CAPRI WORKING PAPER NO. 14

LAND INHERITANCE AND SCHOOLING IN MATRILINEAL SOCIETIES: EVIDENCE FROM SUMATRA

AGNES R. QUISUMBING and KEIJIRO OTSUKA

CGIAR Systemwide Program on Collective Action and Property Rights
www.capri.cgiar.org

Secretariat:
International Food Policy Research Institute
2033 K Street, N.W.
Washington, D.C. 20006 U.S.A.

IFPRI

MAY 2001

CAPRi Working Papers contain preliminary material and research results, and are circulated prior to a full peer review in order to stimulate discussion and critical comment. It is expected that most Working Papers will eventually be published in some other form, and that their content may also be revised.

This research was supported by the Government of Japan, the United Kingdom's Department for International Development, and the United States Agency for International Development, Office of Women in Development, Grant No. FAO-0100-G-00-5020-00, on "Strengthening Development Policy through Gender Analysis: An Integrated Multicountry Research Program." We would like to thank S. Suyanto and Novi Khususiyah for implementing the inheritance survey in Western Sumatra, Ellen Payongayong for excellent research assistance, and Jonna Estudillo and seminar participants at IFPRI and Syracuse University for helpful comments. All errors and omissions are ours.

ABSTRACT

This paper explores statistically the implications of the shift from communal to individualized tenure on the distribution of land and schooling between sons and daughters in matrilineal societies, based on a Sumatra case study. The inheritance system is evolving from a strictly matrilineal system to a more egalitarian system in which sons and daughters inherit the type of land that is more intensive in their own work effort. While gender bias is either non-existent or small in land inheritance, daughters tend to be disadvantaged with respect to schooling. The gender gap in schooling, however, appears to be closing for the generation of younger children.

Keywords: Asia, Sumatra, intergenerational transfers, intrahousehold allocation

TABLE OF CONTENTS

LAND INHERITANCE AND SCHOOLING IN MATRILINEAL SOCIETIES: EVIDENCE FROM SUMATRA

AGNES R. QUISUMBING[1] and KEIJIRO OTSUKA[2]

INTRODUCTION

There is increasing evidence that land tenure institutions in customary land areas of developing countries are evolving from communal ownership towards individualized ownership in response to population pressure and the growing profitability of agroforestry devoted to commercial trees (Otsuka et al., 2000; Place and Otsuka, 2000a, 2000b; Quisumbing et al., 2000). While greater individualization is associated with more secure land rights (Ault and Rutman, 1979) and increased incentives to invest in land improvement (Feder and Feeny, 1993; Besley, 1995), concerns have been raised regarding its equity impact, particularly on the distribution of land ownership rights by gender. It has often been argued that a shift from communal land tenure towards individualized rights erodes women's land rights (Lastarria-Cornhiel, 1997). This argument is often supported by the gradual disappearance of matrilineal inheritance and the rise of patrilineal inheritance systems, e.g., in some parts of South Asia (Agarwal, 1994). Whether such changes in land inheritance patterns necessarily lead to a net deterioration in women's welfare, however, can only be ascertained if other forms of intergenerational transfers are also considered. In economies with rapidly expanding nonfarm employment opportunities, education may be a more valuable form of

[1] International Food Policy Research Institute and Tufts University
[2] Foundation for Advanced Studies on International Development and International Food Policy Research Institute.

investment in one's children than agricultural land. Empirical evidence on both land inheritance and other forms of transfers, however, is scanty.

This study attempts to explore the evolution of education and land inheritance patterns in matrilineal societies based on a case study of Sumatra. Throughout this region, land is traditionally bequeathed from a mother to her daughters. Joint ownership of paddy fields by lineage members or by sisters also has been common. But for upland fields growing commercial tree crops, such as rubber, cinnamon, and coffee, more individualized tenure institutions have become dominant and their incidence has been increasing. Furthermore, matrilineal inheritance has been replaced by a bilateral system, or even by a patrilineal system in some areas (Otsuka et al., 2000).

Suyanto et al. (2000a, 2000b) report that the individualization of land tenure institutions has helped eliminate management inefficiency in communal land tenure areas. While individualization may have occurred to provide incentives to invest in tree planting and management, it is not clear why traditional matrilineal inheritance systems have become weaker. In this study, we hypothesize that inheritance systems have changed to provide proper work incentives to men and women while maintaining gender equity in the distribution of resources. We also hypothesize that differential investments in the education of sons and daughters have adjusted to the changes in the distribution of inherited land, insofar as land inheritance and education are alternative forms of intergenerational transfers (Estudillo et al., 2000a, 2000b).

This paper explores statistically the allocation of land and schooling between sons and daughters along with the shift from communal to individualized tenure, in comparison with similar studies in the Philippines (Estudillo et al., 2000a, 2000b) and

Ghana (Quisumbing and Otsuka, 2000). Using a specially designed retrospective household survey of inheritance conducted in Western Sumatra, we relate changes in the distribution of land and schooling between sons and daughters to the individualization of land tenure institutions, the adoption of agroforestry, and differential labor inputs by men and women in traditional food crop production and agroforestry. We also examine whether changing land inheritance patterns have shifted schooling investments between boys and girls in the next generation. We conclude that the individualization of land tenure institutions has contributed both to increased efficiency and equity in intergenerational transfers by promoting an inheritance system which rewards differential work effort by men and women.

CONCEPTUAL FRAMEWORK

A THEORY OF INTERGENERATIONAL TRANSFERS[3]

In the wealth model of transfers, parents are often assumed to be altruistic (Becker, 1974; Becker and Tomes, 1986) and care about their children's future incomes as well as their own consumption. Parents collectively maximize a utility function spanning generations, in which utility depends on consumption of parents (C), and the expected future incomes of the daughter (Y_d) and son (Y_s), which enter separately into the utility function (U_p):

$$U_p = U_p\,(C,\ Y_d,\ Y_s)\ . \qquad (1)$$

For simplicity, we assume that parents have one daughter and one son. In a more general model, the number of children is a choice variable.

An income generating function for i-th child is defined as

$$Y_i = F\,(E_i,\ a_i,\ g_i) + G\,(E_i,\ A_i,\ g_i) + u_i\ , \qquad i = d,\ s \qquad (2)$$

where F and G are production functions of upland crops and lowland paddy, respectively; a_i and A_i are inherited upland and lowland areas, respectively; E_i is the education level represented by schooling; g_i is the gender of the child; i indexes the daughter and son; and u_i is a stochastic component with mean zero and variance σ_i^2. In this specification, child's income is the sum of incomes from upland and lowland farming. In an expanded model, the choice of nonfarm jobs and wage earnings, which are intensive in the use of human capital, can be also included.

The income constraint for parents is

---

3 This discussion draws heavily on Quisumbing (1994).

$$Y_p = C + p_E \, \Sigma \, E_i + p_a \, \Sigma \, a_i + p_A \, \Sigma \, A_i \quad , \qquad (3)$$

where the income of parents Y_p is spent on parental consumption of goods C (the numeraire), and expenditures on education ($p_e \Sigma E_i$) and asset transfers ($p_a \Sigma a_i + p_A \Sigma A_i$), in which the price of education is p_e and the prices of the upland and lowland areas are p_a and p_A, respectively. It is assumed that unit cost of a transfer is the same for each child. In most altruistic models, a parent maximizes (1) subject to (2) and (3) to obtain the optimal investments in human capital and asset transfers to the daughter and son.

If the daughter were particularly efficient in generating income from lowland production, parents would bequeath larger lowland areas to her. Conversely, if the son has a comparative advantage in using upland areas, due to greater physical strength required for clearing forest and bushland, parents would efficiently allocate more upland areas to him. Actual land transfers to the daughter and son would then be unequal, depending on their comparative advantages.

Suppose now that the relative prices of land and education change. Even if the comparative advantage of each child remains the same, such changes will result in a new utility-maximizing equilibrium, leading parents to change the equilibrium allocation of the two types of land and education. Alternatively, suppose that new technologies or crops are introduced, changing the comparative advantage of each child in generating income from land or education. For example, the person who once had a comparative advantage in generating income from education-intensive activities now may be able to generate more income from land-intensive activities. If parents are concerned with efficiency and equity, parental allocations should change in response to changes in the external environment.

