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CHANGES IN INTRAHOUSEHOLD LABOR ALLOCATION TO ENVIRONMENTAL GOODS COLLECTION: A CASE STUDY FROM RURAL NEPAL, 1982 AND 1997

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ABSTRACT

This study explores the impact of changes in environmental conditions on intrahousehold labor allocation to the collection of environmental goods such as fuelwood and leaf fodder for a sample of rural Nepali households. Using household-level panel data collected in 1982 and 1997, the study finds that household collection time significantly increases with measures of environmental resource scarcity, and that the increase appears to come almost equally from men and women. Additionally, the results of this study indicate that household collection burdens are significantly lower in 1997 than in 1982, and that women have seen the largest decrease in their time spent collecting. The picture is not an entirely rosy one, however, as consumption of environmental goods is also significantly lower in 1997 compared to 1982. The results taken together indicate that one should not hastily attribute decreases in collection labor burdens to successful forest rehabilitation in areas managed by forest user groups. In this case it appears that lower collection times are principally due to reduced consumption and increased collection from private land.

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1. INTRODUCTION

Households in rural areas of developing countries often rely very heavily on the surrounding environment for goods such as water, wood for fuel, and fodder for livestock. Frequently these and other environmental products are collected from local common forestland, a task that in many areas is predominantly carried out by women. Given the increasing pressure on biomass resources in many developing areas and the common gender division of collection labor, there is concern that women in particular will bear the burden of increases in resource scarcity by having to spend more labor time and effort to collect forest products.[1]

This concern would appear to be a particularly valid one in the hill region of rural Nepal where women may spend several hours per day collecting fuelwood, water, and cut grass or leaf fodder for livestock, and growing populations are exerting more pressure on commonly owned forest resources. Studies using Nepal data from 1982/1983 indicate that households respond to increasing costliness of environmental goods, at least in the short run, by consuming less of them and devoting more female labor to their collection (Cooke 1998a; Kumar and Hotchkiss 1988). An important line of questioning is whether this is still the case after enough time has passed for households to undertake other responses to the costliness, such as planting trees on their property. A related question is

[1] See, e.g., Cecelski (1987). See, also, Agarwal (1986), Dankelman and Davidson (1988), and Dasgupta (1993) for discussions of women and environmental good collection.

whether women's labor burdens will be lightened more than those of men and youth if local common environmental resources are improved.

In order to address these questions this study examines changes in intrahousehold labor allocation to the collection of environmental goods over time and in response to changes in local environmental conditions for a sample of Nepali hill households. An empirical analysis of the changes in labor allocation patterns and how these relate to changing environmental conditions will contribute to a greater understanding of how policies that influence the environmental resource base may influence the welfare of different groups within households. This is of particular interest in Nepal, where much policy emphasis currently is being placed on local forest resource management for improvement of local common forest resources.

This study has the advantage of resurveying the same households after a 14-year period. This allows for an assessment of the effects of environmental changes over time as opposed to relying principally on cross-sectional analysis as was the case in the earlier Nepal studies. Common forest resources in the survey sites have changed over this period, some for the better, some for the worse, and many of the sites have instituted community forest management in more recent years. The data used also allow seasonality to be taken into account. Household productive activity varies dramatically in Nepal between the monsoon and dry seasons, as does the availability and ease of collection of various environmental goods. Inferences drawn for one season may not hold for the other. Both seasons should be included to make an accurate assessment of what is driving any observed changes in collection labor allocation.

This paper is organized as follows. Section 2 provides background information on the data, households, and local conditions related to environmental goods collection and consumption in the Nepali hills. Section 3 presents the analytical framework and discusses estimation issues. The empirical results are discussed in Section 4, and conclusions based on the findings of the research are presented in the final section.

2. THE DATA AND BACKGROUND

THE DATA

The data for this study come from several different surveys on the same sample of households in the middle hills of Nepal. The households were initially sampled in 1982/1983 for the Nepal Energy and Nutrition Survey (NENS), and there are data for 118 households in the NENS data set.[2] Three different Village Development Committee areas (formerly called *panchayats*), one in each of three districts in Nepal's Western Development Region, were originally chosen for the survey. Two wards were then selected from each Village Development Committee (VDC) to obtain variation in ethnicity, altitude, market access, and environmental degradation. Approximately 20 households were randomly sampled from each ward.[3] The NENS data set contains observations from four survey rounds conducted over a one year period, allowing for an

[2]NENS 1982/1983 Agricultural Projects Services Center of Nepal, Food and Agriculture Organization of the United Nations, International Food Policy Research Institute.

[3]See Kumar and Hotchkiss (1988) for more information on the survey design and sampling strategy.

assessment of seasonal variation. The data are at the household level, with no individual-level data available. In 1996/1997 the NENS sample was resurveyed both by this author and by Winrock International-Nepal. This study uses data collected by both resurvey teams. Data from survey rounds covering the late dry season and the monsoon season in 1997 are used in this paper, and correspond to NENS data covering the same periods. Thus, the full panel of data has four rounds with observations from two dry seasons and two monsoon seasons.

Seventeen of the original 118 households included in the NENS data set had either migrated (10 households), died leaving no one able to respond (5 households), or simply were not found in any of the resurvey rounds (2 households). Twenty-seven additional households not classified by this study as NENS households were also surveyed in both the late dry season and the monsoon season of 1997. Generally these are households that are living in the home of a NENS family that migrated, or are a close neighbor (and often a relative) of the original NENS household. For most purposes in this paper, data from households defined strictly as original NENS households are used. In almost all cases this means that the households have the same household head, or have a new head that is the son or wife of the deceased NENS household head. For certain estimates that use information only collected in the 1997 surveys, the full sample of households is utilized.

HOUSEHOLD DESCRIPTION

The region of study ranges from roughly 500 to 1,500 meters and consists of steep hills and valley bottoms. All of the survey sites are rural, and they have varying degrees of access to roads and markets. One site has had a road built to it since 1982. Most survey wards have seen an increase in the number of households over the 14-year period between surveys, and in some cases this increase has been quite dramatic. One ward, which is furthest from a road and predominantly Gurung in ethnicity, is the exception to this general increase; the number of households appears to have remained relatively constant.

The households for this study are mostly small-scale agriculturalists producing primarily for home consumption. Maize, rice, wheat, and finger millet are the principal crops in the region. Agricultural activities are conducted all year long, although the summer monsoon season (roughly July–September) is by far the heaviest agricultural season.[4] Fifty percent of the NENS households are Brahmin, or high caste, and 16 percent are occupational, or low caste. Approximately 30 percent belong to Tibeto-Burman ethnic groups (Gurung and Magar). Household size has dropped slightly over the last 14 years for the NENS households, from approximately 6.5 residents to 5.9 residents. This decrease is largely attributable to fewer adult men (age 16-59) and fewer very young children (age 0-5) in the households. One cause of this change may be that children are growing up and leaving the household. In 1983 only 5 households had 2 or

[4] See Schroeder (1985) for a more detailed description of agricultural systems in rural Nepal.

less household residents, while 12 did in 1997. The average age of the household head in these small households increased from 38 in 1983 to 62 in 1997. In general, the NENS households are aging, although often at least one son will live with the household, bring in a wife, and produce the next young generation of household residents.

Almost all of the NENS households own farmland. Farmland may be divided into two types: lowland (*khet*), which can be irrigated and usually is found in valley bottoms, and upland (*pakho*), which generally consists of hillside terraces where irrigation is not possible. In the 1982/1983 survey all households owned at least some land, with average landholding of slightly less than 1.5 hectares. In the 1996/1997 survey, the NENS household average landholdings had dropped to 0.8 hectares and one household now has no land. This drop in the amount of land owned may be due to giving land to sons who are starting their own households. However, the average landholding of the non-NENS households sampled is even lower than that of the NENS households, at slightly less than 0.6 hectares, indicating that scarcity of farmland may be worsening as local populations increase. Perhaps not surprisingly, average landownership is the smallest in the sites with the largest growth in the number of households.

Most of the NENS households own some combination of goats, cattle, and water buffaloes. For purposes of this study, livestock ownership is computed in terms of livestock units calibrated in cattle equivalents.[5] Over the 14-year period since 1983,

[5]Livestock units are calculated according to the weights used by Kumar and Hotchkiss (1988). Male and female cattle equal one unit each, water buffaloes equal 1.5 units each, and goats and sheep equal .2 units each.

average livestock holdings dropped from 7.0 to 6.0 livestock units. There appears to be some switching in the type of livestock held. Fewer households own cows or bullocks and more households now report owning female water buffaloes. She-buffaloes are very productive animals in that they produce both milk and manure, which is an important source of fertilizer. Households often stall feed their livestock, a practice that has increased since 1982/1983. Typical livestock feeds are straw, leaf fodder and grass, and a cooked gruel of oilseed cake, straw, and water called *kundo*. Livestock may also be grazed, although there may be local restrictions on where grazing is allowed.

COLLECTION AND USE OF ENVIRONMENTAL GOODS

Hill households such as those in the NENS sample traditionally have relied quite extensively on local common forest areas for fuelwood, water, leaf fodder, and grass. Table 1 shows the average daily household consumption of these goods by season for 1982/1983 and for 1997. Averages are for households who report using the good only. Table 1 also gives the percentage of the sample surveyed in each round that uses the particular environmental good. Most energy consumption comes from fuelwood, which is used both to cook household meals and *kundo* for livestock. Households may also use crop residues such as maize stalks and cobs as fuel.[6] This is particularly true in the monsoon season after the maize harvest. Water is collected for household consumption and for *kundo* preparation. Leaf fodder and cut grass are important sources of livestock

[6]Amacher, Hyde, and Joshee (1993) find that crop residues are more important fuelwood substitutes for low income households in two other Nepal districts.

feed, and are seasonal in nature. They may also be considered inputs to agricultural production since livestock manure is the primary source of fertilizer in the region. Cut grass is the preferred livestock feed, but it is generally only available in the monsoon season. In the dry season households rely on leaf fodder. The figures in Table 1 indicate that average consumption of fuelwood, grass, and leaf fodder has declined since 1982/1983. While some of this may be attributable to lower livestock holdings and smaller household populations, the decline in consumption seems larger than these factors alone would cause.[7] It should also be noted that variation across the sample is rather large.

