Participation by Men and Women in Off-Farm Activities: an Empirical Analysis in Rural Northern Ghana

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Summary

The paper evaluates the household- and community-level factors influencing women's and men's decisions to participate in off-farm activities, either in the off-farm labor market or in local community groups, and the relationship with on-farm crop returns. Results reveals female participation in off-farm labor markets increases at higher levels of labor availability, and female on-farm work and group participation are complementary activities. Results also indicate that male labor is relatively more productive on-farm versus off-farm than female labor. Finally, the study shows that education increases the likelihood for both women and men to work off-farm, although the impact is greater for women.

JEL classification: J22, Q12

Key words: off-farm labor supply, participation, community groups, gender, Ghana, Africa

1. Introduction

As is well known, agricultural productivity has been declining or has remained stagnant in many countries in sub-Saharan Africa (IFAD 2001), including the Upper East of Ghana, which is considered the poorest in Ghana (IFAD, 2007). Individuals and households in this region rely on a variety of agricultural and nonfarm income strategies to meet household needs. Off-farm income can be a particularly important strategy for meeting subsistence needs as well as absorbing shocks to agricultural income (FAO, 2007). In addition to allocating time to farm and off-farm work,[1] individuals also participate in local groups dedicated to a wide variety of purposes. Participating in such social networks can yield a number of benefits to members, including increased access to public goods and perhaps credit, information sharing, and increased solidarity and strengthened reciprocal relationships (Coady, Dai, and Wang 2001; Hoddinott, Dercon, and Krishnan 2005; Weinberger and Jutting 2001; Grootaert and Narayan 2001). To summarize, both off-farm work and participation in groups may enable household members to better smooth consumption through their impact on income variability, and both activities may increase on-farm productivity and total incomes via enhanced access to credit. Additionally, participation in both may reduce transactions associated with market participation; for example, participation in groups may increase access to relatively local information on market opportunities, whereas off-farm work may increase access to a wider range of information.

On the other hand, the participation decision may differ for male and female members of the household. Participation in off-farm activities[2] has been found to empower women, increasing their bargaining power within the household and increasing household welfare (Newman and Canagarajah 1999), indicating relatively higher returns from such participation outside of simple cash earnings. While much empirical work indicates that female household members are less likely to be involved in nonfarm work in Africa in general (Matshe and Young 2004; Abdulai and Delgado 1999), Ghana has a long tradition of female traders in particular (Canagarajah, Newman, and Bhattamishra 2001). Local community-based groups are also pervasive in Ghana,

some of which are gender specific, and many of which have mixed membership. Women may also improve their intrahousehold bargaining position by participation in groups (Weinberger and Jutting 2001). The above suggests that even if returns to men's and women's labor in crop agriculture are the same, different members may face different marginal benefits from participating off-farm, either in off-farm work or in local community groups.

This paper aims to contribute to the literature evaluating the household- and community-level factors influencing households' decisions to participate in off-farm activities, looking specifically at participation by male and female household members in off-farm work and participation in local community groups that are either predominantly male, predominantly female, or of mixed membership. As developed below, the system of time allocation demands under uncertainty and multiple binding constraints makes evaluating this system difficult theoretically and empirically. Our strategy will be to estimate reduced-form equations and evaluate coefficients to determine whether different time allocation strategies are consistent with different activities' being substitutes or complements. For instance, relatively labor-abundant households may face low marginal labor returns to crop production and thus be more likely to engage in either of the off-farm activities. Similarly, to the extent that participation in local groups provides information relevant to off-farm labor or trading opportunities, benefits from participation in local labor groups may increase returns to off-farm labor relative to on-farm returns. Finally, to the extent that off-farm wages are less risky and increase cash flow, this activity may overcome the impact of imperfect or missing credit and insurance markets and thus lead to greater expenditures on-farm.

The rest of the paper is organized as follows. In section 2, we provide a brief overview of the literature on participation in off-farm activities and impacts on household welfare. In section 3, we provide background information on the Upper East region of northern Ghana, presenting relevant descriptive statistics from household- and community-level surveys implemented in the region in 2005. Model development and the

empirical strategy are presented in section 4, and econometric results are presented in section 5. Concluding comments are provided in section 6.

2. An Overview of the Literature

Much of the literature looking at time-allocation decisions of rural household members focuses on the benefits accruing to households from diverse sources of both on- and off-farm income, mainly through the reduction of income risk (cf. Ruben and Van Den Berg 2001). Off-farm income may also increase average income, for example, where seasonal labor demands differ across activities (Holden, Shiferaw, and Pender 2004). Access to nonfarm cash earnings may also ease credit constraints and smooth consumption, thereby increasing food security and enabling households to better cope with shocks *ex post* (Matshe and Young 2004; Araujo 2003; Abdulai and Delgado 1999). As developed in the "new economics of labor migration" literature, off-farm work may also complement on-farm productivity by increasing the household capacity to purchase farm inputs and/or make on-farm investments leading to improved yield and labor productivity (Taylor, Rozelle, and de Brauw 2003; Ruben and Van Den Berg 2001; Stark and Wang 1999). Similarly, one of the main benefits associated with participation in groups is the ability to form and maintain reciprocal relationships that enable members to smooth shocks to household income (Hoddinott, Dercon, and Krishnan 2005). Additional hypothesized benefits include greater access to production and market-related information and thus greater household income (Haddad and Maluccio 2003). Participation in groups also helps to build trust and social cohesion and allows group members to gain bargaining power within their own households (Weinberger and Jutting 2001).

With respect to empirical evidence on factors affecting the decision to participate in off-farm work in the African context, Matshe and Young (2004) examined both the decision to participate in off-farm work and the amount of time devoted to this activity by individual household members for both women and men in rural Zimbabwe. They found that though women are less likely to work off-farm, women who do decide to work off-

farm subsequently work more hours off-farm than men. Education has a positive impact on the off-farm work decision supporting the hypothesis that returns to education are higher for off-farm versus on-farm activities. Results also show that a higher number of adults in the household increases the probability that both men and women participate in off-farm work. In a study using data from rural households in Ghana, Jolliffe (2004) estimated returns to education in off-farm earnings and on-farm profits at the household level. Results indicate that households with higher average education levels allocate more labor to off-farm work. Damite and Negatu (2004) explored the determinants of rural livelihood diversification in southern Ethiopia. The authors used livestock holdings as the proxy for asset and wealth. The results indicate that greater livestock holdings are associated with a greater diversification of income sources. Available labor supply is also associated with greater income diversification, whereas farm size has a negative impact on generating income from off-farm activities, indicating that labor-abundant households are more likely to participate off-farm. As in Jollife (2004), the only gender variable is a dummy variable for the gender of the household head; it is not significant.