Parents may have different objectives that motivate transfers to children. Such decisions may be based on future returns that the children would bring to them (Rosenzweig, 1986), preferences for inter-sibling equality (Behrman et al., 1982) or trade-offs between equity and efficiency (Pitt et al., 1990). The parental allocation rules may be modified by disagreement between parents and also by non-altruistic transfer motives. If parents disagree, or if they do not pool their incomes, the common preference model with a single parental utility function specified above does not hold, and the outcome of the allocation is the result of bargaining between parents (e.g., McElroy, 1990). Like other household allocation outcomes (see Thomas (1990, 1994)), intergenerational transfers may reflect individualistic preferences of husband and wife in decision-making, and thus the differential bargaining power of parents may influence the allocation of land and education to children.

Our null hypothesis is that parents are basically egalitarian with respect to intergenerational transfers. In particular, we argue that parents pay attention to comparative advantages of daughters and sons in the cultivation of lowland and upland areas. The null hypothesis of egalitarian parental motives is consistent with egalitarian cultural practices in Southeast Asia relative to South and East Asia: according to a recent study of selected villages in the Philippines by Estudillo et al. (2000a, 2000b), sons work on rice farms more than daughters and inherit larger areas of paddy land, whereas daughters work in non-farm sectors more than sons and receive more schooling.

AN APPLICATION TO MATRILINEAL SUMATRA

Sumatra is a unique site to test models of intergenerational transfers due to its tradition of matrilineal inheritance and descent. Unmarried men typically work as farm laborers, or emigrate to other areas to engage in non-farm work or establish a trade (Errington, 1984), and cultivate their wives' land upon marriage. Major decisions are vested in the lineage head, a maternal uncle. Traditionally, the tie between a maternal uncle and his nieces or nephews (children of his sister) was stronger than the tie between a man and his children.

Classification of property and its transmission across generations also occur along gender-differentiated lines. Minangkabau society classifies property into two types: *harto pusako*, or "ancestral property," and *harto pancarian* or "earned property" (Kahn, 1980, p. 26).[4] A very similar distinction between ancestral or family land and privately acquired property is made in Ghanaian uterine matrilineal societies (Quisumbing and Otsuka, 2000). Ancestral property belongs to the lineage, while earned property can be obtained or purchased with one's own efforts. For example, irrigated rice land, the ancestral homestead, gold, and water buffaloes are classified as ancestral property, while tools and workshops are "earned property." These two forms of property are subject to different systems of inheritance. Ancestral property is always inherited by women, and almost always passes from mother to daughters. In contrast, rules of inheritance for earned or acquired property are relatively flexible. The owner is free to sell, mortgage, or give away acquired property. Earned property can also be passed on to either sex, but reverts back to ancestral property in the next generation.[5] Thus, men were allowed to accumulate only earned property.

4 This discussion of inheritance of different types of property is from Kahn (1980) and Kato (1982).

5 In some villages, earned property owned by women is passed on to their daughters; that owned by men is passed on to sons.

The growth of the cash economy and the advent of commercial tree crops in the 19th century increased the economic significance of earned property. Aside from its association with commercial and artisanial activities, earned property also pertained to newly opened agricultural land (Kato, 1982, p. 169), which could be inherited by men.[6] Fathers gradually became more important than maternal uncles in land bestowals. Education offered another way for a father to invest his earned property: investment in his children could not be contested by his matrilineal relatives after his death (Kato, 1982, p. 183). Traditionally, sons were more educated than daughters, as they often work in non-farm sectors in which returns to education tend to be higher.

The anthropological and ethnographic evidence strongly suggests that inheritance regimes are not static. Although they may appear to be enshrined in custom and tradition, they have evolved in response to changing relative scarcity of land and population and income-earning opportunities in lowland and upland areas (Otsuka et al., 2000). In terms of the theoretical framework specified above, the advent of commercialization changed the relative values of paddy land and agroforestry land in favor of the latter, and since men were more intensively involved in opening up new land for agroforestry, their income possibility frontiers shifted as well. Thus, it is quite possible that parents who wanted to maximize lifetime utility would want to give more agroforestry land, which traditionally has been inherited primarily by daughters, to sons instead.

---

6 If newly opened land was used for permanent cultivation, such as paddy land, it was considered ancestral property.

EMPIRICAL SPECIFICATION

Suppose that parents can transfer either assets (land) or human capital (or education represented by schooling) to their children. To investigate the determinants of the distribution of education and land among sons and daughters, we estimate a transfer equation of the following form:

$$T^{*}_{ij} = ß_0 + ß_1X_{cij} + ß_2X_{fj} + ß_3X_{mj} + \gamma_1DX_{fj} + \gamma_2DX_{mj} + \varepsilon_{ij}, \qquad (4)$$

where T^{*}_{ij} is a vector of transfers $T^{*}_{ij} = [E^{*}_{ij}, p^{*}_{ij}, a^{*}_{ij}, b^{*}_{ij}]$ and $E^{*}_{ij}, p^{*}_{ij}, a^{*}_{ij}, b^{*}_{ij}$ are levels of education, paddy land, agroforestry land, and bush-fallow land inherited by child i in family j. Regression parameters $ß_k$ and γ_m are vectors of coefficients for each type of transfer; X_c is a vector of child characteristics such as sex, birth year, and dummies for the eldest and youngest children; X_f and X_m are vectors of exogenous human and physical wealth of father and mother at the time of marriage, respectively; D is the daughter dummy; and ε_{ij} is the error term in each equation.

To account for the possibility that husband and wife do not have identical preferences regarding bestowals to children, an empirical specification consistent with a collective model of the household is used.[7] Thus, father's and mother's wealth at the time of marriage, which are exogenous to decisions made within marriage, enter separately into the regressions. Parental wealth consists of human capital, as proxied by years of schooling, and each parents' inherited holdings of paddy land, agroforestry land,

7 For a review of collective models of the household, see Haddad, Hoddinott, and Alderman (1997). This formulation draws from McElroy's (1990) specification of the Nash bargaining model and is similar to Thomas (1990, 1994).

and bush-fallow areas. In our sites in Indonesia, assets at marriage devolve to their respective owners in case of divorce; these have been used as proxies for threat points or bargaining power (Thomas et al., 1997). Parents' inherited land holdings are divided by the number of potential heirs to account for the effect of population pressure (larger family sizes) on transfers to the next generation. If the coefficients of the same wealth variables for father and mother are significantly different from each other, the unitary model of household decision-making is rejected.

We also include the number of brothers and sisters in the regression, to test whether sibling rivalry affects the allocation of land and education to children (Butcher and Case, 1994). Parental land assets and schooling are interacted with the daughter dummy to test whether parents with more physical and human capital treat children of different sexes differentially.[8] If the interaction terms with parental characteristics are significantly different from each other, the unitary model is also rejected.

A final test of the unitary model involves comparing the sum of the coefficient on parental wealth variable and the coefficient of its relevant interaction term with child gender with the corresponding sum for the opposite-sex parent. This sum, which captures the total effect of the parental characteristic, includes gender interactions, in contrast to the partial effect, which simply compares the coefficients on the wealth variables. If the sums are significantly different from each other, this is inconsistent with the unitary model.

---

8 For example, Thomas (1990, 1994) finds that maternal education and nonlabor income have a bigger impact on the height of a daughter, relative to a son, and that paternal education has a bigger impact on a son, relative to a daughter.

Equation (4) is estimated both in levels and with family fixed effects. Since land transfers are subject to censoring (many children do not receive any land), a tobit procedure is used for the land regressions in levels. However, it is possible that omitted family-level variables are correlated with regressors, and thus their estimated effects on transfers may be biased. For those families with at least two children, the within family allocation can be used as the source of variation in the sample from which to estimate intrahousehold differences in transfers.[9] A fixed effects estimation procedure could control for these unobservables using family-specific dummy variables.[10] In this specific application, however, only the child's sex, birth year, the eldest and youngest dummies, and interaction between child sex and parent characteristics remain as explanatory variables. That is, the effects of variables that do not vary across children cannot be identified.[11] For simplicity, we report only the level results in this article, because there are no crucial differences in the estimation results between the two methods.[12]

---

9 Families with at least two children are included so that birth order and sex dummies are relevant in the family fixed effects specification. The fixed effects procedure eliminates selectivity bias since family size, which affects selection into the sample, is a family-specific variable (Pitt and Rosenzweig, 1990).

