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Gender, Social Norms and Household Production in Burkina Faso[*]

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Abstract: Empirical studies of intra-household allocation has revealed that, in many instances, gender is an important determinant in the allocation of resources within the household. Yet, within the theoretical literature, why gender matters within the household remains an open question. In this paper, we propose a simple model of intra-household allocation based on a particular social institution for the organisation of agricultural production practised among certain ethnic groups in West Africa. We highlight how this institution, while resolving certain problems of commitment and informational asymmetry, can also lead to a gendered pattern in the allocation of productive resources and consumption within the household. Using a survey of agricultural households in Burkina Faso, we show, consistent with this theory, that plots owned by the head of the household are farmed more intensively, and achieves higher yields, than plots with similar characteristics owned by other household members. Male and female family members who do not head the household achieve similar yields. We argue that the higher yields achieved by the household head may be explained in terms of social norms that require him to spend the earnings from some plots under his control exclusively on household public goods, which in turn provides other family members the incentive to voluntarily contribute labour on his farms. Using expenditures data, and measures of rainfall to capture weather-related shocks to agricultural income, we show that the household head has, indeed, a higher marginal propensity to spend on household public goods than other household members. The fact that the head of the household is usually male accounts for the gendered pattern in labour allocation and yields across different farm plots.

1 Introduction

Empirical studies of intra-household allocation has revealed that, in many instances, gender is an important determinant in the allocation of resources within the household (. For developing countries, in particular, the literature has produced evidence of systematic differences between genders in the allocation of resources relating to nutrition, health and education (see, e.g., Haddad, Hoddinott, and Alderman, 1998, and Duflo, 2005, for reviews of this literature).

Furthermore, the literature has provided extensive evidence that the initial distribution of resources between men and women often affect household outcomes, thus leading to the discrediting of the 'Unitary Model' of the household. Evidence on imperfect risk-sharing within the household (Duflo and Udry 2003, Dercon and Krishnan 2000, Dubois and Ligon 2005) and on inefficiency in the allocation of productive resources within the household (Udry 1996, Goldstein and Udry 2008) has also led to the discrediting of the 'Collective Model' of the household (Browning and Chiappori, 1998) which posits that, regardless of the distribution of resources within the household, the allocation is efficient.

In light of this evidence, the theoretical literature has recently turned its attention to possible constraints that can prevent an efficient outcome within the household and, in particular, to models of dynamic bargaining exhibiting lack of commitment (Ligon 2002, Basu 2006, Lundberg and Pollak 2003).

Yet, within the theoretical literature on intra-household allocation, why gender matters within the household remains an open question. The afore-mentioned models treat the household as a collection of agents, with possibly conflicting preferences, but makes no distinction between the genders.

In this paper we propose a simple model of intra-household allocation based on a particular social institution for the organisation of agricultural production practised among certain ethnic groups in West Africa. We highlight how this institution, while resolving certain problems of commitment and informational asymmetry, can also lead to a gendered pattern in the allocation of

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productive resources and consumption within the household, consistent with the existing empirical literature. Using the survey of agricultural households in Burkina Faso, drawn from 8 village around the country, we also provide evidence consistent with the theoretical predictions.

In the context of agricultural production by a household unit, the ethnographic literature makes a distinction between 'common' farm plots, managed by the household head, to which all household members tend to contribute some labour, and 'private' plots which are worked individually or by smaller groups within the household. The head of the household carries a particular obligation to provide for the entire household using the proceeds from the 'common' plot.

Consistent with this hypothesis, we show, using rainfall variations to capture exogenous weather shocks to agricultural output, that the head of the household has a higher propensity to spend on household public goods out of his farm income than do the other household members. This suggests that members of the household should be more willing to work on the plots farmed by the household head than on private plots, because the former is able, thanks to a particular social institution, to commit to using the fruits of their toil on household public goods. Consistent with this reasoning, we show that 'common' plots managed by the household head use family labour more intensively, and achieve higher yields, than private plots (after controlling for plot characteristics and the crops planted).

As in the previous literature, we also find that farm plots managed by male household members, on average, use family labour more intensively, and achieve higher yields, than those managed by female household members in the same household. However, no such gender difference exists among the *private* plots: male and female private plots have similar yields, and each is farmed primarily with family labour of the same gender as the plot manager. Thus, the social institution which places a particular obligation on the head of the household, and the fact that the household head is usually a man, can account entirely for the gendered pattern in agricultural production documented in the existing literature.

Our empirical tests of productive efficiency within the household are closely related to two other papers in the recent literature. First, Akresh (2008) finds, for a nationally representative sample

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of agricultural households in Burkina Faso, from a survey conducted in 1990, that households which experience negative rainfall shocks do satisfy Udry's test of pareto efficiency in household production. Akresh argues that the efficient allocation of productive resources may require household members to engage in cooperative agreements – where, for instance, one household members promises to provide labour on the plot of another in exchange for some future compensation – and these may be costly to negotiate, monitor and enforce. Therefore, members of a household may only find it worthwhile to negotiate such agreements when agricultural production is particularly hard-hit, as it would be during a season of very low rainfall.

In the case of the CEDRES/Laval survey used for the empirical analysis in this paper, rainfall levels in the four provinces from which our sample is drawn were all above the thirty-year average during 1994 (between 0.3 and 2.0 standard deviations), and no more than 0.4 standard deviations below the average in 1993. Therefore, our finding of higher yields on plots managed by the household head are consistent with the explanation provided by Akresh (although there isn't sufficient variation in rainfall levels in our sample to test this formally). Our findings, in conjunction with the explanation provided by Akresh, would suggest that household members provide labour on farm plots managed by the household head, even when rainfall levels are favourable, because the 'exchange' taking place in this instance does not require specific negotiations, monitoring or enforcement: the social norms ensure that all parties concerned have the appropriate incentives.

Goldstein and Udry (2008) also find, for a sample of agricultural households in Southern Ghana that women achieve significantly lower yields on their farm plots compared to men who belong to the same household, after controlling for observable plot characteristics and the types of crops planted. However, the entirety of the gender effect can be explained by the length of time that the plot was left fallow before planting. They provide evidence to show that fallowing improves soil fertility but individuals with little political power within the community risk losing rights to their land if it is left fallow over extended periods.

It is conceivable that, in the context of the Burkinabe households considered in our analysis, the length of fallow also varies with status within the household or community and that this can

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account for some part of the variation in plot yields observed for our sample. In the absence of information regarding the practice of fallowing land in the CEDRES/Laval survey, it is not possible to confirm or rule out the fallowing hypothesis. However, we would argue that a compelling hypothesis should also account for the dramatic variations in labour intensity and the response of household consumption to shocks to different types of household income that we observe in the data. The norm-related hypothesis proposed in this paper, as well as the ethnographic accounts discussed in the next section, can account for these patterns, but the fallowing hypothesis, on its own, does not.