Woldenhanna and Oskam (2001) analyzed households' off-farm labor supply and choice between off-farm activities in Ethiopia. The authors found that higher farm output discourages farmers from working in off-farm wage employment while it encourages farmers to participate in off-farm self-employment activities. They argue that there are entry barriers to certain off-farm employment opportunities, noting that wealthier farm households dominate the most lucrative nonfarm activities such as trading and masonry. Canagarajah Newman, and Bhattamishra (2001) analyzed the distribution of nonfarm earnings in rural Ghana and Uganda, focusing on issues of gender and inequality. Results show that women earned less than men did but that being a female household head has a positive impact on off-farm earnings. Off-farm earnings were also positively associated with higher education and lower distance to market. The study also implied that on-farm and off-farm activities functioning as substitute in Ghana. Abdulai and Delgado (1999) estimated the nonfarm labor participation decision as well as wage rate and labor supply for husbands and wives in rural Northern Ghana. Again

schooling has a positive impact on nonfarm labor participation; here both husbands and wives with more schooling have a higher probability of engaging in nonfarm activities. In general, members of labor-abundant households located in less-isolated, population-dense localities with greater infrastructure were more likely to participate in nonfarm work, supporting the hypothesis that households with excess labor supply per unit of cropland, and those with lower transaction costs of accessing markets, were more likely to engage in nonfarm work.

The amount of literature linking off-farm activities and social networks is more limited. Araujo (2003) explored how the neighborhood and neighbors' choices affect an individual's decision to participate in the off-farm labor market, using data from rural Mexico. Results show that young, educated men are more likely to participate in nonagricultural activities. The proportion of neighbors employed in off-farm, nonagricultural activities also plays a positive role in the individual farmer's choice of occupation, indicating that local networks reduced transaction costs of accessing these jobs.Haddad and Maluccio (2003) explored the relationship between membership in groups, indicators of trust, and the effect of both on household welfare (measured by per capita household income), using longitudinal data from South Africa. Results indicate that previous membership in financial groups increases trust and group membership also has a positive effect on per capita income.

Grootaert and Narayan (2001) analyzed local institutions in Bolivia and found that participation in local groups reduced the probability of falling below the poverty line and furthermore that such returns to group membership are greater for the poor than for the rich. Godquin and Quisumbing (2006) explored the determinants of group membership and social networks of households by using longitudinal data from the rural Philippines. They categorized groups into five types: production, credit, burial, religious, and civic groups; women's groups are included in the civic group. They found that a high proportion of the civic groups (56 percent of civic groups) are women's groups and that activities are primarily related to nutrition and other

interests (e.g., cooking). The authors also found that asset-rich, better-educated households and households living closer to town centers are more likely to participate in groups. Coady, Dai and Wang (2001) estimated the determinants of women's participation in community activities in the context of an evaluation of a gender-focused community program in rural China. The author found that the probability of a woman's participation decision is positively affected by her education and negatively affected by the family size. Additionally, participation leads to higher household income.

In summary, the most important variable explaining participation in both off-farm work and local community groups, in terms of being consistently statistically significant, is education. This is consistent with the results of a special issue of *Food Policy* focusing on income diversification; reviewing the papers, Barrett, Reardon, and Webb (2001) found that education is one of the most important determinants of off-farm earnings. Households with more educated members and individuals with more education are more likely to participate in both activities. Labor-abundant households are more likely to seek off-farm work, as are those located in less-isolated, population-dense communities with better infrastructure. Households with greater wealth levels and asset holdings are generally also more likely to participate in off-farm work; the evidence is positive but weaker for participation in groups.

3. Background of the Study Area, Data, and Descriptive Statistics

The study area is the Upper East region of Ghana, the poorest of all the 10 administrative regions of Ghana (Gyasi, Schiffer and McCarthy,2005). Our data come from the project "Integrating Knowledge from Computational Modeling with Multi-stakeholder Governance in Ghana."[3] The fieldwork was undertaken from June to October of 2005. We use data from three data sets: household and community survey data collected by team members, and available GIS-based (Geographic Information System-based) data on road densities and soil quality. Total 292 households from thirty-one communities were surveyed.

Participation in both off-farm, income-generating activities is captured by a dummy variable taking the value of 1 for any working-age adults (20 years old or older) who worked outside of the home or farm in the 12 months before the survey was implemented.[4,5] Among our 292 households, over one-third (104) had at least one member participating in off-farm work, with most households having just one or two members working off-farm. The majority of those working off-farm are either household heads or spouses (83 percent), the remainder being either children or, in rare cases, other relatives. As shown in Table 1, female household members participate in off-farm work more than male members. Among the 104 households that participate in such work, 31 households (less than one-third) have only male members participating, whereas the remaining 73 households have at least one female working off-farm, and 46 households have only females doing so.

[table 1 about here]

Among the 962 off-farm adults older than 20 years old, 177 members (accounting for 18 percent) participate in off-farm work, 112 women and 65 men. We also have information on the types of off-farm work being undertaken. Figure 1 shows that trading is the predominant activity, with almost half of the adults (77) involved in this activity. The second most important occupation is craftwork, undertaken by about one-fourth of members (44). In third place is farm labor, accounting for just 10 percent of those working off-farm.

[figure 1 about here]

We also analyze the sample by the breakdown in age and education. We find that average age for persons participating off-farm work is 37 years old while the mean for people not involving in off-farm work is 42.6 years old. We find the household members' years of schooling is positive associated with his likelihood to participate in off-farm work, the mean education for household members who participate in off-farm work is 2 years of schooling, in comparison with only 1.1 years of school for members who do not involve in off-farm work.

With respect to the gender breakdown of off-farm work, Table 2 highlights the importance of both trade and craftwork for women vis-à-vis men. The number of female traders is almost three times the number of male traders, and the number of craftswomen is double the number of craftsmen. But as farm laborers, the number of male members is a bit higher than that of female members. In summary, in our sample, women are more active in off-farm, income-earning activities than men; and trading and craftwork are particularly important for women. In general, young and educated household member find it easier to be involved in off-farm work.

[table 2 about here]

Next, we consider participation in local community groups. Unlike participation in off-farm work, we do not have data about participation in such groups by individual household member. Rather, we know whether at least one household member participates in different groups, including women's self-help groups, as well as agricultural cooperatives, livestock producers' associations, or crop producers' associations. From the community-level survey's information about whether various groups were composed of mostly men, mostly women, or both, we know that women's self-help groups are composed mainly of women, whereas agricultural cooperative, crop producer, and livestock producer associations are composed mainly of men. The remaining groups, including village development committees, parent-teacher associations, religious groups, burial societies, and so forth, are largely composed of both men and women.[6] In our survey, 59 percent of households had at least one member participating in women's self-help groups, just 21 percent had at least one member participating in the more male-dominated agricultural-focused groups, and 69 percent of households had at least one member participating in the mixed-member groups.