10 That is, the observed transfer, Tij, to child i in family j would be given by: Tij = tj + ßXij +uij, where the family-specific effect is a dummy variable, tj, which is taken to be constant for a family (Hsiao, 1986).

11 On the other hand, if transfers were affected by individual heterogeneity, a random effects procedure would be appropriate. The relevant model would be Tij = t + ßXij + ui + vij, where the individual-specific constant terms, ui, are randomly distributed across families. A Lagrange multiplier statistic tests for the appropriateness of the random effects model compared to ordinary least squares (OLS) without group effects, while a Hausman test compares the random effects model to a fixed-effects specification.

12 Since the dependent variable is censored in the land transfers equations, we used Honore's (1992) least-absolute-deviations estimator rather than the ordinary tobit estimator, which is inconsistent in the presence of fixed effects.

INHERITANCE AND EDUCATION IN SUMATRA

STUDY SITES AND SAMPLE DESCRIPTION

We conducted a retrospective survey of land inheritance and schooling in two areas of the buffer zone of the Kerinci Seblat National Park in West Sumatra. Kerinci, where cinnamon is a major tree crop, is called the Middle Region. Bungo Tebo, located in a low-lying area, is called the Low Region, where rubber is the major tree crop.[13] Sixty households in each site were randomly selected from the households included in a related survey on agroforestry and the evolution of land tenure institutions (see Suyanto et al., 2000a, 2000b). Table 1 presents the distribution and average size of the owned and/or cultivated land of the sample households in the Middle and Low Regions. In the Middle Region, most of the households own or cultivate both lowland rice fields and upland cinnamon fields. Since land is scarce in this area, only 47 percent of households report having bush-fallow land. In the Low Region, where land is more abundant, around three-quarters of households have bush-fallow land. Around 90 percent have plots devoted to mature rubber, 88 percent have lowland rice fields, and a smaller percentage (17%) have upland rice fields.

13 For more information on the dominant farming systems in Sumatra, see Angelsen (1995) on shifting cultivation, Tomich et al. (2000) on highland coffee, Aumeeruddy (1994) on cinnamon, and Barlow and Muharminto (1982) and Gouyon et al. (1993) on rubber.

TABLE 1--Distribution and Average Size of Owned/Cultivated [a] Plots by land Use, Middle Region and Low Region Samples

	Middle Region			Low Region		
	Number of plots	Average size (ha)	Number of households	Number of plots	Average size (ha)	Number of households
Total	370	1.18	60	180	1.35	60
Lowland rice fields	136	0.49	59	96	0.64	53
Young cinnamon fields [b]	96	1.33	52	n.a.[e]	n.a.	n.a
Productive cinnamon fields [c]	154	1.25	53	n.a.	n.a.	n.a.
Upland rice fields	n.a.	n.a.	n.a.	10	0.73	10
Young rubber fields [d]	n.a.	n.a.	n.a.	30	0.75	25
Mature rubber fields [d]	n.a.	n.a.	n.a.	79	1.45	55
Bush – fallow	30	1.66	28	61	1.58	46

Note: (a) Owned under joint-family ownership, owner-cultivated under other ownership systems, and cultivated under tenancy and borrowing arrangements.
(b) Young cinnamon fields refer to those with trees of age one to three.
(c) Productive cinnamon fields refer to those with trees of age four and above.
(d) Young and mature rubber fields refer to those with dominant tree age of zero to seven and eight and above, respectively.
(e) Refers to “not applicable.”

Table 2 shows that in the Middle Region 40 percent of owned or cultivated lowland rice fields is owned jointly by daughters or by daughters and sons together.

TABLE 2--Land Tenure Distribution of Owned/Cultivated Plots by Land Use Type, Middle Region (%)

Land tenure categories	Lowland rice	Young cinnamon	Productive cinnamon
Joint family	41.9	0.0	0.0
Daughters	4.4	0.0	0.0
Daughters & sons	37.5	0.0	0.0
Sons	0.0	0.0	0.0
Single family	27.2	33.3	37.7
Daughters	1.5	1.0	0.6
Daughters & sons	22.8	27.1	35.1
Sons	2.9	5.2	2.0
Borrowing	5.1	11.5	11.7
Private – purchase	6.6	25.0	18.2
Private – forest clearance	0.7	18.7	22.1
Share/fixed rent tenancy	18.4	11.5	10.4

At the time of our survey, the latter type of the joint family ownership was more prevalent. Around 27 percent of owned or cultivated paddy plots are under single-family ownership, in which individual households of both daughters and sons acquired ownership through inheritance. Thus, it seems that even in the category of "ancestral land," under which paddy land has traditionally been classified, the inheritance system seems to have evolved to include both daughters and sons as legitimate heirs. Both young and mature cinnamon fields are more likely to fall under single family ownership (by both daughters and sons) or be privately acquired, whether through purchase or forest clearance.

In the Low Region (Table 3), lineage land can be found only in upland rice, accounting for 70 percent of upland rice plots

TABLE 3--Land Tenure Distribution of Owned/Cultivated Plots by Land Use Type, Low Region (%)

Land tenure categories	Lowland rice	Upland rice	Young rubber	Mature rubber	Bush-fallow
Communal/lineage	0.0	70.0	0.0	0.0	0.0
Joint family	55.2	0.0	0.0	0.0	3.3
Daughters	49.0	0.0	0.0	0.0	0.0
Daughters & sons	6.2	0.0	0.0	0.0	3.3
Sons	0.0	0.0	0.0	0.0	0.0
Single family	7.2	0.0	33.3	29.1	41.0
Daughters	1.0	0.0	6.7	0.0	8.2
Daughters & sons	1.0	0.0	3.3	2.5	6.6
Sons	5.2	0.0	23.3	26.6	26.2
Private-purchase	10.4	0.0	33.3	49.4	22.9
Private-forest clearance	0.0	0.0	13.3	8.9	31.2
Renting	14.6	0.0	0.0	8.9	0.0
Borrowing	11.5	20.0	13.3	3.8	0.0
Others	1.0	10.0	6.7	0.0	1.6

Most joint family land is found in lowland rice fields, and almost 50 percent of lowland rice plots are jointly owned by daughters. Only 7 percent of lowland rice fields are under single family ownership. In contrast, ownership of rubber plots is more individualized. Single family ownership and private purchase are the dominant tenure categories for young and mature rubber plots. Rubber plots have also been acquired by forest clearance, accounting for 13 percent of young rubber plots and around 9 percent of mature rubber plots. Finally, bush-fallow area is owned mostly under single family ownership (41% of plots), followed by forest clearance (31%), and private purchase (23%). For both rubber and bush-fallow areas, single family ownership is dominated by ownership by sons.

The distribution of plots by land tenure status seems to indicate that in the Middle Region, traditional inheritance systems are gradually shifting to a more egalitarian system whereby both sons and daughters inherit. In the Low Region, on the other hand, the evolution of inheritance systems seems to have gone further, with women specializing in paddy land and sons in agroforestry and bush-fallow areas.

In order to explore why land tenure institutions and inheritance systems have evolved along different paths in the two regions, we examine the relative labor contributions of men and women to lowland and upland rice cultivation, and the two major tree crops, cinnamon and rubber, in these two regions (Table 4).[14]

14 The labor input data come from the sampled fields used for the computation of net revenue from food crops and agroforestry discussed in Suyanto et al. (2000a, 2000b). In the Middle Region, wet rice, young cinnamon, and mature cinnamon fields were sampled. In the Low Region, upland rice, young rubber, and mature rubber fields were included. Since the focus of the study in the Low Region was the relative profitability of upland rice and agroforestry (rubber), we do not have data on labor input and net revenue in lowland rice fields.