Collecting these four environmental goods can take up many hours of a household's time in a day. Table 2 gives the average daily time households spent on collection activities by season and year. Times are given in minutes. In similar fashion to Table 1, Table 2 presents averages for collecting households only and also reports the percentage of the sample that collects. Water, cut grass, and leaf fodder generally are collected on a daily basis. Fuelwood may be collected and stored as is discussed more in depth below. On average the total household time spent collecting is lower in 1997 than in 1982/1983 and dry season times are lower than monsoon season times. Most of the total collection hours households report for the dry season are spent collecting fuelwood and water. Most collection hours in the monsoon season are spent collecting grass. In

[7]For the 1996/1997 data, kilogram quantities were calculated using each household's estimate of kilograms per load. The weight of a load can vary substantially (e.g., from 5 to 50 kilograms for fuelwood) Actual weighing of loads for a subsample indicated that the range and variation evident in household estimates was not unusual. Unfortunately, it is not clear how load to kilogram conversions were calculated in the 1982/1983 data.

the 1997 monsoon season, for example, households averaged roughly 7 hours per day collecting, approximately 5 hours of which were spent collecting grass.

Seasonality appears to be a very important factor in assessing collection time allocation changes over the 14-year period considered. On average, less total collection time is spent in the monsoon season than was spent in 1982/1983, and more time is spent in the late dry season. The changes in these average figures appear to be a result of changes in the collection time for fuelwood and water. Households are now less likely to collect fuelwood in the monsoon season, and rely more on crop residues and fuelwood they have stored. In the dry season, more time is spent collecting wood than previously, in order to accumulate wood for storage. Water now appears to be more time consuming to collect in the dry season, despite the fact that most sites have installed some form of community water tap or taps since 1982/1983. The taps still may be far from some households, and in some sites they only work sporadically or only during the monsoon season.

As evidenced in Table 2, intrahousehold allocation of collection time among men, women, and children has changed since 1982/1983. While women still spend by far the largest amount of time collecting of these three household groups, the total amount of time they spend appears to have decreased as has their percentage of household collection time. This percentage has dropped from almost 80 percent of total collection time over both seasons in 1982/1983 to 65 percent in 1997. It also appears that, on average, men now account for more of the daily time spent collecting, either through more hours spent or by increased participation in collection activities. Men's average percentage of total collection time over both seasons has increased from 7 percent to 20 percent. Youth account for only a slightly higher percentage of total time in 1997 compared to 1982/1983.[8] Of note, fewer households report that youth collect in the 1997 late dry season, but the average collection time for those that do have youth collect is much larger. A similar pattern is found for households that report men collecting in the late dry season.

HOUSEHOLD BEHAVIORS AFFECTING ENVIRONMENTAL GOODS COLLECTION AND CONSUMPTION DECISIONS

Table 3 reports a summary of selected household actions that can affect environmental goods collection and consumption decisions. Obviously, the list is not exhaustive, but it does indicate that households are responding to environmental goods scarcity in a variety of ways. Quite a few households have planted trees on their property. Fifty-three percent of the NENS households asked indicated that they had planted trees during the last 15 years and 30 percent said that they had specifically planted them for leaf fodder. An even larger percentage, 82 percent, said that they had let trees grow up naturally. Households that collect fuelwood and fodder from their own land generally face lower per unit collection times for these products. However, trees may reduce the amount of productive agricultural land available for crops, and growing them is obviously only an option for landowning households.

[8] Distinctions between the time of boys and girls are not made in this paper since this breakdown is not available in the NENS data. In 1997, both boys and girls were found to collect, with girls, on average, spending more time collecting than boys.

As indicated in the previous section, households are now spending more time collecting fuelwood in the late dry season, and storing it for use during the monsoon. In 1982/1983 only 21 percent of the NENS households reported storing fuelwood, while 98 percent of them reported storing it in 1997. Storage allows households to spend much less time collecting wood for fuel in the busy agricultural monsoon season. A small number of households have bought fuelwood or fodder. This is not a very common practice, although it does occur. Sixteen NENS households say they have ever bought fuelwood, and 11 say they have ever bought fodder. Most of these households first bought either product within the last decade, and most only purchase occasionally. Four households have switched from using fuelwood as their cooking fuel to biogas. These households still consume some fuelwood, primarily to cook *kundo*. Most households use traditional stoves. Although improved smokeless stoves have been tested in some of the sites, they have not proven very popular.[9] Reasons for not switching to a smokeless stove include an increased risk of fire in thatched roofs and higher fuel consumption due to larger mouth openings.

NATIONAL AND COMMUNITY CHANGES

These household-level changes have occurred against a backdrop of national and ward-level changes. On May 12, 1991, Nepal officially changed its form of government to a constitutional monarchy. The *panchayat* system was abolished and local government

[9] Amacher, Hyde, and Joshee (1992) investigate the adoption of improved stoves in Nepal. See also Barnes et al. (1994).

officials are now elected. In 1993 the Forest Act was passed that recognized local forest user groups (FUGs) as institutions with property rights over community forests. Forest user groups manage local community forests; this can include selling forest products, restricting what is taken out of the forest, and exacting penalties on those who break the rules.

Although two of survey sites had some community forestry management in 1982/1983, all sites with a forest now have a formal forest user group. One ward has two forest user groups because there are distinctly separate forest areas used by two separate villages. One site no longer has a community forest due to changes in the ward boundary; the forest now belongs to a neighboring ward and neither ward has a forest user group. Forest user groups generally consist of a committee and member households. The number of committee members in the six forest user groups operating in the sample sites ranged from 4 to 11, and four user groups had at least one woman on the committee. The number of households belonging to the forest user groups ranges from 40 to over 180. In some places not all local households are group members, and there is anecdotal evidence that occupational (low) caste households may find it more difficult to join or gain equal access to resources. In the sample used here, however, almost all households in wards with forest user groups report that they are members. Of the four households that indicated they were not members, one was of an occupational caste and three were Brahmin.

What the local forest user groups do in practice and how effective they are varies between sites. In general, forest user group members meet to decide how much wood to cut down in the forest and where to cut it. In some groups member households receive a quota for fuelwood that they are allowed to collect whenever they choose. Individual households often are not allowed to cut trees or branches on their own, although some groups allow fodder collection that requires the cutting of branches. Most groups require permission before a tree can be cut for timber. All user groups report having a fine for infractions, but monitoring of forest product extraction and enforcement of any penalty varies from regularly monitored and enforced to no monitoring or enforcement. Only two of the six forest user groups report that they have actually imposed fines or have hired a watchman to enforce the rules. Households who are not members of the forest user groups are not allowed to cut trees or branches in restricted areas reserved for group members. This can make non-user group households have to travel further to collect forest products if the rules are enforced.

3. ANALYTICAL ISSUES AND EMPIRICAL MODELING

This study estimates household-level reduced-form demand equations for environmental goods and for the time allocated by different household groups to environmental goods collection.

In general, the relevant model is one of agricultural household production where maximization of a unified utility function is constrained by budget and time constraints and by environmental goods and agricultural production functions.[10] Assuming an interior solution, the household's maximization problem may be solved to yield a system of reduced form demands that will be functions of wages, prices, nonwage income, and household- and community-level characteristics including environmental conditions. This system includes demands for each type of environmental good and for the time of household members to specific collection activities.

In order to examine how environmental conditions influence intrahousehold labor allocation to collection activities, this paper presents estimates of the demand for total household collection time aggregated over all four environmental goods and for the total collection time spent by men, women, and youth. Related functions of the percentage of total collection time accounted for by men, women, and youth (age 6-15) are also estimated allowing a direct assessment of the influence of environmental and other factors on the distribution of total collection time within a household. This paper also presents estimates of the demand functions for each of the four environmental products and of the functions for the time it takes to collect a unit of each product. This allows a more comprehensive assessment to be made of the effect of changing environmental conditions on household collection decisions.

[10]See Becker (1965, 1991) and Gronau (1973) for seminal works on household time allocation, and Singh, Squire, and Strauss (1986) for a good exposition of agricultural household models. See Cooke (1998a, 1998b) for a more complete exposition of a relevant formulation of the household model in this context.

EXPLANATORY VARIABLES

This study has the advantage of using panel data that allows for an assessment of changes over years and seasons. The 14 years between the initial NENS survey and subsequent resurveys in 1997 allow enough time for forest resource stocks to change within sites and also for changes in forest management practices within a community to take place. The latter is accounted for by including a dummy variable for whether a ward has instituted community forest management in the estimates using all four available rounds of data.[11] It is not completely clear what one should expect the sign on this variable to be in each equation. Wards with more degradation problems, and thus that would be expected to require more collection time or perhaps to have lower consumption of forest products, may be more likely to have started community management. Forest user group rules that restrict collection behavior may also potentially reduce consumption and raise collection costs. On the other hand, the existence of a forest user group may be associated with lower collection times and higher consumption if the imposition of rules have led to increases in community forest cover. Another variable, the number of years community forest management practices have been in place, is included to try to capture the effects of this latter possibility. It takes some time for forest biomass to grow. If management rules are effectively allowing forest areas to regenerate or expand, then the longer the rules have been in place the larger the amount of regeneration that should have

[11]See Tachibana et al. (1998) for an investigation of the determinants of the emergence of community forest management in the hills of Nepal.

been able to occur.[12] To the extent that other forest resource variables included in the estimation accurately capture the effects of changes in forest cover, the forest user group variables are more likely to be associated with higher collection costs and lower consumption.

