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THE IMPACT OF CHANGES IN COMMON PROPERTY RESOURCE MANAGEMENT ON INTRAHOUSEHOLD ALLOCATION

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ABSTRACT

In developing countries, common property resources (CPRs) can be an important source of income for certain individuals within households. This paper demonstrates that if a change in the management of CPRs imposes costs on these individuals, or causes a decline in the prices or productivities associated with goods produced from the CPRs, the intrahousehold allocation of resources may alter in a manner detrimental to those individuals. The paper also shows that the assumption of a unitary household model causes the detrimental effects of certain CPR policy interventions to be overlooked.

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1. INTRODUCTION

In the developing world, the sustainability of current levels of exploitation of common property resources (CPRs) has become an issue of increasing concern. One response to this situation has been changes in ownership or access rights to these resources. The distributional consequences of such policy responses, especially their impact on the well-being of the poor, is now receiving increasing attention (Jodha 1990; Dasgupta 1993). Such changes may have consequences for distribution within the household as well. Although a series of case studies have begun to address this issue, the literature on CPRs and intrahousehold resource allocation has paid relatively little attention to it.

Examination of distributional issues within the household can follow one of two approaches. One, termed the "unitary" model, assumes that the household maximizes a single welfare function. All resources within the household, including income, are assumed to be pooled. If we are prepared to accept that households behave "as if" they are one, the unitary model can provide explanations for a variety of observations of intrahousehold allocative inequality. For example, Pitt, Rosenzweig, and Hassan (1990), and Rosenzweig (1986) argue that the productivity of household members is a function of the resources that they receive and some exogenous endowment. They show that since the welfare-maximizing household allocates resources so as to equate the marginal productivities of its constituents, differences in members' endowments may lead to inequality in resource allocation. Pitt, Rosenzweig, and Hassan (1990) also note that such effects may be offset by a household preference for equality.

The second approach, described by Alderman et al. (1995) as “collective models," explicitly addresses the question of how individual preferences lead to collective choice. These models of household behavior draw on noncooperative game theory (Lundberg and Pollak 1993), cooperative game theory (McElroy 1990; McElroy and Horney 1981) and the concept of a "sharing rule" (Browning et al. 1994). They seek to redress three perceived weaknesses of the unitary approach: that its theoretical foundations—particularly the rationale underlying the aggregation of individual preferences—are based on overly strong assumptions; that a number of empirical studies have called into question the income pooling hypothesis; and that it neglects a number of important policy handles that could alter distribution within the household. Alderman et al. (1995, 15) argue that "under many circumstances, acceptance of a unitary model of the household, when it is inappropriate, has more serious consequences for policy than does rejecting a unitary model when it is appropriate."

Accordingly, this paper addresses two questions: (1) What are the effects of changes in the management of CPRs on intrahousehold resource allocation? (2) Are these theoretical effects sensitive to model (unitary versus collective) selection? The paper begins by briefly reviewing the importance of CPRs for both the rural poor and for women. Specific examples of changes in CPR access from communal forests in India are examined as a means of motivating the models presented in the third section of the paper. Here, the effects of a change in CPR management on a stylized household are examined in a unitary and a collective framework. The different results of these models are emphasized in the final section, where conclusions are drawn.

2. COMMON PROPERTY RESOURCES AND INTRAHOUSEHOLD INEQUALITY

A variety of natural resources are held as common property in the developing world, including community grazing lands, forests, village ponds, streams, and rivers. As Dasgupta (1993, 286) points out, these resources have often been common property historically because they represent basic needs that are contained geographically. He writes, "Exclusive private territoriality over these resources would leave non-owners at the mercy of the owners at the 'bargaining table', most especially in societies where markets are thin." As well as providing for subsistence, CPRs are also an important source of income and may represent complements to private property resources in production.