TABLE 4--Labor Use in Food Crop Production and Agroforestry (Mandays per Hectare), Middle and Low Regions [a]

	Middle Region						Low Region					
	Wet rice		Young cinnamon		Mature cinnamon		Upland rice		Young rubber		Mature rubber	
	Mean	%	Mean	%	Mean	%	Mean	%	Mean	%	Mean	%
Family labor												
Men	37.0	57.5	25.8	54.7	5.1	30.2	47.7	31.8	32.3	82.6	48.4	90.6
Women	27.4	42.5	21.4	45.3	11.8	69.8	102.5	68.2	6.8	17.4	5.0	9.4
Total	64.4	100.0	47.2	100.0	16.9	100.0	150.2	100.0	39.1	100.0	53.4	100.0
Total												
Men	120.0	54.2	32.0	47.3	15.2	61.3	53.6	30.5	35.1	67.9	87.6	92.3
Women	101.6	45.8	35.7	52.7	9.6	38.7	121.9	69.5	16.6	32.1	7.3	7.7
Total	221.6	100.0	67.7	100.0	24.8	100.0	175.5	100.0	51.7	100.0	94.9	100.0

Note: **(a) Data from sampled fields.**

In the Middle Region, wet rice and cinnamon use male and female labor relatively equally. Male family labor accounts for 57% of family labor input and female labor comprises 43% in wet rice cultivation. While young cinnamon uses slightly more male family labor -- males contribute 55% and females 45%--women are more involved in mature cinnamon cultivation, accounting for 70% of family labor input. When both hired and family labor are considered, cultivation of wet rice and young cinnamon uses relatively equal amounts of male and female labor.

In the Low Region, upland rice is very intensive in female family labor: women contribute 68% of family labor input, and men only 32%. Although the relevant data were not collected in this particular study, it is known that female labor dominates in lowland rice cultivation. However, both young and mature rubber plots utilize substantial inputs from male family members: men contribute 83% of family labor in young rubber and 91% in mature rubber. The relative proportions of male and female labor input do not change substantially when we consider both family and hired labor. The relatively high use of male labor arises from the type of rubber agroforestry in this region, the so-called "jungle rubber," in which woody species are densely grown among the rubber trees (Gouyon et al., 1993), so that it is difficult for women to work. In contrast, cinnamon trees are grown in rows and hence cinnamon fields are easily accessible to women. Such differences would reflect comparative advantages in the cultivation of wet rice and tree crops between men and women.

INHERITANCE DATA

The retrospective survey on inheritance was patterned after similar surveys in the Philippines (Quisumbing, 1994; Estudillo, et al., 2000a, 2000b) and in Ghana (Quisumbing and Otsuka, 2000), and included questions on the parents, siblings, and children of the respondents, yielding information on three generations called the parents', respondents, and children's generations.[15] The respondents were asked about schooling and landownership of their parents and in-laws, the schooling and inheritance of their spouses, and schooling and proposed bequests to their children. Each respondent was also asked to list all of his or her siblings, their dates of birth, their educational attainment, and the areas of paddy land, agroforestry land, and bush fallow land which they received or expected to receive from their parents. In many cases, respondents received land at marriage, but stood to inherit more land after their parents' death.

Table 5 presents the average landholdings by type, and years of schooling of the parent and respondent generations in the Middle and Low Regions.

15 We refer to the grandchild generation as the child generation for brevity.

TABLE 5--Schooling and Landholdings of Parent and Respondents' Generations, Middle and Low Regions

	Middle Region		Low Region	
	Mean (hectares)	Std. deviation	Mean (hectares)	Std. deviation
Parent generation				
Father				
Years of schooling	3.67	2.95	2.90	1.70
Inherited paddy	0.61	1.10	0.11	0.26
Inherited agroforestry land	0.44	1.02	0.57	1.60
Inherited bush-fallow area	0.03	0.23	0.42	1.14
Mother				
Years of schooling	2.77	2.59	1.73	1.61
Inherited paddy	0.67	1.07	0.47	0.57
Inherited agroforestry land	0.40	0.96	0.41	1.45
Inherited bush-fallow area	0.06	0.34	0.51	1.85
Respondents' generation				
Number of potential heirs	4.87	2.56	4.17	2.30
Sons				
Year of birth	1956	15.58	1957	13.96
Years of schooling	8.92	4.23	7.07	3.39
Inherited paddy	0.23	0.30	0.07	0.20
Inherited agroforestry land	0.23	0.64	0.33	0.86
Inherited bush-fallow area	0.12	0.75	0.39	0.96
Daughters				
Year of birth	1958	12.97	1956	14.83
Years of schooling	8.02	4.04	4.57	2.78
Inherited paddy	0.21	0.31	0.20	0.29
Inherited agroforestry land	0.28	0.74	0.18	0.82
Inherited bush-fallow area	0.02	0.11	0.11	0.39

In both regions, fathers are better educated than mothers, by at least one year of schooling. Years of completed schooling increase in the respondent generation: in contrast to their fathers, who had 3.3 years of schooling, sons have about 8 years of schooling on the average. Daughters have lower educational attainments than sons, at 6.3 years on the average. Educational attainments are lower and the gender gap is much larger for both generations in the Low Region than in the Middle Region. To some extent, the lower schooling attainment of women in the Low Region seems to be compensated for by their larger holdings of owned paddy land, which is far more valuable than upland fields.

In contrast to the gender difference in schooling, mothers' inherited landholdings were generally larger than their husbands' in the parents' generation. This pattern no longer holds in the respondents' generation. In the Middle Region, daughters and sons have approximately equal inherited areas of paddy land, but daughters have larger inherited agroforestry areas and smaller bush-fallow areas. In the Low Region, daughters maintain the matrilineal custom of inheriting paddy land, but receive substantially smaller areas of agroforestry land and bush-fallow land.

DETERMINANTS OF WEALTH TRANSFER IN THE RESPONDENT GENERATION

Tables 6 and 7 present regression results on the levels of education (years of schooling) and inherited land of the respondent and his or her siblings in the Middle and

Low Regions, respectively. Schooling equations were estimated using ordinary least squares, with standard errors corrected for household clustering.

TABLE 6--Determinants of Schooling and Land Inheritance by Respondents and Siblings, Levels Estimates, Middle Region [a]

	Schooling [b]	Paddy land [c]	Agroforestry [c]	Bush-fallow [c]
Constant	-1444.18	-858.52	-2006.04	-6925.12
Daughter	-1.53	0.02	0.08	3.70
Birth year	1.40	0.88**	2.05*	7.13
Birth year squared [d]	-335.83	-225.56**	-524.05*	-1835.61
Eldest	-0.60	-0.05	-0.23	-0.70
Youngest	-0.73	-0.02	-0.15	-1.09
No . of brothers	-0.01	0.01	0.00	-0.74
No. of sisters	0.38	-0.03*	-0.09*	-1.32
Father's schooling	-0.15	0.01	0.02	0.60*
Mother's schooling	0.28	0.01	0.06	-0.90
Father's paddy land	1.59	0.38**	-0.17	-0.37
Mother's paddy land	3.73*	0.62**	-0.71	0.33
Father's agroforestry land	-2.44	-0.15	1.27**	1.43
Mother's agroforestry land	-0.20	0.44*	0.69	0.37
Father's bush-fallow land	-10.35**	0.18	1.25	8.20
Mother's bush fallow land	-4.45	1.64**	1.11	21.62
Daughter x father's schooling	-0.03	-0.00	-0.02	-1.09
Daughter x mother's schooling	0.28	-0.01	-0.02	-2.38
Daughter x father's paddy land	-2.71**	-0.13	-0.47	-40.24
Daughter x mother's paddy land	-1.96	0.25	-0.40	4.82
Daughter x father's agroforestry land	4.23**	0.01	0.76*	-40.97
Daughter x mother's agroforestry land	0.21	0.40	0.40	-12.08
Daughter x father's bush fallow land	6.06**	-0.36	-0.75	-6.14
Daughter x mother's bush fallow land	3.38	-1.84**	-0.48	37.88
Sigma		0.24	0.71	2.31
Number of observations	292	292	292	292
Uncensored		254	160	19
Log-likelihood		-28.79	-229.03	-58.35
F-statistic (p-value)	29.34 (0.00)**			
Chi-squared (p-value)		180.94 (0.00)**	172.79 (0.00)**	71.01 (0.00)**
R-squared	0.28			
Pseudo R-squared		0.76	0.27	0.38
Hypothesis tests: F test (p-value)				
Father’s schooling=Mother’s schooling	0.95 (0.33)	0.10 (0.76)	0.44 (0.51)	5.79(0.02)*
Father’s paddy=Mother’s paddy	0.93 (0.34)	4.86 (0.03)*	1.21 (0.27)	0.13 (0.72)