Forest resources themselves are measured in several ways. Information from aerial photographs from 1978 and 1996 is used to give a VDC-level measurement of the area under forest cover.[13] While this has the advantage of being a direct measure of forest resources, and the variation in the forest area across VDCs seems to be broadly consistent with variation in forest resources across sites, it is still a flawed measure at best.[14] What is required is a measure of forest resource availability to the households in the sample. This is available for 1997 in the form of ward-level forest area.[15] Unfortunately a similar measure is not available for earlier time periods. In the absence of historical ward-level forest stock measurements, the own-household-excluded ward-level median for the time it takes to collect one kilogram of fuelwood during the dry season is included as an exogenous indicator of resource scarcity at the ward level for estimations using data from both 1982/1983 and 1997. Since its description is quite a

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[12] A third forest management variable, a dummy variable for whether or not forest user groups have actively enforced the rules they impose, is used in regressions using 1997 data only. Two of the three wards that this dummy includes are the two that have existed for the longest period of time.

[13] Table 2, Thapa, Koirala, and Otsuka (1998) and communication with Towa Tachibana.

[14] Another issue is that this measurement only includes forest areas greater than 10 hectares in size due to the resolution of the aerial photographs used. Communication with Ridish Pokharel and Rabindra Man Tamrakar.

[15] Ridish Pokharel, Institute of Forestry, Nepal. This is from forest inventory measurements, not aerial photographs.

mouthful, this variable will henceforth be referred to as the fuelwood median time variable. Almost all sample households collect fuelwood in the late dry season, thus giving the largest sample size for median measurements. Higher median fuelwood collection time is assumed to be associated with higher collection costs for forest products in general. It appears that this median variable will be a reasonable proxy. Ward averages of this median variable do in fact change, as expected with subjective assessments of changes in forest resources by respondents and an outside observer.[16] In other words, wards that have had their forest resources increase over the 14-year period have lower median fuelwood times on average in 1997 than in 1982. The wards that have had their forest resources decrease between the two years have higher median fuelwood times, on average, in 1997 than in 1982. To the extent that this median is influenced by households collecting from their own property, it may not as accurately reflect community forest resource availability. The problem of collection location choice is discussed further below.

Further explanation of the variables that are included, or excluded as the case may be, is warranted. Ward-level dummy variables are included to capture the effects of any unobserved fixed ward-level factors. These ward-level factors may include environmental conditions such as terrain and market conditions such as proximity to a large town. Dummies for the seasonal rounds are also included. The empirical estimates do not include price data for environmental products or data on wage rates. Several

[16] The outside observer is Madhav Gautam who coordinated the 1982/1983 NENS survey.

factors lead to this. Environmental goods are not traded regularly in the survey areas and thus a market price was not consistently available. For wage data there are no comparable measures of wages in the 1982 and 1997 data.[17] In analysis using 1997 information alone, the ward-level agricultural wage data available is found to be strongly collinear with the season and other ward-level information and thus is dropped for estimation purposes.

The remaining explanatory variables included in household choice equations measure a variety of household and production characteristics. Household population variables are included as are the age of the household head and the percentage of literate adults in the household. Dummy variables for occupational caste households and for households of Tibeto-Burman ethnicity are included. These variables may affect the preferences of the household and thus influence labor allocation and consumption decisions. It may also be that occupational caste households have different access to local environmental resources than higher caste households (i.e., Brahmin and Chhetry households). Landownership variables for upland area (*pakho*) and lowland area (*khet*) measured in hectares are included as is the number of livestock units owned. The land variables are assumed to be parameters in the household's environmental goods and agricultural production functions. Livestock influences agricultural production through the provision of manure for fertilizer. Real nonlabor income is measured as the yearly remittances and pension payments received by the household. Many households do not

[17]This is due to the small number of people working off-farm for labor in 1997 and the lack of agricultural wage data in the NENS 1982/1983 data.

receive such payments and so have a value of zero. Nominal figures are converted using the Nepal CPI for 1982 and for 1993. This latter figure is the latest year for which the CPI is available. There has been inflation in Nepal since 1993, so 1997 nonlabor income figures may be overstated in real terms.

POTENTIAL SOURCES OF BIAS

There are several potential sources of bias in estimating the equations just described. For one, it has been postulated that deteriorating environmental conditions may influence the decision of individuals or entire households to migrate.[18] Ten of the households in the 1982 sample have migrated and selected themselves out of the sample. If these households left the sample due to adverse environmental conditions, then the results in this study could suffer from selection bias. To check whether this is potentially a problem or not a probit equation using the 1982/1982 NENS data is estimated to determine whether measures of environmental status influenced the decision to migrate. The results of the probit equation (not presented here) indicate that household variables for the time it took to collect a unit of each environmental good in 1982 do not have any significant explanatory power regarding the decision of whether or not to migrate, nor do the fuelwood median collection time or VDC forest area variables. Results indicate that households with higher adult literacy rates and higher remittances are more likely to migrate, while those with more male adults and more livestock are less likely to migrate.

[18] E.g., Pearce and Warford (1993), p. 273.

Another potential source of bias related to migration is the endogeneity of household composition variables, or the remittance component of nonlabor income. This would be due to the influence of environmental factors on the decision of individual household members to migrate. The resurvey data have information on the number of men who have migrated from each household over the 14-year period in question. A regression on this household-level variable indicates that environmental measures for 1982 do not have a significant effect on the number of men choosing to migrate.[19] The most strongly significant factors in this decision appear to be the number of adult males in the household in 1982 and being of a Tibeto-Burman ethnic group.[20]

Bias may also be a problem due to the fact that, within a household, some groups of household members may not spend any time in collection activities. In particular, many households select themselves out of having men or youth collect, which leads to zero censoring in the men and youth collection time equations. Heckman's two-step estimation method is employed to control for sample selection in these equations (Heckman 1979, 1980).[21] This involves first running a maximum-likelihood probit on a binary variable that equals one if the household reports positive collection time for men (youth), and zero otherwise. The inverse Mill's ratio, lambda, is constructed using the

[19]This is not meant to be a formal analysis of the migration decision, but a quick diagnostic for whether to worry about out-migration causing bias in the results presented here.

[20]Conversations with survey households indicated that Gurung households were very likely to have men working in military service, often in India. For an examination of migration in Nepal, see Gurung (1989).

[21]This follows the methodology Skoufias (1994) uses in estimating time allocation demand functions for children's home, school, and leisure activities. See also Skoufias (1993). An alternative would be to use the Tobit estimator; see, e.g., Rosenzweig (1980) and Khandker (1988).

estimated parameters from the probit on participation, and is included as an additional explanatory variable in the relevant collection time equation. The collection time equation is then estimated with OLS using only positive values of the dependent variable. The inclusion of lambda eliminates potential selectivity bias in the coefficients of this conditional equation. For collection time equations where zero censoring is not an issue, namely the total collection time and female collection time equations, OLS is run on the pooled data.[22]

Selection bias may be a problem for another reason, the self-selection of households not to collect a given environmental product in a given season. Some collection practices tend to be very seasonal in nature. For example, households generally only collect grass in the monsoon season since that is when it grows. Thus, equations pertaining to cut grass or the time per unit to collect cut grass only utilize monsoon season observations for estimation purposes. Leaf fodder is also quite seasonal in nature, typically being collected in the dry season when grass is not available. There are no observations on fodder variables for the 1982/1983 monsoon round; the assumption made for that survey was that households did not collect fodder then. The 1997 surveys did record households collecting fodder in both the late dry season and the

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[22] All households collect environmental products at least to some extent in all of the survey rounds, and there are only four observations over all rounds where women's collection time is zero. Heckman's two-step procedure is also used on the equations for men's and youth's percentage of total collection time.

monsoon season however, so the three rounds of data available are used for the fodder and fodder time per unit estimates.[23]

Households may also choose not to collect a given product in a given round for reasons other than seasonal availability. Of particular concern is that households may have chosen to select themselves out of consuming a good between 1982 and 1997. For example, fewer households in general report collecting leaf fodder in 1997 than did in 1982. Thus, for fuelwood and fodder consumption and time per unit equations, Heckman's two-step selection model was tested. The model could not reject the hypothesis of no significance for the selection coefficient in case of the fuelwood variables, so pooled OLS results are presented in this paper. The selection coefficient in the leaf fodder equations is significant, and so the results of the selection-corrected OLS model are presented. In both years almost all households reported collecting grass in the monsoon season, so pooled OLS results are used for the grass and grass time per unit equations. The same is the case for the time per trip for water equation.