The remainder of this paper is organised as follows. Section 2 discusses the ethnographic literature on the organisation of agricultural production and the consumption among a number of ethnic groups in West Africa, based, in particular, around the Sahel region. Section 3 develops a simple model of intra-household allocation which draws on this ethnographic evidence. A brief description of the household survey used for the econometric analysis is given in Section 4. Section 5 discusses our empirical findings and Section 6 concludes.

2   Household Production and Consumption in Burkina Faso

In this section, we highlight two features of production and consumption within Burkinabe households by drawing on ethnographic studies. The first of these features is that the household typically carries out its farming activities on a number of distinct plots with well-defined boundaries, each under the control of a specific adult household member. Among these plots, there is a separation between 'common' plots under the control of the head of the household, and 'private' plots controlled by other household members. The second feature is that according to existing social norms, the head of the household is expected to provide for the entire household using the proceeds of the 'common' plot, but the other household members have more leeway in how they use the income from their own plots.

These two features will play an important part in the formal model introduced in the following

section. Therefore, we discuss them in some detail here in the context of the ethnographic literature. The studies cited below are all based on the Mossi, an ethnic group that practises farming and constitutes about 40 percent of the population of Burkina Faso.[1] The Mossi are also the predominant ethnic group in two of the eight villages used for the CEDRES/Laval household survey, which is used for the empirical analysis in this paper.

The characterisation of agricultural production within Mossi households by ethnographers consistently distinguish between 'common' plots, which are farmed communally and managed by the head of the household, and 'private' plots managed by other members of the household. Hammond (1966), with regard to the Mossi of the Yatenga region in the north of Burkina Faso, writes

> '... in the extended family, the father has final authority over the allocation of all farmland used by his wives and children. Certain fields are under the more specific proprietorship of each of his matures sons who may in turn delegate the right to use them to their wives and their own sons. In each instance such fields are worked principally by their respective proprietors who have the first right to their products. However, most of the fields farmed by the head of the extended family are worked with the help of his wife or his wives and children, by any younger brothers who might be attached to his household, and, occasionally, by a sister's son who has come to reside with his mother's brother.' (p. 76)

This distinction between fields managed by the head of the household and other family members is also evident in the characterisation of the Mossi provided by Fiske (1991):

> 'The [Mossi] typically work their fields communally. A small group of people led by a senior man jointly cultivates a collective field *(puugo)*. A cultivating group typically consists of the senior man and his wives and children, often with his younger brothers and their wives and children.

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[1]CIA World Factbook 2009

'... The people who spend the bulk of the day cultivating the joint corporate field *(puugo)* of the extended family together also cultivate separate fields *(beolse)*... Such a separate field may be cultivated by a junior man with his wives and children (if any), or by a wife of the senior man together with her children (if any); sometimes older children have separate fields... Sometimes a separate field is cultivated alone by an adolescent, by a young man not yet married, by a widower with no surviving children at home, by a young wife with no children yet, or by a wife with no surviving children. But often the separate field, like the corporate field, is cultivated collectively... ' (p. 260-261)

The descriptions above also suggest that the pattern of family labour contribution to a plot may vary considerably between 'common' and 'private' plots. All household members are expected to contribute labour to the 'common' plot. But 'private' plots are farmed individually or with the assistance of a nuclear group within the extended family. On the other hand, there are also indications in the literature that rules of labour allocation are not strict. Fiske (1991) writes

'In these cultivating groups [farming the "common" plot], what really matters is participation, even token participation – if a member is making an effort, people do not assess the amount. Complete failure to participate in the collective farming, however, produces tension and results in critical gossip, although the group in fact continues to feed a member who does not work.' (p. 260)

Along similar lines, Lallemand (1977) in a detailed study of two extended families in the Yatenga region observes that

'Although the holders of the 'private' plots are meant to provide labour to the 'common' plot between eight in the morning and five in the evening, these time restrictions may be relaxed and flexible according to the vigilance or indulgence of the head worker' (p. 46)[2]

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[2]Authors' translation of the following original text: '*On sait que les détenteurs de ces champs personnels sont*

Since the rules regarding the allocation one's labour across different farm plots cultivated by one's family are fluid, and not necessarily strictly enforced, a reasonable approach to adopt in the formal theory would be to model these allocations as voluntary contributions by the individuals concerned. However, this raises the question why household members would make any contributions to the 'common' plot at all beyond a nominal amount. One possible answer would be that such voluntary contributions are motivated by altruism. But the ethnographic literature points more strongly to an alternative explanation: the proceeds of the 'common' plot are intended for the common good of the entire household. Hammond (1966) writes

> 'The produce from these fields (common plots) is stored in the granaries of the family head. There it is drawn upon principally to meet the individual needs of his household: to feed his wives and dependent children, to pay his tax, to be used as part of the bridewealth payment made by his sons when they marry, to offer hospitality to visitors, and to provide for the preparation of the millet gruel and millet bear used in sacrificial libations. But the millet in the granaries of the family head serves also as an emergency store to be used by any member of the family in need.' (p. 76)

Lallemand (1977; p. 100) provides a similar description of the use of the harvest from the common plot. It is likely that the head of the household is motivated, at least in part, by altruism in his decisions regarding the use of the proceeds from the 'common' plot. However, we argue that a binding social rule is necessary to account for the pattern of usage described in the ethnographic literature, which is also borne out in our empirical analysis: since the extent of head's altruism, and the nature of this altruism, is likely to vary across households, altruism alone would lead to considerable heterogeneity across households in the usage of the proceeds from the 'comon' plot. A more regular pattern is more consistent with a social rule that is generally observed across households.

tenus de ne pas soustraire leurs efforts aux champs collectifs après huit heures du matin et avant cinq heures du soir; cependant, ces limites horaires sont plus souples et plus floues et dépendent surtout de la vigilance ou de l'indulgence du chef des travaux.'

3 Theoretical Framework and Empirical Strategy

Imagine a household consisting of n adult members indexed by $i = 1, 2, .., n$.[3] We denote by $\mathcal{I} = \{1, 2, .., n\}$ the set of household members. There are m_0 possible consumption goods, of which m_1 are private goods, and m_2 are household public goods ($m_0 = m_1 + m_2$). Let the vector $\mathbf{x}^i = (x_1, x_2, .., x_{m_1})$ denote private goods expenditures of household member i, and let $\mathbf{z} = (z_1, z_2, .., z_{m_2})$ denote a vector of public goods. Person i's level of utility is given by $u^i\left(\mathbf{x}^i, \mathbf{z}\right)$.