	Schooling [b]	Paddy land [c]	Agroforestry [c]	Bush-fallow [c]
Father's agroforestry land=Mother's agroforestry land	0.42 (0.52)	1.84 (0.18)	0.83 (0.36)	0.06 (0.81)
Father's bush-fallow land=Mother's bush-fallow land	0.35 (0.56)	3.79 (0.05)*	0.00 (0.95)	1.02 (0.31)
Gender interaction terms with schooling equal	0.60 (0.44)	0.01 (0.94)	0.00 (0.98)	0.15 (0.70)
Gender interaction terms with paddy equal	0.10 (0.75)	4.90 (0.03)*	0.01 (0.93)	0.22 (0.64)
Gender interaction terms with agroforestry equal	1.51 (0.22)	2.72 (0.10)	0.27 (0.61)	2.11 (0.15)
Gender interaction terms with bush-fallow equal	0.10 (0.75)	2.92 (0.09)	0.01 (0.92)	0.43 (0.51)
Schooling plus interaction terms equal	6.01(0.02)*	0.04 (0.85)	0.32 (0.57)	0.71 (0.40)
Paddy plus interaction terms equal	3.23 (0.08)	21.63 (0.00)**	0.45 (0.50)	0.23 (0.63)
Agroforestry plus interaction terms equal	1.81 (0.18)	1.04 (0.31)	10.30 (0.00)**	1.99 (0.16)
Bush-fallow plus interaction terms equal	0.46 (0.50)	0.00 (0.95)	0.01 (0.93)	0.68 (0.41)

Note: (a) Estimated coefficients are shown. ** indicates significance at 1 percent level; * at 5 percent level, according to two-tailed t-test.
(b) OLS with robust standard errors, clustered on households.
(c) Tobit estimates.
(d) (Birthyear/1000) squared.

TABLE 7--Determinants of Schooling and Land Inheritance by Respondents and Siblings, Levels Estimates, Low Region [a]

	Schooling [b]	Paddy land [c]	Agroforestry [c]	Bush-fallow [c]
Constant	-4118.16	-312.19	348.23	-3140.05
Daughter	-2.28**	0.47**	1.70	-4.12*
Birth year	4.16	0.32	-0.37	3.20
Birth year squared [d]	-1051.11	-80.04	99.96	-817.56
Eldest	-0.45	0.03	-0.12	-0.22
Youngest	0.00	0.07	0.94	-0.73*
No . of brothers	0.30	0.01	-0.58**	-0.70**
No. of sisters	0.17	-0.06**	0.07	-0.04
Father's schooling	0.28	0.05*	0.18	0.32**
Mother's schooling	0.02	0.01	0.37*	-0.01
Father's paddy land	-0.56	0.87*	3.28	-1.07
Mother's paddy land	4.05*	0.86**	-3.90	-1.03
Father's agroforestry land	1.31	-0.10	3.52**	-0.59
Mother's agroforestry land	0.32	-0.14	1.85**	1.19**
Father's bush-fallow land	-1.25*	-0.20	-1.02	1.32**
Mother's bush fallow land	-1.00*	0.09	-0.02	1.62**
Daughter x father's schooling	-0.14	-0.02	-2.22*	0.53*
Daughter x mother's schooling	-0.00	-0.04	-16.45	0.50
Daughter x father's paddy land	-0.98	0.73	31.42	0.47
Daughter x mother's paddy land	-1.96	0.64	3.30	-4.58
Daughter x father's agroforestry land	0.93	0.01	9.07	2.06
Daughter x mother's agroforestry land	0.75	0.21	4.78*	2.47*
Daughter x father's bush fallow land	0.62	-0.05	e	1.95
Daughter x mother's bush fallow land	2.35**	-1.08	e	-1.10
Sigma		0.31	1.44	1.23
Number of observations	247	247	247	247
Uncensored	247	93	44	51
Log-likelihood		-82.29	-107.89	-121.16
F-statistic (p-value)	18.75 (0.00)**			
Chi-squared (p-value)		148.28 (0.00)**	140.17 (0.00)**	139.37 (0.00)**
R-squared	0.38			
Pseudo R-squared		0.47	0.39	0.37
Hypothesis tests: F test (p-value)				
Father’s schooling=Mother’s schooling	0.92 (0.34)	1.19 (0.28)	0.91 (0.34)	4.93 (0.03)*
Father’s paddy=Mother’s paddy	1.29 (0.26)	0.00 (0.98)	3.49 (0.06)	0.00 (0.99)
Father’s agroforestry land=Mother’s agroforestry land	0.75 (0.39)	0.04 (0.84)	5.05 (0.03)*	4.22 (0.04)*
Father’s bush-fallow land=Mother’s bush-fallow land	0.11 (0.74)	1.48 (0.22)	0.53 (0.47)	0.25 (0.62)
Gender interaction terms with schooling equal	0.13(0.72)	0.06 (0.80)	1.52 (0.22)	0.01 (0.91)

	Schooling [b]	Paddy land [c]	Agroforestry [c]	Bush-fallow [c]
Gender interaction terms with paddy equal	0.05 (0.82)	0.01 (0.91)	0.99(0.32)	0.30 (0.58)
Gender interaction terms with agroforestry equal	0.01 (0.92)	0.52 (0.47)	0.44 (0.51)	0.05 (0.83)
Gender interaction terms with bush-fallow equal	1.87 (0.18)	2.10 (0.15)	e	4.13 (0.04)*
Schooling plus interaction terms equal	0.08 (0.78)	2.71 (0.10)	1.48 (0.22)	3.04 (0.08)
Paddy plus interaction terms equal	1.90 (0.17)	0.03 (0.87)	1.58 (0.21)	0.31 (0.58)
Agroforestry plus interaction terms equal	0.50 (0.48)	0.66 (0.42)	0.86 (0.36)	1.71 (0.19)
Bush-fallow plus interaction terms equal	6.24 (0.02)*	1.20 (0.27)	e	4.27 (0.04)

Note: (a) Estimated coefficients are shown. ** indicates significance at 1 percent level; * at 5 percent level according to two-tailed t-test.
(b) OLS with robust standard errors, clustered on households.
(c) Tobit estimates.
(d) (Birthyear/1000) squared.
(e)Variables not included due to non-convergence.

From Table 6, the following observations can be made. First, the gender effect is insignificant. None of the coefficients of the daughter dummy are significant according to the two-tailed t-test, which suggests the absence of gender bias against daughters. If we apply a one-tailed test, however, the coefficient is significantly negative at the 5 percent level in the schooling regression, both in the levels and fixed-effect estimates. Thus, we cannot deny the tendency for daughters to be disfavored in schooling investments. An increase in the number of sisters reduces the inherited paddy and agroforestry areas, whereas an increase in the number of brothers has no such effect. Second, mother's paddy land ownership has a positive effect on schooling. Mothers seem to exhibit greater concern for their children's schooling than do fathers, and those with larger paddy areas tend to send their children for further study. F-statistics reported at the bottom of Table 6 show that the coefficient on mother's paddy land is significantly different from that of father's. Third, father's bush-fallow land has a negative effect on schooling. The larger bush-fallow area of fathers is associated with lower schooling attainment of children, which would reflect the relatively low returns to schooling when ample areas of uncultivated land exist. It seems that uncultivated land and schooling are substitutable means of transferring wealth from one generation to another. The coefficient on father's bush-fallow land is significantly different from the mother's coefficient.

Fourth, it may seem that mothers express weaker gender preference than fathers with respect to their asset holdings. Four interaction terms between the daughter dummy and mother's human and physical assets are all insignificant except for one case. In contrast, three interaction terms between the daughter dummy and father's land ownership are significant in the schooling regression. The results imply that while fathers who own larger paddy areas are less likely to keep their daughters in school, they are more likely to do so if they own large upland fields. Despite the differential effect of paddy land and bush-fallow land, it is only in the case of gender interactions with paddy land that father's and mother's effects are significantly different from each other. Lastly, land inheritance persists over generations. Larger parental holdings per capita of specific types of land typically lead to larger areas bequeathed to children.

To sum up, the findings that some father- or mother-specific asset ownership variables are significantly different from each other in the wealth transfer decisions imply that the unitary model of household behavior is rejected. These differences are associated with specific types of assets, the strongest effect being observed with paddy land.