Finally, a further complicating issue to consider is household choice of the place of collection. The time it takes to collect a unit of an environmental product is obviously related to the location of the collection site. Households in the survey area primarily collect from either common forest areas or from their own private property. Typically, collecting from one's own property requires less time per unit than collecting from

[23]The monsoon season observations of fodder collection were from the very early part of the recall period close to the end of the dry season (personal communication with Madhav Gautam). Note that the total collection time variable will include grass collection times of zero for most households in the dry season, and fodder collection times of zero for all households in the 1982/1983 monsoon season.

community forest areas. This is illustrated in Table 4 with data from the full sample of households in the 1997 survey.[24] The 1997 survey data indicate the place of collection of the various environmental goods, but unfortunately the NENS data do not. To assess the extent to which community forest resource availability influences household decisions regarding where to collect, probit equations for whether or not a household collects on its own land or whether or not it collects from community forestland are estimated for fuelwood and leaf fodder.[25] The binary choice variable for these equations equals one if the household reports collecting the product on its own land (community forest), and zero if it reports not collecting the product on its own land (community forest). This formulation is a bit messy in that it also includes the decision of whether or not to collect the product in the first place. For example, the dependent variable for collection on one's own land equals zero if the product is not collected at all as well as if it is collected in some other place. Since restricting the sample for this estimation to only those households that report collecting the good brings us back to the potential selection bias problem discussed earlier, I have chosen to retain the formulation as just described.

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[24] There is also an issue of measurement error with regard to the variable on time per kilogram collected of fuelwood. The NENS data do not include the quantity of fuelwood collected, so the variable is constructed using the quantity of fuelwood consumed. This may overestimate the time taken to collect a unit if collection quantities differ significantly from consumption in the relevant time period.

[25] Similar equations are not estimated for place of grass collection since only three collecting households report collecting from community forest areas and the rest collect on their own property. Individual ward dummy variables are not included in the regressions using 1997 data only due to collinearity problems. Instead a dummy variable for upland wards is included. Upland wards are those that are located principally along mountain ridges instead of in valleys, and are in contrast to lowland wards that are principally located in valleys. Environmental conditions may vary with differences in terrain.

4. EMPIRICAL RESULTS

Of particular interest for this study is how intrahousehold collection time allocation has changed over time and in response to changes in environmental conditions. Table 6 contains the selectivity-corrected results of the estimation for total collection time demand equations.[26] The coefficients of the time period dummies indicate that, after accounting for other household- and community-level factors, men and women both spent less time collecting in 1997 than in 1982. Both men and women appear to have spent less time collecting in the 1997 dry season compared to the 1982 dry season, and also less time in the 1997 monsoon season compared to the 1982 monsoon season. In contrast, it appears that youth's dry season collection time has not significantly changed between years, although there is some indication that their monsoon season labor burden is less than it was in the earlier time period.

Perhaps of more interest is how the percentage of total collection time accounted for by men, women, and youth has changed over the time periods considered. Table 7 presents the estimates for the percentage equations. Not surprisingly, given the preceding results, youth account for a significantly higher percentage of the dry season collection time in 1997 than they did in 1982. In fact, after correcting for household selection of youth into collection activities, it appears that youth account for a larger percentage of

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[26]The probit estimates from the Heckman selection models are given in Appendix Table 12.

total collection time in 1997 than in 1982 regardless of season.[27] This seems to be making up for decreases in the percentage of total time spent by both men and women. Another interesting result is that regardless of year, women account for a smaller percentage of total collection time in the monsoon season than in the dry season, and youth a larger percentage in the monsoon season than in the dry season. This may be due to increased agricultural activity in the monsoon season and the fact that school is out of session.

The VDC forest area, median fuelwood time, and forest management-related variables are now examined to try to ascertain the effect of environmental conditions on household time allocation. For simplicity of reference these variables are referred to as "environmental variables." It should also be noted that the location dummies will capture any of the ward-specific environmental effects that are constant over time and that are not captured by these environmental variables. These ward-level dummy variables are particularly significant in the equations for men's collection activity indicating that there is significant difference in the utilization of male labor for collection activities across the different survey sites.

It appears that men spend more time collecting and account for a larger percentage of household collection time in VDCs that have a larger forest area. In and of itself this would seem to indicate that households allocate more male time to collecting when resources are relatively more abundant, although one must be careful in interpreting

[27]The probit equation on youth participation in collection activities given in Appendix Table 12 indicates that youth were less likely to collect in 1997 than in 1982.

such a broadly measured variable. VDC forest area does not have a significant effect on women's or youths' collection time. The other environmental variable coefficients seem to indicate that household collection time increases when environmental conditions are less good, and the effect on the collection time of men and of women appears to be similar. These variables appear to have no significant effect on the allocation of youths' labor to collection activities.

Higher median fuelwood time, an indicator of higher resource collection costs in a ward, appears to lead households to use more of both male and female labor in collection activities, although this result is not significant at the 5 percent level. Male and female collection times are also both higher, and men tend to account for a larger percentage of total collection time, in wards that have a forest user group. This may mean that sites with forest user groups are more degraded and thus it is more time consuming to collect forest products, or it may mean that forest user group restrictions are making it more difficult to collect, or both. Group community forest activities may also encourage the use of more male labor in collection type activities; e.g., group forays to decide which trees to fell. Interestingly, the longer a ward has had community forestry the longer men and women spend in collection activities. This result may be because the two communities that have had community forestry the longest (and being the only ones reporting community forestry in 1982) are also the ones that report enforcing their restrictions the most strictly.[28] There is also the possibility that having a forest user group

[28] According to 1997 forest measurements, these two wards also have smaller amounts of ward-level forest area than all other survey sites that have forest user groups.

for a longer period of time increases forest resource availability and that households in these areas are simply collecting more of the forest products. Some of these possibilities are explored further below.

It is worth noting that household demographic measures significantly influence the time spent by various household groups in collection activities and the percentage of total collection time accounted for by each group. Collection labor between groups seems to be substitutable, at least to some degree. Men account for less of total collection time in households where there are more women and more youth; women account for a smaller percentage when there are more men or more youth. Youth do not account for a smaller percentage of total collection time when there are more adults, however. Interestingly, the total time spent by each of these groups does not significantly increase with more household members in the relevant group. The results on the caste variables are also particularly interesting. Occupational caste and Tibeto-Burman households both spend more time in collection activities than do higher caste households, with much of the difference accounted for by larger amounts of time spent by youth. Caste does not appear to be a factor in determining the percentage of collection time accounted for by each household group.

Households may choose to allocate more time to collection activities because of higher per unit collection time costs or because of collecting, and consuming, a larger quantity of environmental goods. Conversely, lower per unit collection time or smaller quantities may lead to lower total collection time. Estimates of demand equations for the consumption of fuelwood, fuelwood per capita, leaf fodder, and cut grass are presented in

Table 8. Estimates of the time per unit equations, including the time per trip to collect water, are presented in Table 9.

Interpreting the effect of the environmental variables on consumption and per unit collection time is at first somewhat difficult. The confusion arises from the coefficients on the VDC forest area variable that indicate that fuelwood consumption decreases and the time per unit of fuelwood collected increases as forest resources increase. This result seems counterintuitive and is most likely a product of the inability of this variable to adequately proxy local resource availability. The median fuelwood time variable should be a better measurement of local environmental conditions. A relatively worse local environmental state, as measured by an increase in the median fuelwood time, is shown to increase a household's per unit collection time for fuelwood and cut grass, and to decrease a household's consumption of these goods. The signs are similar for fodder consumption and per unit collection time, but the coefficients are not significant. These results are more consistent with the thinking that households will face higher collection costs and consume less when natural resources are more scarce.

The effect of forest user groups on household per unit collection times and consumption of environmental goods is difficult to interpret. For example, there appears to be no effect of having community forestry on the fuelwood variables. Most community forest management practices in the survey sites seem to be geared toward regulating fuelwood collection so this is perhaps a bit surprising.[29] Households in wards

[29]For an examination of the effect of specific forest management rules on firewood extraction see Upadhyaya and Otsuka (1998).

with forest user groups face higher per unit collection times for fodder, perhaps due to those wards having fewer community forest resources. The longer community forestry has been in place, however, the larger is household consumption of leaf fodder.

The seasonal dummy results in Tables 8 and 9 indicate that, after taking other factors into account, household per unit collection times and environmental goods consumption have changed significantly over the different survey periods. Strikingly, the results show that households consumed less of all three environmental goods in 1997 than in 1982. Despite a reported increase in the use of stall feeding for livestock, the consumption of leaf fodder and cut grass appear to have fallen by rather large absolute amounts.[30] For fuelwood the decrease comes about mainly due to a large and significant drop off in consumption in the 1997 monsoon season. It is not clear why this is the case, especially given the higher incidence of fuelwood storage in 1997 compared to 1982. The 1997 data indicate that households supplemented their fuelwood use with crop residues to a large extent in the monsoon season. The quantity of maize stalks and cobs used as fuel is quite large for some households. Although many households reported that they did use crop residues at least to some extent in 1982/1983, the NENS data do not give quantities of crop residues used as fuel so a comparison over time is not possible.

While consumption is declining, the seasonal dummy variable results in Table 9 indicate that per unit collection times have actually decreased since 1982 for most goods.

[30]Table 8 also shows that consumption of fodder, grass, and fuelwood all increase with additional livestock units. The increase in fuelwood consumption is likely due to cooking more *kundo* and perhaps to the cooking of more milk as well.

The exception is the unit collection time for grass, which shows no significant change between monsoon periods. Water collection times have likely decreased due to communities building water taps. A plausible explanation for the decreases in fuelwood and fodder per unit collection times is that households are increasingly relying on forest products collected on their own property. As shown in Table 4, average time per unit collected is lower for households that collect on their own property compared to those that collect from community forest areas. Households themselves are reporting an increased reliance on environmental goods collected from their own land. Table 10 reports the percentage of fuelwood, fodder, and grass that households say they collect from their own land based on recall questions in the 1997 survey. The average reported percentage is higher in 1997 than in 1982 for all three goods.

