Gender, Land Rights and Agriculture in Ghana[*]

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INTRODUCTION

> The fact that West African marriage bears so little resemblance to European marriage, in terms both of the domestic economy of the household, and of day to day social activities, receives insufficient emphasis in the literature. Spouses usually enjoy little everyday companionship except, perhaps, when they grow old: they rarely sit and converse; they eat separately; they tend to have separate ceremonial and recreational activities. Considering that they are rarely seen walking down a path together, it is no wonder that they seldom work jointly to produce crops which either party may sell, or toil alongside each other on the fields. Hill, 1975, p.124

The notion that a household should achieve a Pareto efficient allocation of resources seems like a sensible benchmark in many contexts. Moreover, empirical examinations of this hypothesis are largely supportive; while strict notions of a unitary household are commonly rejected, several studies have failed to reject the hypothesis that efficient allocations are achieved. Households in Africa, however, present a challenge to this notion.

In this paper we examine productive efficiency among households in Southern Ghana. We find that women produce less and achieve lower profits than their husbands on comparable plots – an apparent contradiction of intrahousehold efficiency. We trace this difference to variations in the fallowing patterns of husbands and wives. Wives' plots are left fallow for much shorter periods than those of their husbands. Once this difference is taken into account, we find no difference in the output on the plots of spouses. Hence the salient issue is the determinants of the different choices of husbands and wives to invest in the long-run fertility of their separate plots. We argue that underlying these different choices is the less secure tenure of women over their land.

In the next section we discuss optimal investment in soil fertility and production in an efficient household. In section 3 we describe the data and the empirical context from which they are drawn. Section 4 describes the empirical implications of efficient households for optimal land resource management. Section 5 is the empirical core of the paper. We see that the data contradict the simple implications of the efficient household model. However, we also show that apparent static inefficiency is indeed only apparent and can be traced to dynamic issues of fertility management. Two main hypotheses for the different patterns of fertility management of husbands and wives are advanced: first, that husbands and wives face different opportunity costs of capital and hence make different decisions regarding investment in fertility; and second, that varying patterns of land tenure insecurity lie at the heart of the differences in fallowing decisions. We conclude that there is no evidence that variations in the opportunity cost of capital play an important role in the intrahousehold variation in fallowing patterns. Instead, we show that fallowing decisions over a plot are strongly related to the political and social influence of the cultivator.

This introduction will eventually be expanded to a more complete literature review (economic literature on intrahousehold allocation and anthropological literature on gender relations in Ghana) as well as a more complete discussion of the farming system (and its gender-separate features) in the area under discussion. For now: Farmers in this area grow a wide range of crops. In the past, this area was home to a large number of cocoa farmers but during the first half of the twentieth century swollen shoot disease decimated the cocoa farms. In recent years, the area has seen a surge in pineapple production for export. However, the predominant crops (in terms of area) remain food crops. While there is some growth of vegetables and some tree crops such as oil palm and orange, the main food crops, by far, are maize and cassava, which are staples in the local diet.

HOUSEHOLDS AND RESOURCE MANAGEMENT

In many African societies, agricultural production is carried out on plots managed separately by individuals in households. In many of these societies, soil fertility is managed through fallowing: cultivation is periodically stopped in order for nutrients to be restored and weeds and other pests to be controlled. A Pareto efficient allocation of resources within the household has strong implications for both the pattern of agricultural output conditional on fertility, and for the optimal time path of fertility.

Consider a household with two members $i \in \{m, f\}$, each of whom manages a plot (also designated i). In each period t, each member of the household consumes a vector of goods c_{it}, so aggregate consumption in the household is $c_t = c_{mt} + c_{ft}$. The preferences of i over the stream of consumption in the household is summarized by the function

$$v_{it} = \sum_{\tau=t}^{\infty}(1+\delta)^{-\tau}u_i(c_{m\tau}, c_{f\tau}) \tag{1}$$

(for now, we assume that labor is supplied inelastically).

Soil fertility is a dynamic system which affects and is affected by crop growth. We simplify drastically by supposing that all the relevant aspects of soil fertility on plot i at time t can be represented by a single index ϕ_{it}. Output on plot i at t depends upon its fertility and on labor input l_{it}: $y_{it} = f(\phi_{it}, l_{it})$. There are some fixed costs associated with maintaining a plot under cultivation. For example, there is a minimal amount of weeding that is required. Therefore, $f(\phi_{it}, l_{it}) = 0$ for all $l_{it} < m$.[1] This fixed cost introduces a nonconvexity into f, however, for $l_{it} > m$, we assume $\frac{\partial f(.)}{\partial l} > 0$, $\frac{\partial^2 f(.)}{\partial l^2} < 0$ (conditions on ϕ). Let w_t be the (possibly household-specific) cost of labor (easy to generalize to a vector of inputs - nothing of substance changes, though fertility dynamics can be more interesting).

Consider a particularly simple law of motion for fertility on plot i:

$$\phi_{i,t+1} = \phi_{it} + g(l_{it}) \tag{2}$$

where $g(0) = \bar{g} > 0$, $g(x) \leq 0$ for all $x > 0$, with $g'(x), g''(x) \leq 0 \ \forall x > 0$. When (and only when) the plot is fallowed, labor inputs are zero and the fertility of the plot regenerates at a rate of $\bar{g}$ per period.[2] When the plot is cultivated, fertility declines, and that decline is possibly increasing with more intensive cultivation.

Another essential aspect of a system of resource management based on periodic fallowing is the existence of a transition cost associated with returning a plot to cultivation after

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[1] It may be that m depends upon ϕ, but the thrust of the argument that follows does not depend upon this detail.

[2] This is not an entirely sensible assumption in farming systems with managed fallows, as in Ghana. In such systems, farmers sometimes find it optimal to use labor on fallow plots to speed the regeneration of fertility (Amanor 1994). For our purposes here, though, little is lost by this simplification.

fallowing. In southern Ghana, this is the cost of clearing (and burning) the fallowed plot before it can be cultivated. Let b_{it} be the cost associated with clearing on plot i in period t, so $b_{it} = \bar{b}$ if $l_{i,t-1} = 0$ and $l_{it} > 0$, and $b_{it} = 0$ otherwise.