As depicted above, women in the Upper East region actively participate in local community groups and in off-farm, income-generating activities, and in fact, their participation rates in off-farm work are higher than men's. While both activities require time, time allocated to off-farm, income-generating activities is more likely to conflict with (or substitute for) time allocated to on-farm activities vis-à-vis local community groups, since it

is reasonable to assume that such groups schedule meetings and activities at times that do not directly conflict with on-farm labor demands.

The opportunity costs of time allocated to off-farm activities should be directly related to on-farm returns. However, returns to agriculture are generally constrained by given land endowments,[7] and we expect that adults per acre of owned land will largely drive labor returns to agriculture.[8] Higher total on-farm returns due to underlying agro-ecological characteristics or excess labor (given imperfect land markets) may free up time to devote to both off-farm work and community groups. On the other hand, greater participation in off-farm work may relieve cash constraints to purchase crop inputs or to participate in local community groups, where these require cash outlays by members. Greater participation in community groups may increase productivity through increased information flows and increased access to informal credit. Participation in community groups may also increase information available regarding off-farm work opportunities. In short, all three activities might function as substitutes or complements, depending on relative returns across activities and household constraints. To get an idea of how these activities are related, Table 3 gives the simple correlation coefficients between gross crop returns per acre, participation of females and males in off-farm work, and participation in groups that are mainly composed of female, male, or both members.

[table 3 about here]

Statistically significant correlations are shown in bold. First, we note that on-farm returns have no statistically significant correlation with either female or male off-farm work; however, the correlation is significant and positive for participation in all three different types of groups. Participation by females and males in off-farm work is positive, indicating synergies among household members in obtaining off-farm work. Female participation in off-farm work is also significantly and positively correlated with participation in both women's and other types of groups, consistent with limited time constraints imposed by belonging to these groups vis-à-vis farmwork. Male participation in off-farm work is also positively associated with participation

in women's groups and participation in other groups but is not correlated with the agriculture-specific, male-dominated groups. Finally, households with members participating in one type of group are correlated with participation in the other groups. These simple correlations are consistent with the hypothesis that participation in local community groups is complementary to both off-farm work and on-farm crop returns, while the insignificant correlation between off-farm work and on-farm returns is consistent with the hypothesis that households with excess labor supply are those that work off-farm but where higher off-farm income is not reinvested on-farm.

Given that the adults-land endowment ratio is likely to be important in explaining time allocation decisions, in Table 4, we have divided the household sample into three categories: highly labor abundant (more than 1.33 adults per acre), moderately labor scarce (between 0.5 and 1.33 adults per acre), and labor scarce (less than 0.5 adult per acre). In Table 4, we report descriptive statistics for land and human capital endowments.[9]

[table 4 about here]

First, we note that gross returns per acre are declining as labors become scarce, though the difference between moderate and labor-scarce households is not statistically significant. Second, we note that women's participation in off-farm work and in women's groups is higher for both the labor-abundant and labor-scarce households, indicating that females in moderately labor-scarce households are less likely to participate in either off-farm activity. On the other hand, male participation in off-farm work is highest for labor-abundant households, declining thereafter, whereas participation in agriculture-specific community groups increases as labor becomes more scarce. The latter indicates that male labor time is increasingly focused on agriculture-specific activities as labor becomes more scarce, perhaps due to the increased role of men in management and supervision on larger farms vis-à-vis women members of the household.

4. Empirical Model Development

4.1. The Model

In this section, we develop our empirical estimation strategy. Given the data set, we will focus on deriving an empirical model to evaluate factors affecting the household-level decision to allocate to participate in off-farm, income-generating activities and overall on-farm returns.[10] The households maximize expected utility of on-farm and off-farm returns, subject to a number of household constraints, as captured in the following:

$$\max EU(y_i) = EU\left(p^A f\left(l_{Fi}^A, l_{Mi}^A, h_i, x_i; Z_i^{hh}, Z^C\right) - w_x x + r_F l_{Fi}^O + r_M l_{Mi}^O\right) \quad (1)$$

$$\text{s.t. } p^A f\left(l_i^A, h_i, x_i; Z_i^{hh}, Z^C\right) - w_x x + r_F l_{Fi}^O + r_M l_{Mi}^O \geq 0 \quad (2)$$

$$\bar{L}_{Fi} - l_{Fi}^A - l_{Fi}^O \geq 0 \quad (3)$$

$$\bar{L}_{Mi} - l_{Mi}^A - l_{Mi}^O \geq 0 \quad (4)$$

$$\bar{H}_i - h_i \geq 0 \quad (5)$$

where p^A is a composite price for the agricultural outputs; f is the agricultural production function; l_{Fi}^A and l_{Mi}^A are the amounts of labour allocated by female and male members of household *i* to agricultural activities; h_i and x_i are the amount of land and variable inputs allocated to agriculture, respectively; Z_i^{hh} and Z^C are exogenous household and community/geographical characteristics affecting agricultural production; and w_x is the price of purchased inputs. Labor from off-farm work are captured by l_{Fi}^O and l_{Mi}^O, the amount of female and male labour allocated to off-farm work; and r_F and r_M are wages earned by female and male workers, respectively. $\bar{L}_{Fi}$ and $\bar{L}_{Mi}$ are total household female and male labour endowments, which added equal $\bar{L}_i$, the total household labour endowment; $\bar{H}_i$ is the total household land endowment. Assuming that female and male labor constraints are binding and the maximization problem yields the following first-order conditions for the labor allocation variables:

$$\frac{\partial EU}{\partial l_F^A} = \frac{\partial EU}{\partial Y}\left\{\left(1+\lambda\right)\left[p^A f'_{l_F^A} - r_F\right]\right\} \geq 0 \quad (6)$$

$$\frac{\partial EU}{\partial l_M^A} = \frac{\partial EU}{\partial Y}\left\{\left(1+\lambda\right)\left[p^A f'_{l_M^A} - r_M\right]\right\} \geq 0 \quad (7)$$

From the first-order conditions, we see that if male and female labor are equally productive in agriculture, then all else equal (including the impact on the expected marginal utility of income), higher off-farm wages for women will lead to more women's working off-farm, which increases the marginal product of labor in agriculture, drawing in more male labor to replace the lost female labor. If female labor is less productive than male labor in agriculture, but off-farm wages for both are the same, then again, we expect relatively more female labor to be allocated off-farm and more male labor allocated on-farm. Of course, time may also be allocated to community groups as well as to domestic chores and to leisure. The intuition from the simple model remains; time will be allocated according to marginal benefit received, and to the extent that such returns differ systematically for men and women, we should observe different time allocation decisions.