Each household member owns a plot of land with a vector of characteristics $\mathbf{A}^i$, which includes land area, soil quality, etc. There are m_k different crops which may be grown on a farm, indexed $k = 1, 2, .., m_k$. These crops may overlap with the private and public consumption goods. Each household member has access to the same production technology described by

$$y_k = F_k\left(L_m, L_f, \mathbf{A}^i\right) \tag{1}$$

Here, y_k is the output level of crop k on person i's farm plot, assuming that crop k has been planted on this farm (for simplicity, we assume that a single crop can be planted on a farm at any one time). L_m and L_f are, respectively, the levels of male and female labour used on person i's farm plot.

Household member i has a labour endowment of L^i hours. Each person has the same labour productivity except that male and female labour may vary in their relative productivity in different tasks. This last assumption is implicit in the description of agricultural production in (1). We assume that there is no labour market present, such that all farm work must be done using family labour (Although this is a simplification, the data will show that there is only very limited use of hired labour in agriculture for our sample of households).

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[3]Hereafter, whenever we refer to a 'household member', this will mean an adult member.

3.1 The Collective Model of the Household

First, we provide a characterisation of the efficient allocation of resources within the household. The following maximisation problem solves for such an allocation:

$$\max_{\substack{\mathbf{x}^1,..,\mathbf{x}^n,\mathbf{z} \\ \left(L_m^i,L_f^i,k_i\right)_{i=1}^n}} \sum_{i=1}^n \lambda^i u^i \left(\mathbf{x}^i,\mathbf{z}\right) \tag{2}$$

subject to

$$\mathbf{p}_z\mathbf{z}+\sum_{i=1}^n \mathbf{p}_x\mathbf{x}^i \leq \sum_{i=1}^n p_{k_i} F_{k_i}\left(L_m^i,L_f^i,\mathbf{A}^i\right) \tag{3}$$

$$\sum_{i=1}^n L_m^i \leq \sum_{i\in\mathcal{I}_m} L^i \tag{4}$$

$$\sum_{i=1}^n L_f^i \leq \sum_{i\in\mathcal{I}_f} L^i \tag{5}$$

where $\mathbf{p}_x, \mathbf{p}_z$ and p_k represent, respectively, a vector of prices of the private and household public goods, and the market price of crop k; $\mathcal{I}_s$ is the set of all household members belonging to gender s: $\mathcal{I}_s = \{i \in \mathcal{I} : i \text{ belongs to gender } s\}$, k_i is the choice of crop on the farm plot of household member i. λ^i is the pareto weight assigned to individual i in the household welfare maximisation problem.

It is well-known that this problem satisfies the standard separation property of the agricultural household model (see, e.g. Bardhan and Udry, Chapter 1). In particular, Udry (1996) shows that if $F_k\left(.\right)$ is increasing and concave in both types of labour, then the output levels are equal on plots which have the same characteristics and are planted with the same crop: i.e. $F_{k_i}\left(L_m^i,L_f^i,\mathbf{A}^i\right) = F_{k_j}\left(L_m^j,L_f^j,\mathbf{A}^j\right)$ if $k_i = k_j$ and $\mathbf{A}^i = \mathbf{A}^j$. Then, adjusting the notation to allow for multiple households and time periods, the following specification enables us to test for efficiency in household production:

$$Q_{htci} = \mathbf{X}_{hci}\beta + \mathbf{G}_{hi}\gamma + \lambda_{htc} + \epsilon_{htci} \tag{6}$$

where Q_{htci} is the log of yield on plot i in year t, planted to crop c and belonging to household h; X_{hci} is a vector of physical characteristics of plot i; λ_{htc} is a household-year-crop fixed effect;

and $\mathbf{G}_{hi}$ is a vector of individual characteristics of individual i in household h. Udry (1996) shows that if productive resources are allocated efficiently within the household, then $\gamma = 0$; i.e. yield on a plot should not depend on the characteristics of the individual who controls it. Our data will enable us to replicate Udry's test of productive efficiency within the household for our household sample.

Furthermore, efficient production implies that if $k_i = k_j$ and $\mathbf{A}^i = \mathbf{A}^j$, then $L_m^i = L_m^j$ and $L_f^i = L_f^j$; i.e. if two farm plots with the same characteristics are planted to the same crop, then they should make use of the same amount of male labour and the same amount of female labour. Therefore, corresponding to (6), we can derive a specification for the level of each type of labour used on a particular plot:

$$l_{htci}^j = \mathbf{X}_{hci}\hat{\beta}^j + \mathbf{G}_{hi}\hat{\gamma}^j + \hat{\lambda}_{htc}^j + \hat{\epsilon}_{htci}^j \tag{7}$$

where l_{htci}^j is the amount of labour of type j applied to plot i per unit area, in year t, and plot i is planted to crop c and belongs to house h. $\hat{\lambda}_{htc}^j$ is a household-year-crop fixed effect. Productive efficiency within the household implies that $\hat{\gamma}^j = 0$ for $j = m, f$.

3.2 A Model of Voluntary Contributions under a Social Norm

Next, we consider a non-cooperative equilibrium for the model. We assume that each household member is able to allocate the proceeds of his farm plot and his labour endowment freely and that, because of lack of commitment, the members of the household cannot have a cooperative agreement that would enable them to implement the pareto efficient outcome in household production. However, traditional institutions require that the proceeds of a 'common plot' managed by the head of the household be spent entirely on certain household public goods; failing which the household head will be subject to social sanctions by the wider community.

For ease of exposition, we assume there are just three household members: the head of the household (represented by the letters h) who has a zero endowment of labour and manages only the common plot, and one adult male and another adult female member (represented by the letters

m and f) who have labour endowments E^m and E^f respectively and manage their own private plots. There is a single crop with market price of 1, a single private good x, with market price p_x, and one household public good z with market price p_z. We assume that there is no scope for saving. The social norm requires the household head to spend the proceeds from the common plot on the public good z.

Labour allocation and consumption decisions are made in two stages. In the first stage, household members m and f decide how to allocate their labour endowments across the three plots. Following these decisions, farm incomes are realised. Income from person i's plot is given by $y_i = F\left(L_m^i, L_f^i, \mathbf{A}^i\right)$. In the second stage, m and f choose how to allocate their incomes across the different consumption goods. The household head h is constrained to spend all the income from the common plot on good z. Hence we have $\bar{z}^h = \frac{1}{pz}F\left(L_m^h, L_f^h, \mathbf{A}^h\right)$ where $\bar{z}^h$ denotes the level of expenditures by the household head on the public good.