An efficient allocation of resources within the household can be characterized as the solution to

$$\max_{\{l_{it}\},\{c_{it}\}} v_{f0} + \lambda v_{m0} \tag{3}$$

subject to

$$\sum_{t=0}^{\infty}(1+r)^{-t}\left(\pi_{ft} + \pi_{mt} - p_t c_t\right) \geq 0 \tag{4}$$

and (2), where

$$\pi_{it} = f(\phi_{it}, l_{it}) - w_t l_{it} - b_{it} \tag{5}$$

and v_{i0} is defined in (1).

In any efficient allocation, the optimal sequence of labor inputs (and therefore fallowing decisions and time path of fertility) on plot i simply maximizes the present value of the stream of profits on that plot:

$$\max_{\{l_{it}\}} \sum_{t=0}^{\infty}(1+r)^{-t}\pi_{it}.$$

It is straightforward (and tedious) to show that for sufficiently large values of m and $g(x) < 0$ for $x > 0$, there is a unique optimal sequence $\{l^*_{it}\}$ such that there exists a $\hat{\phi}$ such that $l^*_{it} > 0$ for all t such that $\phi_{it} > \hat{\phi}$. Because $l_{it} > 0$ in such periods, $\phi_{i,t+1} < \phi_{it}$. At $\hat{t}$ such that $\phi_{i,\hat{t}-1} > \hat{\phi} \geq \phi_{i\hat{t}}$, $l_{i\hat{t}} = 0$ and the land is fallowed. There also exists a $\bar{\phi}$ such that at $\bar{t} > \hat{t}$, $\phi_{i,\bar{t}-1} < \bar{\phi} \leq \phi_{i,\bar{t}}$, and for all τ such that $\hat{t} \leq \tau < \bar{t}$, $l_{i,\tau} = 0$ but $l_{i\bar{t}} > 0$ and the land is put back into cultivation and remains in cultivation until ϕ again drops below $\hat{\phi}$ and the cycle repeats.[3]

The values $\hat{\phi}$, $\bar{\phi}$, the optimal sequence $\{l^*_{it}\}$ and its implied $\{\phi^*_{it}\}$ depend upon r, and thus will be household-specific. However, $\hat{\phi}$ and $\bar{\phi}$ are *independent* of initial fertility ϕ_{i0}.

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[3] Lewis and Schmalensee (1977, proposition 11) were the first to describe optimal fallowing cycles for renewable resources. McConnell (1983), Barrett (1991) and Krautkraemer (1994) use closely related models to examine the responsiveness of optimal fertility management policies to exogeneous changes in the economic environment.

Thus the particular sequence $\{l_{it}^*\}$ depends upon the initial level of fertility of plot i only to the extent that ϕ_{i0} determines the point of entry into the optimal fertility cycle. The duration of fallowing will be the same on plots m and f, and labor use (and profits and output) are identical on the two plots when they are at the same point in the fertility cycle. This conclusion forms the basis of our initial empirical tests of resource allocation within the household.

THE DATA AND EMPIRICAL SETTING

The data in this paper come from a two year rural survey in the Akwapim South District of the Eastern Region of Ghana. We selected four village clusters (comprising 5 villages and two hamlets) with a variety of cropping patterns and market integration. Within each village cluster we selected 60 married couples (or triples - about 5-10 percent of the population is polygynous) for our sample; in three village clusters this was random, and in the fourth, we interviewed the entire population of married couples. Each member of the pair or triple was interviewed 15 times during the course of the two years. Every interview was carried out in private, usually by an enumerator of the same gender.

The survey was centered around a core group of agricultural activity questionnaires (plot activities, harvests, sales, credit) that were administered during each visit. In addition about 35 other modules were administered on a rotating basis. We also administered (once per field) an in-depth plot rights and history questionnaire and mapped each plot using a geographical information system. We supplemented this with data on soil fertility: the organic matter and pH of each plot was tested each year.

The core of the analysis in this paper is based on the plot activities questionnaires. These collected data on inputs, harvests and sales at intervals of 5-6 weeks for all plots farmed by individual respondents. We complement this with data on education (administered once) credit use (14 times), family background (administered once), household demographics (administered 3 times), and time allocation (administered twice). {description of data on individual wealth. definitions of each of the family background variables, description of contract types and sources of land variables} {description of summary statistics, maize&cassava as an intercropped system, focus on that system alone}

EFFICIENCY

We turn now to an empirical examination of the efficiency of the allocation of resources within households. A necessary condition for productive efficiency is that the marginal value products of inputs used on farm operations of the wife be equated with those used on farm operations of her husband. A simple characteristic of an efficient allocation is that

$$\phi^*_{ft} = \phi^*_{mt} \Rightarrow l^*_{ft} = l^*_{mt}.$$

This follows immediately from the separability of production and consumption in (3)-(5) and the concavity of $f(\phi, l)$ for $l > m$. Within the household, plots of similar fertility should be cultivated similarly. Moreover, we have seen that the optimal fallowing path does not vary across plots within the household, so in the efficient allocation ϕ^*_{it} varies across plots only because plots are observed at different points in the cycle. For now, we take the timing of the survey to be arbitrary and assume that the within household variation in position of plots within the fallowing cycle is uncorrelated with other plot characteristics.