Labor is not the only constraint in the system; thin land and credit markets and missing insurance markets also characterize this system. These additional constraints make the comparative statics of a fully characterized system complex and generally lead to ambiguous effects of changes in exogenous parameters, as noted by Feder (1985), Kevane (1996), and Moschini and Hennessy (2001). Owning highly productive agricultural land increases the opportunity costs of allocating labor to other activities but may also relieve cash constraints, generating sufficient income to enable workers whose labor is more productively allocated to off-farm work to overcome cash-based entry barriers in certain off-farm activities. In general, poorer households are expected to allocate time to activities that reduce overall risk but do not have high cash barriers to entry, and labor-abundant households are expected to allocate more time off-farm. A negative coefficient on variables capturing productivity of land owned in the off-farm work decision would be consistent with the hypothesis that

opportunity costs of labor drive the off-farm participation decision, whereas a positive coefficient would be consistent with the "cash barriers to entry" hypothesis.

From the above maximization problem and focusing on the time allocation decision, by the implicit function theorem, we can write the reduced-form demand for time allocated to each activity as follows:

$$l_{Bi}^{k*} = g\left(p^{A}, r, \overline{L}_i, \overline{H}_i, Z_i^{hh}, Z^{C}\right) \tag{8}$$

where k indicates the activities to which time can be allocated, and $B = 1, 2$ indicates female and male time. We can also write the reduced-form optimal agricultural income as follows:

$$Y_i^{A*} = f\left(p^{A}, r, \overline{L}_i, \overline{H}_i, Z_i^{hh}, Z^{C}\right) \tag{9}$$

Finally, the dataset allows us to test only factors associated with the discrete decision to allocate female and male time to off-farm income-generating activities and to participate in either female-dominated, male-dominated, or female/male groups. The only continuous variable we can measure is on-farm crop revenues. Households consider the allocation of the male and female time to off-farm work and to various community groups by underlying utility. We do not observe the continuous utility function, but rather a vector of discrete choices for time allocation for males and females to both off-farm, income-generating activities and to community groups, l_{Bi}^{k*}. Consequently, we have the following:

$$l_{Bi}^{k} = \begin{cases} 1 \;\; if \;\; l_{Bi}^{k*} > 0 \\ 0 \;\; if \;\; l_{Bi}^{k*} \leq 0 \end{cases} \tag{10}$$

Note that to estimate each equation separately requires the further assumption that error terms be uncorrelated. However, particularly for labor allocated to off-farm work, the error terms may well be correlated. Though we cannot test for the correlation of the error terms for all possible combinations of time allocation, we can test each pairwise combination using a bivariate probit.

A priori, we expect that allocation between off-farm work and participation in community groups is likely to be separately determined since such groups are organized around the work commitments of its

members, for example, by scheduling meetings during off-peak hours. Participation by both genders in off-farm work, however, is more likely to be jointly determined. Similarly, the participation of household member(s) in different community groups may also be correlated to the extent that households that gain underlying benefits for group participation may do so from a variety of groups.

4.2. Explanatory Variables

A table of descriptive statistics of dependent variables and explanatory variables is provided in the Appendix. The vector of explanatory variables from equations (8) and (9) includes the price of agricultural output, the wages received in off-farm work, the land and labor constraints, and a vector of household and community characteristics. As with many cross-sectional data sets, prices and off-farm wages are particularly difficult to include directly. In our case, though we have prices for the six major agricultural crops, these prices come from district-level data, and we have no separate wage data for the various off-farm occupations. We thus chose to include district-level dummies—which reflect more than just price differentials—to capture the relative opportunity costs of agricultural output and off-farm work.

In terms of land and labor constraints, we are particularly interested in testing whether "excess labor" per acre is driving participation in off-farm activities, particularly off-farm work. To test for this, we constructed spline functions for labor availability per hectare, implicitly assuming that male and female labor were perfectly substitutable in agricultural production.[11] We started with a spline function at 2.2 acres (1 hectare) per adult, and in fact, this specification fits the data very well and was used in the final specification (captured by the variables $AdpAcre\_L$, $AdpAcre\_H$, where $\_L$ connotes the section of the spline with few adults per hectare and $\_H$ connotes the more labor-abundant section of the spline). Including the total land constraint separately allows us to test landholdings as a wealth variable as well as contributing to labor returns and overall crop returns per hectare via its impact on binding cash constraints and missing insurance markets. Following standard crop profit function arguments, we use the natural log of total land owned ($\ln OwnLnd$).

Finally, though female and male labor may be perfectly substitutable on cropland, women and men may face different opportunity costs off-farm. We thus included the proportion of adult females in adult labor to capture relative differences in off-farm opportunity costs (*PropFem*).

Additional opportunity costs for female members directly, and male members indirectly, are captured by variables associated with domestic time allocation, including gender of the household head and number of dependent children in the household. Female-headed households are hypothesized to be more time constrained, and likely cash constrained, as this status generally signifies a single-headed household (the variable is titled *FHH*). Alternatively, unlike in many countries, in Ghana, women are very active in both trade and craft activities, and in our sample, they participate in these activities more than do men. Given traditional gender differentiation of agricultural tasks, a female household head may be relatively more likely to allocate household resources to these female-dominated activities. Likewise, the impact on participation in local community groups is ambiguous. Female-headed households may be more time constrained, but participation in these groups may be relatively more important for these households to improve access to diverse income sources, increase access to credit, and cope with shocks. Additionally, to capture domestic demands on women's time in particular, we include a variable to capture child dependency (*DependC*). This variable was created by dividing the total number of children younger than six by the number of adult females in the household.[12] The number of dependents is hypothesized to decrease time allocated to off-farm work, but as with female-headed households, households with many dependents may benefit relatively more from group participation, especially as time constraints should be less likely to bind for participation in groups.

Additional opportunity costs of allocating labor off-farm are captured by variables that directly affect crop productivity. We use three variables that should directly affect crop returns, including the sum of agricultural implements held by the household (*SumAgImp*), which may also capture household wealth; and two community-level variables, a soil quality index (*SoilQ*) and a dummy variable capturing whether irrigation

is potentially available at the community level (*IrrigD*). For soil quality, we used information from a soil quality map generated by the Food and Agricultural Organization (Aregheore 2005), which provides information on seven different soil types in the region. Given household GPS coordinates, we generated an indicator of average soil quality at the community level by assigning relative values to the different types of soil and generating an index weighted by area in the different soil types.[13] Additionally, whether to irrigate is a choice variable for the household; to account for higher crop returns where irrigation was possible, then, we included a dummy variable capturing whether any households were undertaking irrigation within the community.