We assume that the household decisions constitute a subgame perfect equilibrium. Therefore, the equilibrium choices can be determined using backward induction. Given income $\mathbf{y} = \left(y^m, y^f, y^c\right)$ (representing incomes from the male, female and common plots, respectively), the expenditure levels denoted by $\left(\bar{x}^i, \bar{z}^i\right)$, $i = m, f$ solve the following problems:

$$(\bar{x}^m, \bar{z}^m) \quad = \quad \arg\max_{x^m, z^m} u^m \left(x^m, z^m + \bar{z}^f + \bar{z}^h\right) \text{ subject to } p_x x^m + p_z z^m \leq y^m \qquad (8)$$

$$\left(\bar{x}^f, \bar{z}^f\right) \quad = \quad \arg\max_{x^f, z^f} u^f \left(x^f, \bar{z}^m + z^f + \bar{z}^h\right) \text{ subject to } p_x x^f + p_z z^f \leq y^f \qquad (9)$$

The interesting case occurs when both m and f make zero contribution to the public good z. In this case, we obtain $\bar{x}^m(\mathbf{y}) = y^m/p_x$, $\bar{x}^f(\mathbf{y}) = y^f/p_x$ and total expenditures on the public good, $\bar{z}(\mathbf{y}) = y^c/p_z$.

Given the functions $\bar{x}^m(\mathbf{y})$, $\bar{x}^f(\mathbf{y})$ and $\bar{z}(\mathbf{y})$, we can derive the equilibrium labour allocation decisions made by the household members. Let $\mathbf{L}^i = \left(L_m^i, L_f^i, L_c^i\right)$ represent the allocation of labour by household member i across the male, female and common plots. Then, the equilibrium

choices $\left(\mathbf{\overline{L}}^m, \mathbf{\overline{L}}^f \right)$ are given by

$$\mathbf{\overline{L}}^m = \arg \max_{\left(L_m^m, L_m^f, L_m^c \right)} u^m \left(\bar{x}^m \left(\mathbf{y} \right), \bar{z} \left(\mathbf{y} \right) \right) \text{ subject to } L_m^m + L_m^f + L_m^c \leq E^m \tag{10}$$

$$\mathbf{\overline{L}}^f = \arg \max_{\left(L_f^m, L_f^f, L_f^c \right)} u^m \left(\bar{x}^m \left(\mathbf{y} \right), \bar{z} \left(\mathbf{y} \right) \right) \text{ subject to } L_f^m + L_f^f + L_f^c \leq E^f \tag{11}$$

where $\mathbf{y} = \left(y^m, y^f, y^c \right)$, $y^i = F \left(L_m^i, L_f^i \right)$ for $i = m, f, c$.

Since all the proceeds from the private plots are used for private consumption, we obtain $L_f^m = L_m^f = 0$; i.e. the household members do not contribute any labour to each other's private plots because doing so does not yield any benefits for themselves. Therefore, both m and f allocates all of his/her labour endowment between the common plot and his/her own private plot. The precise allocation of labour across the two types of plots are given by the first-order conditions to (10) and (11):

$$u_x^m \frac{\partial F \left(E^m - L_m^c, 0 \right)}{\partial L_m^m} = u_z^m \frac{\partial F \left(L_m^c, L_f^c \right)}{\partial L_m^c} \tag{12}$$

$$u_x^f \frac{\partial F \left(0, E^f - L_f^c \right)}{\partial L_f^m} = u_z^f \frac{\partial F \left(L_m^c, L_f^c \right)}{\partial L_f^c} \tag{13}$$

where u_x^i and u_z^i denote the partial derivative of person i's utility function, $u^i (x, z)$ with respect to x and z respectively.

Thus all household members are persuaded to provide some labour on the farm managed by the head of the household; given the social norm that proceeds from the common plot are to be used for household public goods only, they can expect to reap some rewards from the toiling on the common plot. On the other hand, they do not contribute any labour on each other's private farms; because the managers of the private plot cannot commit to spend their income on anything other than their own private goods. Thus, we obtain the result that the common plot is farmed with a mix of male and female labour while the private plots are farmed almost entirely with labour of

the same type as the gender of the plot manager[4].

3.2.1 Predictions

These predictions can be tested by estimating (7). Let H_{hi} be a dummy variable which takes a value of 1 if individual i in household h is the household head and zero otherwise; and let M_{hi} be a dummy variable which takes a value of 1 if individual i in household h is an adult male but not the household head, and zero otherwise. If $\mathbf{G}_{hi} = (H_{hi}, M_{hi})$, and correspondingly, $\hat{\gamma}^j = \left(\hat{\gamma}^j_H, \hat{\gamma}^j_M\right)$, then, under the noncooperative equilibrium analysed above, we have $\hat{\gamma}^m_M > 0$, $\hat{\gamma}^f_M < 0$, and $\hat{\gamma}^m_H > 0$, $\hat{\gamma}^f_H > \hat{\gamma}^f_M$. In words, these conditions imply that (i) male plots use male labour more intensively than female plots with similar characteristics and planted to the same crops; (ii) female plots use female labour more intensively than male plots with similar characteristics and planted to the same crops; (iii) the common plot uses male labour more intensively than female plots, and female labour more intensively than male plots, after controlling for the type of crop, and the plot characteristics.

Note that the model also predicts that $\hat{\gamma}^f_M = \hat{\gamma}^m_H = 0$ but we acknowledge that these conditions may not hold in reality because of elements not captured in the model; e.g. the junior household members may provide *some* labour on each other's plots as a result of side transactions; we discuss such possibilities after presenting the econometric results.

Furthermore, the model predicts that yields across different plots belonging to the same household can depend on the characteristics of the plot owner (after controlling for plot characteristics, and the type of crop planted). In particular, if the junior household members value the household public good sufficiently, then the common plot will be farmed more intensively than either the male or female plots. Therefore we would expect yields to be higher on the common plots compared to the individual plots. In (6), if $\mathbf{G}_{hi} = (H_{hi}, M_{hi})$, and correspondingly, $\gamma = (\gamma_H, \gamma_M)$, then we have the prediction that $\gamma_H > 0$ and $\gamma_H > \gamma_M$. There is no clear prediction about the sign of γ_M.

If both m and f make voluntary contributions to the household public good, then equilibrium

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[4]Fachamps (2001) discusses how land and labor transactions within the households are used to overcome the commitment problem.

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expenditures on consumption goods will be determined by total household income only, and will be independent of the income shares of the different household members (see Lundberg and Pollak, 1993). In this situation, household members will allocate their labour across different plots so as to maximise total household income. Therefore, labour allocation within the household will be efficient and the empirical predictions will correspond to those for the efficient model.

3.3 Consumption

The collective model of the household, and the model of voluntary labour contributions introduced in section 3.2 above also provide testable predictions involving household consumption.

First, in the case of the collective model, temporary shocks to household income should have no impact on expenditures on any particular good after total household expenditures has been controlled for. Otherwise, it would be possible to achieve better consumption smoothing by reallocating expenditures on that good across time periods. Duflo and Udry (2004) uses this insight to devise a test for efficiency in household consumption using rainfall data to capture weather-related shocks. We replicate their test in this paper using data on household public goods, and income from the common and private plots. We briefly discuss here Duflo and Udry's test of efficiency in consumption.

