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HOUSEHOLD CHARACTERISTICS AND DEPENDENCY ON COMMUNITY FORESTS IN TERAI OF NEPAL

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Abstract

An econometric model linking user household's socio-economic characteristics and their fuel-wood collection patterns from local common property forests was examined in a highly heterogeneous (>60% by caste and wealth status) Terai community of Nepal. The cross-sectional analysis provides evidence in favor of the hypothesis that socio-economic inequalities within the group are inexorably associated with the ability of the households in resource use. In general, it is evident that household's wealth status (coefficient for rich = -0.420; p = 0.019), proximity to the forest (coefficient for distance = -0.280; p = 0.083), forest visit (coefficient for frequent forest visit = +0.257; p = 0.066) exert a strong influence on appropriating fuel-wood from the forest. Above all, income status of households was found to be key determinant of household's fuel-wood collection from the forest. Poor households were highly dependent on the forests for fuel-wood (average annual extraction = 4561.3 kg/household) in order to sustain their day-to-day livelihood. The high dependence of poor coupled with their large population size in the region (>27%) will possibly cause forest degradation in future. Therefore, policy must be directed towards reducing fuel-wood dependency of poor households by lifting their economic status so that they can substitute fuel-wood in day-to-day use. A broader policy implication of our analysis is to consider socio-economic heterogeneity of society and household's dependency on natural resources prior to devolution of management rights to local level.

Keywords: *fuel-wood dependency, community forestry, group heterogeneity, devolution, Nepal.*

Introduction

Dependency of rural households on common pool resources (CPRs) and their diverse use pattern have become an important topical issue in developing economies. CPRs, are usually characterized by multiple use

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values such as consumptive, recreational, environmental and spiritual with different interests of rural households (Baland & Platteau 1999). Most CPRs are sufficiently large so multiple actors are able to use the resource system simultaneously (Varughese & Ostorm 2001). Further, the resources are common to everyone who wants to exploit them, but goods produced are private (Ostrom *et al.* 1999). In this light, CPRs that generate finite quantities of resource units (e.g. water, timber, fodder etc.) have characteristics of both private and public good since exclusion of the users from using the resource is difficult and joint use involves substractability[2].

Scholars of the commons have indicated suboptimal outcomes of CPRs held in an open access situation, arguing that resources will ultimately become depleted because of the temptation of free ride. As the pervasiveness nature of the CPRs has caused failure in both market and policy arena, community based property rights over CPRs are considered to be the most viable option for both ecological and economic sustainability of the commons. Consequently, governments of more than one hundred countries are now perusing community forestry (CF) initiatives that provide some sort of local users control over the resources (Wily 2005).

As in other developing countries, devolution of management rights of forest resources from centralized government to local users group has widely been experienced in Nepal for more than two decades, when national forests were progressively handed-over to community forest users group (CFUGs). Under a strong legal framework[3], government handed over certain sections of national forests to self-organized local institutions bringing together traditional users of the forests. The landmark shift of forest ownership to local community has become a major forest policy in Nepal that seeks twin role of CF in poverty alleviation thorough its significant positive impact on local level economic development and biodiversity conservation. About one million ha of forest land from different parts of the country have been handed over to 11 147 CFUGs constituting ca. 1.2 million households accounting for ca. 35% of total population (Sapkota 2003). Most of the easily accessible forests have already been put under the community-based management and the

[2] Two basic attributes of CPRs make their management difficult at individual or household level. Firstly, spatial scale and externalities involved in their use in most CPRs such as irrigation systems, forests, rangelands, fisheries, and other forms of CPRs involves joint use (Meinzen-Dick & Knox 1999). Secondly, resource units derived from the CPRs such as water, timber, fodder etc. are subtractive in nature where one person's use subtracts from the quantity of resource units available to others. See Ostrom *et al.* (1994) for more details.

[3] The Master Plan set the stage for devising and implementing more user-oriented legislation and development approaches in the forestry sector. With the advent of democracy in 1990, the Forest Act in 1993 and Forest regulation in 1995 were enacted and were considered as the most important developments in the forestry sector. The Act provided a strong legal framework for the registration of CFUGs as independent organizations for management of forests.

government is planning to hand over most of the potential community forests[4] to local users by 2010.

Although the CF programme has succeeded in halting the ongoing trend of deforestation, empirical evidence on benefit sharing among the users (Richards *et al*. 1999, Springate-Baginski *et al.* 1999, Adhikari *et al.* 2004) and their dependency levels on the forests are rather ambiguous. On one hand, researcher have described the positive impacts of the CF programme on forest regeneration and improvement of the biophysical condition of forests but on the other hand they have pointed out discriminations in benefit-sharing among the users of the forest resources. It is claimed that neither common property resources have been used more efficiently by all users than under state management (Meizen-Dick & Knox 1999), nor have individual incentives from these resources been analyzed. Besides, there is now some evidence that formalized systems of common property regimes may lead to a gradual but systematic exclusion of poorer households from CPRs (Adhikari *et al.* 2004).