In a study of villages in dry regions of India, Jodha (1990, 66) finds that "The rural poor obtain the bulk of their fuel supplies and fodder from CPRs. CPR products collection is an important source of employment and income, especially during the periods when other opportunities are almost nonexistent." He notes that in the region surveyed, CPRs have declined in both area and productivity, with significant increases in the number of people per unit area of CPR. Much of this decline is due to policies of privatization. The privatization in this region led to interhousehold inequality because the poor received less of the CPR land per household than the better-off. In some areas of the world, privatization has involved the commercialization of CPRs (examples are given in Chambers, Saxena, and Shah 1989). The goal of such policy is usually to increase the productivity of the resource. Often this involves the creation of a monopoly in the collection or marketing of CPR products. Sometimes new production methods are not compatible with traditional uses of the resource; for example, commercial forestry may prevent the gathering of other forest products. New management structures may exclude certain groups from CPR access.

Clearly, changes in the ownership and management of CPRs can increase interhousehold inequality. To examine the effects at the intrahousehold level, we must consider the use of CPRs made by different household members, and the ways in which their access to these resources is altered. Many authors have noted that the collection of a number of CPR products is a task primarily undertaken by women and sometimes children. Dasgupta (1993, 291-295) suggests that the gathering of resources such as fuelwood and water, nuts and berries, medicinal herbs, resin and gum is the responsibility of these household members. Hart (1980, 200) finds that the gathering of fuel and vegetables is a task of women and children in a Javanese village, while gathering from another CPR in the form of fishing is a task of men. Tinker (1976, 25) notes that in many subsistence economies, women traditionally engage in gathering, processing, and preserving foods from common property. Chambers, Saxena, and Shah (1989, 144) emphasize the importance to women of the gathering of "minor forest products" (MFPs) in five states of India. These products include "fodder and grasses; raw materials like bamboo, canes and bhabbar grass for artisan-based activities of the poor; leaves, gums, waxes, dyes and resins; and many forms of food, including nuts, wild fruits, honey, and game." The products are important for both subsistence consumption and as a source of cash income. Chambers, Saxena, and Shah cite a survey of five Indian villages where the contribution of women to household cash income was higher in villages close to forests than in commercialized villages. They suggest that "such gathering by women can improve their status in the family."

From these examples, one would suspect that resource depletion or changes in ownership and management of communal forests may have adverse effects on women. Chambers, Saxena, and Shah (1989, 146) cite a number of such cases. Resource depletion, in the form of deforestation, has greatly increased women's workloads in some parts of India. In one survey in the state of Orissa, the average time spent by women in collecting forest products more than quadrupled over the two decades up to 1986. This increase can be traced to the cost of additional traveling time imposed by the receding forest line, and to the fall in the productivity of gathering activities. The effects of changes of ownership of forests are highlighted in a study of two villages in the Indian state of Madhya Pradesh (Chambers, Saxena, and Shah 1989, 71). The collection of *sal* seeds from trees in local forests was predominantly undertaken by women. In the 1970s, these seeds became a commercial source of oil and their collection and marketing was nationalized by the state government. As a result, the women were only able to sell the seeds to government-appointed agents, at very low monopsony prices. In another survey in the same state (pp. 149-151), tribal women complained that they had to travel a long way to the marketing board's office, and then often found it closed. Their only alternative was to sell the seeds privately, at an even lower price, due to the illegal nature of the transaction. The nationalization of trade in *tendu* leaves in the states of Madhya Pradesh and Orissa also resulted in very low incomes to gatherers. In one area, the nationalization of forests for the *tendu* leaf trade also led to restrictions on the collection of other MFPs, in particular, *mahua* flowers and seeds, which represented the local people's major source of income. Finally, a survey by Ninan, quoted in Chambers, Saxena, and Shah (1989, 146) finds that in South Bihar, changes in the use of communal forests have imposed costs on women firewood pickers. These costs take the form of both traveling time and additional expenses in bribing forest guards and railway staff. Commenting on these studies, Chambers, Saxena, and Shah (1989, 164) write that in the context of tenure changes of forestlands in India, "Transition in land rights from communal to private ownership has affected women adversely. So long as land was commonly owned, women had a voice in its management, but with private owning of land, their control has got diluted." Similarly, referring to Africa, Benería (1979) argues that "The strengthening of private property under colonial regimes and the tendency for communal land-tenure rights to disappear have often dispossessed women and reduced their control over productive resources by making men the new owners of land."