The test involves, first, estimating a linear regression of the difference over two years in the logarithm of household income from a particular source on the change in rainfall realisation over this period. Specifically, the equation to be estimated may be represented as follows:

$$\log\left(y_{hi2}\right) - \log\left(y_{hi1}\right) = \lambda_{1i}\left(R_{h2} - R_{h1}\right) + \left(R_{h2} - R_{h1}\right) * P_{hi}\lambda_{1i} + \left(X_{h2} - X_{h1}\right)\theta_i + \xi_{hi} \qquad (14)$$

where y_{hit} represents income in period t from plot i belonging to household h, R_{ht} is the rainfall realisation specific to household h in period t (i.e. using available data from the rainfall station closest to household h), P_{hi} is a vector describing the time-fixed characteristics of plot i such as soil type and topography, X_{ht} denotes other time-variant household characteristics pertaining to

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period t, and ξ_{hi} is the error term that captures other exogenous shocks that affect income from plot i.

The estimated coefficients results are then used to compute a linear combination of the rainfall variables as follows: $DR_{hi} = \hat{\lambda}_{1i}(R_{h2} - R_{h1}) + (R_{h2} - R_{h1}) * P_{hi}\hat{\lambda}_{1i}$. These fitted values, which represent the component in the change in plot income that is explained by rainfall variations, are used in linear regressions involving household expenditures in different categories:

$$\log(e_{h2}) - \log(e_{h1}) = \sum_{i \in \mathcal{I}} DY_{hi}\pi_i + (X_{h2} - X_{h1})\delta + \upsilon_h \tag{15}$$

$$\log(x_{h2}) - \log(x_{h1}) = \sum_{i \in \mathcal{I}} DY_{hi}\pi_{xi} + (X_{h2} - X_{h1})\delta_x + \upsilon_{xh} \tag{16}$$

where e_{ht} represents total expenditures in household h in period t, and x_{ht} represents expenditures on some specific consumption good in household h in period t. The error terms υ_h and υ_{xh} capture other exogenous factors that may influence household expenditures. Under the collective model of the household, we have the following relationship:

$$\frac{\pi_{xi}}{\pi_i} = \frac{\pi_{xj}}{\pi_j} \text{for each } i, j \in \mathcal{I} \tag{17}$$

Following Duflo and Udry (2003), we test for (17) using a non-linear Wald test.

Equation (16) also provides a test for the model of voluntary contributions under the social norm. Specifically, the model predicts that, if x is a household public good, then $\pi_{xm} = \pi_{xf} = 0$ and $\pi_{xc} = 1$; i.e. public goods expenditures are responsive to exogenous shocks to income from the common plot (and, in particular, a one-on-one effect if the social norms requires that all income from common plots be spent on household public goods); but is not responsive to income shocks on private plots farmed by the household.

4 Description of the Household Survey

The household survey was conducted by the University of Laval, Quebec and the University of Ouagadougou in Burkina Faso. It was carried out in 4 provinces in different parts of Burkina Faso: the Namentenga province in the Central Plateau, the Soum province in the North, the Kossi province in the West and the Nahouri province in the Southeast. In each province, two villages were chosen, one to represent the wealthier villages and the other to present the poorer ones in that region. A sample of 35 households were randomly selected in each village except in the North where 40 households were chosen in anticipation of a higher dropout rate due to out-migration. Agriculture is the primary source of livelihood in all the villages, but livestock is relatively more important in the North, the region where population pressures and soil degradation have been most acute.

The survey was conducted during the 1993 and 1994 agricultural seasons and covered farm characteristics, production technologies, agricultural inputs and outputs, market activities, household expenditures and consumption. Information relating to each farm plot was obtained from the individual in the household who had responsibility for it during that season, while information regarding the 'common' plots were obtained from the head of the household. Information about expenditures, sales, livestock holding and transfers were also gathered at the individual level; while information about housing and farming equipment were gathered at the household level, with the head of the household usually providing most of the information.

The household survey did not distinguish between household head's 'private' plots and 'common' plots that he managed on behalf of the household.Therefore, for the purpose of the analysis in this paper, we consider all plots farmed by the household head as 'common' plots.

The questionnaire on household expenditures recorded information not only on the identity of the household member who made each purchase but also the identity of the person for whom the expense was incurred. For the consumption analysis, expenditures on household public goods include all those for which the answer to the latter question was 'all members of the household'.

5 Household Headship and 'Junior' Household Members

As the theoretical framework used in this paper makes a distinction, in the context of agricultural production, between gender and household headship, we explore in the data how closely these two variables are correlated. Only 22 of the random sample of 290 households interviewed for the CEDRES/Laval survey in 1993 were headed by women. Therefore, it is evident that household headship is predominantly a male phenomenon.

The female heads are invariably widows, often the sole adult in a household with young children or grandchildren, and in some instances living with unmarried sons or daughters. The distinctive structure of female-headed households raises the question whether the social norms described in Section 2 on the allocation of productive resources within the household should apply to them. Given the small number of households with female heads in our sample, we are not able to answer this question satisfactorily using the available data. For the main analysis, we do not distinguish between male-headed and female-headed households. Nevertheless, we return to this question after the main results have been presented.

To be able to test the model of voluntary labour contributions presented in Section 3.2, we need to be able to compare farm plots managed by a male household head with those managed by other – both male and female – household members. Table 1 shows, for all plots farmed by the households in the CEDRES/Laval sample during the years 1993 and 1994, the relationship of the plot manager to the household head. About 69% of these were farmed by the household head himself (or herself). For the purpose of our empirical analysis, these plot observations will be classified as 'common' plots. In the remainder of the cases, the plot is managed (in order of decreasing frequency), by a spouse of the head, a son or daughter, a brother, a daughter-in-law or a sister-in-law. These observations will serve as the 'private' plots in this study. The managers of the private plots are henceforth referred to as 'junior male' and 'junior female' household members.

Table 2 shows that the 'common' plots, as defined here, are, on average, about twice as large as the private plots farmed by the junior men, and three times as large than the private plots farmed

by the junior women. On the other hand, the common plots have the lowest average yields: about 15 percent lower than on junior female plots, and barely half of that on junior male plots.

Table 2 also indicates the use of very different types of labour on the farm plots depending on the identity of the plot owner. The junior female plots are farmed primarily with female family labour, which very likely includes hours that the plot owner has, herself, spent working on the plot. The junior male plots use both male and female family labour, but the contribution of male labour is more significant (about twice as large) than that of female family labour. The 'common' plots use substantial amounts of both male and female family labour. All three types of plots use some amount of child family labour.

The descriptive statistics shows that the nature of production on 'common' plots are, on average, very different from that on private plots, at least in terms of the scale of farming and the types of labour used. This differentiated pattern does not, in itself, imply that the allocation of labour across the household plots is inefficient. The pattern may be explained by the different labour requirements of crops grown by different household members, by differences in soil type, etc. Therefore, we estimate equations (6) and (7), which will enable us to see if these patterns persist after these factors have been controlled for.