Moreover, when a responsibility of allocating natural resources is delegated to local organizations, communities are expected to consider socio-economic capacity of individual users in resource use so as to figure out their dependency on the resources. Hence, the subject has become increasingly concerned with contested roles of socio-economic disparity among users and their dependency on CPRs. This paper, therefore aims to analyze the relationship between individual household's socio-economic attributes and their ability to use the CF resources. Section two reviews theoretical and empirical work on group heterogeneity, poverty and dependence on CPRs and sets a working hypothesis for the study. Section three discusses study area, methodological issues and survey designs. Section four reports and discusses the results obtained from descriptive statistics and econometric analysis. The final section concludes with policy recommendations.

Socio-Economic Heterogeneity, Poor and Resource Dependence

Theory on the relationship between socio-economic heterogeneity and local level collective action[5] in community-based resource management receives much attention in both economic and social science literature (Adhikari 2005). The term heterogeneity is often used to describe inequalities in income and private endowments, inequalities in contribution to collective action, inequalities in benefits derived from CPRs and inequalities in outside

[4] In a survey made by the Forest Department in 1991, it is stated that 61% of the total forest area (5.5 million ha) in Nepal is potential for Community Forestry (Khanal 2001).

[5] See Varughese & Ostrom (2001) for a full theoretical exploration with empirical analysis of collective actions based on histories and firsthand observations of ongoing activities of 18 community forests in Nepal.

earning opportunities (Bardhan & Dayton-Johnson 2000). The sources of heterogeneity are diverse and include disparities in culture, caste, gender, languages, ethnicity, political ideology, preferences, appropriation skills and settlements, which might influence an individual's incentives from collective action.

Kant (2000) posits that heterogeneity with regard to CPR management exists at three different levels. First, economic, socio-cultural and social differences form a basic level of heterogeneity. Second, due to basic heterogeneity, members of the user group may have diverse preferences for CPR products and hence prefer to harvest different mixture of products. Third, preferences over diversified CPR products often lead to different preferences for resource management either because of different personal interests in the resource or differing degrees of involvement in social group. Therefore, resource management regime can be treated as a function of product preference differences, which can in turn be treated as a function of cultural, economic, and social inequalities. Consequently, management objectives become more diverse and challenging for effective implementation since users may assign different priorities to various objectives of resource management.

More precisely, considerable amount of theoretical and empirical research have focused on the heterogeneity of assets. Many theoretical arguments are made for how asset heterogeneity is positively, negatively or unrelated to the use of the common pool resources (see Kant 2000, Bardhan & Dayton-Johnson 2000, Varughese & Ostorm 2001, Kerapeletswe & Lovett 2002, Adhikari *et al.* 2004, Adhikari 2005). The current empirical consensus is that inequality of assets can favor better commons management when there are high fixed costs (*viz.* effort, time and money) for the establishment of a community based regime or when each resource user's cooperative effort is proportional to the benefits derived from the system (see Baland & Platteau 1999, Bardhan & Dayton-Johnson 2000). However, when these are not met, asset inequality is generally detrimental to collective action (Pérez-Cirera & Lovett 2005) [6]. It is evidenced by Adhikari *et al.* (2004) and Agrawal & Gupta (2005) that asset heterogeneity in society can provide opportunities for powerful minorities to impose management rules that serve their own interests, which ignores group incentives from CPR management.

Along the line of users group's heterogeneity, their degree of direct dependence on the CPRs is an equally crucial socio-economic factor[7] that

[6] Recent theoretical developments have pointed towards a U-Shaped relationship between asset inequality and commons governance (see Dayton-Johnson & Bardhan 2001).

[7] Kant (2000) describes two socio-economic factors: Heterogeneity of users group and their dependency in the resources as the independent contributors for the change in forest regime in developing economies. He demonstrated that the optimal resource regime vary with the

determines optimal management regimes[8] (see Kant 2000). Kant (2000) demonstrated that the degree of direct dependence is defined as the share of direct returns from forests in the total utility bundle. Its range is also defined as 0 to 1, and may be reasonably measured by fraction of the user group's gross local production contributed by the forests. The degree of direct dependence will depend on the sustainability of forest returns that, in turn, will depend upon the availability of substitutes and the capacity of the users group for substitution. The capacity of the user group will depend on the consumption of utility bundle. In the case of utility bundle being comprised of forest returns only, there is no possibility of substitution and hence, the degree of direct dependence will be very high and equal to one. The case of subsistence dependence of poor communities will fall in this category because there are substitutes, but the user group is unable to acquire it because of their low monetary income.