Certainly in the cases of communal forests outlined above, changes in access to these CPRs have had adverse effects on women. These are manifest in a variety of ways. Most significant would seem to be the reductions of prices paid for MFPs due to the introduction of monopsony marketing boards and the imposition of additional costs in the form of both travel (to the resource or a marketing board) and charges for the use of forests (for example, bribing a guard), and reductions in the productivity of gathering activities due to changes in forest usage. As CPR-based production represents an important part of women's contribution to household income, and thus to their status within the family, changes in CPR access imply that women may be disadvantaged not only at the "bargaining table" of the resource-owners but also at the "bargaining table" that may exist within the household. Thus, our next step is to formulate household models that incorporate the effects of changes in CPR management.

3. MODELING THE EFFECTS OF CHANGES IN CPR ACCESS ON INTRAHOUSEHOLD DISTRIBUTION

Based on the case study material presented in the previous section, the impact of two changes in CPR access are modeled here. The first is a fall in the price of a forest good, p_f. The second is the imposition of a fixed-cost, z, for use of the forest. These effects are examined in, first, a unitary model, and then in a cooperative collective model.

A third effect in the form of a decline in the productivity of gathering the forest good is more briefly examined. Such declines can occur because of deforestation or a change in the principal use of the forest (for example, commercial forestry may make the collection of MFPs more difficult). The framework adopted in the unitary model is similar to that of Rosenzweig (1986). The collective model synthesizes Rosenzweig's (1986) framework with the cooperative Nash bargaining models of McElroy and Horney (1981) and McElroy (1990).

Both models are based on a stylized household comprised of two agents ($I = 1, 2$), who may be viewed as a man and a woman, respectively. All household income is used to purchase a quantity of a food good, X, with a numeraire price. This good is divided between the two agents in amounts x_1 and x_2, such that $x_1 + x_2 = X$. Each agent has an endowment of time, T_i, which they divide between a number of hours of labor, L_i, and a number of hours of leisure, l_i, such that they each face a time constraint $L_i + l_i = T_i$. The amount of food received by each agent, x_i, and the amount of time that they devote to labor, L_i, determine their individual health, H_i, via specific health production functions of the form $H_i = h_i(x_i,L_i)$. Returns of health to food are positive but diminishing and returns of health to labor time are negative, thus $\partial H_i/\partial x_i > 0$, $\partial^2 H_i/\partial x_i^2 < 0$, and $\partial H_i/\partial L_i < 0$.

Agent 1 devotes all of his or her labor time to the production of a crop, C, all of which is sold at a price, p_c. Similarly, agent 2 devotes all of his or her labor time to the production of F, a "forest good" using a local communal forest. All of the forest good produced is sold at a price, p_f. The level of output produced by each agent is determined by production technologies that make output a function of the agents' health and labor time. Production returns to both health and labor time are assumed to be positive and diminishing. Thus, for agent 1,

$$C = c(H_1, L_1),$$

where

$$\partial C/\partial H_1 > 0, \partial^2 C/\partial H_1^2 < 0$$
$$\partial C/\partial L_1 > 0, \partial^2 C/\partial L_1^2 < 0,$$

and for agent 2,

$$F = f(H_2, L_2),$$

where

$$\partial F/\partial H_2 > 0, \partial^2 F/\partial H_2^2 < 0$$
$$\partial F/\partial L_2 > 0, \partial^2 F/\partial L_2^2 < 0.$$

Both agents are assumed to be maximizing utility, but they do not exhibit altruism regarding the well-being of the other household member in their preferences (incorporating altruism into this framework is discussed in the conclusion). Additional assumptions are model-specific.