6 Results

6.1 Plot Yields

Column 1 in Table 3 shows the estimated coefficients for equation (6) with dummy variables for household headship and junior male status within the household (the default category being junior female status). The estimated coefficient for the household head dummy is large and significantly different from zero. Therefore, we are able to reject the hypothesis of Pareto efficiency in household production. The coefficient for the junior male dummy variable (which takes a value of 1 if the plot owner is an adult male who does not head the household and zero otherwise) is small and not statistically different from zero. Therefore, for plots owned by same household, that have

similar characteristics and are planted to the same crops in the same year, there are no significant differences in yields between those controlled by women and those controlled by junior men.

On the other hand, the estimated coefficients are consistent with the model of voluntary contributions. Recall, from section 3.2.1 that the model predicts that yields on common plots will be higher than those on private plots. The estimated coefficient for the household head dummy is greater than zero and greater than the coefficient for the junior men, and the difference is statistically significant in both cases.

Note that these results are consistent with findings in the existing literature which has shown, in similar contexts, that plot yields are higher for men than for women, when comparing across farms owned by the same household, planted to the same crops and with similar characteristics (see, for example, Udry, 1996 and Goldstein and Udry, 2008). However, our findings show that, for our sample of households, the higher yields achieved by men can be attributed entirely to household headship, since there is no statistically significant difference in plot yields between female plots and those farmed by men who do not head the household in which they live.

The large, positive coefficient for the household head dummy obtained in the yield regression contrasts with the fact that 'common' plots have lower yields on average than 'private' plots, as shown in Table 1. This is primarily due to the fact the yields decline with plot size (which is evident from the plot size coefficients in Table 3) and that common plots are, on average, larger than private plots. The estimated coefficients for equation (6) imply that, for a given plot size, yields are higher on common plots than on private plots.

Next, we trace the difference in plot yields to variations in labour use across plots.

6.2 Labour Allocation

Table 4, column 1 shows the estimated coefficients for equation (7). The results show that plots controlled by the household head use all types of family labour – adult male, adult female, and child labour – more intensively than other plots owned by the same household, after controlling for plot characteristics, the crop planted and the year of planting (with the difference being statistically

significant in each case). This pattern is inconsistent with the predictions of the Pareto efficient (collective) model. As discussed in section 3.1, the model predicts that the allocation of labour across plots can depend on the plot characteristics and the crop planted, but should be independent of the characteristics of the plot owner.

While plots farmed by 'junior' men use male family labor more intensively than those farmed by 'junior' women, the opposite is true for female family labor, by about the same order of magnitude. There are no significant differences in the use of child labor between the 'junior' men and women. The pattern of labor allocation across agricultural plots appear consistent with the variation in plot yields discussed earlier, with the common plots achieving the highest yields and also making use of family labour and outside labour most intensively.

This pattern is also, at least in part, consistent with the predictions of the model of voluntary labour contributions discussed in section 3.2.1. Recall that one of the model's predictions is that the common plot uses male family labour more intensively than private plots farmed by women, and female family labour more intensively than private plots farmed by junior men. If we interpret the plots farmed by the household head as 'common' plots, then the estimated coefficients correspond to these predictions.

However, the model of voluntary labour contributions also generated the prediction that household members do not provide any labour on each others' private plots, and the descriptive statistics in table 1 shows that they clearly do (since family labour of the opposite gender is used on private plots). We speculate that such labour contributions, which are much smaller than contributions to the common plots, may be due to 'side transactions' between the junior male members and the women within the same household; a dynamic flow of goods and services in which labour is just one element. Hammond (1966) describe some exchanges along these lines: a junior male, with a bicycle, may help out a female household member to carry some of her produce to a distant market and, in exchange, she may spend some time working on his plot during the farming season. Our theoretical model did not allow for such exchanges.

The pattern of labor allocation indicates that the household head is able to induce family

members to provide labour on common plots much more effectively than the junior men and women. It also shows that while these junior household members have the assistance of some family labour of the opposite gender on their private plots, they are relying primarily on labour of their own gender. This labour of their own gender is potentially their own labour, although there is no way of verifying this on the basis of the available data.

Why is the head of the household so much more successful at commanding family labour? The model presented in section 3.2 posits that it is because the household head is committed to spend the proceeds from the common plot on household public goods. We analyse consumption data next to see if this hypothesis has any support in the data.

6.3   Expenditures on Household Public Goods and Rainfall Shocks

Using data on annual rainfall for each province in Burkina Faso, we estimate equation (14) for three different sources of household income: junior female, junior male and household head farm income. The coefficients from the first-stage regressions are shown in Table 5. The F-tests indicate that the the coefficients for the rainfall variables, and the plot characteristics-and-rainfall interactions are jointly significant in all three regressions. Next, using the fitted-values for the different types of farm income and total expenditures on household public goods, we estimate equation (16). The coefficients from the second-stage regression provide a measure of the responsiveness of household expenditures to changes in household income due to exogenous rainfall shocks.

The coefficients indicate that a 10% increase in the household head's income due to variations in rainfall leads to a 3.23% increase in expenditures on household public goods. This effect is statistically significant at the 1% level. By contrast, the corresponding values for income from junior male, and junior female, private plots lead are 1.07% and 1.54% respectively (significant at the 5% level). Using chi-square tests, we can reject the null-hypothesis of equality between the household head and the junior male coefficients at the 1% level, and of equality between the household head and female coefficients at the 13% level. The null-hypothesis of equality between the coefficients for the junior male and junior female household members cannot be rejected.

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Therefore, the household head has a higher marginal propensity to spend on household public goods out of income from farms managed by him or her, than do the junior household members. In this case, the household members would have a stronger incentive to provide labour on the fields managed by the household head than on the private plots of the other household members, and can explain the pattern of allocation family labour across household plots described in the preceding section.

The results are also consistent with the reasoning underlying the model of voluntary contributions under a social norm presented in section 3.2. However the estimated coefficients do not match exactly with the predictions of the model, and therefore we discuss briefly why. First, the model predicts that, for household public goods, the coefficient π_{xc} in (16) should equal 1. However, if we allow for intertemporal savings within the model, then an argument akin the Permanent Income Hypothesis should imply that a temporary income shock, as rainfall variations would produce, should not lead to a one-for-one change in expenditures, even if the household head is socially obliged to spend the proceeds from his (common) farm plots on household public goods. This would explain why $\hat{\pi}_{xc} < 1$ in the second-stage regression. Second, the model predicts that $\pi_{xm} = \pi_{xf} = 0$ (with x denoting expenditures on household public goods). However, if there are multiple household public goods, and the corner solution in consumption expenditures assumed in section 3.2 applies to only a subset of them, this would explain why we obtain $\pi_{xm} > 0$ and $\pi_{xf} > 0$.