Some evidence for the possibility that place of collection is influencing per unit collection times and environmental product consumption is given by the coefficients on the landownership variables in Table 8 and Table 9. Lowland area enters with a significantly negative coefficient in the per unit time equations for leaf fodder and cut grass. Grass may be collected from lowland areas, often from the edges of fields or from the fields themselves if left fallow. There are some difficulties in interpreting this coefficient for fodder, however, since trees are almost always located on upland area and not on lowland area. The upland area coefficients are negative for both the fuelwood and fodder equations, but are not significant. It may be that upland area does not fully capture the effect of collection location and that lowland area is capturing some other effect (e.g., wealth). Relatedly, households with more upland area consume significantly more fuelwood and those with more lowland area consume significantly more leaf fodder.

It is worth investigating this place of collection issue more deeply in order to understand changes in household collection time allocation decisions. Although place of collection for each good is not given in the NENS data, it was collected in the 1997 survey rounds. Table 10 reports the means of binary choice variables on place of collection for fuelwood and leaf fodder. The variables equal one if the household collects the particular product (e.g., fuelwood) from a particular location (e.g., own land), and zero otherwise.[31] Maximum-likelihood probit estimates on these choice variables may be used to more fully understand how environmental and demographic factors influence a household's collection location choice. This should help interpret the changes observed in per unit collection time and perhaps in total collection time and consumption figures as well.[32]

The probit results are presented in Table 11. The first thing to note is that the monsoon dummy is significantly negative in every equation. This result is reflecting the decision of whether or not to collect fuelwood or fodder at all. In other words, the likelihood of a household participating in fuelwood or leaf fodder collection is significantly less in the monsoon season than it is in the dry season, and thus, so is the

[31]For comparison, the means of the binary choice variable on whether the household collects the product at all are included in Table 10 as well.

[32]It should be noted that the regressors in these equations are not exactly the same as in the previous equations, and the sample includes all households with full data interviewed in 1997.

likelihood of them collecting on their own land, or in community forest areas.[33] Turning to the effect of the forest area variable included in the regressors, we see that households in wards with more forest area are less likely to collect fuelwood or fodder from their own land, and are more likely to collect fuelwood from the community forest.[34] The effect of more community forest area on the likelihood of collecting leaf fodder from the community forest is also positive but the coefficient is not quite significant at the 10 percent level. Thus it appears that, all else constant, households living in more environmentally favorable wards are less inclined to collect from their own land, or, put another way, households in less environmentally favorable areas are more likely to collect on their own land.

While it cannot be said conclusively from these results that households are switching over time to collecting on their own land in response to changes in environmental conditions, it does appear that this is happening at least to some extent.[35] There is also some evidence that living in a location with a forest user group that actively

[33]The monsoon dummy was strongly significant on probit equations of whether or not to collect each good at all, but was not significant in equations on place of collection that were restricted to households that collect the good.

[34]It should be noted that the variable measuring forest resources is not the same as in previous regressions. It is a more refined measure of ward-level forest area.

[35]The coefficient estimates for environmental variables in earlier equations may be biased due to this underlying selection of place to collect. For example, coefficients that show an increase in per unit collection times and a decrease in consumption for households living in environmentally worse locations may be underestimated (in absolute value) if households are turning to collecting on their own property as a result of being in the poor location and this is not accounted for in the estimation. In other words, if the equations were corrected for this selection issue, we would expect the positive effect of poor resource availability on per unit collection times to be larger and the negative effect on consumption to be even more negative. This of course ignores any problems with construction of the median per unit fuelwood time variable, which may itself understate the time cost of obtaining community forest resources.

enforces its rules may influence a household's choice of collection location. Specifically the results here indicate that households in such locations have a higher probability of collecting fodder from their own land. However, the same result is not obtained for fuelwood, nor is there indication of reduced collection of either product from community forests. A final point to be made from these results is that occupational caste households and those of Tibeto-Burman ethnicity are more likely to collect from community forest areas than area higher caste households, even after accounting for farmland ownership. This may help account for the longer amount of time households of these caste groups spend in collection activities compared to households of higher caste.

5. CONCLUSION

The results presented in this paper indicate that households in less environmentally favorable areas spend significantly more time in environmental goods collection activities than do households in more favorable areas. This corroborates the cross-sectional findings of Kumar and Hotchkiss (1988) and Cooke (1998). What is a particularly interesting result of this study is that the increased collection labor time appears to come close to equally from men and women. Indeed, the coefficients on the median fuelwood time variable and on the forest user group dummy are larger for men's collection time, and the percentage of total collection time accounted for by men also increases with these measures of environmental conditions. Another interesting point is that there is no significant effect of these environmental variables on the total time or percentage of total collection time by youth. From these results it would appear that improvement of local forest resources would help relieve the labor burdens of both men and women, but may not directly relieve those of youth.

Coupled with these results is the finding that total household collection time declined between 1982 and 1997. It appears that, while all household groups spent less time collecting, women's collection time decreased the most and women's percentage of total collection time also decreased. This appears to be an optimistic trend, especially given the extremely heavy collection labor burden that women bear in this region. To some extent decreases in household collection time between the two years may be a result of increased availability of local environmental resources. All of the sites have installed at least one water tap, which is likely to be decreasing household time allocated to water collection. Additionally, some survey sites have seen their community forests improve over the 14-year period in question, although this is certainly not the case with all of them.

One must be only cautiously optimistic, however. The results in this paper indicate that total collection time has decreased not only due to decreases in per unit collection times for environmental goods, but also due to reduced consumption of those goods. To some extent this may be due to forest user group restrictions on forest product extraction from community forests, although this is hard to say conclusively without more detailed information on forest management rules.[36] There is also evidence that the decreases in per unit collection time may be due to increased reliance on forest products collected from one's own property.

These changes cannot in and of themselves indicate decreases in household welfare, but they do hint that the picture may not be a completely positive one. Decreases in fuelwood, fodder, and grass consumption can be tied at least partially to decreased livestock holdings, and, albeit somewhat tenuously, to decreased landholdings. Decreases in per capita fuelwood consumption during the 1997 monsoon season are particularly troubling, given that very few households have changed cooking technology. Most households are relying to some extent on crop residues for fuel during the monsoon season, although it is not possible to assess how this has changed over time. Crop residue use is heaviest in the ward that now has no community forest at all. In terms of fuel efficiency, crop residues are an inferior fuel compared to wood; they have less energy per kilogram than fuelwood and tend to burn quickly, requiring more attention during the cooking process.[37] Increased seasonal fluctuation in household energy consumption, and perhaps in meal preparation practices, as a result of changes in forest resources or in forest resource management, is thus a potential area of concern and worthy of further investigation.

[36] Upadhyaya and Otsuka (1998) find that restrictions on the cutting of green branches reduces firewood extraction from community forests. This restriction may also decrease the amount of leaf fodder collected.

[37] Crop residues yield approximately 13.5 MJ of energy per kilogram while fuelwood yields approximately 16 MJ/kilogram (personal communication, Keith Openshaw, World Bank, 1994).

Finally, this study provides empirical evidence that using one's own land to produce fuelwood and fodder is an important coping response to scarcity of community forest resources for hill households. While this study does not formally address the household decision of whether to invest in trees, many sample households claim they are relying more on private trees for these goods. It is very likely that this is contributing to lower per unit collection times. Of course, growing trees on one's property is usually not a costless option, given the competition for space for crops, and it is obviously not an option at all for households who do not own any land. Unfortunately this study cannot give an accurate assessment of the effect of environmental conditions on landless households since all but four of the 1997 sample households own at least some farmland. Nonetheless, it can highlight the often-mentioned point that the poorest households in a community are likely to bear the highest costs of environmental degradation, at least in terms of the labor burden required for collection.

TABLES

Table 1—Household collection and consumption of environmental products by season and year (NENS households only[a])

	Late dry season				**Monsoon season**			
Variable (average kilograms per day)	1997	Percent of sample consuming	1982/83	Percent of sample consuming	1997	Percent of sample consuming	1982/83	Percent of sample consuming
Fuelwood								
Consumption	9.59 (6.54)	100%	10.88 (5.32)	100%	5.63 (5.58)	94%	10.46 (6.25)	99%
Consumption per capita	1.82 (1.26)	100%	1.87 (1.25)	100%	1.26 (1.72)	94%	1.83 (1.21)	99%
Collection	30.22 (28.56)	93%	n/a	n/a	5.49 (7.26)	36%	n/a	n/a
Leaf fodder								
Collection (consumption)	8.26 (6.57)	53%	28.61 (15.63)	75%	19.96 (9.50)	22%	n/a	n/a
Cut grass								
Collection (consumption)	12.81 (7.20)	12%	24.54 (10.35)	9%	48.15 (39.92)	95%	63.70 (33.67)	96%
Water								
Collection trips per day	6.97 (3.67)	99%	n/a	n/a	6.67 (3.77)	95%	n/a	n/a

Sources: Nepal Energy and Nutrition Survey, 1982/1983, Western Region, Nepal, Nepal Agricultural Projects Service Center, the Food and Agriculture Organization of the United Nations, and the International Food Policy Research Institute; and Nepal Household Resurveys, 1996/1997, the International Food Policy Research Institute, U.S. Agency for International Development, Goteborg University, Sweden, Winrock International-Nepal, and author's fieldwork.

Notes: Standard deviations in parentheses; n/a = not available.

[a] Sample sizes vary due to data availability. Means are for consuming households only.