However, the insignificance of the daughter dummy, as well as its generally insignificant interactions with parental wealth variables, strongly indicate that wealth transfers in this community are largely egalitarian with respect to gender. These qualitative conclusions remain unchanged with the fixed-effects estimation.

Despite distinct differences in climatic conditions, population pressure, and type of tree crops grown between the two regions, the estimation results for the Low Region shown in Table 7 are not markedly different, with major exceptions being the significant and negative coefficient of the daughter dummy and the insignificance of the interaction terms between the daughter dummy and father's asset ownership. In other words, daughters are significantly disadvantaged with respect to schooling and inheritance of bush-fallow land, but are favored with respect to inheritance of paddy land. Daughters receiving larger areas of paddy land, with sons being compensated by more years of schooling, is consistent with the tradition of the matrilineal inheritance system. That sons inherit more bush-fallow land is a new custom, consistent with the requirement of men's labor for future development of such land. The result that more sisters decrease one's inheritance of paddy land, while more brothers decrease receipts of agroforestry and bush-fallow areas is also consistent with the differences in comparative advantages in lowland and upland farming between daughters and sons. These differences are likely to reflect both efficiency and egalitarian motives of parents.

We reject the unitary model only for differences in the effects of parental schooling and differences in the interaction terms with bush-fallow land in the case of the Low Region. Judging from the insignificant differences in the effects of asset ownership by fathers and mothers and the insignificant effects of their interactions with the daughter dummy, the rejection of the unitary model is weaker in the Low Region than in the Middle Region. This is not surprising since households in the Middle Region still cling more strongly to traditional matrilineal systems which give greater bargaining power to wives rather than husbands. In general, parents are not only egalitarian but also tend to pool their resources in making wealth transfer decisions in the Low Region.

DETERMINANTS OF SCHOOLING IN THE CHILD GENERATION

While land inheritance systems seem to have been evolving in favor of sons, the persistence of gender bias against daughters in schooling, particularly in the Low Region, is worrisome, since low schooling levels would limit women's chance of seeking non-agricultural employment. Does this bias persist in the generation of the respondents' children? We thus examine intrahousehold differences in schooling attainment in the children's generation. Altogether we have 178 observations on children in school, i.e., those between 7 and 21 years of age.

Unlike the respondent and his or her siblings, schooling decisions for the respondents' children are not yet complete. To take into account incomplete schooling decisions, we use two individual level outcomes: (i) the deviation of each child's completed years of schooling from the cohort mean; and (ii) actual years of completed schooling, controlling for child age.[16] In the first specification, we are measuring how well each child is doing relative to other children of the same age. In the second, we control for the correlation between age and schooling completion by including linear and quadratic terms in child age. An advantage of the deviation from cohort mean is that it is

16 We follow the methodology in Quisumbing and Maluccio (1999).

not prone to censoring, unlike schooling attainment, which could be censored at zero. In order to test whether family-specific unobservables or individual heterogeneity are important, we estimated both fixed- and random-effects estimates. In both regions, the Lagrange multiplier test indicates that individual heterogeneity is important. Moreover, the Hausman test does not lead us to reject random effects in favor of fixed effects (with the exception of schooling attainment in the Low Region). This suggests that differences in schooling can be explained by factors that vary across families and individuals, rather than by unobserved family characteristics.

According to the estimation results of schooling functions in Tables 8 and 9, the gender gap in schooling has practically disappeared in the child generation.

TABLE 8--Determinants of Schooling Attainment of the Respondents' Children, Middle Region [a]

	Deviation from cohort mean [b] (levels)	Years of schooling [b] (levels)	Deviation from cohort mean (random effects)	Years of schooling (random effects)
Constant	-2.81	-13.64	-3.98	-15.20
Daughter	2.49	3.91	2.14	3.32**
Birth year	-0.06	1.59**	0.11	1.80**
Birth year squared	0.01	-0.03**	0.00	-0.03**
No . of brothers	-0.28	-0.22	-0.23	-0.25
No. of sisters	-0.09	0.02	-0.29	-0.12
Father's schooling	0.13	0.15	0.17	0.21
Mother's schooling	0.21	0.36	0.14	0.27*
Father's paddy land	-0.87	-0.44	-1.78	-1.52
Mother's paddy land	3.63	3.00	3.93	3.32
Father's agroforestry land	-0.77	-0.65	-0.21	-0.14
Mother's agroforestry land	-1.27*	-1.09	-1.49**	-1.30**
Father's bush-fallow land	0.94	1.36	0.68	0.92
Mother's bush fallow land	-6.21	-5.88	-6.07*	-5.96*
Daughter x father's schooling	-0.12	-0.15	-0.15	-0.18
Daughter x mother's schooling	-0.15	-0.31	-0.06	-0.19
Daughter x father's paddy land	0.60	-0.57	2.40	1.59
Daughter x mother's paddy land	-3.49	-3.10	-4.06	-3.72
Daughter x father's agroforestry land	0.69	0.64	0.06	0.02
Daughter x mother's agroforestry land	1.03	1.49	1.80	2.24
Daughter x father's bush fallow land	-0.87	-1.28	-.71	-0.92
Daughter x mother's bush fallow land	6.68	5.96	6.18*	5.69*
Number of observations	70	70	69	69
F-statistic (p-value)	4.39 (0.00)**	10.02 (0.00)**		
Chi-squared (p-value)			29.97 (0.09)	621.12 (0.00)**
R-squared	0.40	0.89		
Breusch-Pagan LM test (p-value)			5.59 (0.02)*	6.91 (0.01)**
Hausman test (FE vs. RE) (p-value)			5.61 (0.90)	12.79 (0.31)
Hypothesis tests: F test (p-value)				
Father's schooling=Mother's schooling	0.03 (0.87)	0.24 (0.62)	0.03 (0.87)	0.11 (0.74)
Father's paddy=Mother's paddy	1.06 (0.31)	0.74 (0.39)	4.72 (0.03)*	3.86 (0.05)*
Father's agroforestry land=Mother's agroforestry land	0.36 (0.55)	0.41 (0.53)	2.20 (0.14)	2.07 (0.15)
Father's bush-fallow land=Mother's bush-fallow land	4.40 (0.04)*	5.19 (0.03)*	4.61 (0.03)*	5.49 (0.02)*
Schooling interaction terms equal	0.00 (0.95)	0.13 (0.72)	0.03 (0.87)	0.00 (0.99)
Paddy interaction terms equal	0.83 (0.37)	0.38 (0.54)	4.72 (0.03)*	3.39 (0.07)
Agroforestry interaction terms equal	0.09 (0.77)	0.80 (0.38)	2.20 (0.14)	2.30 (0.13)

	Deviation from cohort mean [b] (levels)	Years of schooling [b] (levels)	Deviation from cohort mean (random effects)	Years of schooling (random effects)
Bush-fallow interaction terms equal	4.70 (0.04)*	5.10 (0.03)*	4.61 (0.03)*	4.92 (0.03)*
Schooling plus interaction terms equal	0.24 (0.63)	0.28 (0.60)	0.16 (0.68)	0.13 (0.72)
Paddy plus interaction terms equal	0.38 (0.54)	2.10 (0.15)	0.13 (0.71)	0.07 (0.79)
Agroforestry plus interaction terms equal	0.06 (0.81)	0.42 (0.52)	0.03 (0.87)	0.84 (0.36)
Bush-fallow plus interaction terms equal	0.46 (0.50)	0.00 (0.99)	0.09 (0.76)	0.12 (0.73)

Note: (a) Estimated coefficients are shown. ** indicates significance at 1 percent level; * at 5 percent level, according to two-tailed t-test.
(b) OLS with standard errors corrected for clustering.