We also test for efficiency in consumption expenditures using equation (17) for the category household public goods as defined above. The null-hypothesis of efficiency is strongly rejected, with a Wald statistic of 15.11 and p-value of 0.00172 .

We should note that, according to the estimates in Table 4, the common plot, on average, uses all types of family labour more intensively than private plots managed by household members of either gender. This suggests that the marginal product of family labour is higher on a private plot than on a household common plot. But if so, can the promise of household public goods be sufficient inducement for an individual, with her own parcel of land, to work on the common plot? Could she not provide the public good more cheaply by allocating more of her labour to her private

plot at the expense of the common plot, and using the proceeds to pay for the public good?

We offer two possible answers to this question. First, the pattern of allocation of family labour suggests that the model of voluntary labour contributions is not capturing all the tools at the disposal of the household head to induce family members to work on the common plot; that is, the patriarch can threaten or coax them in ways not captured in the model.

A second explanation is that labour activities on the common plot follow a more specialised division of family labour than the private plots. If the family members are given specific and well-defined tasks on the common plot, than any withdrawal of labour could have a significant impact on production. If so, the marginal product of each person's labour may be higher on the common plot than on his or her private plot, even if the common plot is being farmed more intensively. This may happen even if the labour inputs of different family members are close substitutes in terms of the production possibility set. Unfortunately, in the absence of more detailed information on labour activities on farm plots, it is not possible to verify the second hypothesis.

6.4   Female Headship

To determine whether the pattern of production and consumption previously discussed also extend to female-headed households, we re-estimate equations (7) and (14) with separate dummies for male and female household heads. The plot-level data includes 67 observations where the plot manager is a female household head. The estimated coefficients for the main variables of interest are shown in Table 6. In the case of plot yields, the estimated coefficient for the female head dummy is smaller than that of male head and larger than that of a junior male household member. However, because of large standard errors, the difference is not statistically significant in either case.

In the case of the allocation of family labour, we find that the male and female household heads have similar levels of labour intensity in the case of both adult male and adult female labour. Interestingly, the female head uses child labour much more intensively than the male head, with the difference being statistically significant. This may be due to the fact that some of the female headed households consist of widowed grandmothers living with, possibly orphaned, grandchildren.

The female household head also uses all types of family labour more intensively than junior male and female members of the same household, but the differences are not statistically significant in every case).

Therefore, there is some suggestive evidence that female-headed households exhibit, broadly, similar patterns in the allocation of productive resources as the male-headed households, at least along the dimensions measured. But given the small sample size, these results are, at best, tentative.

7   Conclusion

Empirical studies of households in developing countries have repeatedly found that the allocation of resources within the household is correlated with gender. By contrast, theories of intra-household allocation, for the most part, have remained gender-blind. The household is treated as a collection of agents with distinct preferences, but with no a priori difference between a man and a woman.

In this paper we suggest that some of the gender-related patterns observed in the empirical investigation of households may be explained by the fact that the head of the household, who is bestowed with authority over as well as responsibilities towards the other members of the household by existing social norms, is in most instances male. We suggest that gender-related patterns in the allocation of resources within the household can be explained without resorting to any assumption of *innate* differences in preferences or power between men and women; but rather by differences in their positions created by social norms. The key piece of evidence we provide for this argument is that, for agricultural households in Burkina Faso, yields on plots owned by men who are not household heads are similar to those achieved on plots owned by women in the same household (controlling for plot characteristics and the crops planted), while yields achieved by household heads (who are, in most instances male) are significantly higher.

The variations in plot yields can be accounted for by the pattern of labour allocation within the household: both male and female household members provide significant amounts of labour to the farm plots managed by the household head, but substantially less labour on plots managed

by junior household members of the opposite gender. This pattern of labour allocation does not appear to be Pareto efficient. However, the pattern is consistent with a scenario where family labour is offered voluntarily, and to the farm plots where one calculates the greatest benefit for oneself. If the household head is obliged, by social norms, to provide for household public goods using the proceeds from his farm plots, then the junior household members would have much stronger incentives to work for the household head, than on some other household plot, over which he or she has no claim. This explanation finds substantial support in the ethnographic literature which describes a distinction between 'common' and 'private' plots belonging to the same household, and the different rules which apply in each case. Lastly, in support of this explanation, we show that the head of the household has, indeed, a higher propensity to spend on household public goods out of his agricultural income than do the other household members.

The hypothesis and evidence provided in this paper naturally begs the question whether female-headed households exhibit the same pattern of behaviour as male-headed households. This is also related to the following, broader question: if the pattern of allocation of productive resources and consumption expenditures within a household are heavily influenced by patriarchal norms of responsibilities and obligations, do these norms extend to settings where there is no longer a patriarch, as traditionally defined? The small number of female-headed households in our sample means that we are not able to answer this question satisfactorily with the available data. Therefore, it remains an open question to be explored in future research.

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Table 1: Relationship of Plot Manager to Household Head
(% of Total Sample)

	Male	Female
Self	65.3	3.6
Spouse	0.1	17.5
Son/Daughter	6.7	1.5
Son/Daughter-in-Law	0.1	1.3
Grandchild	0.3	0.1
Sibling	1.5	0.0
Spouse of Sibling	0.0	0.9
Nephew/Niece	0.1	0.2
Father/Mother	0.1	0.5
Other Relations	0.1	0.3

Table 2: Mean Yield, Area and Labour Inputs by Different Types of Cultivator[1]

	Yield (FCFA/Hectare)	Area (Hectare)	Child Labour (Labour Days/Hectare)	Male Labour (Labour Days/Hectare)	Female Labour (Labour Days/Hectare)	Observations[2]
Male Heads	77,042	1.18	11.71	44.27	29.96	1420
	(305,190)	(1.26)	(20.9)	(53.8)	(45.3)	
Female Heads	177,185	0.58	6.19	21.17	46.29	67
	(691,669)	(0.40)	(17.8)	(37.6)	(48.2)	
All Household Heads	81,579	1.15	11.43	43.05	30.81	1487
	(332,740)	(1.24)	(20.7)	(53.3)	(45.6)	
Junior Men	150,545	0.60	8.98	38.97	21.96	160
	(589342)	(0.57)	(20.1)	(51.0)	(42.4)	
Junior Women	95,392	0.45	7.35	9.17	40.9	333
	(433,985)	(0.52)	(16.6)	(16.2)	(60.9)	

Standard Errors in Parantheses.

[1] Excludes, for each variable, the top percentile of observations.

[2] Due to missing values, labour averages are based on a total of 1600 observations.