We rely on the theoretical models developed in the "new economics of migration labor" literature discussed above to specify additional relevant household- and community-level explanatory variables affecting labor productivity and constraints facing the household; these include human capital endowments, wealth, and community-specific factors affecting the net returns of participating in off-farm activities. As highlighted in the descriptive statistics, both theoretically and empirically, human capital endowments are hypothesized to play an important role in household decisions to engage in off-farm activities. To the extent that securing and maintaining off-farm work are more complicated and/or require more skill to be prepared to deal with outside techniques and to fulfill obligations, both education and experience may be relatively more productive off-farm rather than on-farm. In our case, the three most frequently engaged occupations are trader, craftsperson, and farm laborer. Greater educational attainment and learning by doing are helpful means to train a farmer to be a smarter trader, cleverer craftsperson, or more capable laborer. Experience may also capture the extent of contacts necessary to learn about and secure off-farm work. To capture experience, we include the natural log of the age of the household head (ln*Age*); age of the household head is highly correlated with the age of other adults in the household. Unlike the age of the household head, however, the number of school years attained by adults in the household is not highly correlated. Attendance is largely a function of whether a school existed in, or close by, the community; the average years of schooling for household heads is 1.21 and the median 0, the

average for non–household head adults—who are much younger—is nearly four years, capturing the increased accessibility to primary schools during the 1980s in the study area. Additionally, as argued by Jolliffe (2004), benefits to schooling may be more easily shared among household members than individual experience. We thus include the total years of schooling of adult family members, divided by the number of adults (*AvgEdu*). Both age and education are expected to increase participation in off-farm work; more experience is expected to decrease opportunity costs of seeking such opportunities, and greater knowledge should be relatively more valuable in this activity. Expected impacts on participation in community groups are ambiguous; on the one hand, groups may increase knowledge and reduce transaction costs associated with participation in income-generating activities both on- and off-farm, but on the other hand, the returns to participating in these groups may be relatively low for well-educated, experienced households.

Households with greater wealth are also expected to be more likely to participate in both off-farm activities and local community groups, to the extent that participation in these activities is characterized by barriers to entry—either in terms of initial or recurring capital expenditure or in terms of social prestige. However, wealthier households are also hypothesized to be less risk averse. Thus, wealthier households should benefit relatively less than poorer households in terms of diversification and increased networks to cope with shocks. To test this in the multivariate model, we include both the natural log of owned cropland (which is also related to overall crop returns per hectare as described above) and a simple sum of the number of consumer durables held by the household, for example, radios, bicycles, and sewing machines (*SumConsDur*). Capturing the severe poverty characterizing this region, 50 of the 292 sampled held no consumer durables.

Participation in off-farm activities will also be affected by the characteristics of the community in which a household is located; a separate survey of basic community characteristics was collected in the 31 communities in which households are located. The first measure is a simple sum of basic infrastructure available in the community, including schools, health clinics, churches, stores, a daily market, and other

community facilities (*SumInfra*). Greater infrastructure should increase the marginal value of time allocated to on-farm labor and may also reduce transaction costs of searching for, and maintaining, off-farm employment. Greater infrastructure may also complement the information-sharing benefits of belonging to groups. We also include the number of community groups extant in the community (*SumGroups*); a wider variety of groups may increase the opportunities to benefit from the spread of information relevant to on-farm and off-farm activities and may also increase reciprocal, informal, insurance-based arrangements. On the other hand, many community groups may indicate a fractionalized community. To capture economic and social heterogeneity separately, we include a measure of differentiation in cropland holdings, which is simply the difference between the largest and smallest landholding in the community (*LandDif*), and a sum of the number of different ethnic groups living in the community (*SumEth*)[14].

Writing out the linearized model yields to the following equations to be estimated:

$$\begin{aligned} l_{Bi}^{K} = {} & \alpha + \overline{\gamma}\,\overline{D} + \beta_1 AdpAcre\_L + \beta_2 AdpAcre\_H + \beta_3 \ln OwnLnd + \beta_4 PropFem \\ & + \beta_5 FHH + \beta_6 DependC + \beta_7 SumAgImp + \beta_8 SoilQ + \beta_9 IrrigD \\ & + \beta_{10} \ln Age + \beta_{11} AvgEdu + \beta_{12} SumConsDur \\ & + \beta_{13} SumInfra + \beta_{14} SumGroups + \beta_{15} LandDif + \beta_{16} SumEth + u_i^l \end{aligned} \tag{11}$$

$$\begin{aligned} RpAcre = {} & \omega + \overline{\varphi}\overline{D} + \delta_1 AdpAcre\_L + \delta_2 AdpAcre\_H + \delta_3 \ln OwnLnd + \delta_4 PropFem \\ & + \delta_5 FHH + \delta_6 DependC + \delta_7 SumAgImp + \delta_8 SoilQ + \delta_9 IrrigD \\ & + \delta_{10} \ln Age + \delta_{11} AvgEdu + \delta_{12} SumConsDur \\ & + \delta_{13} SumInfra + \delta_{14} SumGroups + \delta_{15} LandDif + \delta_{16} SumEth + u_i^R \end{aligned} \tag{12}$$

5. Empirical Results

The number of observations included in the survey was constrained by missing data mainly for educational attainment and crop yields. A total of 292 households were surveyed; full information was available for 272 households for the rainy- plus dry-season crop returns and for 270 households for rainy-season-only returns; the participation decisions were thus run on the 272 households for which full information was

available for rainy- plus dry-season crops.[15] Table 5 presents results we ran; rainy- and dry-season crop returns per acre (in column [1]); participation by female and male members in off-farm work, respectively (in column [2]); and participation by household members in the three types of local community groups (in columns [3] and [4]). Running the bivariate probits for all combinations of the discrete decisions led us to accept the null hypothesis that the error terms were correlated in all combinations, that is, female and male participation in off-farm work, participation by household member(s) in male-dominated and female/male community groups, and participation by household member(s) in female-dominated and female/male community groups. Thus, results in Table 5 are the results of one ordinary least squares and three bivariate probits. All equations were run adjusting for clustering at the community level. We have also dropped the district dummy variables from the tables, though it is interesting to note that these variables are largely insignificant for most of the regressions.

[table 5 about here]

5.1. Crop Returns per Acre

Column (1) of Table 5 gives the coefficients and *t* statistics for average gross returns per acre. We first note that the coefficient on log labor availability for households at low levels of labor availability is positive and significant. However, for households with greater labor availability per acre, there is no impact on returns per acre, consistent with the "excess labor" supply hypothesis. The proportion of females in adult labor is negative, indicating that male labor is relatively more productive in crop production even after accounting for the child dependency ratio and whether the household head is female, both of which are not statistically significant. Having more agricultural implements, access to better quality soils, and greater household wealth all have statistically positive impacts on crop returns. Greater education and experience of household head, however, do not affect crop returns. Households located in communities with better infrastructure and greater heterogeneity in terms of ethnic groups but with fewer community groups also have greater crop returns per acre. The latter is unexpected; while community groups may not directly increase crop yields, one would not expect a negative

impact unless the effect were indirect. Our next set of results points to reasons why the indirect effect may well be negative.