Table 2—Household collection time for environmental products by season and year (NENS households only[a])

Variable (minutes per day)	Late dry season 1997	Percent of sample collecting	1982/83	Percent of sample collecting	Monsoon season 1997	Percent of sample collecting	1982/83	Percent of sample collecting
Total collection time								
All household members	382.83	100%	341.45	100%	423.26	100%	570.42	100%
	(252.54)		(265.97)		(286.17)		(310.69)	
Men	131.01	60%	45.51	73%	152.98	68%	160.30	46%
	(115.07)		(52.20)		(144.07)		(147.26)	
Women	271.73	100%	296.50	100%	241.88	98%	432.88	98%
	(208.93)		(254.32)		(169.03)		(223.78)	
Children	115.53	37%	21.70	54%	153.82	55%	153.24	84%
	(109.53)		(31.94)		(134.50)		(115.66)	
Total collection time for:								
Fuelwood	160.74	93%	101.79	100%	42.95	37%	157.95	74%
	(147.71)		(93.53)		(45.64)		(152.93)	
Water	185.01	98%	139.67	100%	101.28	94%	129.47	99%
	(169.01)		(134.93)		(99.91)		(133.47)	
Leaf fodder	65.47	54%	109.43	75%	96.09	24%	n/a	n/a
	(91.47)		(94.43)		(73.3)			
Cut grass	132.50	13%	216.80	8%	315.53	95%	352.47	92%
	(55.61)		(110.22)		(247.73)		(257.57)	

Sources: Nepal Energy and Nutrition Survey, 1982/1983, Western Region, Nepal, Nepal Agricultural Projects Service Center, the Food and Agriculture Organization of the United Nations, and the International Food Policy Research Institute; and Nepal Household Resurveys, 1996/1997, the International Food Policy Research Institute, US Agency for International Development, Goteborg University, Sweden, Winrock International-Nepal, and author's fieldwork.

Notes: Standard deviations in parentheses; n/a = not available.

[a] Sample sizes vary due to data availability. Means are for collecting households only.

Table 3—Selected Household Actions (NENS households only)

	Number of households	Percentage of sample[a]
Planted trees on property between 1982 and 1997	54	53%
Planted fodder trees between 1982 and 1997	30	30%
Have let trees grow up naturally on property since 1982	80	82%
Stored fuelwood in 1982	23	21%
Stored fuelwood in 1997	90	98%
Have ever bought fuelwood	16	16%
Have ever bought leaf fodder	11	11%
Switched to biogas for cooking between 1982 and 1997	4	4%

Sources*:* Nepal Energy and Nutrition Survey, 1982/1983, Western Region, Nepal, Nepal Agricultural Projects Service Center, the Food and Agriculture Organization of the United Nations, and the International Food Policy Research Institute; and Nepal Household Resurveys, 1996/1997, Winrock International, Nepal, the International Food Policy Research Institute, Goteborg University, Sweden, and author's fieldwork.

[a] Sample sizes vary.

Table 4—Time per unit of collected environmental goods

	1982/1983[a]		1996/1997[a]	
	Mean	Standard deviation	Mean	Standard deviation
Minutes per kilogram, fuelwood	14.49	16.15	6.97	5.63
Minutes per kilogram, leaf fodder	4.05	3.11	6.60	6.72
Minutes per kilogram, cut grass	6.52	4.39	8.71	9.10
Minutes per trip, water	25.20	24.38	21.64	19.66
	Collect from own land[b]		Collect from community forest[b]	
Minutes per kilogram, fuelwood	5.97	5.54	9.11	5.14
	(6.14)	(4.96)	(9.20)	(5.41)
Minutes per kilogram, leaf fodder	3.88	4.46	12.43	7.52
	(3.53)	(2.92)	(12.33)	(7.13)

Sources*:* Nepal Energy and Nutrition Survey, 1982/1983, Western Region, Nepal, Nepal Agricultural Projects Service Center, the Food and Agriculture Organization of the United Nations, and the International Food Policy Research Institute; and Nepal Household Resurveys, 1996/1997, Winrock International, Nepal, the International Food Policy Research Institute, Goteborg University, Sweden, and author's fieldwork.

[a] NENS households only.

[b] 1997 full sample, NENS households only in parentheses.

Table 5—Explanatory variable means and standard deviations, by year (NENS households only[a])

	1982/1983		1996/1997	
	Mean	Standard deviation	Mean	Standard deviation
VDC forest area (hectares)	778.01	754.83	814.79	700.13
Ward-level own-household-excluded median minutes per kilogram for fuelwood	8.98	4.64	5.49	2.28
FUG dummy = 1 if have FUG	0.30	0.46	0.85	0.35
Years to date of community forestry	2.74	5.57	9.85	9.94
FUG enforcement dummy=1 if FUG reports active enforcement of rules[b]			0.57	0.49
Ward forest area (hectares)[b]			108.86	132.71
Age of household head	44.64	13.82	55.35	11.65
Percentage of literate adults	42.21	28.89	62.22	30.79
Number of resident males age 16-59	1.70	1.24	1.21	1.04
Number of resident females age 16-59	1.69	1.00	1.67	1.02
Number of youth age 6-15	1.69	1.41	1.69	1.49
Number of children age 0-5	1.31	1.17	0.80	1.03
Upland area owned (*pakho*), hectares	0.83	0.71	0.34	0.30
Lowland area owned (*khet*), hectares	0.62	0.57	0.45	0.55
Number of livestock units	7.04	5.57	6.04	3.24
Real nonlabor income, thousand rupees[c]	2.64	5.51	1.47	2.67
Tibet-Burman ethnic group dummy	0.33	0.47	0.29	0.45
Occupational caste dummy	0.08	0.27	0.15	0.36
Upland ward dummy[b]			0.50	0.50

Sources*:* Nepal Energy and Nutrition Survey, 1982/1983, Western Region, Nepal, Nepal Agricultural Projects Service Center, the Food and Agriculture Organization of the United Nations, and the International Food Policy Research Institute; and Nepal Household Resurveys, 1996/1997, the International Food Policy Research Institute, U.S. Agency for International Development, Goteborg University, Sweden, Winrock International-Nepal, Thapa, Koirala, and Otsuka (1998), Towa Tachibana, and author's fieldwork.

[a] Sample sizes vary between years.

[b] Full 1997 sample included.

[c] Base year = 1987.

Table 6—Total environmental goods collection time, minutes per day

Independent variable	Total	Men	Women	Youth
VDC forest area	0.135	1.652**	0.201	-0.091
	(0.807)	(2.896)	(1.449)	(-1.017)
Median minutes per kilogram fuelwood	3.064	9.926*	8.197*	-2.929
	(0.529)	(1.731)	(1.667)	(-0.906)
FUG dummy	170.504**	137.450**	119.214**	50.419
	(2.718)	(3.377)	(2.248)	(1.381)
Years of organized community forestry	15.014**	5.789*	12.371**	1.348
	(2.573)	(1.703)	(2.519)	(0.392)
Male adults 16-59	17.222	4.948	-0.394	0.903
	(1.257)	(0.676)	(-0.034)	(0.138)
Female adults 16-59	9.700	4.127	12.953	0.677
	(0.585)	(0.395)	(0.919)	(0.081)
Youth 6-15	9.393	-7.858	3.896	1.747
	(0.917)	(-1.425)	(0.451)	(0.327)
Children 0-5	8.698	1.877	13.385	-8.289
	(0.602)	(0.237)	(1.098)	(-1.085)
Age of household head	3.394**	0.080	2.501**	2.113**
	(2.701)	(0.123)	(2.371)	(2.999)
Percentage literate adults	1.264**	0.061	0.815*	0.556*
	(2.298)	(0.194)	(1.753)	(1.743)
Occupational caste dummy	104.238**	-26.595	59.066	69.642**
	(2.324)	(-1.058)	(1.571)	(3.144)
Tibeto-Burman dummy	112.090**	17.062	62.063	51.046*
	(1.958)	(0.537)	(1.259)	(1.791)
Real nonlabor income	2.621	-0.482	0.834	2.419
	(0.776)	(-0.260)	(0.295)	(1.468)
Livestock units	14.733**	1.398	8.325**	3.331
	(3.568)	(0.524)	(2.401)	(1.492)
Upland area	0.504	-10.133	8.497	18.082
	(0.014)	(-0.477)	(0.283)	(1.002)
Lowland area	-19.812	8.666	-8.450	-21.881
	(-0.481)	(0.364)	(-0.243)	(-1.064)

(continued)

Table 6—(continued)

Independent variable	Total	Men	Women	Youth
Monsoon 1997 dummy	-163.382**	-92.663	-235.357**	75.913*
	(-2.122)	(-1.542)	(-3.638)	(1.772)
Monsoon 1982 dummy	226.769**	249.580**	123.283**	159.239**
	(6.227)	(4.250)	(4.075)	(8.384)
Dry season 1997 dummy	-193.898**	-111.398*	-189.951**	21.099
	(-2.501)	(-1.809)	(-2.913)	(0.464)
Bagkhor Ward 1	96.762	759.077**	120.040	26.126
	(0.795)	(2.739)	(1.169)	(0.403)
Bagkhor Ward 2	93.916	773.441**	141.942	-11.043
	(0.717)	(2.796)	(1.279)	(-0.162)
Bagkhor Ward 8	-376.949**	533.293**	-211.137*	-84.421
	(-2.497)	(2.169)	(-1.662)	(-1.003)
Chhoprak Ward 7	-89.955	-137.586**	-98.018	69.197
	(-1.076)	(-2.907)	(-1.373)	(1.516)
Manapang Ward 5	-151.163	-2,170.517**	-214.682	149.858
	(-0.736)	(-2.974)	(-1.254)	(1.342)
Manapang Ward 8	-306.217	-2,195.341**	-299.958	122.003
	(-1.397)	(-3.049)	(-1.629)	(1.016)
Constant	-166.008	-822.338**	-163.707	-148.051*
	(-1.032)	(-2.438)	(-1.207)	(-1.654)
Lambda	--	-86.61**	--	23.43
		(-2.65)		(19.11)
Number of observations	357	348	348	348
R^2	0.32		0.26	
Chi-Square (51)		91.26		126.82
Log-likelihood		-1,291.11		-1,413.71

Notes: t or z-statistics in parentheses; ** significant at 5 percent level, * significant at 10 percent level.

