations

Conflict of interest The authors have no relevant financial or non-financial interests to disclose.

Ethical approval I hereby confirm that the research is my own work and has not been published elsewhere. Participants were fully informed about the nature and purpose of the study before they participated. All collected data were treated with utmost confidentiality and were anonymized and aggregated to protect the privacy of the participants.

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