5.2. Participation in the Off-farm Labor Market

Column (2) of Table 5 shows the coefficients and *t* statistics for labor participation in off-farm work, disaggregated in males and females. First we look at female member's participation decision. We find that household labor availability per acre does not affect the decision of females to work off-farm where labor is relatively scarce (the lower spline), but does affect the decision positively at higher levels of labor availability. Thus the female participation decision is consistent with the excess labor hypothesis. As expected, the proportion of female labor is positively associated with female participation. None of the variables directly capturing returns to crop production are statistically significant in the female participation equation. Household education levels positively affect female participation in off-farm work. The household wealth, as captured by the index of consumer durables, is not significant in the female participation decision, implying there is no entry-barrier for women. Given the different occupation profiles of females and males, one might suspect that female participation would be relatively more likely to face barriers to entry, for example, trading versus agricultural labor. These results indicate that even if this were so, female members are not necessarily constrained by household wealth to overcome these barriers, though total landholdings do affect this decision positively and this variable also captures household wealth as well as returns to crop activities.

Secondly, let us look at the equation for male labor's participation decision. We find that increasing labor availability has a positive impact on the male decision to participate in off-farm work across both categories of households. The proportion of female labor is negatively associated with male participation. The soil quality has a negative and significant impact on the male off-farm labor decision. These results indicate that returns to male on-farm labor are higher than female returns for households with better-quality cropland. Household education levels also positively affect male participation in off-farm work, consistent with the

numerous empirical studies discussed above, whereas this variable had no impact on crop returns. In fact, the coefficient is statistically greater for females than for males, implying education helps a female member more in involving off-farm work. Combined with the soil quality index and the negative sign of the proportion of females, the statistically lower impact of education on male off-farm work participation reinforces the hypothesis that men are more likely to face a trade-off between increasing crop returns versus increasing returns to off-farm income than are women. Male participation is also negatively affected by the age of the household head, likely capturing life cycle effects. Interestingly, greater household wealth has a statistically positive impact on the male participation decision.

Neither participation decision is affected by whether the household is female headed or by dependency ratios. To the extent that these characteristics capture greater cash as well as time constraints and perhaps greater risk aversion, the results indicate that such constraints do not affect the off-farm work decision consistent with the hypothesis that barriers to entry are not important for these households and that working off-farm is not necessarily an important risk-diversification strategy.

The community variables play nearly exactly opposite roles in participation decisions by females and males. Female members are more likely to work off-farm when located in communities with high levels of infrastructure and where ethnic heterogeneity is greater. Note that ethnic heterogeneity is also associated with greater crop returns but has no impact on male off-farm work or group participation. Men, however, are less likely to participate where there is greater heterogeneity in land ownership—perhaps reflecting "defensive" crop cultivation—but are more likely to participate where the number of community groups is large.

5.3. Participation in Community Groups

The last two columns (columns [3] and [4]) of Table 5 give us the results from two bivariate Probits: participation in male groups and mixed groups as well as participation in female groups and mixed groups. Participation in women's groups increases at lower levels of labor abundance but has no impact at higher levels.

This impact is the same for crop returns but the opposite of results for female off-farm work, indicating that group participation and on-farm work are complementary activities. Greater land ownership is also statistically significant and positive. The proportion of females in household labor and the dependency ratio, however, have no impact, indicating that female-specific time constraints do not affect this participation decision. However, women in female-headed households are more likely to participate in female-dominated community groups, and this is the only equation in which this variable is statistically significant.

Participation in male-dominated groups, which tend to focus on agricultural production, is not affected by labor availability, whether the household is female headed or has many dependents. However, participation in such groups is negatively affected by the proportion of females, indicating that where adult men are in relatively short supply, their participation in local men's groups declines, similar to the negative impact of this variable on male off-farm work. Owned land, which has a strongly positive effect on participation in women's groups, has no impact on participation in men's groups, perhaps indicating that barriers to entry are more likely to be binding for women's groups.

For mixed male/female groups, participation increases from very low levels of labor availability, but there is no impact at higher levels, similar to participation in women's groups. However, dependency ratios positively affect participation in these groups, consistent with the hypothesis that such households may find participation relatively more valuable in reducing risks and/or that such groups focus on children's issues such as parent-teacher associations.

For the variables that specifically capture returns to crop production, only soil quality is important, and it has a positive impact in the decision to participate in either men's or mixed groups. Age and education have no impact on the decision to participate in gender-specific groups, but households with younger heads with greater education are more likely to participate in the mixed groups. Wealth, proxied by consumer durables, has a positive impact on the participation decision for all three groups.

In terms of community-level variables, greater infrastructure increases participation in women's and mixed groups. Note that infrastructure also has a positive impact on the female off-farm work decision but no effect on the male off-farm work decision. The greater the number of community groups, the more likely it is that men will participate in men's groups. This is quite interesting because the number of groups is also positively associated with male off-farm work and negatively associated with gross crop returns. While such groups may be dedicated to agricultural production, membership in these groups may enable male members to "break into" petty trading that is otherwise largely dominated by women. Finally, ethnic heterogeneity has no impact on group participation decisions; greater heterogeneity in landholdings, however, leads to greater likelihood of participating in mixed groups.

6. Concluding Comments

In this region of Ghana, off-farm income appears to be an important component of incomes, particularly for relatively labor-abundant (land-scarce) households. While population density is quite high in this region, some households still have excess labor relative to landholdings. Female participation in off-farm income appears to be complementary to on-farm crop returns; women are less likely to participate in off-farm work until labor becomes abundant relative to landholdings. The proportion of females, indicating reduced pressure for women to stay at home, also increases participation by females in off-farm work, though it also leads to lower crop returns and participation by males in off-farm work. On the other hand, men increase participation in off-farm work at all levels of labor availability. Unlike the decision of women, the decision of men to work off-farm is dependent on the underlying productivity of the land, as captured by the negative impact of soil quality, and potentially land security, since heterogeneity in landholdings reduces the likelihood that men seek off-farm labor opportunities.

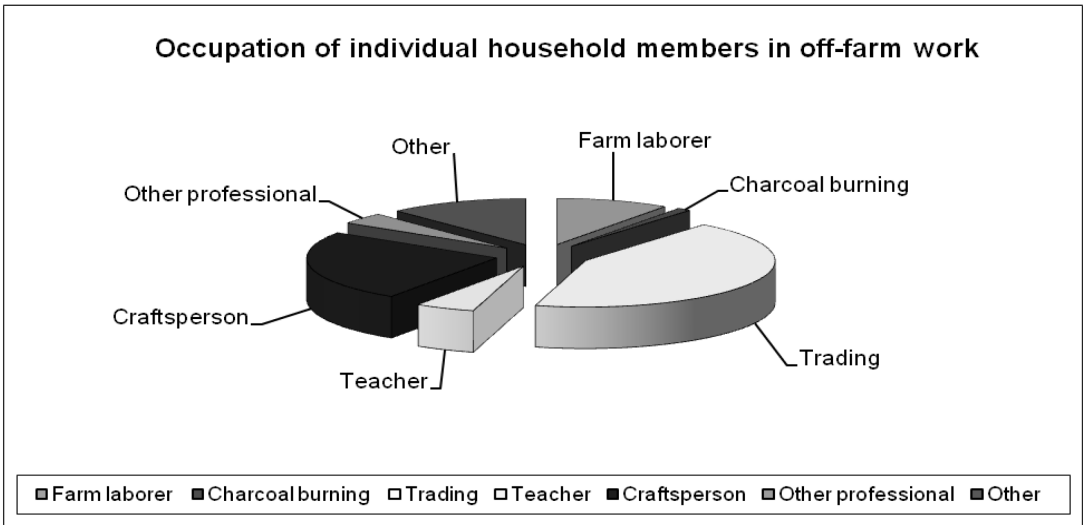
Our results on the impact of education provide further evidence that returns to education are higher in off-farm rather than on-farm activities in regions characterized by fairly marginal biophysical conditions and

where access to improved agricultural technologies and inputs remains limited, as in northern Ghana. This impact is important for both men and women, though the estimated coefficient is statistically greater for female versus male off-farm work decisions, indicating that higher relative earnings off-farm are greater for women than for men.