So we can define profits on plot i at time t as a function only of fixed characteristics of that plot:

$$\pi_t(\phi_{i0}, X_i) \equiv f(\phi^*_t(\phi_{i0}, X_i), l^*_t(\phi_{i0}, X_i), X_i) - w_t l^*_t(\phi_{i0}, X_i) - b^*_{it}(\phi_{i0}, X_i),$$

where X_i is defined as a vector of fixed characteristics of plot i. A first-order approximation of the difference across plots within a household is

$$\pi_t(\phi_{m0}, X_m) - \pi_t(\phi_{m0}, X_m) \approx \frac{\partial \pi_t}{\partial X}(X_m - X_f) + \frac{\partial \pi_t}{\partial \phi}(\phi_{m0} - \phi_{f0}). \tag{6}$$

We rewrite (6) as

$$\pi_{it} = \mathbf{X}_i \beta + \gamma G_i + \lambda_{h_i,t} + \epsilon_{it}, \tag{7}$$

where X_i is the vector of fixed characteristics of plot i, β is $\frac{\partial \pi_t}{\partial X}$, and G_i is the gender of the cultivator of that plot. h_i is the household in which the cultivator of plot i resides, and λ_{h_it} is a fixed effect for the household-year . $\epsilon_{it} = \frac{\partial \pi_{it}}{\partial \phi}(\phi_{hm0} - \phi_{hf0}) + \nu_{it}$, where ν_{it} is an error term (that might be heteroskedastic and correlated within household-year groups) that summarizes the effects of unobserved variation in plot quality and plot-specific production shocks on profits. The exclusion restriction of the model is that $\gamma = 0$, in an efficient household, the identity of the cultivator is irrelevant for profits.

Within the vector **X** we include a variety of plot characteristics – size, toposequence, direct measures of soil quality (the soil pH and organic matter content) as well as the respondent-reported soil type classified into clay, sand or loam. These soil types might affect profits and inputs through their different nutrient retention capacities, among other factors.

RESULTS

The Within-Household Gender Differential

Table 2 presents estimates of equation (7). Recall that the interpretation of the results is in terms of deviations from household-year means for cassava-maize plots: with imperfect factor markets we do not expect returns to be equalized across households or years. However, a systematic difference in the returns to cassava/maize cultivation on similar plots of men and women *within* households contradicts our simple model of Pareto efficient households. Nonetheless, this is what we find. Conditional on plot characteristics and household fixed effects, profit per hectare (x1000 Ghana cedis, column 1) are much lower on women's plots then on the plots of their husbands.[4] Moreover, the coefficient on gender is quite large – at approximately one million cedis, it is about twice the size of average profits on maize and cassava plots. In column 2 we see a similar result for yield per hectare. Again the effect is large: the coefficient is about the same as the average yield per hectare. Conditional on the observed characteristics of their plots, wives produce much less maize and cassava than their husbands and achieve correspondingly lower profits.

There is no strong evidence that factor inputs are systematically different on the plots of

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[4] During the survey, the value of the cedi was approximately 2200 cedis to $1 US.

women and those of their husbands. While the point estimates of the gender effect are large (almost twice the mean) for both labor and seed costs, the standard errors are even larger. It is not possible to draw strong conclusions regarding the relative intensity of input use on husbands and wives' plots from our data.

Other observed plot characteristics have little effect on profits. Plot size is particularly relevant for yields: output per hectare drops strongly with plot size, but so does labor use. We do not have strong evidence that observed soil type, measured soil chemistry and plot topography are strongly related to profits, yields, or input use.

Men are much more likely to have attended school than women: on average, husbands have 4 more years of schooling than their wives ($t = 8.6$), and average schooling in the sample is just 7 years. In addition, men are an average of 7 years older than their wives ($t = 10.6$). However, in column 1 of Table 3 we see that these differences in the human capital of husbands and their wives do not contribute to the gender differential in farm profit (or, in results not shown, to the difference in yields). We find that the gender differential in farm profit is actually larger when we condition on age and education, because education is strongly negatively correlated with plot profits. This almost surely reflects the strong selection induced by rural-urban migration in Ghana: well educated individuals who are cultivating in rural Ghana are not typical of the population.[5]

It is not possible to reject the hypothesis that the coefficients of soil pH and OM are jointly zero in any of these regressions. Moreover, soil chemical analysis is not available for all of the plots cultivated by individuals in our sample. Approximately 200 observations with missing values for these variables are gained by dropping pH and OM from the analysis. As can be seen in column 2 of Table 3, the gender differential is somewhat smaller in this larger sample, but still large and statistically significant.

Perhaps the most obvious and worrisome potential econometric problem with the estimates presented thus far is the possibility that there are systematic unobserved differences

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[5] There could be an additional selection process into maize and cassava cultivation (as opposed to production of pineapple for export). However, the negative correlation between education and profitability remains strong when we pool together plots with any crop.

in the quality of land farmed by husbands and wives. The regressions include measures of the topography, soil type and basic soil chemistry of each plot. This is a relatively rich characterization of land quality. However, unobserved variation in land quality certainly remains. If women farm systematically lower quality land then their husbands, then it is not surprising that there is a gender differential in profits and yields within the household on observationally similar plots.

Land characteristics change gradually across space, hence our maps of the cultivated plots may help mitigate the consequences of unobserved land quality in this data. In Column 3 of Table 3, we maintain the assumption that ϵ_{hit}, the unobservable term in equation (7) is uncorrelated with the regressors but permit it to be correlated across plots as a general function of their physical distance using the spatial GMM estimation strategy in Conley (1999).[6] The standard error of the gender coefficient is lower once we account for this possible correlation.

We generalize 7 further to permit a local neighborhood effect in unobserved land quality that could be correlated with gender and the other regressors. With some abuse of notation, let N_i denote both the set of plots within a critical distance of plot i and the number of such plots. We construct a within estimator by differencing away these spatial fixed effects:

$$\begin{aligned} \pi_{it} - \frac{1}{N_i}\sum_{j\in N_i}\pi_{jt} &= (\mathbf{X}_i - \frac{1}{N_i}\sum_{j\in N_i}X_j)\beta + \gamma(G_i - \frac{1}{N_i}\sum_{j\in N_i}G_j) \\ &\quad + \lambda_{h_it} - \frac{1}{N_i}\sum_{j\in N_i}\lambda_{h_jt} + \epsilon_{hit} - \frac{1}{N_i}\sum_{j\in N_i}\varepsilon_{jt}. \end{aligned} \tag{8}$$

In column 4 of Table 3, the geographical neighborhood N_i is defined using a critical distance of 250 meters. If that component of unobserved land quality that is correlated with observed plot characteristics is fixed within this small neighborhood, then the spatial fixed effect

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[6] Spatial standard errors are calculated using the estimator in Conley (1999) with a weighting function that is the product of one kernel in each dimension (North -South, East-West). In each dimension, the kernel starts at one and decreases linearly until it is zero at a distance of 1.5 km and remains at zero for larger distances. This estimator is analogous to a Newey-West (1987) time series covariance estimator and allows general correlation patterns up to the cutoff distances.

estimator defined in (8) removes this potential source of bias.