UNITARY MODEL

We assume that our two-person household allocates food and time so as to maximize the following welfare function, $U = u(x_{\cap}, x_{\|}, H_{\cap}, H_{\|}, l_{\cap}, l_{\|})$. This exhibits positive and diminishing returns to agents' food, health, and leisure time. Thus,

$$\partial U/\partial x_i > 0, \partial^2 U/\partial x_i^2 < 0, \partial U/\partial H_i > 0, \partial^2 U/\partial H_i^2 < 0, \partial U/\partial l_i > 0, \text{and } \partial^2 U/\partial l_i^2 < 0 .$$

No weight is given to equality of resource allocation within the household. The household's joint time and budget constraint is written as

$$p_c \cdot C + p_f \cdot F + (T_1 - L_1) + (T_2 - L_2) = x_1 + x_2 + l_1 + l_2 . \qquad \textbf{(1)}$$

Substituting for the technology and health constraints yields the full-income constraint:

$$p_c \cdot c[L_1, h_1(x_1, L_1)] + (T_1 - L_1) + p_f \cdot f[L_2, h_2(x_2, L_2)] + (T_2 - L_2) = x_1 + x_2 + l_1 + l_2 . \qquad \textbf{(2)}$$

Accordingly, we can construct the following Lagrangean:

$$\begin{aligned} L &= u(x_1, x_2, H_1, H_2, l_1, l_2) \\ &\quad + \lambda\left\{p_c \cdot c\left[L_1, h_1(x_1, L_1)\right] + (T_1 - L_1) + p_f \cdot f\left[L_2, h_2(x_2, L_2)\right] + (T_2 - L_2) - x_1 - x_2 - l_1 - l_2\right\}, \end{aligned} \qquad \textbf{(3)}$$

which yields the following first-order conditions:

$$\partial L/\partial x_1 = \partial u/\partial x_1 + \partial u/\partial H_1 \cdot \partial H_1/\partial x_1 + \lambda\,[\,p_c \cdot \partial C/\partial H_1 \cdot \partial H_1/\partial x_1 - 1\,] = 0 , \qquad \textbf{(4)}$$

$$\partial L/\partial x_2 = \partial u/\partial x_2 + \partial u/\partial H_2 \cdot \partial H_2/\partial x_2 + \lambda\,[p_f \cdot \partial F/\partial H_2 \cdot \partial H_2/\partial x_2 - 1] = 0\ . \qquad \textbf{(5)}$$

The first two terms represent the partial differentiation of the household utility function with respect to the agents' allocations of food. They take the form shown here because food allocations enter the utility functions *twice*: once "directly" (giving rise to $\partial u/\partial x_i$) and once through the health production function (giving rise to $\partial u/\partial H_i \cdot \partial H_i/\partial x_i$, via the chain rule). We can rearrange these to yield

$$\lambda^{-1} \cdot \partial u/\partial x_1 + \partial H_1/\partial x_1 \cdot [\lambda^{-1} \cdot \partial u/\partial H_1 + p_c \cdot \partial C/\partial H_1]$$
$$= \lambda^{-1} \cdot \partial u/\partial x_2 + \partial H_2/\partial x_2 \cdot [\lambda^{-1} \cdot \partial u/\partial H_2 + p_f \cdot \partial F/\partial H_2] = 1\ . \qquad \textbf{(6)}$$

Equation (6) states that the marginal returns to resources allocated to each agent, in terms of household utility and the agents' earnings, are set equal, and also equal to the (numeraire) price of the food good. The marginal returns in terms of utility are given by the expressions of the form $\lambda^{-\cap} \cdot (\partial u/\partial x_i + \partial u/\partial H_i \cdot \partial H_i/\partial x_i)$, and the returns in terms of earnings are given by the expressions $(p_c \cdot \partial C/\partial H_\cap \cdot \partial H_\cap/\partial x_\cap)$ and $(p_f \cdot \partial F/\partial H_\| \cdot \partial H_\|/\partial x_\|)$. The left-hand side and central expressions of equation (6) represent the sum of these returns to x_1 and x_2, respectively. The household adjusts the allocation of resources between the two agents to ensure that the equalities in this constraint hold. The assumptions of diminishing returns to food in both the utility function and the health production functions mean that a transfer of resources from agent 1 to agent 2 (a decrease in x_1 and an increase in x_2) will cause the terms $\partial u/\partial x_{\cap}$ and $\partial H_{\cap}/\partial x_{\cap}$ to rise, while the terms $\partial u/\partial x_{\|}$ and $\partial H_{\|}/\partial x_{\|}$ fall.