Taken together, the results first suggest that even though the Upper East is characterized by relatively marginal cultivation conditions but high population densities, household time constraints do not play a significant role in gross crop returns, except for in households with very low labor availability. It is fitting to note that those who participate in the off-farm labor market are generally household heads or their spouses, who might otherwise be considered the most experienced in crop production. Even so, excess labor is sufficiently great as to outweigh any "drain" from the household of what may be their most productive members (vis-à-vis other members in crop production). Participation in groups may provide insurance mechanisms for some households, such as labor-scarce, female-headed households with a relatively large number of dependents, but consistent with other studies, variables capturing wealth also positively affect the decision to participate in such groups. Households located in communities with more favorable land conditions and greater infrastructure are also more likely to participate in groups.

Figures

Figure 1. Occupation of Individual Household Members in Off-farm Work



Tables

Table1: Classification of off-farm work in household level

Who Participate in off-farm work	Number of households
Household Head (or spouse) versus other household members	
Only household head (or spouse)	68
Both household head (or spouse) and other members	14
Only other members	22
Nobody in the household	188
Total	292
Male members versus female members	
Only male member(s)	31
Both male members and female members	24
Only female member(s)	49
Nobody in the household	188
Total	292

Table 2. Occupation and Gender of Individuals in Off-farm Work

Gender	Trader	Craftsperson	Farm laborer
Female	58	30	7
Male	19	14	10
Total	77	44	17

Table 3. Correlation Coefficients, On-farm Returns, Off-farm Work, Groups

	1	2	3	4	5	6
1. Off-farm gross return	—					
2. Females, off-farm	–.01	—				
	(.872)					
3. Males, off-farm	.008	**.22**	—			
	(.887)	(.000)				
4. Female groups	**.14**	**.17**	**.11**	—		
	(.022)	(.003)	(.098)			
5. Male groups	**.16**	–.03	.03	**.29**	—	
	(.008)	(.622)	(.629)	(.000)		
6. Female/male groups	**.16**	**.18**	**.11**	**.39**	**.22**	—
	(.007)	(.002)	(.091)	(.000)	(.000)	

Note: *p* values are in parentheses. Statistically significant correlations are shown in bold.

Table 4: Land and Human Capital Endowments (in Household Level)

Variable	Labor abundant	Moderately Labor Scarce	Labor Scarce
Gross on-farm return (1,000 Cedis/acre)	619.3	484.6	461.8
Female in off-farm work	0.26	0.22	0.26
Male in off-farm work	0.19	0.17	0.15
Women's groups	0.65	0.51	0.57
Men's groups	0.17	0.24	0.28
Women/men groups	0.76	0.67	0.63
Household's total owned land (acre)	2.80	5.69	9.29
Number of adults in household	4.77	3.74	2.92
Observations (number of household)	129	78	65

Table 5: Empirical Results of the Crop Revenue, Participation in Off-farm Work, and Participation in Community Groups

Dependent Variables	Gross Crop Revenue (Eqn. 12)		Participation in Off-farm Work (Equation 11)				Participation in Local Community Groups (Equation 11)							
	OLS		Bivariate Probit				Bivariate Probit				Bivariate Probit			
			Fem. Off-Farm		Male Off-farm		Men's Group		Mixed Group		Wom's Group		Mixed Group	
	(1)		(2)				(3)				(4)			
	Coef.	t Stat.	Coef.	t Stat.	Coef.	t Stat.	Coef.	t Stat.	Coef.	t Stat.	Coef.	t Stat.	Coef.	t Stat.
Labor and Land														
Labor low_spline	0.389	1.71*	0.557	1.58	0.800	1.86*	-0.091	-0.26	0.906	2.71**	0.940	3.40**	0.882	2.65**
Labor high_spline	0.085	0.54	0.453	1.65*	0.853	2.05**	0.085	0.23	-0.204	-0.82	0.418	1.48	-0.242	-0.96
Log of owned land	0.057	0.39	0.920	4.15**	1.180	3.61**	0.372	1.36	0.157	0.67	0.818	4.07**	0.106	0.46
Demographics														
Prop. of females	-0.547	-1.90*	1.271	2.22**	-2.640	-3.55**	-0.856	-1.76*	-0.516	-1.23	-0.039	-0.11	-0.450	-1.06
Female-headed HH	0.276	0.97	0.171	0.52	-0.552	-1.26	0.461	1.18	-0.269	-0.78	0.758	2.73**	-0.293	-0.82
Child depend. rate	0.201	1.20	0.180	1.11	0.219	1.05	0.227	1.36	0.278	1.90*	0.219	1.44	0.254	1.88*
Agr. Productivity														
Agr. Assets	0.112	2.06**	-0.011	-0.13	-0.136	-1.47	0.035	0.43	0.128	1.39	0.083	0.79	0.136	1.40
Soil Quality	0.207	2.52**	-0.126	-0.68	0.330	-2.87**	0.368	1.74*	0.454	2.42**	0.198	1.19	0.449	2.50**
Irrigatation	-0.092	-0.52	-0.529	-0.98	-0.260	-0.59	0.536	1.61	-0.167	-0.41	0.163	0.47	-0.137	-0.34
Human Capital														
Log of HH head age	-0.202	-1.20	0.156	0.47	-0.638	-2.07**	-0.359	-1.13	-0.568	-1.98**	-0.342	-1.54	-0.566	-1.92*
Average education	0.006	0.27	0.093	2.84**	0.068	1.99**	-0.044	-1.22	0.118	2.50**	0.054	1.44	0.125	2.51**
Wealth														
Household durables	0.039	2.42**	0.000	0.03	0.043	1.96**	0.062	2.69**	0.076	2.84**	0.074	2.90**	0.086	2.75**
Community Charac.														
Infrastructure	0.060	1.95*	0.119	2.78**	-0.004	-0.08	0.084	1.28	0.165	1.87*	0.257	3.42**	0.156	1.77*
Number of groups	-0.054	-1.80*	-0.025	-0.81	0.183	3.27**	0.160	1.89*	-0.059	-0.76	-0.049	-1.13	-0.051	-0.69
Land heterogeneity	0.001	0.41	0.001	0.21	-0.058	-3.88**	0.004	0.42	0.013	1.69*	0.003	0.24	0.014	1.65*
Num. of ethnic group	0.183	1.77*	0.477	3.05**	-0.039	-0.22	0.089	0.37	0.315	1.02	-0.104	-0.44	0.309	1.02
Constant	12.560	15.89**	-4.248	-3.12**	1.340	1.14	-1.628	-1.12	0.872	0.62	-0.803	-0.67	0.906	0.63
Number of Obs.	272		272				272				272			
Adjusted R-square	0.238													
Psuedo Log-likelihood			-206.9				-231.5				-257.5			
Rho in the Bivariate			0.56				0.36				0.56			
Chi2 in the Bivariate			12.37				5.19				18.18			