The estimate of the gender differential with both household-year and spatial fixed effects is larger than the estimate not conditional on spatial fixed effects, and the standard error (again robust to unobserved spatial correlation in the remaining error) remains small. Unobserved, spatially-correlated dimensions of land quality do not appear to underlie the gender differential in agricultural profits within households. Women achieve much lower profits than their husbands on plots that appear to be of similar inherent quality.

Land Resource Management

There is no evidence that unobserved variations in the inherent fertility of land help explain the within-household gender differential in plot profits. However, anthropogenic variations in fertility do appear to be at the root of the gap in profits between wives and their husbands. In column 1 of Table 4 we introduce a measure of the duration of the most recently completed fallow on the plot to the profit regression. When we condition on the last fallow duration, the gender differential in profits drops by about two-thirds and becomes statistically insignificant. The duration of the previous fallow is strongly positively associated with current profits. Note that this difference in fallowing durations is entirely a within-household phenomenon. Evidence for this is provided in Figure 1, which indicates that there is no striking difference in the overall fallowing patterns of men and women.

Of course, the duration of the previous fallow is chosen and likely to be correlated with unobserved plot characteristics, so these estimates are likely to be inconsistent. In column 2, we present household-year fixed-effect instrumental variables estimates of the same relationship, using a variety of measures of the family background of the cultivator as instruments for the duration of the most recent fallow. There is now no discernible difference between the profits on plots cultivated by women and those cultivated by their husbands; the point estimate is now *positive*, albeit small and statistically indistinguishable from zero. An additional year of fallowing is associated with an increase in profits of over $400,000$ cedis, and this estimate is statistically significant at conventional levels. This difference in fallowing behavior fully accounts for the gender differential in profits. What appeared to be evidence of an inefficient static allocation of factors of production across the plots cultivated by husbands and wives instead reflects differences in the endogenously-determined dynamic of soil fertility.

The first stage estimates of fallow duration are presented in column 3 of Table 4. The instrument set includes some important aspects of the family background of the cultivator of the plot (the number of wives of the cultivator's father and the parity of the cultivator's mother in that set, the number of children of the father,the educational background of the parents, some aspects of the migratory history of the cultivator, and an indicator equal to one if the cultivator holds a traditional family or village office). Of these indicators, only traditional office-holding has a significant relationship to fallowing behavior: plots cultivated by those who hold a traditional office have been fallowed almost 4 years longer than other plots. This is a very strong effect: the average duration of the last fallow period in our sample is just over 4 years.

This result is robust to spatially-correlated unobserved effects. In column 4 we present the instrumental variables profit function estimates with both spatial and household-year fixed effects. The estimated relationship between fallow duration and plot profits falls by about one-quarter, but is estimated more precisely. Once again there is no discernible relationship between the gender of the cultivator and profits conditional on the duration of the last fallow. The first stage estimates of the determinants of fallow duration are reported in column 5. Again, the estimates imply that those who hold traditional offices fallow for longer periods, though the coefficient falls to approximately two years. Conditional on spatial fixed effects, children of fathers who had more wives are also estimated to fallow for longer periods; this variable may be our best measure of parental wealth.

What drives these different fallowing behaviors of husbands and their wives? In particular, why should individuals who hold a traditional office (who are virtually all men), or those with richer parents fallow their plots for longer periods than their spouses? The simple model of land resource management by an efficient household described in section 2 implies that all similar plots within the household have similar fertility dynamics: in particular, the duration of the fallow period is the same across all plots. Two types of explanation for why cultivators within a single household might make different decisions regarding the fallowing of physically similar plots are consistent with the evidence presented thus far.

1. It might be the case that the household is an inappropriate unit of analysis for the purposes of modeling land resource management. The intertemporal budgets of the cultivators in the household might be sufficiently individualized and the different cultivators might face credit constraints of varying severity. In this case, the different cultivators could confront different opportunity costs of capital and therefore would chose different optimal fertility paths for their plots. This is consistent with the evidence thus far because those who hold traditional office or who have wealthier fathers are both more wealthy than average and more likely to have good access to informal finance.
2. The security of tenure might vary across plots, so that the expected return to investments in the fertility of these plots is different. Tenure rights in southern Ghana are often ambiguous and negotiated, and there are a variety of mechanisms through which wealth and political influence might be manifested in superior security of tenure.

We begin by examining the hypothesis that women fallow their plots less than their husbands because they face a higher opportunity cost of capital. It is plausible that if this hypothesis is correct that (within a household) relatively wealthy individuals are less credit constrained and therefore choose longer fallow periods. Of course, individual wealth is likely to be correlated with unobserved characteristics of the plots cultivated by the individual. Therefore we estimate the determinants of the duration of the last fallow period treating current wealth as endogenous, using the occupational background of the cultivator's parents as instruments for wealth. The relevant conditioning information includes all the measures of the social and political background of the cultivator that appeared in Table 4, including the amount of inherited land, traditional office-holding status, and migratory history. The identification assumption is that conditional on these other dimensions of the cultivators background, parental occupation influences fallowing decisions only through its effect on wealth.

The first stage estimates of the determinants of current wealth are reported in column 1 of Table 5. The instruments are jointly highly significant determinants of current wealth: in particular, current wealth is much higher if the cultivator's mother was a trader rather than a farmer (the excluded category is "other occupation") or if the cultivator's father was a farmer or civil servant (relative to the excluded category of laborer). Several of the conditioning variables are also strongly related to current wealth: current wealth is positively related to the schooling of one's mother, and negatively correlated with father's schooling, strongly positively correlated to the number of wives of the father and to the parity of one's own mother in that set, and negatively related to the number of children of one's father. Individuals whose families have recently migrated to the village tend to be wealthier, and those who were fostered as children poorer.