Due to greater dependence, poor people extract more resources and hence generate higher income from the commons (see Jodha 1992, Iyenger & Shukla 1999). Based on quantitative assessment of household's various income sources in Uttar Pradesh of India, Reddy & Chakravarty (1999) found that poor generated more than 22% of their gross income from forests. Therefore, poverty is often blamed as primary reason for resource destruction because of high social discount rates and shorter time horizons of the poor. Due to shorter time horizons, poor tend to adopt strategies which yield more immediate results rather than long-term considerations in resource use. Moreover, if poverty drives the marginal rate of time preferences to infinity, then future environmental impacts of the current strategy are optimally ignored (Holdne *et al.* 1998). However, scholars conducting empirical analysis on CPRs use challenge this hypothesis arguing that compared to non-poor, the poor may depend more on commons in relative terms, but in absolute terms their dependency is lower, particularly for resources with good market opportunities (e.g. Dasgupta 1993, Adhikari 2005). They posits that the poor may attempt to minimize risk by using forest resources to mitigate shortfalls in consumption levels, the rich or less poor may be interested in enhancing their earning by selling these resources, particularly when there are good market opportunities.

variation in these socio-economic factors. The change in optimal resource regime is directly proportional to the rate of change in heterogeneity and dependence. However, increase in the dependence will drive the optimal resource regime towards a community regime, where all users entitled to all the products following a set of institutional norms.

[8] See Ostrom *et al*. (1994) for a discussion of common pool resources and an analysis of the conceptual differences between common pool resources and common property regimes.

In the rural context of Nepal, inequalities in private endowments (land and livestock holdings etc.) and income sources (occupation, employments, pensions etc.), family size, caste and location of settlements etc. together create socio-economic stratifications of households. These stratifications are often apparent in society differentiating households in rich and poor or upper and lower caste or proximate and distant users or big and small sized family etc. within the group. These phenomena are treated herein as socio-economic heterogeneity among user's households. Subsequently, we hypothesize that socio-economic heterogeneity has a strong association with quantity of fuel-wood collection from the CF since individual household's fuel-wood dependence varies in relation to their socio-economic attributes. As already mentioned above, among various socio-economic attributes, income status plays crucial role in resource use from CPRs. Therefore, it is assumed that the level of fuel-wood dependency of the poor is very high in comparison to the rich since the integral part of their subsistence is frequently based on the fuel-wood selling. Besides, the livelihood of some poor households e.g. balcksmith, local tea shoppers and wine makers is widely based on fuel-wood (Varughese & Ostrom 2001). Therefore, it is argued (based on Indonesian and Vietnamese experience) that the CF affects the livelihood systems of those dependent on resources (Adger & Luttrell 2000) with different magnitude. So, an attempt is made to investigate empirically through examination of the individual household's dependency level on fuel-wood corresponding to their heterogeneous income status.

Methodology

1. Study Area

The study was undertaken in Rupandehi district (27°20'-27°45' N and 83°10'-83°30' E) in western region of Nepal (see Figure 1 in Appendices). The district is surrounded by outermost Himalayan foothills in the north and Nepal-India boarder in the south, occupying a 26 to 32 km wide broad belt of flat and fertile land popularly known as 'Terai'[9](Sapkota 2003). The altitude of the district headquarter is 109 m above sea level. The region is

[9] The Terai of Nepal is different from other parts of country, especially from Hills. An extensive migration rate from the Hills has resulted in higher population density, which in turn creates heavy encroachment on the forests for agricultural production. Unlike Hills, it is characterized by ethnically and economically heterogeneous communities having widespread access to the forests. Forests in Terai are under heavy pressure due to the high population coupled with commercialization of forests products with favorable market opportunities. Although the new forest Act 1993 foster the community forestry programme in the Terai, management responsibilities of only 150 000 ha of forest land, accounting *ca.* 3% of total forest area of the country, have been handed over to 900 CFUGs, which is about three times less than in Hills of Nepal. It is so because, the users and the forest patches are situated spatially in the hills, and it is very easy to identify a given patches of forests and traditional users, which indeed rather difficult in the Terai. See Sapkota (2003) for details.

characterized by sub-tropical monsoon type of climate. The mean minimum (January) and maximum (June) temperatures are 22.5^{o} and 36.13^{o}C, respectively, with average annual precipitation of 2220 mm. Land use in the region is mostly categorized as cultivated land (60.2%) followed by forest land (21.6%) (Sapkota 2003). Almost one-fourth of the total forest area of the district has already been handed over to forty-two communities constituted by 31 871 households (Sapkota 2003).

Shankarnagar CF situated in the northern part of the district was selected for the study. The location of the forest is about 5 km south-east of the biggest city, Butwal. The CF is surrounded by human settlements and therefore under heavy pressure to meet primary forest product, mainly fuel-wood needs of rural households. This CF was selected for the study as it is the oldest CFUG in the district. Moreover, comprehensive analyses of this CF is also recommended elsewhere (see Sapkota 2003).

During late 70s, approximately 3600 households encroached upon the forest area due to political instability in the country. Government evicted the encroachers and replanted the area with support from local people. Following the Master Plan for Forestry Sector (MPFS), which emphasizes community forestry as the highest priority programme, government handed over 503 ha of forest area in 1989 and 46 ha in 1996 to the community. The forest is predominantly covered with Sal (*Shorea robusta*; 97.8%) regeneration associated with *Eugenia jambolana*, *Terminalia tomentosa* and *Anogeissus latifolius* in its natural form. About 90.4% of the regeneration was of sapling size (Sapkota 2003). The forest was also enriched by planting tree species such as *Dalbergia sissoo*, *Tectona grandis*, *Eucalyptus camaldulensis*, *Acacia catechu* and *Leucaena leucocephala*.