Table 3: Plot Yield

	Dependent Variable: Ln(Plot Yield in CFA Franc)	
	Coefficients	Standard Errors
Junior Male Dummy	0.0127	(0.123)
Male HHead Dummy	0.7747	(0.105)
Plot Size (1st decile omitted):		
2nd decile	-0.6671	(0.149)
3rd decile	-0.4843	(0.156)
4th decile	-0.9434	(0.162)
5th decile	-1.208	(0.162)
6th decile	-1.447	(0.175)
7th decile	-1.254	(0.171)
8th decile	-1.616	(0.181)
9th decile	-1.854	(0.182)
10th decile	-2.037	(0.178)
Toposequence ('mid-slope' omitted):		
Near Bottom	-0.492	(0.268)
Plain	-0.461	(0.250)
Soil Type ('clay' omitted):		
Sand	0.0326	(0.146)
Laterite	-0.3464	(0.187)
Gravel	-0.2647	(0.288)
Location ('village' excluded)		
Outside village	0.0225	(0.104)
Observations	1967	

Household-crop-year fixed effects included in each regression.

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Table 4: Labour Intensity

	Dependent Variable: Ln(Labour Days Per Unit Area on Plot of Land)		
	Male Labour (1)	Female Labour (2)	Child Labour (3)
Junior Male Dummy	1.211	-1.163	0.2114
	(0.137)	(0.126)	(0.131)
Male HHead Dummy	2.162	0.5196	0.8146
	(0.114)	(0.104)	(0.108)
Plot Size (1st decile omitted):			
2nd decile	-0.6086	-0.5258	-0.7544
	(0.178)	(0.164)	(0.170)
3rd decile	-0.9657	-0.8277	-0.7673
	(0.188)	(0.173)	(0.180)
4th decile	-1.312	-1.389	-0.8364
	(0.195)	(0.179)	(0.186)
5th decile	-1.474	-1.317	-1.046
	(0.188)	(0.173)	(0.179)
6th decile	-1.723	-1.71	-1.133
	(0.198)	(0.182)	(0.189)
7th decile	-1.757	-1.814	-1.083
	-0.201	(0.185)	(0.192)
8th decile	-1.643	-1.881	-1.012
	(0.203)	(0.187)	(0.194)
9th decile	-1.872	-2.267	-1.035
	(0.210)	(0.193)	(0.201)
10th decile	-2.204	-2.577	-1.21
	(0.217)	(0.199)	(0.207)
Toposequence ('near bottom' omitted):			
Mid-slope	0.3143	0.3994	0.2027
	(0.304)	(0.279)	(0.290)
Plain	-0.1746	-0.0093	-0.3498
	(0.192)	(0.177)	(0.184)
Soil Type ('clay' omitted):			
Sand	-0.2028	-0.0766	0.2597
	(0.152)	(0.140)	(0.146)
Laterite	0.0724	-0.1066	0.4236
	(0.177)	(0.163)	(0.169)
Gravel	0.3381	0.0471	0.8797
	(0.308)	(0.284)	(0.295)
Location ('village' excluded)			
Outside village	0.2246	-0.0013	-0.0065
	(0.112)	(0.103)	(0.107)
Observations	1979	1979	1979

Household-crop-year fixed effects included in each regression. Standard Errors in Parantheses.

Table 5: Household Public Goods Expenditures and Income. First Stage Regression Results

| | Dependent Variable: Ln(Income from plots managed by X) | | |
	Household Head	Junior Male	Female
1994 year dummy	1.128	-6.850	3.335
	(2.517)	(2.789)	(3.372)
Rainfall	-0.006	0.017	-0.007
	(0.007)	(0.008)	(0.009)
Rainfall interacted with Household Plot Characteristics:			
<u>Junior Male Plot Topography</u>			
'Near Bottom'	-0.003	-0.024	-0.005
	(0.006)	(0.007)	(0.008)
'Plan'	-0.003	-0.022	-0.004
	(0.006)	(0.007)	(0.008)
<u>Junior Male Soil Type</u>			
'Clay'	0.005	0.024	0.004
	(0.006)	(0.007)	(0.008)
'Sand'	0.003	0.024	0.004
	(0.006)	(0.007)	(0.008)
'Laterite'	0.000	0.027	0.003
	(0.006)	(0.007)	(0.008)
'Gravel'	0.005	0.023	0.006
	(0.007)	(0.007)	(0.010)
<u>Female Plot Topography</u>			
'Mid-slope'	-0.002	-0.001	-0.004
	(0.003)	(0.003)	(0.004)
'Plain'	0.000	0.000	0.002
	(0.002)	(0.002)	(0.003)
<u>Female Plot Soil Type</u>			
'Clay'	-0.002	0.001	0.003
	(0.003)	(0.003)	(0.003)
'Sand'	0.001	0.000	0.001
	(0.002)	(0.002)	(0.003)
'Laterite'	0.002	-0.001	0.001
	(0.002)	(0.002)	(0.003)
'Gravel'	0.000	0.000	-0.001
	(0.008)	(0.009)	(0.003)
<u>Common Plot Topography</u>			
'Near Bottom'	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)
'Mid-slope'	0.001	0.000	0.001
	(0.001)	(0.001)	(0.001)
'Plain'	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)
<u>Common Plot Soil Type</u>			
'Clay'	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)

'Sand'	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)
'Laterite'	-0.001	-0.001	-0.001
	(0.001)	-0.008	(0.001)
'Gravel'			
Observations	249	249	249

Test for all coefficients being
jointly significant

F-statistics (p values):	2.05	2.45	1.82

Standard Errors in Parantheses

Table 6: Household Public Goods Expenditures and Income. Second Stage Regression Results

Dependant Variable: Ln(Expenditures on Household Public Goods)		
Fitted Values from First-Stage	Coefficient	Standard Errors
Ln(Household Head Income)	0.323	0.071
Ln(Junior Male Income)	0.108	0.049
Ln(Female Income)	0.155	0.072
1994 Year Dummy	0.230	0.384
Constant	9.732	0.896
Observations	249	

Chi-Square Tests:	Chi-Square	Prob > Chi-Square
Coefficients for Household Head and Junior Male are Equal:	6.75	0.0094
Coefficients for Household Head and Female are Equal:	2.26	0.1331
Coefficients for Junior Male and Female are Equal:	0.22	0.6379

Table 7: Estimated Coeffficients for Female-Headed Households

Dependant Variable:	Ln(Plot Yield)	Ln(Labour Days Per Unit Area on Plot of Land)		
		Male Labour	Female Labour	Child Labour
Junior Male Dummy	0.021	1.216	-1.164	0.206
	(0.12)	(0.14)	(0.13)	(0.13)
Male Head Dummy	0.778	2.185	0.517	0.790
	(0.11)	(0.12)	(0.11)	(0.11)
Female Head Dummy	0.377	1.658	0.582	1.348
	(0.75)	(0.48)	(0.44)	(0.46)

Standard Errors in Parantheses.