Current wealth is well-determined by the occupation of one's parents, but in turn has nothing to do with fallowing decisions. In column 2 we present the fixed-effect instrumental variables estimates of the determinants of fallow duration with current wealth treated as endogenous. The coefficient on current wealth is quite precisely estimated to be near zero: the point estimate implies that individuals with $1,000,000$ cedis in additional wealth (mean wealth is $700,000$ cedis) fallow their plots an additional 5 months, and the coefficient is not significantly different from zero. Intrahousehold variation in fallowing durations is not related to differences in wealth across members of the household. We conclude that variations within the household in the cost of capital do not lie at the root of variations in fallowing across the plots cultivated by household members.

Security of Land Tenure

We turn, therefore, to an investigation of tenure security and its relationship to fallowing decisions. This area of Ghana is characterized by extremely complex property rights and tenure patterns. Control over many plots is subject to negotiation Land is bought and sold or rented, but more often it comes through family or household channels with a less explicit contract. The primary source of plots for both genders is allocated family land, i.e. land that is provided by the family for use by the cultivator, usually for an open-ended period and for no rent or a small token payment. Aside from this source, men and women do have some differences in acquisition. Women rely more on allocated household land – plots that are given to them by their husband. Men, on the other hand, are more active on the land market, drawing about 30 percent of their plots from the land market through share cropping or cash rent. Although it is a less important source of land, women do engage in the land market, sharecropping and cash rent account for about 20 percent of their plots.

No single measure of tenurial security is evidently sufficient to summarize individual rights to particular plots of land. Our method will be guided, therefore, by the conclusions of a sequence of seven focus group interviews conducted in the four villages in August-September 2002.

Description of composition & construction of focus groups: voluntary participation, drawn from both survey respondents and non-respondents. Some groups single-gender, others mixed.

When confronted with preliminary results relating to the gender differential in plot profits and fallowing behavior, and its relationship to holders of traditional office many participants expressed little surprise. A consensus quickly emerged that the primary cause of our finding is uncertainty over land tenure, particularly for women, and particularly for those not well-connected to chiefs and family heads.

Interestingly, the mechanism that was emphasized was not a fear of investing in future land fertility on plots over which future rights were uncertain, but rather a fear that the very act of investment (that is, leaving the land fallow) would weaken future rights over the plot.[7] Much of the land cultivated in these villages is obtained through negotiation. More than half of the plots cultivated are on land that is allocate to them by either their lineage (*abusua*) or village. The rhetoric surrounding this allocation process focuses primarily

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[7] One female participant stated,“Se me gya asase no to ho sε enyin a obi bε ba abεsa efi sε eyε mekunu asase.”

on need. Any member of the *abusua* who needs land is entitled to some for cultivation. The determination of "need", not surprisingly, is often contentious. In our focus group discussions, the claim was made several times that the act of leaving a plot fallow would demonstrate a lack of sufficient need, and therefore cast doubt on one's right to the plot.

In this section we propose a simple model of land allocation and fallowing that we believe is consistent with the claims of our focus group participants. We then distinguish the empirical implications of this model from those of a model in which fallowing decisions are made on the basis of expectations of future tenurial security that depend upon one's social and political power and the contractual arrangements through which one has obtained land.

The problematic concept raised by the focus group participants was 'need', and the idea that the degree of one's need could be signalled by one's choices regarding fallowing. If this concept is to have any traction in an explanation of intrahousehold differences in fallowing behavior, then it must be the case that 'need' is determined on an individual basis. Therefore, we begin our model with an extreme version of this and consider each individual as autonomous from his/her household. Each individual has a plot of land, and an off-farm income opportunity. The return to this off-farm activity is private information to the individual.[8]

The model has two periods (years). Individuals are risk neutral and do not discount the future. Each individual has an endowment of T units of time in each period and control over a plot of land (of area 1). Let c be the amount of time spent cultivating the plot, and choose units of area such that c is also the amount of land that is cultivated in that c units of time. Thus $(1-c)$ of the plot is left fallow. Any land cultivated each year has a yield of 1 in each year; land left fallow this year yields $y > 2$ next year, so fallowing is productively efficient.

Any time spent not cultivating is spent on an off-farm job with return w. There are two types of individual, one with a high return off-farm activity with return w_h, where $y > w_h > 1$; and the second with a low return $w_l < 1$.

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[8] The argument that follows builds on suggestions from Ashok Rai; we thank him, but claim all errors as our own.

The high-type individual's (undiscounted) income over the two periods is

$$w_h(T-c)+c+(1-c)y+(T-(1-c))w_h.$$

The first two terms are the first period return: w_h for the time spent not cultivating, and 1 for the time spent cultivating. The second two terms are the second period return: y for the time spent cultivating the $(1-c)$ land that was left fallow in the first period, and w_h for the time spent not cultivating (any land that had been cultivated in period 1 is not worth cultivating in the second period, since $w_h > 1$). Left to his own devices, the high type chooses to fallow his plot in the first period ($c = 0$ since $y > 2$). Hence the high type obtains

$$w_h(2T-1)+y$$

The low-type's income is

$$w_l(T-c)+c+(1-c)y+c+(T-1)w_l,$$

where once again the first two terms are period 1 income. In the second period the low-type obtains a return of y for the time spent cultivating the $(1-c)$ land left fallow in the first period, 1 for the time spent cultivating again the land cultivated in the first period (because $w_l < 1$), and w_l for the remaining time. As with the high type, the low type would choose $c = 0$ (since $y > 2$) and obtains

$$w_l(2T-1)+y.$$

Both types fallow their land in the first period, and because w (and, obviously, consumption) is private information, look identical to outsiders.

We consider a lineage head who allocates land to maximize his own income subject to a constraint that the incomes of the members of the lineage must be sufficiently high. In particular, suppose $w_l(2T-1)+y$ is too low, so the lineage head is obliged to allocate land to them, but not to the high types.