Note: **, * represent significance at 5% and 10%, respectively

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Appendix: Definition and Descriptive Statistics of Variables

Variable	Definition	Mean	Minimum	Maximum
Dependent variable				
Female members, off-farm work	Dummy, 1 = any female household member(s) participating in off-farm work, 0 = otherwise	0.25	0	1
Male members, off-farm work	Dummy, 1 = any male household member(s) participating in off-farm work, 0 = otherwise	0.19	0	1
Participation in women's groups	Dummy, 1 = any household member(s) participating in female groups, 0 = otherwise	0.59	0	1
Participation in men's groups	Dummy, 1 = any household member(s) participating in men's groups, 0 = otherwise	0.21	0	1
Participation in mixed groups	Dummy, 1 = any household member(s) participating in mixed groups, 0 = otherwise	0.69	0	1
RpAcre	Average on-farm return dry- and rainy-season crop (1000 cedis/acre)	445	0	3,093
Household characteristic				
AdpAcre_L	Spline function for labor availability (lower limit)	–0.61	–2.19	–0.4
AdpAcre_H	Spline function for labor availability (upper limit)	0.50	0	3.11
OwnLnd	Land owned, unit is acre	5.07	0	21.5
PropFem	Proportion of female adults	0.57	0	1
FHH	Dummy, 1 = female household head	0.14	0	1
DependC	Dependency rate of children (younger than six years old) to female members	0.38	0	3
SumAgImp	Sum of agricultural implements by household	3.89	0	6
Age	Age of household head	50	15	96
AvgEdu	Average adult schooling in household	2.49	0	16.5
SumConsDur	Sum of consumer durables	4.37	0	28
Community characteristic				
IrrigD	Dummy, 1 = irrigation present, 0 = otherwise	0.41	0	1
SoilQ	Soil quality index	1.51	0	2.37
SumInfra	Sum of infrastructure in the community	2.22	0	8
SumGroups	Sum of community groups extant	3.83	1	9
LandDif	Land heterogeneity	9.79	0	52
SumEth	Sum of ethnic groups in the community	1.52	1	3

Notes:

[1] "Off-farm work" in this paper refers to participating in the off-farm, income-generating labor market, such as wage employment (e.g., teacher), working outside the farm or home (e.g., farm laborer), or self-employment (e.g., petty trader, craftsperson, etc.). Because petty trading often involves trading of agricultural products, and engaging in paid agricultural labor on another's farm is also "farm-related," we use the term "off-farm" rather than "nonfarm" to describe the range of activities undertaken.

[2] Off-farm activity in this paper is referred to as either of the following: "participation in off-farm work" or "participation in local community groups."

[3] That project was funded by the Consultative Group on International Agricultural Research Challenge Program on Water and Food for the duration of June 2004 to June 2008. The research was led by the International Food Policy Research Institute in collaboration with the University of Hohenheim in Germany; the Institute for Statistical, Social and Economic Research; and the Water Resources Institute, the latter two based in Accra, Ghana.

[4] In the data set, information about whether household members aged 16 years or older but younger than 20 years old was often missing from the off-farm participation section of the questionnaire; it's likely that teenagers do not often work off farm, but we have no way of knowing for sure if the missing information simply reflects nonparticipation. However, there are few members working off farm younger than 25, and the majority of those working off farm are older household heads or spouses. Thus, for the purposes of calculating the number of adults working off farm, we use the cutoff age of 20, instead of 15, for those considered "adults" for on-farm purposes.

[5] A question regarding the number of months worked outside the household during the past 12 months was also included; this information was often missing for informal labor market or self-employed labor, particularly for members who were not household heads and/or spouses. Measurements of "intensity" of off-farm labor

allocation would thus likely be biased for informal/self-employed vis-à-vis formal labor market participation, and for households with non-head/spouse members participating. We thus chose to use the more simple dichotomous measure of participation since we are confident in these survey responses.

[6] It is interesting to note the dearth of rotating credit and savings societies in our survey; in fact, only four households belonged to such a society, all in the same community.

[7] Less than 7 percent of surveyed households either rent or sharecrop in land.

[8] Besides seeds, few households purchased any inputs; only about 10 percent of households purchased some fertilizer, and a similar percentage of households paid hired labor, mainly during harvest.

[9] A table of descriptive statistics for all variables used in the analysis is provided in the appendix.

[10] To conserve on notation, we have left the time allocated to participation in local community groups as well as the value of leisure time out of the model; including these additional activities simply adds additional terms for returns to these activities and additional constraints to the time allocation decision. The basic intuition concerning the potential for different time allocation decisions depending on whether members are male and female remains similar to results generated for the off-farm work/on-farm work decision.

[11] Estimating crop returns per acre using various splines separating male and female labor or, alternatively, simply adding these constraints without a spline, indicated that there was no difference between male and female labor availability in terms of returns per acre.

[12] We tried a number of different ages to create the dependency ratio, including only children younger than 2, children younger than 6, and children younger than 10. All of these indicators performed similarly.

[13] There were some missing values for the latitude and longitude coordinates, which is why we generated community-level averages; additionally, households do not necessarily hold parcels that are contiguous with the homestead. Given the coarseness of the data, intercommunity differences in soil quality are far stronger than within-community differences.

[14] The survey also obtained information on the proportion of each ethnic group in the community population; unfortunately, this information was not given for two communities, so we used the simple sum instead. Nonetheless, the simple correlation coefficient between the cruder measure—the simple sum—and a Simpson index based on proportions was .57, indicating that the simple sum is a good proxy.

[15] There were five households in the survey that did not own land, four households for which information on rainy season crops were missing, and four households with missing information on either education or age of the household head. Additionally, there were five households for which reported crop yields were zero. Because the underlying linearized crop production function is in natural logs and because so few observations had zero values, we decided to exclude these observations from the analysis. The empirical results for the participation decisions—which we can run on 284 observations when natural logs are not taken—are qualitatively exactly the same and very close quantitatively.