The forest user's group committee (FUGC) is the executive body of the CFUG. This committee had 20 elected members who have a two-year term of office. The FUGC employed four forest watchers with the responsibility to look after the forest. Committee members and staff from the local district forest office (DFO) jointly monitored the management activities inside the CF. As a rule, the FUGC had made arrangement for collection of fuel-wood levying Nepalese Rupee (NRs.[10]) 1/household as an entry fee to the CF. Alternatively, CFUG could acquire fuel-wood from the CF depot at almost half the normal market price (NRs. 80-100/quintal). Income from the fuel-wood was used for administrative purposes as allowance to members, office stationery and salary for office employees. Rest of the fund is used in rural and social development such as road construction, school and health post maintenance and sensitization campaign to the community.

[10] 1 US dollar = 71.11 NRs

2. The Data

The study was mainly based on primary data collected through a household survey made in autumn 2002. Because of the large population of the study area, a two-stage sampling technique was applied. Firstly, it was adopted to select the wards of the village development committee (VDC[11]) and then to select the households within the selected wards. A stratified cluster sampling was adopted in the first stage dividing the whole population of VDC into two sub-populations (strata). Each ward of the VDC was considered as the cluster and delineated into two different strata by the Siddhartha highway passing through north to south in the VDC. Wards east to the highway and close to the forest (1, 2, 3, 4 and 5) and the rest (6, 7, 8 and 9) were placed in first and second strata, respectively. Accordingly, we randomly drew a sample cluster, *i.e.* ward no. 1 from the first strata and 6 from second strata for next stage-sampling frame. Wealth ranking exercise and household survey were confined only within these selected wards.

Wealth ranking (see Adams *et al.* 1997) based on PRA technique was used to determine the relative economic status of each household in each sampled ward. The empirical validity of this method as a means of socio-economic stratification of households has already been tested in CF related research in Nepal (see Richards et al. 1999). A group of user's committee members and other key person *viz*. school teachers, VDC secretaries, holy persons and VDC leaders were asked to categorize all households into three wealth groups (rich, less poor and poor) using their own criteria (Table 1, in Appendices). The name of each head of household was written on a card and shown to the participants to verify their wealth condition. During the process, the participants discussed with each other, finalized the socio-economic status of each household and categorized them into the three different wealth groups.

In the second stage, a stratified random sampling was performed to draw the sample households for questionnaire survey in order to secure the representation of each economic class (Table 2). A total of 52 households were randomly chosen at 15% sampling intensity[12] (see Neuman 1994) from each wealth class (strata) and interviewed. Interview in most cases was conducted in a group of family members in order to get in-depth information. Closed as well as open-ended questions were administered and triangulated to gather the quantitative as well as qualitative information. Questions were asked to obtain information on households' size, distance from the forests, number of

[11] A VDC is smallest political unit of the country, which consist of nine wards. There are 3914 VDCs in Nepal.

[12] According to Nueman (1994), more than 10% sampling intensity for moderately large population is valid for the social studies.

trees in homestead, major income sources, caste[13] and ethnicity, landholdings, sources of fuel-wood, quantity of fuel-wood collection and consumption from the CF, and issues related to household level awareness concerning fuel-wood distribution. These questionnaires were prepared in Nepali language for the convenience of the respondents. Questionnaire was pre-tested in the same community to arrange the questions in a sequential order and removed in case of irrelevance. All information gathered from the open-ended questionnaires during household survey was coded and Statistical Package for the Social Sciences (SPSS, Version-12) was used for analysis.

3. The Heterogeneity Index

Socio-economic heterogeneity within the sample frame was determined based on wealth as well as caste status of households. Index of fractionalization was used to measure socio-economic heterogeneity differentiating the sample population into three income groups (rich, less poor and poor) and three caste groups (upper, middle and lower). The index was computed following Varughese & Ostrom (2001).

$$A = 1 - \sum_{i=1}^{n} (P_i)^2$$

where, P_i is the proportion of total population in the ith wealth or caste group. A varies from 0 to 1 and measures the probability that two randomly selected persons will not be the same wealth or caste group.

4. Model Specification

An econometric model was tested to understand the relationship between household's fuel-wood dependency (fuel-wood collection from CF[14]) and their socio-economic characteristics. It was hypothesized that household-level fuel-wood collection from CF is inextricably associated with household's socio-economic attributes. So variation in forest dependency for fuel-wood among households can be explained by the socio-economic status of user-households. The relationship can be represented as:

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[13] Brahmin, Chhetri and Thakuri belong to upper caste. Lower caste includes Kami, Sarki, and Damai. Caste such as Magar, Gurung, Newar, Chaudhari and Yadav were considered as middle caste group.