If the lineage head has full information about the individuals' types, he simply allocates a unit of land to each of the low types, withholding land from the high types. In this case the low-type's income becomes

$$w_l(T-c)+c+(2-c)y+c+(T-2)w_l,$$

and once again the low type chooses $c=0$. She now achieves an income of

$$w_l(2T-2)+2y.$$

Unfortunately, the lineage head does not have full information and so must devise a contract such that the high types will refuse the additional land; a cultivation requirement serves this purpose. The lineage head offers an additional unit of land on the condition that at least c units of land are cultivated in period 1. The incentive compatibility constraint of the high type is that

$$w_h(2T-1)+y \geq w_h(T-c)+c+(2-c)y+(T-(2-c))w_h \tag{9}$$

or

$$c \geq \frac{y-w_h}{y-1} \equiv c_h. \tag{10}$$

At some critical level of required cultivation ($c_h < 1$ because $w_h > 1$), the high type refuses the additional land because it is too costly in terms of the high wage non-farm activity that he would have to sacrifice.

The low type will benefit from the additional land, despite the cultivation requirement as long as

$$w_l(2T-1)+y < w_l(T-c)+c+(2-c)y+c+(T-2)w_l \tag{11}$$

or

$$c < \frac{y-w_l}{y+w_l-2} \equiv c_l. \tag{12}$$

As long as the cultivation requirement is not too high, the low type will accept the additional land ($c_h < 1 < c_l$, because $w_l < 1$) even with the low level of fallowing.

Given these information constraints, the constrained-efficient mechanism of land allocation is for the lineage head to offer the land with cultivation requirement c_h. A farmer's willingness to accept this requirement reveals that her return to off-farm work is low, and that she therefore needs the additional land to avoid poverty.

Suppose that the lineage head has access to the otherwise private information about some individuals' returns to off-farm work, perhaps because these individuals are socially or politically well-connected to the lineage leadership. For these individuals, the land allocation can be made without the cultivation requirement, and both high- and low- types in this set efficiently fallow their land.

The key empirical implication is that all plots under the control of an individual are treated similarly. Well-connected individuals about whom the lineage head has full information efficiently fallow their entire portfolio of plots. Low types among the set of more isolated individuals reveal their 'need' by inefficiently cultivating land that - considered only from the viewpoint of technical productivity - should be fallowed. It is inconsequential what the source of that land is, it could either be the cultivator's own land or the land provided by the lineage head.

An alternative model is based on the idea that land rights over plots vary with both the political position of the individual and the mechanism he or she used to obtain the land. In this model, plots are characterized by uncertain land tenure that is vested in individuals, rather than households. Suppose that the security of one's rights over a plot are determined by one's social position in the village and extended matriclan. This is a plausible approximation to much of the literature on land tenure systems in West Africa (Berry; Otsuka and Quisumbing).

Once again, consider a simple two period model. As above, each individual in the household has a plot. The probability that i will control his or her plot next period is $p(z_i, s_i)$ where z_i indicates the political influence of i and s_i indicates the source of the plot (e.g., purchased or allocated by the lineage). If a plot is cultivated this year and next, output each year is 1. If instead it is fallowed, next year's output is $y > 2$. An efficient household with risk neutral members and access to financial markets with interest rate r chooses to fallow plot i if

$$1 + r < p(z_i, s_i)(y - 1).$$

If tenure security were perfect ($p(z_i, s_i) = 1$) and $r < y - 2$, then an efficient household would fallow both plots. However, if $p(z_f, s_f) < p(z_m, s_m)$ because the wife is less politically-connected then the husband, then it might be optimal for this household to fallow the plot of the husband and not that of the wife. The most important empirical implications of this model are that

1. Optimal fallowing behavior might vary with the source of the land, because the source of the land could influence the security of tenure. One would expect that this same implication might emerge in an enriched version of the preceding model.
2. The effect of political influence (most directly, occupation of a traditional office) on fallowing choices could vary depending upon the source of the land. Political influence is likely to play a crucial role in obtaining and maintaining control over allocated land, but less so over purchased or inherited plots.

In column 1 of Table 6 we present fixed-effect instrumental variables estimates of a profit function with fallow duration treated as endogenous, and additional control variables that distinguish the mode of acquisition of the plot. The instruments for fallow duration remain as in the previous tables. The omitted category for the contractual arrangement through which access to the plot was gained is allocated lineage land. It is apparent from the estimated coefficients that relative to allocated land, profits are significantly higher on land that is acquired from one's spouse, or through inheritance, purchase or a caretaking arrangement. The point estimate indicates that profits are particularly low on land that is obtained through cash rent, but the estimate is rather imprecise. There is no evidence of an effect of sharecropping on profits. Current cultivation activities within the household are influenced by the contractual arrangements that provide access to the household's plots.

There is also some evidence that fertility management varies with the contract through which the land is obtained. In column 2 of Table 6, estimates of the determinants of the duration of last fallow are presented, with the contract under which the land is held as additional covariates. Land that is acquired via one's spouse has a shorter fallow duration than land obtained in other manners. This result is likely a consequence of a limitation of our data. In Table 1 it is shown that very few men obtain land via their spouse; however, this is an important mechanism through which women obtain land. In our focus group interviews, it became apparent that a common arrangement is that plots are obtained for the wife from the husbands's lineage. In our data, this would generally be recorded as household land allocated to the wife, but much of the uncertainty regarding future access to such plots likely arises due to the plots' status as lineage land.

The finding that land allocated to the wife from her husband is fallowed less than other land within the household is compatible with a simple model of plot-specific variations in tenurial security, if the claims of the household to such land are relatively weak. It would be possible to enrich our model of land allocation based on signals of neediness to permit variation in fallowing based on other aspects of tenure security, but this finding is not supportive of the core thrust of that mechanism.