Effect of a Fall in p_f

A reduction in the price of the forest good, p_f, reduces the central expression of equation (6). The household will restore equilibrium by transferring food from agent 2 to agent 1—x_2 falls and x_1 rises. The terms $\partial u/\partial x_1$ and $\partial H_1/\partial x_1$ decrease whereas $\partial u/\partial x_2$ and $\partial H_2/\partial x_2$ increase. Thus, the price change is detrimental to agent 2's allocation of resources. The effect on intrahousehold inequality will depend upon the relative magnitudes of x_1 and x_2 initially, and on the magnitude of the fall in p_f. If agent 1 starts off with the larger allocation, $x_1 > x_2$, intrahousehold inequality will increase as x_1 rises and x_2 falls.[1]

Effect of Reduction in Productivity of Forest Good Collection

A change in the management of a communal forest may cause a decline in productivity for those whose work centers on the resource. If it is assumed that the productivity change is multiplicative, then it can be introduced into the model by substituting the expression θF for F, where $0 < \theta < 1$. It is clear that the effect of a

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[1] The magnitude of the price fall will determine the magnitude of the resource transfer. The initial allocations of the two agents will determine whether a resource shift will increase or decrease intrahousehold inequality. Thus, even if $x_1 < x_2$ initially, a fall in p_f may cause a resource transfer of sufficient magnitude to make $x_1 > x_2$ to such an extent that the level of inequality rises—although the direction of the allocative inequality will of course have changed. Full comparative statics are available on request.

multiplicative decrease in forest good productivity is thus mathematically identical to a fall in the price p_f.

Effect of the Imposition of a Fixed Cost for Use of the Forest

A fixed cost, z, changes the constraint in equation (2) as follows:

$$p_c \cdot c[L_1, h_1(x_1, L_1)] + (T_1 - L_1) + p_f \cdot f[L_2, h_2(x_2, L_2)] + (T_2 - L_2) - z = x_1 + x_2 + l_1 + l_2 \ . \qquad (2')$$

The Lagrangean function in equation (3) is similarly altered. However, equations (4) and (5), and thus the marginality condition in equation (6), are *unchanged*. The fixed cost has no effect on the intrahousehold allocation of resources in this unitary model.

COOPERATIVE COLLECTIVE MODEL

Both agents are assumed to allocate food and set their levels of labor time according to a cooperative bargaining process. The resolution of this process is represented by a Nash-bargaining equilibrium rule. That is, individual utility-maximizing agents choose to maximize a single Nash utility gain product function of the following form:

$$\underset{x_1, x_2, l_1, l_2, H_1, H_2}{Max} \quad N = \max[U_1 - V_1] \cdot [U_2 - V_2] \ . \qquad \mathbf{(7)}$$

U_1 and U_2 represent the agents' individual utility functions under cooperation, and take the following forms:

$$U_1 = u_1(x_1, H_1, l_1) \tag{8}$$

and

$$U_2 = u_2(x_2, H_2, l_2), \tag{9}$$

where H_1 and H_2 represent health production functions, as in the unitary model. These production functions exhibit positive and diminishing returns to the agents' food, health, and leisure time. The absence of altruism is manifest in the "egoistic" nature of the utility function. The utility function of each agent does not feature the food, health, and leisure time of the partner.

V_1 and V_2 represent the agents' "fallback positions." These are the levels of utility that the agents would have under noncooperation, that is, if the household broke up and the agents acted entirely independently. These fallback positions are the indirect utility functions derived from the maximization of the agents' utility functions, subject to their individual full-income constraints under noncooperation. V_1 and V_2 will therefore be functions of the exogenous variables that feature in these maximizations.[2] Thus, for agent 1,

[2] The subscript n denotes the level of a variable under noncooperation. The use of different time endowments under noncooperation, T_{in}, allows for possible gains (or losses) to agents from forming a household, an example being the sharing of household tasks such as cooking or maintenance.