[14] More than 70% of total respondent households perceived that fuel-wood is their major concern among the benefit they derived from the forests. Therefore, for the purpose of the study, we used fuel-wood collection as an indicator of resource use by the households as it is the key forest product in the region.

Fuel-wood collection of household$_i$ from CF (Y_i) = f [wealth$_i$ (x_1), caste$_i$ (x_2), distance to forest$_i$ (x_3), landholding size$_i$ (x_4), family size$_i$(x_5), employment$_i$ (x_6), labor allocation$_i$ (x_7)] where, the dependent variable, Y, measures the household-level fuel-wood collection from CF. Household attributes, on the other hand, were used as explanatory variables. The corresponding regression equation was defined as a log-linear model to be empirically tested in following section.

$$\ln Y_i = \beta_{i1} + \sum_{i=1}^{7} \beta_{ij} \ln X_{ij} + \varepsilon_i$$

We treated quantity of fuelwood collected by households as an indicator of fuel-wood dependence on CF for subsistence (Amacher *et al.* 1996, Bandyopadhyay & Shyamsundar 2004). The explanatory variables used to explain fuel-wood dependency of households in the CF are given in table 3.

Results and Discussions

Descriptive statistics revealed differences in household's characteristics within the sample frame (Table 4). Wealth and caste heterogeneity indices were more than 0.6 implying high socio-economic disparity in the community (Varughese & Ostrom 2001). Moreover, a large difference in amount of fuel-wood collection among households was also evident suggesting inequality in fuel-wood collection. Results presented in table 5 show inequalities in distribution of landholding size among wealth and caste groups. Hence, the results herein provided ample evidences of socio-economic heterogeneity among households, both in terms of socio-economic characteristics and their patterns of fuel-wood collection.

Results presented in table 6 show that household's wealth status, proximity to the forests, landholding size and labor allocations for fuel-wood collection are crucial socio-economic determinants for fuel-wood collection. The amount of fuel-wood collection varied greatly between rich and poor, and between proximate and distant users. Share of fuel-wood from the CF was higher for lower income group and proximate households. Rich households collected almost ten times less fuel-wood from the CF than the poor households, where as distant households did so almost four times less than the proximate users. Lower caste group collected more fuel-wood than upper caste groups. Similarly, the pattern of fuel-wood collection among households in relation to the size of family showed that the bigger family sized households consume slightly higher amounts of fuel-wood than the smaller family sized households. Likewise, non-employed households showed higher amount of fuel-wood collection from the CF than the employed households.

An analysis of the household characteristics in relation to high labor input in fuel-wood collection revealed that more than 90% of sampled households belonged to poor and less poor income group (Table 7). Also, very few wealthier households (9.1%) showed high labor input for fuel-wood collection. Similarly, 72.7% of households having smaller land endowment and 86.4% of households belonging to the larger sized family allocated high labor sources in fuel-wood collection activities.

The econometric output of the fuel-wood collection model is presented in table 8. Multicollinearity among the explanatory variables was seriously tested prior to run the model. Number of trees in private lands was found to be highly correlated to land holding size. Though it was preferred than landholding size in estimating the model, it drastically reduced significance and magnitude of 'distance' variable. Hence it was dropped from the model to avoid multicollinearity. Logarithmic transformation of the data was used in order to reduce the possibility of heteroscedasticity. Following the transformation, Breusch-Pagan diagnostic analysis indicated that heteroscedasticity was not significant and assumption of homoscedasticity was met. The goodness of fit of the model was high, as it showed the joint significance of the coefficients. The fuel-wood model produced a R^2 value of 0.49 suggesting moderate explanatory power of the model. The F-test statistics showed high significance, indicating that explanatory variables included in the model are significantly related to the dependent variable.

Our results corroborate with a study made by Fox (1984), who discussed similar variables in detail and reached with similar conclusions. Among the socio-economic explanatory variables, the income category 'rich' was negatively and significantly associated with amount of fuel-wood collection. The high negative coefficient value for 'rich' suggested that the better-off households collect lower amounts of fuel-wood from the CF. Rich households have ample choices of substitutes (e.g. LP gas[15], bio-gas and electricity) for fuel-wood they can readily afford for cooking and heating purposes. On the other hand, fuel-wood is the only available source of energy for 'poor' households as they cannot afford the substitution, and hence, they collect larger amounts of fuel-wood from the CF. Moreover, local 'poor' groups such as fuel-wood sellers and local wine-makers need a large quantity of fuel-wood for their livelihood (Springate-Baginski *et al.* 1999). These results were along lines of those reported by Jodha (1992), that relatively poor households depend more on common property resources. Based on a study made in

[15] Liquefied Petroleum Gas. A highly contrasting result was depicted on the use of LP gas between richer and poorer households, where 82% of richer households and 7% of poorer households use LP gas as a substitute of fuel-wood for cooking purposes. These facts fully describe the magnitude of fuel-wood dependency among poorer household, which indeed is very high in comparison to richer households.