Table 7—Percentage of total collection time by men, women, and youth

Independent variable	Men	Women	Youth
VDC forest area	0.003**	5.45 e-06	-0.0001
	(2.872)	(0.041)	(-0.515)
Median minutes/kg fuelwood	0.017*	0.007	0.003
	(1.708)	(1.588)	(0.619)
FUG dummy	0.197**	-0.031	0.024
	(2.926)	(-0.618)	(0.433)
Years of organized community forestry	-0.004	0.004	0.006
	(-0.755)	(0.815)	(1.099)
Male adults 16-59	0.009	-0.019*	-0.002
	(0.854)	(-1.733)	(-0.158)
Female adults 16-59	-0.031**	0.012	0.008
	(-2.248)	(0.896)	(0.633)
Youth 6-15	-0.020**	-0.014*	0.004
	(-2.257)	(-1.664)	(0.491)
Children 0-5	-0.013	0.025**	-0.019*
	(-1.001)	(2.197)	(-1.647)
Age of household head	0.001	0.0003	0.001
	(0.593)	(-0.354)	(1.044)
Percentage literate adults	0.0001	0.0004	0.0001
	(-0.141)	(-1.032)	(0.306)
Occupational caste dummy	-0.047	-0.023	0.025
	(-1.261)	(-0.652)	(0.751)
Tibeto-Burman dummy	-0.041	0.022	0.023
	(-0.804)	(0.462)	(0.523)
Real nonlabor income	0.002	-0.004	0.002
	(0.768)	(-1.457)	(0.938)
Livestock units	0.008**	-0.007**	-0.002
	(2.185)	(-1.987)	(-0.712)
Upland area	-0.051	0.036	0.027
	(-1.490)	(1.264)	(0.974)
Lowland area	-0.004	-0.015	-0.010
	(-0.120)	(-0.461)	(-0.316)

(continued)

Table 7—(continued)

Independent variable	Men	Women	Youth
Monsoon 1997 dummy	-0.084	-0.212**	0.228**
	(-0.841)	(-3.452)	(3.495)
Monsoon 1982 dummy	0.128**	-0.091**	0.180**
	(2.285)	(-3.160)	(6.220)
Dry Season 1997 dummy	-0.089	-0.099	0.148**
	(-0.871)	(-1.600)	(2.135)
Bagkhor Ward 1	1.298**	0.012	0.080
	(2.797)	(0.125)	(0.814)
Bagkhor Ward 2	1.274**	0.025	0.023
	(2.742)	(0.236)	(0.225)
Bagkhor Ward 8	1.121**	0.071	-0.075
	(2.794)	(0.588)	(-0.584)
Chhoprak Ward 7	-0.152**	0.006	0.028
	(-2.001)	(0.083)	(0.405)
Manapang Ward 5	-3.566**	-0.001	0.171
	(-2.936)	(-0.009)	(1.006)
Manapang Ward 8	-3.530**	0.135	0.139
	(-2.973)	(0.771)	(0.763)
Constant	-1.291**	0.803**	-0.042
	(-2.250)	(6.235)	(-0.305)
Lambda	0.043**	--	-0.003**
	(17.87)		(18.94)
Number of observations	348	348	348
R^2		0.26	
Chi-Square (49)	170.12		125.48
Log-L	-73.72		-76.52

Notes: t or z-statistics in parentheses; ** significant at 5 percent level, * significant at 10 percent level.

Table 8—Environmental goods consumption demands, kilograms per day

Independent variable	Fuelwood	Fuelwood per capita	Leaf fodder	Cut grass
VDC forest area	-0.009**	-0.002**	-0.057	-0.004
	(-2.544)	(-2.498)	(-0.816)	(-0.135)
Median minutes/kg fuelwood	-0.212*	-0.087**	-0.901	-2.329**
	(-1.696)	(-3.237)	(-1.157)	(-2.341)
FUG dummy	-0.411	-0.117	-0.039	34.979**
	(-0.306)	(-0.407)	(-0.007)	(3.283)
Years of organized community forestry	-0.025	-0.037	1.491**	0.582
	(-0.201)	(-1.369)	(3.068)	(0.589)
Male adults 16-59	0.299	-0.160**	-0.386	9.947**
	(1.011)	(-2.521)	(-0.502)	(3.437)
Female adults 16-59	0.349	-0.196**	-0.804	1.160
	(0.976)	(-2.552)	(-0.783)	(0.386)
Youth 6-15	0.279	-0.259**	-1.222*	0.503
	(1.274)	(-5.507)	(-1.709)	(0.295)
Children 0-5	0.200	-0.262**	2.522**	-1.523
	(0.644)	(-3.918)	(2.466)	(-0.594)
Age of household head	-0.015	-0.004	-0.014	0.216
	(-0.542)	(-0.621)	(-0.142)	(1.001)
Percentage literate adults	0.018	0.001	-0.008	0.022
	(1.491)	(0.297)	(-0.197)	(0.229)
Occupational caste dummy	0.990	0.351*	4.977	4.446
	(1.029)	(1.698)	(1.573)	(0.582)
Tibeto-Burman dummy	0.472	-0.105	7.545**	12.826
	(0.384)	(-0.397)	(2.055)	(1.315)
Real nonlabor income	0.055	0.005	-0.446**	0.663
	(0.740)	(0.306)	(-2.095)	(1.131)
Livestock units	0.195**	0.028	0.531*	1.932**
	(2.195)	(1.489)	(1.790)	(2.722)
Upland area	1.616**	0.351**	-3.151	-7.653
	(2.070)	(2.091)	(-1.268)	(-1.240)
Lowland area	-0.435	-0.049	5.207**	-2.887
	(-0.487)	(-0.257)	(1.922)	(-0.408)

(continued)

Table 8—(continued)

Independent variable	Fuelwood	Fuelwood per capita	Leaf fodder	Cut grass
Monsoon 1997 dummy	-4.568**	-0.717**	-18.081**	-45.111**
	(-2.753)	(-2.009)	(-2.374)	(-3.651)
Monsoon 1982 dummy	-0.613	-0.193	--	--
	(-0.781)	(-1.144)		
Dry season 1997 dummy	0.306	0.104	-30.500**	--
	(0.184)	(0.292)	(-3.830)	
Bagkhor Ward 1	-7.868**	-1.906**	-24.533	-4.242
	(-2.990)	(-3.368)	(-0.716)	(-0.205)
Bagkhor Ward 2	-4.079	-1.401**	-10.807	-9.917
	(-1.438)	(-2.295)	(-0.319)	(-0.441)
Bagkhor Ward 8	-7.501**	-1.079	-62.465**	-56.359**
	(-2.305)	(-1.542)	(-1.996)	(-2.172)
Chhoprak Ward 7	-1.887	-0.411	-18.107**	-13.699
	(-1.045)	(-1.059)	(-2.771)	(-0.951)
Manapang Ward 5	8.015*	1.487	76.050	-30.406
	(1.808)	(1.560)	(0.846)	(-0.866)
Manapang Ward 8	6.980	1.061	59.934	-24.595
	(1.474)	(1.042)	(0.687)	(-0.655)
Constant	15.610**	5.511**	64.765	52.332*
	(4.479)	(7.353)	(1.537)	(1.913)
Lambda	--	--	0.608	--
			(15.110)	
Number of observations	358	358	262	178
R^2	0.31	0.30		0.41
Chi-Square (49)			129.33	
Log-L			-648.30	

Notes: t or z-statistics in parentheses; ** significant at 5 percent level, * significant at 10 percent level.

Table 9—Per unit collection time, minutes per kilogram

Independent variable	Fuelwood	Leaf Fodder	Cut Grass	Water[a]
VDC forest area	0.017**	0.024	-0.004	0.040**
	(2.175)	(0.954)	(-1.208)	(3.190)
Median minutes per kilogram fuelwood	1.254**	0.101	0.390**	0.534
	(4.080)	(0.366)	(3.084)	(1.203)
FUG dummy	-3.411	5.886**	0.616	0.630
	(-0.984)	(2.905)	(0.444)	(0.131)
Years of organized community forestry	-0.091	-0.046	0.058	2.003**
	(-0.293)	(-0.267)	(0.445)	(4.482)
Male adults 16-59	-0.188	0.124	-0.228	0.646
	(-0.279)	(0.449)	(-0.606)	(0.614)
Female adults 16-59	-0.298	-0.010	-0.005	0.054
	(-0.345)	(-0.026)	(-0.014)	(0.043)
Youth 6-15	-0.519	0.399	0.314	-0.007
	(-0.949)	(1.562)	(1.424)	(-0.008)
Children 0-5	1.027	0.362	0.183	0.994
	(1.376)	(0.988)	(0.539)	(0.902)
Age of household head	-0.039	0.025	0.017	-0.036
	(-0.603)	(0.740)	(0.614)	(-0.374)
Percentage literate adults	-0.004	0.031**	0.001	-0.010
	(-0.125)	(2.120)	(0.083)	(-0.227)
Occupational caste dummy	2.112	-0.386	-0.043	-0.811
	(0.941)	(-0.343)	(-0.042)	(-0.236)
Tibeto-Burman dummy	1.544	-0.674	0.651	3.648
	(0.521)	(-0.513)	(0.511)	(0.815)
Real nonlabor income	0.156	-0.045	-0.076	0.336
	(0.884)	(-0.586)	(-1.011)	(1.270)
Livestock units	-0.084	0.072	0.155	0.219
	(-0.404)	(0.675)	(1.636)	(0.688)
Upland area	-2.779	-0.505	1.008	-1.510
	(-1.564)	(-0.566)	(1.269)	(-0.552)
Lowland area	2.321	-2.274**	-1.682*	-3.572
	(1.044)	(-2.348)	(-1.843)	(-1.132)