We now examine the hypothesis that the importance of political connections for tenurial security (as indicated by fallowing choices) varies according to the source of the plot. Column 3 of Table 6 presents estimates of the relationship between the duration of the last fallow and the source of the land, and interactions between the source of the plot and traditional officeholding status. The excluded category is land from one's own extended family. The estimates are not precise, however, it seems that officeholders choose to fallow plots from non-relatives resident in the village more than they fallow plots from their own family (relative to the same difference for non-officeholders). This estimate is only statistically different from zero at approximately the 10 percent level, but the pattern of these results is not supportive of the model derived from our focus group interviews. Closer political and social connections to the leadership of the village and lineage seems to have a differential effect on fallowing decisions on lands of different provenance. This pattern is just what would be expected if security of tenure is a function of the network of political and social influence in the community rather than individual need as perceived by a benevolent social planner.

Table 1: Summary Statistics

Plot Level Data

	Men		Women	
Variable	Mean	Std. Dev.	Mean	Std. Dev.
profit x1000 cedis/hect	794.63	7175.28	-95.71	1502.33
yield x1000 cedis/hect	1788.00	7705.59	880.06	1777.64
hectares	0.39	0.43	0.21	0.17
labor cost x1000 cedis/hect	802.20	2281.07	912.53	1196.60
seed cost x1000 cedis/hect	285.52	782.23	133.45	259.23
ph	6.37	0.72	6.28	0.78
organic matter	3.20	1.12	3.02	0.95
last fallow duration (years)	4.26	3.37	3.66	1.74
length of tenure (years)	10.11	12.05	6.17	9.90
plot from spouse=1	0.03	0.16	0.29	0.46
plot from spouse's family=1	0.07	0.26	0.12	0.32
plot from family=1	0.60	0.49	0.41	0.49
plot from resident non-relation=1	0.20	0.40	0.16	0.36
plot from non-res. non-relation=1	0.10	0.30	0.03	0.16
plot contract: alloc family land=1	0.53	0.50	0.41	0.49
plot contract: alloc hh land=1	0.04	0.19	0.32	0.47
plot contract: cash rent=1	0.20	0.40	0.14	0.35
plot contract: sharecropping=1	0.15	0.36	0.08	0.27
plot contract: other=1	0.08	0.27	0.06	0.23

Individual Level Data

	Men		Women	
Variable	Mean	Std. Dev.	Mean	Std. Dev.
age	42.63	12.65	42.04	13.18
average assets x1000 cedis	905.85	1066.63	596.58	1023.81
years of schooling	8.50	4.84	4.80	6.01
1 if mother was a trader	0.20	0.40	0.21	0.41
1 if mother was a farmer	0.77	0.42	0.75	0.44
1 if father was a farmer	0.80	0.40	0.83	0.38
1 if father was an artisan	0.10	0.30	0.07	0.25
1 if father was a civil servant	0.08	0.27	0.08	0.27
1 if father was a laborer	0.00	0.00	0.02	0.14
1 if first in village of family	0.14	0.35	0.30	0.46
yrs family or resp has been in village	64.11	39.48	48.62	39.21
1 if resp holds traditional office	0.26	0.44	0.05	0.22
number of wives of father	2.28	1.39	2.05	1.11
number of children of father	10.48	6.57	11.81	6.28
parity of mother in father's wives	1.38	0.74	1.33	0.70
1 if fostered as a child	0.60	0.49	0.79	0.41
size of inherited land	0.33	0.63	0.09	0.35
1 if mother had any school	0.05	0.21	0.15	0.36
1 if father had any school	0.22	0.42	0.32	0.47

Table 2: Base results

	1 profit x1000 cedis/hectare	2 yield x1000 cedis/hectare	3 labor cost x1000 cedis/hectare	4 seed cost x1000 cedis/hectare
gender: 1=woman	-1,043.43	-1,497.18	-262.71	-91.22
	[472.73]	[561.54]	[276.17]	[125.70]
hectare decile=2	446.64	-775.44	-1,313.13	-244.97
	[576.66]	[684.99]	[336.89]	[184.37]
hectare decile=3	1,039.18	-793.74	-1,734.12	-238.22
	[595.48]	[707.34]	[347.88]	[182.15]
hectare decile=4	1,135.09	-331.22	-1,556.35	-169.9
	[597.12]	[709.30]	[348.84]	[165.58]
hectare decile=5	656.62	-1,188.55	-1,721.02	-345.87
	[588.40]	[698.94]	[343.75]	[168.38]
hectare decile=6	810.67	-1,083.07	-1,821.08	-209.65
	[586.80]	[697.03]	[342.81]	[159.66]
hectare decile=7	875.33	-1,369.88	-2,079.89	-277.51
	[590.16]	[701.03]	[344.78]	[170.48]
hectare decile=8	438.97	-1,816.14	-2,074.95	-232.3
	[599.90]	[712.60]	[350.47]	[182.80]
hectare decile=9	249.13	-2,733.71	-2,783.99	-298.64
	[638.96]	[759.00]	[373.29]	[178.01]
hectare decile=10	-315.67	-2,847.31	-2,278.36	-587.54
	[700.07]	[831.59]	[408.99]	[190.82]
soil type=loam	-174.76	-249.94	-105.46	-7.57
	[400.06]	[475.21]	[233.72]	[103.42]
soil type=clay	-511.77	-101.82	329.79	108.4
	[467.71]	[555.58]	[273.24]	[117.99]
ph	-259.79	-118.68	200.78	-102.67
	[249.19]	[296.00]	[145.58]	[59.12]
organic matter	-15.94	19.09	73.05	-46.63
	[151.08]	[179.46]	[88.26]	[37.65]
topo: midslope	299.14	96.63	-295.81	499.03
	[1,595.93]	[1,895.74]	[932.35]	[600.76]
topo: bottom (level)	663.23	358.48	-228.79	279.67
	[1,584.04]	[1,881.62]	[925.41]	[593.65]
topo: steep slope	2.73	460.28	282.27	389.05
	[1,625.75]	[1,931.16]	[949.77]	[609.07]
Constant	1,209.25	3,234.46	1,253.24	949.85
	[2,186.75]	[2,597.55]	[1,277.51]	[702.08]
Observations	614	614	614	336
R-squared	0.81	0.52	0.9	0.89