India, Reddy & Chakravarty (1999) argued that the poor have less land and are dependent on forests for a greater share of their total income. Therefore, CF is more attractive to the poorest of the poor as it provides highest relative contribution to their livelihood (Khanal 2001).

Distance showed negative and significant relationship with fuel-wood collection from the CF. Households residing close to the forest were more likely to acquire higher amount of fuel-wood from the CF and reverse was true for the distant users. Kerapeletswe & Lovett (2002) also found similar observation in Botswana and argued that the distance involves walking and carrying the harvest resulting in increasing difficulty in the collection. Our result is in contrary to the findings by Adhikari *et al.* (2004) in mid hills of Nepal, where the households' distance to the forests do not really hinder them to access the forest for fuel-wood collection. This is probably due to the fact that fuel-wood is the basic need for a household in remote hills of Nepal and cannot easily be substituted by other sources of energy. However, the case is different in our study sites (Terai) as ample sources of energy to substitute fuel-wood, such as electricity, kerosene oil, LP gas and bio-gas are easily available.

Labor allocation was positively and significantly associated with the amount of fuel-wood collection. Households, who allocate high labor supply collect higher amount of fuel-wood from the CF. The frequent access to the forest leads to higher knowledge on availability of fuel-wood (twigs and dead branches) since they are only confined to the productive part of forests. The knowledge on 'where to collect fuel-wood' makes household labor more productive. Moreover, variation in labor allocation was depicted in relation to the socio-economic status of the households (Table 7), which probably explains the inequality in opportunity costs of households for fuel-wood collection. For example, due to their high opportunity cost of labor, wealthier households allocate less labor supply in fuel-wood collection than poorer households (Amacher *et al.* 1996, Baland *et al.* 2002).

Although not significant, landholding size was negatively associated with fuel-wood collection from the CF. The negative coefficient for landholding indicated that the households having larger size of landholdings collect lower amounts of fuel-wood from the CF. Households having larger landholdings are more likely to grow larger number of private trees on their land (Table 5), which indicate the fuel-wood productive opportunity. An insignificant relationship however may explain that better land endowed households often favor commercial timber production, and hence, private trees account for relatively small proportion of household's fuel-wood consumption (Cooke 1998). The positive but not significant association between fuel-wood consumption and family size here was probably in line with Fox (1984), who discussed in detail adjusting to account for consumption of fuel-wood on a

per capita basis. Fox (1984) argued that household with larger family size burn more fuel wood, but they burn less per capita than households of smaller family size.

Caste was positively associated, however not significant, with amount of fuel-wood collection implying that lower caste collect higher amount of fuel-wood from the CF. This may be due to the fact that lower caste households such as blacksmith (untouchable caste in Nepalese context) often belong to poor income group (Table 9), who require higher amounts of fuel-wood for their occupation and livelihood strategy. Khanal (2001) and Springate-Baginski *et al.* (1999) also found the positive relationship between caste disparity and level of collective action in mid-hills of Nepal. Interestingly, insignificant association between fuel-wood collection and household size may be due to the fact that fuel-wood collected from the CF is widely traded by poor households despite its entire consumption. On the other hand, employment displayed negative sign indicating that more labor allocation from employed households in fuel-wood collection might not be as productive as off-farm employment due to higher education level of the family.

Our results exemplify that individual household's socio-economic status reflects the fuel-wood needs and their ability to access the CF for fuel-wood collection. However, due to unavailability of data, we could not document the case-wise relationship between the users accessing village forests for multiple uses and their socio-economic attributes. It is claimed that village communities are dynamic and socio-economic status of households change with time. In the present era, as village communities pass through the different phases of economic development, the socio-economic status of households and their dependence will change in due course. More importantly, another Indian experience showed that the rate of change in social and economical attributes of rural households is directly proportional to the rate of change in resource use (see Kant 2000). Therefore, whatsoever the products extracted, household's socio-economic dynamics ultimately drive the ability to use village forest resources.

Conclusions and Policy Implication

The results from our research suggest that villages are not homogeneous entities that can be isolated and identified by single objective and common interests. Hence, heterogeneity in resource users, having different economic and social status, perspectives, knowledge systems, values, understanding and objectives (Adger & Luttrell 2000, Adhikari *et al.* 2004, Adhikari 2005) are fundamental dimensions of a society. Therefore, policies based up on the assumptions of village cohesiveness and homogeneity cannot assure the symmetric pattern of resource use even after the devolution of management

rights of resources to local level. Although differences in use of village resources apply to socio-economic attributes of rural households, institutional norms and priorities and/or interests of households cannot be ignored. In this light, we conclude that priorities for the use of resources differ due to different socio-economic capacity of resource users defending their priorities. Therefore, prior to devolution programme, policy makers should first acknowledge heterogeneity nature of local community rather than starting from a general assumption of group homogeneity. In order to integrate interests of various sub-groups of a heterogeneous society into management plans of CF, there must be in-depth socio-economic analysis to gauge their dependence level on the forests.