(continued)

Table 9—(continued)

Independent variable	Fuelwood	Leaf Fodder	Cut Grass	Water[a]
Monsoon 1997 dummy	3.157	-6.561**	2.409	-24.065**
	(0.692)	(-2.414)	(1.490)	(-4.101)
Monsoon 1982 dummy	9.794**	--	--	3.246
	(5.401)			(1.153)
Dry Season 1997 dummy	1.461	-3.396	--	-12.526**
	(0.342)	(-1.200)		(-2.131)
Bagkhor Ward 1	7.151	4.545	1.757	33.335**
	(1.168)	(0.372)	(0.662)	(3.565)
Bagkhor Ward 2	7.704	5.266	-0.766	32.131**
	(1.157)	(0.437)	(-0.268)	(3.204)
Bagkhor Ward 8	12.479	1.460	-0.573	-0.188
	(1.530)	(0.131)	(-0.171)	(-0.016)
Chhoprak Ward 7	7.270	-9.503**	-1.061	2.736
	(1.625)	(-4.103)	(-0.563)	(0.425)
Manapang Ward 5	-16.695*	-31.862	4.203	-13.881
	(-1.753)	(-0.994)	(0.955)	(-0.890)
Manapang Ward 8	-13.769	-36.154	7.063	-44.794**
	(-1.330)	(-1.163)	(1.493)	(-2.683)
Constant	-9.385	-7.707	1.734	-13.798
	(-1.148)	(-0.513)	(0.494)	(-1.115)
Lambda	--	1.716	--	--
		(15.669)		
Number of observations	271	262	164	349
R^2	0.30		0.22	0.36
Chi-Square (49)		131.82		
Log-L		-505.97		

Notes: t or z-statistics in parentheses; ** significant at 5 percent level, * significant at 10 percent level.
[a] minutes per trip.

Table 10—Collection of environmental goods from own land

	1982/1983		1996/1997	
	Mean	Standard deviation	Mean	Standard deviation
From recall data from 1996/1997[a]				
Percentage of fuelwood from own land	47.98	39.22	59.51	36.83
Percentage of fodder from own land	68.70	40.31	84.45	30.40
Percentage of cut grass from own land	69.43	38.07	80.83	30.14
From 1997 collection data[b]				
Dummy = 1 if collect fuelwood[c]			0.65	0.47
and collect on own land			0.40	0.49
and collect in community forest			0.19	0.39
Dummy = 1 if collect leaf fodder[c]			0.38	0.48
and collect on own land			0.26	0.44
and collect in community forest			0.11	0.31
Dummy = 1 if collect cut grass[d]			0.93	0.25
and collect on own land			0.89	0.30
and collect in community forest			0.03	0.17

Sources*:* Nepal Household Resurveys, 1996/1997, the International Food Policy Research Institute, U.S. Agency for International Development, Goteborg University, Sweden, Winrock International-Nepal, and author's fieldwork.

[a] NENS households only.
[b] Full 1997 sample.
[c] Late dry season and monsoon rounds both included.
[d] Grass figure for monsoon round only.

Table 11—Probit for place of collection for fuelwood and leaf fodder

Independent variable	Fuelwood from own land	Fodder from own land	Fuelwood from community forest	Leaf fodder from community forest
Ward forest area	-0.002*	-0.002**	0.003**	0.003
	(-1.650)	(-2.020)	(2.118)	(1.594)
FUG enforcement dummy	0.135	0.539**	-0.513	0.382
	(0.524)	(2.212)	(-1.210)	(0.794)
Adult males 16-59	-0.197	0.028	0.012	-0.057
	(-1.518)	(0.234)	(0.072)	(-0.262)
Adult females 16-59	0.027	-0.092	0.108	0.088
	(0.224)	(-0.783)	(0.581)	(0.367)
Youth 6-15	-0.219**	0.039	0.041	0.395**
	(-2.601)	(0.506)	(0.385)	(2.631)
Children 0-5	-0.197*	-0.036	0.097	0.134
	(-1.792)	(-0.338)	(0.584)	(0.628)
Age of household head	-0.001	-0.001	0.010	0.008
	(-0.067)	(-0.178)	(0.923)	(0.471)
Percentage of literate adults	0.003	0.005	-0.002	-0.006
	(0.839)	(1.325)	(-0.324)	(-0.713)
Occupational caste dummy	-0.080	0.014	0.129	1.458**
	(-0.250)	(0.042)	(0.263)	(2.056)
Tibeto-Burman dummy	-1.199**	-0.234	0.496	2.148**
	(-3.143)	(-0.701)	(1.211)	(3.218)
Real nonlabor income	-0.079*	-0.007	0.014	0.024
	(-1.864)	(-0.285)	(0.462)	(0.626)
Livestock units	-0.039	-0.047	-0.043	0.012
	(-0.892)	(-1.128)	(-0.851)	(0.195)
Lowland area	-0.071	0.727**	-0.036	0.080
	(-0.230)	(2.526)	(-0.087)	(0.164)
Upland area	0.184	-0.261	-0.456	0.912
	(0.491)	(-0.648)	(-0.921)	(1.504)
Upland Ward dummy	-0.333	-0.342	2.540**	0.719
	(-1.014)	(-1.109)	(3.919)	(1.104)
Monsoon dummy	-1.157**	-0.715**	-1.593**	-2.482**
	(-5.456)	(-3.574)	(-5.446)	(-4.428)
Constant	1.764**	-0.179	-2.930**	-4.716**
	(2.768)	(-0.290)	(-3.227)	(-3.216)
Number of observations	218	217	218	217
Chi-Square (16)	89.31	43.06	109.76	96.95
Log-L	-102.76	-108.29	-56.12	-33.04

Notes: z-statistics in parentheses; ** significant at 5 percent level, * significant at 10 percent level.

APPENDIX

Table 12—Probit results from Heckman Selection Model

Independent variable	Men participate in collection	Youth participate in collection	Household collects leaf fodder
VDC forest area	-0.0004	-0.0001	-0.003
	(-0.314)	(-0.132)	(-0.427)
Median minutes per kilogram fuelwood	0.059	-0.075**	-0.027
	(1.478)	(-2.306)	(-0.362)
FUG dummy	0.374	0.549	1.084*
	(0.943)	(1.490)	(1.876)
Years of organized community forestry	0.015	0.001	0.153**
	(0.416)	(0.016)	(3.177)
Male adults 16-59	0.238**	0.011	0.011
	(2.341)	(0.141)	(0.115)
Female adults 16-59	-0.153	0.113	-0.060
	(-1.391)	(1.167)	(-0.534)
Youth 6-15	0.085	0.209**	0.058
	(1.143)	(3.435)	(0.831)
Children 0-5	-0.025	-0.156**	0.144
	(-0.271)	(-1.929)	(1.363)
Age of household head	0.005	-0.0002	-0.0002
	(0.688)	(-0.036)	(-0.028)
Percentage literate adults	0.004	0.0001	0.004
	(0.989)	(0.018)	(1.110)
Occupational caste dummy	0.280	0.373	0.317
	(0.994)	(1.457)	(1.064)
Tibeto-Burman dummy	-0.044	-0.043	0.386
	(-0.124)	(-0.134)	(1.047)
Real nonlabor income	0.003	0.030	0.012
	(0.167)	(1.514)	(0.403)
Livestock units	0.076**	0.005	0.010
	(3.038)	(0.200)	(0.336)
Upland area	-0.441*	-0.154	-0.153
	(-1.765)	(-0.743)	(-0.533)
Lowland area	-0.089	0.350	0.762**
	(-0.315)	(1.505)	(2.718)

(continued)

Table 12—(continued)

Independent variable	Men participate in collection	Youth participate in collection	Household collects leaf fodder
Monsoon 1997 dummy	-0.496 (-1.023)	-0.553 (-1.222)	-3.263** (-3.783)
Monsoon 1982 dummy	-2.168** (-8.254)	0.943** (4.474)	--
Dry Season 1997 dummy	-0.743 (-1.266)	-1.145** (-2.504)	-2.283** (-2.667)
Bagkhor Ward 1	0.370 (0.429)	0.388 (0.564)	-0.378 (-0.111)
Bagkhor Ward 2	0.288 (0.318)	1.126 (1.412)	1.050 (0.309)
Bagkhor Ward 8	-0.458 (-0.458)	-0.665 (-0.767)	-4.838 (-1.557)
Chhoprak Ward 7	0.264 (0.503)	0.542 (1.136)	-1.172** (-1.937)
Manapang Ward 5	0.641 (0.383)	0.521 (0.459)	4.849 (0.546)
Manapang Ward 8	0.535 (0.300)	-0.265 (-0.218)	2.381 (0.272)
Constant	-0.652 (-0.580)	0.014 (0.016)	1.510 (0.358)
Lambda	--	--	--
Number of observations	348	348	262
Chi-Square (51)[a]	91.26	126.82	129.33
Log-L	-1,291.11	-1,413.71	-648.30

Notes: z-statistics in parentheses; ** significant at 5 percent level, * significant at 10 percent level.
[a] Chi-Square (49) for the fodder equation.

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