$$\text{Max. } U_{1n} = u_{1n}(x_{1n}, H_{1n}, l_{1n}),$$

subject to

$$p_c \cdot c[h_1(x_{1n}, L_{1n})] \quad = \quad x_{1n} \tag{10}$$

$$=> V_1 = v_1(p_c, T_{1n}),$$

and for agent 2,

$$\text{Max. } U_{2n} = u_{2n}(x_{2n}, H_{2n}, l_{2n}),$$

subject to

$$p_f \cdot f[h_2(x_{2n}, L_{2n})] \quad = \quad x_{2n} \tag{11}$$

$$=> V_2 = v_2(p_f, T_{2n}).$$

The Nash utility gain product function in equation (7) is maximized, subject to the joint full-income constraint, which is the same as that in the unitary model in equation (2). Multiplying out equation (7) and formulating a Lagrangean function gives

$$\begin{aligned} L &= U_1U_2 - U_1V_2 - U_2V_1 + V_1V_2 \\ &+ \lambda\left\{p_c \cdot c\left[L_1, h_1(x_1, L_1)\right] + (T_1 - L_1) + p_f \cdot f\left[L_2, h_2(x_2, L_2)\right] + (T_2 - L_2) - x_1 - x_2 - l_1 - l_2\right\}. \end{aligned} \tag{12}$$

Optimization yields the following first-order conditions for the intrahousehold allocation of food (x_1,x_2). These can be written as

$$\partial L/\partial x_1 = [U_2 - V_2] \cdot \partial U_1/\partial x_1 + \lambda\,[p_c \cdot \partial C/\partial H_1 \cdot \partial H_1/\partial x_1 - 1] = 0 \tag{13}$$

and

$$\partial L/\partial x_2 = [U_1 - V_1] \cdot \partial U_2/\partial x_2 + \lambda\,[p_f \cdot \partial F/\partial H_2 \cdot \partial H_2/\partial x_2 - 1] = 0\ . \quad \textbf{(14)}$$

Substituting in for $\partial U_i/\partial x_i = \partial u_i/\partial x_i + \partial u_i/\partial H_i \cdot \partial H_i/\partial x_i$ and rearranging equations (13) and (14) yields

$$\lambda^{-1} \cdot [U_2 - V_2] \cdot [\partial u_1/\partial x_1] + \partial H_1/\partial x_1 \cdot [\lambda^{-1} \cdot (U_2 - V_2) \cdot (\partial u_1/\partial H_1) + p_c \cdot \partial C/\partial H_1] = 1 \quad \textbf{(15)}$$

and

$$\lambda^{-1} \cdot [U_1 - V_1] \cdot [\partial u_2/\partial x_2] + \partial H_2/\partial x_2 \cdot [\lambda^{-1} \cdot (U_1 - V_1) \cdot (\partial u_2/\partial H_2) + p_f \cdot \partial F/\partial H_2] = 1\ . \quad \textbf{(16)}$$

Thus the Nash utility gain product-maximizing household will set

$$\begin{aligned} &\lambda^{-1} \cdot [U_2 - V_2] \cdot [\partial u_1/\partial x_1] + \partial H_1/\partial x_1 \cdot [\lambda^{-1} \cdot (U_2 - V_2) \cdot (\partial u_1/\partial H_1) + p_c \cdot \partial C/\partial H_1] = \\ &\lambda^{-1} \cdot [U_1 - V_1] \cdot [\partial u_2/\partial x_2] + \partial H_2/\partial x_2 \cdot [\lambda^{-1} \cdot (U_1 - V_1) \cdot (\partial u_2/\partial H_2) + p_f \cdot \partial F/\partial H_2] = 1\ . \end{aligned} \quad \textbf{(17)}$$

This marginality condition in equation (17) is analogous to the condition of equation (6) in the unitary model. It indicates that agents will set the product of their marginal utility returns to food and the utility gain of their partner,

$$\lambda^{-1} \cdot [U_j - V_j] \cdot [(\partial u_i/\partial x_i) + (\partial u_i/\partial H_i) \cdot (\partial H_i/\partial x_i)]\,,$$

plus their marginal returns to earnings, $p_c \cdot \partial C/\partial H_1 \cdot \partial H_1/\partial x_1$ and $p_f \cdot \partial C/\partial H_2 \cdot \partial H_2/\partial x_2$, equal to the (numeraire) price of the food good.