Both qualitative and quantitative analyses herein suggest that varying degree of household's fuel-wood dependence on the forests is primarily driven by their socio-economic conditions. More precisely, poor depends directly on the forest as their pattern of fuel-wood collection is very high. From the view point of Kant (2000), our results show that the share of fuel-wood from the forests in the total 'utility bundle' for poor households is close to one as their substitutability of fuel-wood is almost nil (see section 2). Despite the availability, the poor households are not able to acquire the substitutes because of their limited monetary income and private wealth endowment.

Dependence in terms of livelihood of poor should seriously be taken into account together with ecological consideration. Looking at our results from view point of Holdne *et al.* (1998), high dependence coupled with larger population size of poor and less poor (see table 2 and table 6) might cause forest degradation in the future (see section 2). Therefore, in the face of high dependence on forests in order to sustain livelihood strategy of poor, forest policy needs to be directed in shifting their livelihood strategy from direct exploitation of forests to alternate income generating activities, such as cultivation of non timber forest products (NTFPs) inside the forests that provide income to poorer households. Further, economic incentives seem the best means to seek the involvement of poor households in conservation efforts. Therefore, it is vital to provide economic incentives to poor households to substitute fuel-wood for their livelihood strategy at community level, which may transform an exploitative group into a conservation group.

If an optimal common property regime does not acknowledge the poverty in the region, it affects the quantity and quality of environmental resource-base in the long-run (Dasgupta & Maler 1991). A more egalitarian regime can generate positive environment on collective action balancing socio-political power structure and may combat poverty. Therefore, another policy implication of our study is to seek the direct involvement of the poorest of the poor in CF activities in order to ensure their representation in decision

making authority. Representation of interests of poor in community forest management regimes is highly required since they are primary stakeholders of forests.