TABLE 9--Determinants of Schooling Attainment of the Respondents' Children, Low Region [a]

	Deviation from cohort mean [b] (levels)	Years of schooling [b] (levels)	Deviation from cohort mean (random effects)	Years of schooling (fixed effects)
Constant	-1.62	-9.99	-1.62	-8.55
Daughter	-0.49	-1.33	-.47	-0.80
Birth year	0.24	1.66**	0.25	1.50**
Birth year squared	-0.01	-0.04**	-0.01	-0.03*
No . of brothers	-0.19	-0.12	-0.19	---
No. of sisters	-0.10	-0.05	-0.11	---
Father's schooling	0.05	0.04	0.05	---
Mother's schooling	-0.04	-0.07	-0.05	---
Father's paddy land	-2.82	-3.51**	-2.83*	---
Mother's paddy land	1.50**	0.78*	1.48**	---
Father's agroforestry land	0.30*	0.39**	0.29	---
Mother's agroforestry land	1.54**	2.20**	1.56	---
Father's bush-fallow land	0.22	0.17	0.23	---
Mother's bush fallow land	0.62	0.79	0.64	---
Daughter x father's schooling	0.04	0.05	0.04	-0.01
Daughter x mother's schooling	0.12	0.24	0.12	0.20
Daughter x father's paddy land	1.27	1.43	1.41	1.88
Daughter x mother's paddy land	-0.47	0.94	-0.56	-0.82
Daughter x father's agroforestry land	-0.48	-0.54	-0.44	0.14
Daughter x mother's agroforestry land	-0.11	-0.80	-0.15	-0.70
Daughter x father's bush fallow land	-0.16	-0.19	-0.4	-0.07
Daughter x mother's bush fallow land	0.02	0.22	0.00	0.62
Number of observations	108	108	107	107
F-statistic (p-value)	12.29 (0.00)**	7.82 (0.00)**		15.02 (0.00)**
Chi-squared (p-value)			27.31 (0.16)	
R-squared	0.25	0.75		
Breusch-Pagan LM test (p-value)			12.09 (0.00)**	14.68 (0.00)**
Hausman test (FE vs. RE) (p-value)			3.39 (1.00)	357.43 (0.00)**
Hypothesis tests: F test (p-value)				
Father's schooling=Mother's schooling	0.32 (0.57)	0.72 (0.40)	0.30 (0.59)	n. a.
Father's paddy=Mother's paddy	7.80 (0.01)**	11.62 (0.00)**	8.97 (0.00)**	n. a.
Father's agroforestry land=Mother's agroforestry land	10.29 (0.00)**	22.01 (0.00)**	0.64 (0.42)	n. a.
Father's bush-fallow land=Mother's bush-fallow land	0.51 (0.48)	1.83 (0.18)	0.47 (0.49)	n. a.
Schooling interaction terms equal	0.16 (0.69)	0.58 (0.45)	0.09 (0.76)	0.38 (0.54)
Paddy interaction terms equal	0.84 (0.37)	0.04 (0.84)	0.90 (0.34)	0.62 (0.43)
Agroforestry interaction terms equal	0.28 (0.60)	0.09 (0.77)	0.02 (0.89)	0.15 (0.70)

	Deviation from cohort mean [b] (levels)	Years of schooling [b] (levels)	Deviation from cohort mean (random effects)	Years of schooling (fixed effects)
Bush-fallow interaction terms equal	0.10 (0.76)	0.30 (0.59)	0.02 (0.90)	0.22 (0.64)
Schooling plus interaction terms equal	0.00 (0.97)	0.10 (0.76)	0.01 (0.93)	n. a.
Paddy plus interaction terms equal	1.62 (0.21)	1.78 (0.19)	2.12 (0.15)	n. a.
Agroforestry plus interaction terms equal	7.01 (0.01)**	4.14 (0.05)**	0.98 (0.32)	n. a.
Bush-fallow plus interaction terms equal	0.61 (0.48)	0.97 (0.33)	0.32 (0.57)	n. a.

Note*:* (a) Estimated coefficients are shown. ** indicates significance at 1 percent level; * at 5 percent level, according to two-tailed t-test.
(b) OLS with standard errors corrected for clustering.

In the Middle Region, we find that girls tend to do even better in terms of years of schooling, using the random effects estimates. In general, there are few significant variables in the regressions, the major exceptions being birth year and its squared term in the years of schooling regressions. Such results are consistent with the egalitarian bequest motives of parents.

The daughter dummy is insignificant in the Low Region (Table 9), and none of the interactions with the daughter dummy are significant. It seems that parents no longer exhibit preferential treatment for either daughters or sons with respect to child schooling. However, we find that the coefficients on parental wealth variables continue to be significantly different from each other in the case of paddy land and bush-fallow land in the Middle Region (random effects estimates). In all the regressions, the interactions of the daughter dummy with parents' bush-fallow land are significantly different from each other. In the Low Region, in both levels and random effects estimates, the coefficients on parental paddy land are significantly different from each other. Thus, it seems that egalitarian bequest motives coexist with a collective model of household behavior in Sumatra.

The closing of the gender gap in schooling reflects the general trend of increasing returns to female education in the Indonesian economy. Using a nationally representative data set, Deolalikar (1993) found that in Indonesia, women are acquiring secondary and tertiary education in relatively larger numbers than men, in response to the greater relative returns to female higher education. Again, using nationally representative data, Behrman and Deolalikar (1995) found that private rates of return to schooling investments in females in Indonesia are higher than those for males. Specifically, the marginal increases of wage rates and earnings with post-primary schooling are greater in percentage terms for females than for males.

4. CONCLUSIONS

We found that the shift from communal to individualized land tenure has been accompanied by a shift from a strictly matrilineal regime to one where both sons and daughters inherit. In effect, it is a move towards a bilateral system of inheritance similar to those found in other parts of Southeast Asia, e.g., in the Philippines (Estudillo et al. (2000a, 2000b). Moreover, our results show that the inheritance system is evolving to a more egalitarian system in which sons and daughters inherit the type of land which is more intensive in their own work effort. The newly-emerging customary land tenure institutions, by allowing for inheritance to be consistent with comparative advantage and work effort by gender, seem to be incentive-compatible for men and women. We find a similar phenomenon in Ghana, where wives traditionally did not inherit land from their husbands. However, as demand for women's labor in cocoa production increased, women who helped their husbands establish cocoa fields began to receive land from their husbands as a gift, with secure private rights (Quisumbing et al., 2000).

It is heartening that the large gender gap in schooling in the respondents' generation is closing in the child generation. Even if daughters continued to maintain control of land in their own right, lower levels of education would make them less likely to benefit from nonagricultural income earning opportunities. If education is becoming more important than land in the determination of income, as in the Philippines (Estudillo and Otsuka, 1999), a persistent gender gap in schooling would contribute to the inequality in income earning capacity between men and women. Improvements in female schooling observed in the younger generation would enable women to move out of agriculture, which, with increasing population pressure, would no longer be able to absorb the growing labor force. To what extent the gender gap in income persists and whether changes are taking place towards greater gender equality, however, need to be investigated by further empirical studies.

REFERENCES

Agarwal, Bina. 1994. *A field of one's own: Gender and land rights in South Asia.* Cambridge: Cambridge University Press.

Angelsen, Arild. 1995. Shifting cultivation and deforestation: A study from Indonesia. *World Development*, Vol. 23, pp. 1713-1729.

Ault, D. E. and G. L. Rutman. 1979. The development of individual rights to property in tribal Africa. *Journal of Law and Economics*, Vol. 22 (1979), pp. 163-182.

Aumeeruddy, Y. 1994. Local representations and management of agroforests on the periphery of Kerinci Seblat National Park, Sumatra, Indonesia. *People and Plants Working Paper* No. 3, Division of Ecological Sciences, UNESCO, Paris.

Barlow, C. and Muharminto, 1982. The Rubber smallholder economy. *Bulletin of Indonesian Economic Studies*, Vol. 18, pp. 86-119.

Becker, G. S. 1974. A theory of social interactions. *Journal of Political Economy*, Vol. 82, pp. 1063-1093.

Becker, G. S. and Nigel Tomes. 1986. Human capital and the rise and fall of families. *Journal of Labor Economics*, Vol. 4, pp. S1-S39.

Behrman, J. R. and Anil Deolalikar. 1995. Are there differential returns to schooling by gender? The case of Indonesian labor markets. *Oxford Bulletin of Economics and Statistics*, Vol. 57, pp. 97-117.

Behrman, J. R., Robert Pollak, and Paul Taubman 1982. Parental preferences and provision for progeny," *Journal of Political Economy*, Vol. 90, pp. 52-73.

Besley, Timothy. 1995. Property rights and investment incentives. *Journal of Political Economy*, Vol. 103, pp. 913-937.

Butcher, K., and Ann Case. 1994. The effect of sibling sex composition on women's education and earnings. *Quarterly Journal of Economics*, Vol. 109, pp. 531-563.