all regressions include household-year fixed effects

standard errors in brackets

hectare decile=1, soil type=sand, topo=uppermost (level) excluded

Table 3: Robustness of base result

	1	2	3	4
	OLS	OLS	spatial GMM	spatial GMM*
	dep variable = profit x1000 cedis/hectare			
years of school	-61.9			
	[81.88]			
gender: 1=woman	-1,233.99	-858.66	-1043.43	-1666.78
	[570.43]	[369.05]	[299.87]	[373.79]
ph	-153.47		-259.79	-346.83
	[276.30]		[88.51]	[75.62]
om	-45.44		-15.94	154.97
	[159.16]		[52.27]	[42.95]
Observations	558	888	614	575
Fixed Effects	household-year	household-year	household-year	household-year and spatial**

standard errors in brackets

plot controls and constant included in every regression

* spatial standard errors calculated as defined in footnote 5

** spatial fixed effects for unobserved characteristics in the plot neighborhood

Table 4: Profits and fallow duration

	1 OLS profit x1000 cedis/hect	2 IV profit x1000 cedis/hect	3 first stage fallow duration (years)	4 IV profit x1000 cedis/hect	5 first stage fallow duration (years)
fallow duration (years)	163.12	421.41		314.07	
	[47.88]	[225.67]		[182.00]	
gender: 1=woman	-356.19	19.28	-0.58	143.06	-0.43
	[397.00]	[537.24]	[0.67]	[426.13]	[0.54]
1 if first of family in town			-0.44		0.29
			[0.66]		[0.64]
years family/resp lived in village			-0.01		0.01
			[0.01]		[0.01]
1 if resp holds trad. office			3.91		1.95
			[1.11]		[0.80]
number of wives of father			0.39		0.52
			[0.35]		[0.23]
number of father's children			-0.08		-0.02
			[0.07]		[0.05]
parity of mom in father's wives			-0.44		-0.42
			[0.41]		[0.36]
1 if fostered as child			0.86		0.35
			[0.74]		[0.61]
size of inherited land			-0.29		-0.52
			[0.63]		[0.57]
1 if mother had any education			-0.87		0.96
			[1.17]		[1.05]
1 if father had any education			-0.13		-0.98
			[0.80]		[0.63]
Observations	760	755	755	700	700
Fixed Effects	household-year	household-year	household-year	household year anc spatial	household year anc spatial
F-test of instruments			F(10,415)=2.10		F(10,381)=2.49

standard errors in brackets
plot controls and constant included in every regression

Table 5: Fallow and credit constraints

	1 IV last fallow duration (yrs)	2 first stage avg assets x1000 cedis
average assets x1000 cedis	0	
	[0.00]	
gender: woman=1	-1.01	-2.37
	[1.10]	[126.38]
1 if first of family in town	-1.18	537.51
	[0.99]	[106.60]
years family/resp lived in village	-0.03	7.96
	[0.01]	[1.59]
1 if resp holds trad. office	2.77	-68.91
	[1.79]	[185.27]
number of wives of father	0.12	416.23
	[0.63]	[59.27]
number of father's children	-0.05	-44.74
	[0.10]	[9.61]
parity of mom in father's wives	-0.51	156.64
	[0.63]	[61.46]
1 if fostered as a child	1.05	-983.67
	[1.28]	[132.66]
size of inherited land	-0.02	140.36
	[1.18]	[133.90]
1 if mother had any school	-0.48	1,546.91
	[1.72]	[232.34]
1 if father had any school	-0.54	-969.84
	[1.40]	[160.69]
1 if mother was a trader		1,041.00
		[304.51]
1 if mother was a farmer		-1,982.73
		[346.50]
1 if father was a farmer		4,070.56
		[500.44]
1 if father was an artisan		971.38
		[423.82]
1 if father was a civil servant		4,283.37
		[516.50]
Observations	486	486
Fixed Effects	household-year	household-year
F-test of instruments		F(5,212)=36.18

standard errors in brackets
all regressions include plot controls and a constant
excluded categories: father other occupation, mother other occupation

Table 6: Fallow and land tenure

	1 IV profit x1000 cedis/hect	2 first stage last fallow duration (years)	3 OLS last fallow duration (years)
last fallow duration (years)	568.18		
	[260.65]		
gender: woman=1	-297.36	-0.26	-0.45
	[556.58]	[0.71]	[0.62]
1 if first of family in town		0.01	
		[0.75]	
years family/resp lived in village		-0.01	
		[0.01]	
1 if resp holds trad. office		3.72	2.21
		[1.19]	[1.12]
number of wives of father		0.42	
		[0.36]	
number of father's children		-0.1	
		[0.07]	
parity of mom in father's wives		-0.44	
		[0.43]	
1 if fostered as a child		0.65	
		[0.77]	
size of inherited land		-0.3	
		[0.66]	
1 if mother had any school		-0.58	
		[1.25]	
1 if father had any school		-0.51	
		[0.87]	
contract: 1=allocated hh land	1,336.20	-1.25	
	[650.91]	[0.62]	
contract: 1=cash rent	-798.81	0.21	
	[477.80]	[0.45]	
contract: 1=sharecrop	103.1	0.3	
	[640.20]	[0.60]	
contract: 1=other	1,342.66	-0.68	
	[749.62]	[0.70]	
1 if plot is from spouse			-1.35
			[0.75]
1 if plot is from spouse's family			0.19
			[0.74]
1 if plot is from res. non-relation			-0.41
			[0.57]
1 if plot is from non-res. non-relation			0.36
			[1.04]
office*from spouse			2.25
			[3.27]
office*from spouse's family			-0.04
			[2.48]
office*from res. non-relation			2.89
			[1.79]
office*from non-res. non-relation			-1.45
			[2.41]
Observations	728	728	468
Fixed Effects	household-year	household-year	household-year

standard errors in brackets
all regressions include plot controls and a constant
excluded categories: allocated family land (contract) land from family (source)