As in the unitary model, the household can ensure that the equalities in the condition of equation (17) hold by transferring resources between the two agents. The assumptions of diminishing returns to food in the utility functions and health production functions cause the terms $\partial u_i/\partial x_i$ and $\partial H_i/\partial x_i$ to fall in response to a rise in x_i. There is a further effect, acting in the same direction, due to changes in the utility functions U_j. By way of example, a shift of resources from agent 2 to agent 1 (increasing x_1 and decreasing x_2) will cause $\partial u_1/\partial x_1$ and $\partial H_1/\partial x_1$ to fall and $\partial u_2/\partial x_2$ and $\partial H_2/\partial x_2$ to rise. Since each agent's utility is a positive function of his or her allocation of food, it can also be seen that U_1 will rise and U_2 will fall. The presence of U_2 on the left-hand side and U_1 in the central term will thus compound the effects of the marginal changes.

Effect of a Fall in p_f

The explicit appearance of p_f in the central term of the marginality condition of equation (17) means that a fall in this price will reduce the value of this term. From equation (11) we know that the fallback position of agent 2 is a positive function of p_f, $V_2 = v_2(p_f, T_{2n})$. Since V_2 enters negatively into the left-hand side of equation (17), a decrease in p_f will also generate an increase in the value of the left-hand side term. To restore equality in the condition after this fall in the central term and rise in the left-hand side term, the household will transfer resources from agent 2 to agent 1. As explained above, this equalization operates through both the marginal terms, $\partial u_i/\partial x_i$ and $\partial H_i/\partial x_i$, and the utility functions, U_j.

A fall in p_f clearly will be detrimental to the welfare of agent 2. As in the unitary model, the effect on intrahousehold inequality will depend upon the initial allocation of food and the magnitude of the price change. However, if initially $x_1 > x_2$, then the fall in the price of the forest good will increase inequality in the household allocation of food. Further, it can be shown that a multiplicative change in productivity, such that θF is substituted for F throughout, will be mathematically identical to the analysis of a fall in p_f described here.

Effect of the Imposition of a Fixed Cost for Use of the Forest

A fixed cost, z, for use of the forest CPR may be seen to enter this collective model in two ways. First, it enters into the household budget constraint in exactly the same way as in the unitary model, that is,

$$p_c \cdot c[L_1, h_1(x_1, L_1)] + (T_1 - L_1) + \{p_f \cdot f[L_2, h_2(x_2, L_2)] + (T_2 - L_2) - z\} = x_1 + x_2 + l_1 + l_2 . \qquad (2')$$

Since the marginality condition of equation (17) is derived from the partial derivatives of the Lagrangean equation (12) with respect to x_1 and x_2, it is clear that the term z from the household budget constraint will not feature in the condition—as is also the case in the unitary model. However, the second way in which z enters the collective model *does* alter the marginality condition. In addition to altering the cooperative household's budget constraint, the fixed cost also alters the budget constraint faced by agent 2 under noncooperation. This will change the form of agent 2's fallback position of equation (11) as follows:

$$\text{Max. } U_{2n} = u_{2n}(x_{2n}, H_{2n}, l_{2n}),$$

subject to

$$\begin{aligned} p_f \cdot f[h_2(x_{2n}, L_{2n})] &= x_{2n} \\ => V_2 = v_2(p_f&, T_{2n}, z) \end{aligned} \tag{11'}$$

where

$$\partial V_2 / \partial z < 0 .$$

To understand why the exogenous variable *z* enters agent 2's noncooperative indirect utility function, it is easiest to think of the fixed cost as representing a quantity of negative nonwage income. A change in an agent's nonwage income alters the maximum level of utility available outside the household. Since the fallback position V_2 features in the marginality condition of equation (17), the imposition of the cost, *z*, alters this condition as follows[3]:

$$\begin{gathered} \lambda^{-1} \cdot [u_2(x_2, H_2, l_2) - v_2(p_f, T_{2n}, z)] \cdot [\partial u_1 / \partial x_1] + \partial H_1 / \partial x_1 \cdot \{\lambda^{-1} \cdot [u_2(x_2, H_2, l_2) - v_2(p_f, T_{2n}, z)] \\ \cdot (\partial u_1 / \partial H_1) + p_c \cdot \partial C / \partial H_1\} = \\ \lambda^{-1} \cdot [u_1(x_1, H_1, l_1) - v_1(p_c, T_{1n})] \cdot [\partial u_2 / \partial x_2] + \partial H_2 / \partial x_2 \cdot \{\lambda^{-1} \cdot [u_1(x_1, H_1, l_1) - v_1(p_c, T_{1n})] \\ \cdot (\partial u_2 / \partial H_2) + p_f \cdot \partial F / \partial H_2\} = 1 . \end{gathered} \tag{17'}$$

[3] The importance of nonwage income in an agent's fallback position to the intrahousehold allocation of resources in collective models is emphasized in McElroy (1990). McElroy uses this feature to argue that the unitary model is a special case of the Nash model where the coefficients on this nonwage income, and on the "extra-household environmental parameters," are set to zero.

An increase in z causes the left-hand side of equation (17') to rise. This is because V_2 is a negative function of z and features negatively in the left-hand side expressions. The fixed cost acts on the condition of equation (17') solely through the fallback positions. To restore equality to the condition, the household will once again transfer resources from agent 2 to agent 1. The equalization operates in exactly the same way as before: through the marginal terms, $\partial u_i/\partial x_i$ and $\partial H_i/\partial x_i$, and the utility functions, U_j. The effect on intrahousehold inequality is dependent on the initial allocation of resources, as well as on the magnitude of the fixed cost. The reallocation will be detrimental to agent 2, and inequality will increase if we assume again that agent 1 initially has the greater share of food.

4. CONCLUSIONS

In developing countries, common property resources can be an important source of income for certain groups within communities and certain individuals within households. This paper has demonstrated that if CPR-based production is specific to certain household members or constituents and if a change in the management of that CPR imposes costs on them, or causes a decline in the prices or productivities associated with goods produced from the CPR, the intrahousehold allocation of resources may alter in a manner detrimental to individuals using the CPR. This suggests that policymakers concerned with welfare should consider the precise identity of the users of a CPR both within the community and within the household before advocating any change in its ownership or use.

A second objective of the paper has been to determine whether these theoretical effects are sensitive to model selection. In the unitary model, a fall in the price of the forest good, p_f, or a multiplicative decline in productivity, will alter the intrahousehold allocation of resources. The introduction of a fixed cost for use of the forest will not, however, have such an effect in this model. By contrast, intrahousehold resource allocation in the collective model will be affected by *both* a change in the price, p_f, (or a multiplicative productivity change) and by the introduction of a fixed cost. Thus, acceptance of the unitary model causes the detrimental effect on intrahousehold inequality of the fixed cost, z, to be overlooked. This supports the Alderman et al. (1995) contention that acceptance of the unitary model when it is false may have serious consequences for policy.

Three simplifying assumptions were made in the formulation of these models. First, we assumed the presence of two agents within the household. However, these may be taken to represent different types of household constituents. The models may also be expanded to include more than two constituents. Second, both models posit complete specialization in different tasks by the agents. This assumption can be relaxed without harming the key results of the models. If the benefits of CPR-based production decline, then agents will have an incentive to substitute other tasks for it at the margin. However, if CPR-based production continues to dominate the activities of one household constituent, changes in the management of that resource are likely to be detrimental to that constituent's allocation of household resources. The degree of specialization in production may be seen to depend on the constituents' relative productive advantages in different tasks, and on their preferences for the different goods. Finally, the models rather unrealistically assume that agents are not altruistic. Both models can be reformulated to incorporate a degree of altruism, but allocative shifts detrimental to one constituent may still be found if the constituents value their own well-being more highly than that of their partners.

There is scope for additional development and applications of these models. For example, the model used here could be applied more generally to cases where men and women specialize in the production of different products, some of which are characterized by the presence of both fixed and variable costs. But perhaps more important, there is space in the study of CPR management and intrahousehold resource allocation for further empirical investigation. As this paper has shown, policy changes in CPR management have the potential to put certain household members at a disadvantage.

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