Deolalikar, Anil. 1993. Gender differences in the returns to schooling and in school enrollment rates in Indonesia. *Journal of Human Resources*, Vol. 28, pp. 899-932.

Errington, F. K. 1984. *Manners and Meaning in West Sumatra: The Social Context of Consciousness.* New Haven, Conn. USA: Yale University Press.

Estudillo, J. P. and Keijiro Otsuka. 1999. Green revolution, human capital, and off-farm employment: Changing sources of income among farm households in Central Luzon, 1965-1995 *Economic Development and Cultural Change*, Vol. 47, pp. 497-523.

Estudillo, J. P., A. R. Quisumbing, and Keijiro Otsuka. 2001. Gender difference in land inheritance and schooling investments in the rural Philippines. *Land Economics.* 77(1): 130-143.

Estudillo, J. P., A. R. Quisumbing, and Keijiro Otsuka. 2001b. The implications of gender differences in land inheritance and schooling on life-time incomes: Evidence from the rural Philippines," *Journal of Development Studies,* forthcoming.

Feder, Gershon and David Feeny. 1993. The theory of land tenure and property rights. In *The Economics of Rural Organization: Theory, Practice, and* Policy. Karla Hoff, Avishay Braverman, and J. E. Stiglitz, eds. Oxford: Oxford University Press.

Gouyon, A., H. de Foresta, and P. Levang.. 1993. Does jungle rubber deserve its name? An analysis of rubber agroforestry systems in Southeast Sumatra. *Agroforestry Systems*, Vol. 22, pp. 181-206.

Haddad, Lawrence, John Hoddinott, and Harold Alderman, eds. 1997. *Intrahousehold Resource Allocation in Developing Countries: Methods, Models, and Policy*. Baltimore, Md., USA: Johns Hopkins University Press.

Honoré, Bo. 1992. Trimmed LAD and least squares estimation of truncated and censored regression models with fixed effects. *Econometrica*, Vol. 60, pp. 533-565.

Hsiao, Cheng. 1986. *Analysis of Panel Data*, Econometric Society Monographs No. 11 Cambridge: Cambridge University Press.

Kahn, J. S. 1980. *Minangkabau Social Formations: Indonesian Peasants and the World* Economy. Cambridge: Cambridge University Press.

Kato, T. 1982. *Matriliny and Migration: Evolving Minangkabau Traditions in Indonesia* Ithaca, NY, USA: Cornell University Press, 1982.

Lastarria-Cornhiel, Susana. 1997. Impact of privatization on gender and property rights in Africa. *World Development*, Vol. 25, pp. 1317-1333.

McElroy, M. B. 1990. The empirical content of Nash-bargained household behavior, *Journal of Human Resources*, Vol. 25, pp. 559-583.

Otsuka, Keijiro, S. Suyanto, Tetsushi Sonobe, and T. P. Tomich. 2001. Evolution of customary land tenure and development of agroforestry: Evidence from Sumatra. *Agricultural Economics*, forthcoming.

Pitt, M. M. and M. R. Rosenzweig. 1990. Estimating the intrahousehold incidence of illness: Child health and gender inequality in the allocation of time. *International Economic Review*, Vol. 31, pp. 969-989.

Pitt, M. M., M. R. Rosenzweig, and M. N. Hassan. 1990. Productivity, health, and inequality in the intrahousehold distribution of food in low-income countries, *American Economic Review*, Vol. 80, pp. 1139-1156.

Place, Frank and Keijiro Otsuka. 2000a. Population pressure, land tenure, and tree resource management in Uganda. *Land Economics*, Vol. 76, pp. 233-251.

Place, Frank and Keijiro Otsuka. 2001b. Population, land tenure, and natural resource management in Malawi. *Journal of Environmental Economics and Management,* forthcoming.

Quisumbing, A. R. 1994. Intergenerational transfers in Philippine rice villages: Gender differences in traditional inheritance customs. *Journal of Development Economics*, Vol. 43, pp. 167-195.

Quisumbing, A. R. and J. A. Maluccio. 1999. *Intrahousehold allocation and gender relations: New empirical evidence*. Policy Research Report on Gender and Development Working Series, No. 2. Washington, DC: The World Bank.

Quisumbing, A. R. and Keijiro Otsuka. 2001. Land, Trees, and Women: Evolution of Land Tenure Institutions in Western Ghana and Sumatra. *IFPRI Research Report* Washington, DC: International Food Policy Research Institute.

Rosenzweig, M. R. 1986. Program interventions, intrahousehold distribution, and the welfare of individuals. *World Development*, Vol. 14, pp. 233-243.

Suyanto, S., T. P. Tomich and Keijiro Otsuka. 2000a. *Land tenure and farm management efficiency: The case of paddy and cinnamon production in customary land areas of Sumatra*. Mimeo, International Center for Agroforestry, Indonesia, and Tokyo Metropolitan University.

Suyanto, S., T. P. Tomich and Keijiro Otsuka. 2000b. *Land tenure and farm management efficiency: The case of smallholder rubber production in customary* *land areas of Sumatra.* Mimeo, International Center for Agroforestry, Indonesia, and Tokyo Metropolitan University.

Thomas, Duncan. 1990. Intrahousehold resource allocation: An inferential approach. *Journal of Human Resources*, Vol. 25, pp. 635-664.

Thomas, Duncan. 1994. Like father, like son; like mother, like daughter: Parental resources and child height. *Journal of Human Resources*, Vol. 29, pp. 950-88.

Thomas, Duncan, D. Contreras and E. Frankenberg. 1997. *Child health and the distribution of household resources at marriage.* Mimeo, RAND Corporation.

Tomich, T. P., P. Hastuti and C. P. A. Bennett. 2001. Policy failure and private initiative in upland agriculture: Evidence from smallholder coffee in highland Sumatra. *Bulletin of Indonesian Economic Studies,* forthcoming.

List of CAPRi Working Papers

01 *Property Rights, Collective Action and Technologies for Natural Resource Management: A Conceptual Framework*, by Anna Knox, Ruth Meinzen-Dick, and Peter Hazell, October 1998.

02 *Assessing the Relationships Between Property Rights and Technology Adoption in Smallholder Agriculture: A Review of Issues and Empirical Methods*, by Frank Place and Brent Swallow, April 2000.

03 *Impact of Land Tenure and Socioeconomic Factors on Mountain Terrace Maintenance in Yemen*, by A. Aw-Hassan, M. Alsanabani and A. Bamatraf, July 2000.

04 *Land Tenurial Systems and the Adoption of a Mucuna Planted Fallow in the Derived Savannas of West Africa*, by Victor M. Manyong and Victorin A. Houndékon, July 2000.

05 *Collective Action in Space:Assessing How Collective Action Varies Across an African Landscape*, by Brent M. Swallow, Justine Wangila, Woudyalew Mulatu, Onyango Okello, and Nancy McCarthy, July 2000.

06 *Land Tenure and the Adoption of Agricultural Technology in Haiti*, by Glenn R. Smucker, T. Anderson White, and Michael Bannister, October 2000.

07 *Collective Action in Ant Control*, by Helle Munk Ravnborg, Ana Milena de la Cruz, María Del Pilar Guerrero, and Olaf Westermann, October 2000.

08 *CAPRi Technical Workshop on Watershed Management Institutions: A Summary Paper*, by Anna Knox and Subodh Gupta, October 2000.

09 *The Role of Tenure in the Management of Trees at the Community Level: Theoretical and Empirical Analyses from Uganda and Malawi*, by Frank Place and Keijiro Otsuka November 2000.

10 *Collective Action and the Intensification of Cattle-Feeding Techniques a Village Case Study in Kenya's Coast Province*, by Kimberly Swallow, November 2000.

11 *Collective Action, Property Rights, and Devolution of Natural Resource Management: Exchange of Knowledge and Implications for Policy*, by Anna Knox and Ruth Meinzen-Dick, January 2001.

12 *Land Dispute Resolution in Mozambique: Evidence and Institutions of Agroforestry Technology Adoption*, by John Unruh, January 2001.

13 *Between Market Failure, Policy Failure, and "Community Failure": Property Rights, Crop-Livestock Conflicts and the Adoption of Sustainable Land Use Practices in the Dry Area of Sri Lanka*, by Regina Birner and Hasantha Gunaweera.