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Appendices

Figure 1. The Location of the Study Area

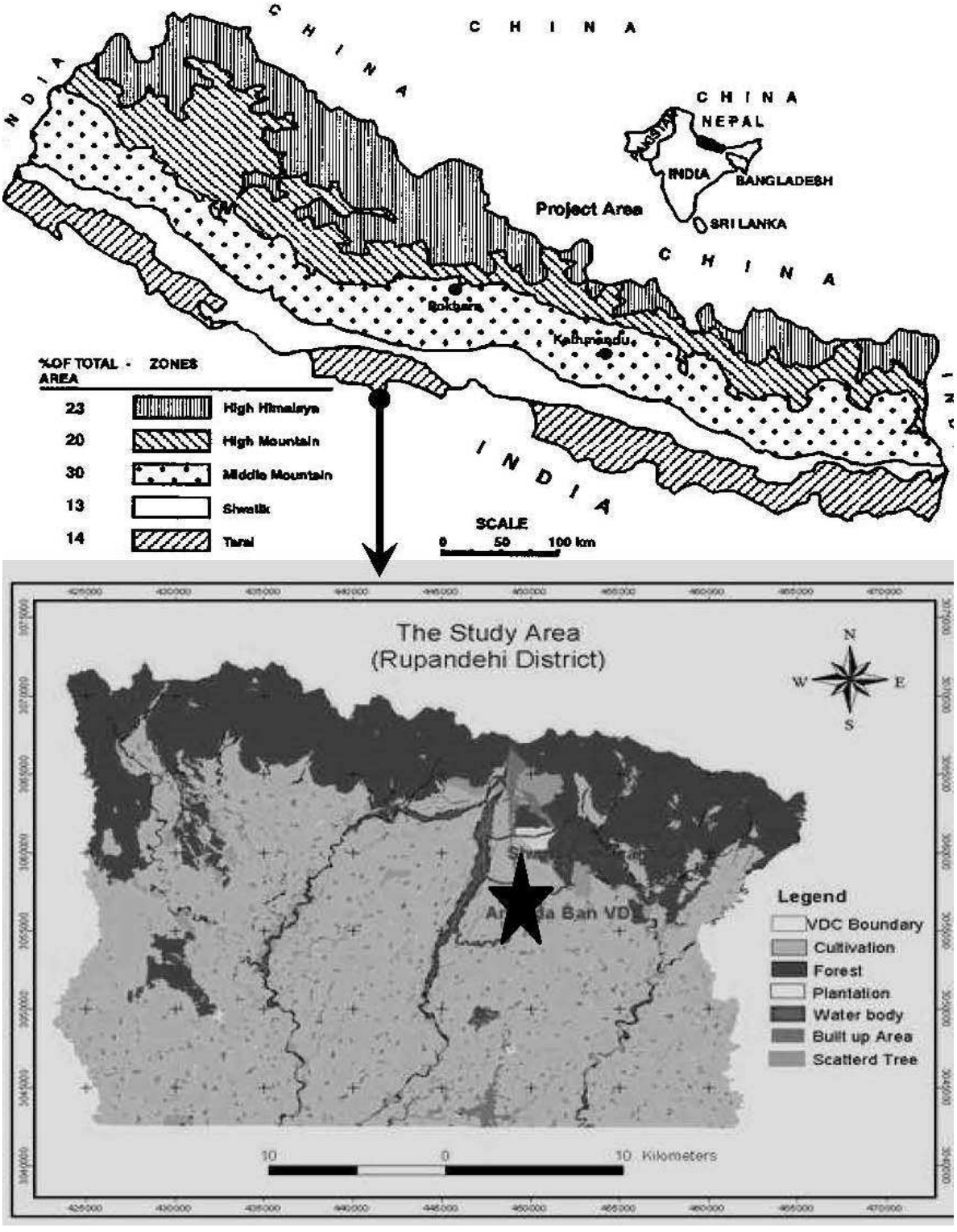

Table 1. Criteria Used by the Participants for Wealth-Ranking Exercise

S. No.	Criteria	Rich	Less poor	Poor
1	Land holding and/or quality of land	> 20 *Katha** fertile and cultivated in three season	5-20 *Katha*, hardly cultivated in three seasons	< 5 *Katha*, not fertile for all seasons, landless and tenancy
2	Size and/or patterns of houses	Big, 1-2 storied, concreted roof and cement walled	Small, 1 storied concreted or two-storied zinc platted roof	Small, thatch roofed, brick walled, or not, using landowner's dwelling
3	Pension	Highly paid, retired officers from British or Indian army	Low paid, retired non-officer from Indian army	Not paid
4	Savings	Able to save and supply debt	No saving, sometimes in debt	No saving, always in debt
5	Food sufficiency	Sufficient, able to sell	Hardly sufficient	Not sufficient
6	Animal holding and/or quality of livestock	Large in number, high quality breed cows and buffalos	Small in number, low quality breed cows and buffalos	No, less in number and quality breed goats and pigs, tenancy
7	Business and/or employments	Entrepreneurs, highly paid service holders	Tea shops or grocery owner, low paid service holders	No business, daily wages, hard labor job holders

Note: * 1 *Katha* = 340 sq m

Table 2. Number of Households (HHs) by Income Group and Their Representation in Questionnaire Survey

Economic class	Cluster 1		Cluster 2	
	Total	Sampled	Total	Sampled
Rich	40(17.2)	6	31(27.6)	5
Less poor	129(55.6)	19	49(43.7)	8
Poor	63(27.2)	9	32(28.7)	5
Total	232(100)	34	112(100)	18

Note: Figures in parentheses represent the percentages

Table 3. Definition of Explanatory Variables Considered for the Econometric Analysis

Variables	Description
Rich	Dummy for rich households (1, if households belong to the rich income group and 0 otherwise)
Lower caste	Dummy for lower caste (1, if lower caste and 0 otherwise)
Family size	Number of family members in a household
Landholding size	Land area under household management (*Katha*)
Distance	Distance between community forests and house (km)
High labor allocation	Frequency of forest visit; dummy for high frequency (1, if more than twice a week (high) and 0 otherwise)
Employed households	Households member employed in government offices; dummy for employment as the main source of income (1, if households' livelihood based on the employment and 0 otherwise)

Table 4. Descriptive Statistics and Heterogeneity Index of Variables Used in Econometric Model

Attributes	Observations	Mean	Std. dev.	Min	Max
Fuel-wood consumption (kg)	52	3463.30	3509.40	0	13870
Wealth*	52	0.21	0.41	0	1
Caste*	52	0.54	0.51	0	1
Family size (No. of persons)	52	5.90	1.83	1	10
Landholding (*katha*)	52	11.0	10.8	1	40
Distance (km)	52	1.90	1.31	1	4
Labor allocation	52	0.42	0.49	0	1
Employment	52	0.10	0.23	0	1

Note: * Heterogeneity indices were calculated for these attributes.
Wealth heterogeneity index = 0.615, and caste heterogeneity index = 0.632

Table 5. Average Landholding Size (*Katha*) and Number of Private Trees in Homestead by Income and Caste Groups

Socio-economic class	Land holding size	Private trees
Rich	25.3(3.6)	41.6(20.4)
Less poor	9.4(1.3)	11.0(3.4)
Poor	2.7(0.6)	7.9(1.8)
Upper caste	12.8(2.1)	18.4(6.4)
Middle caste	12.8(2.9)	20.1(11.3)
Lower caste	3.35(0.8)	4.7(1.1)

Note: Standard error in parentheses

Table 6. Pattern of Fuel-Wood Collection from CF in Relation to Household's Characteristics

Household characteristics		Average annual collection of fuel-wood (kg)
Wealth	Rich	390.91(150.4)
	Less poor	4145.6(741.8)
	Poor	4561.3(763.3)
Caste	Upper	3533.5(715.5)
	Middle	2809.1(861.2)
	Lower	4472.3(1056.9)
Distance (km)	< 3 km	4289.5(581.7)
	> 3 km	984.6(369.0)
Landholding size (*Katha*)	<10	4536.6 (550.2)
	10-20	2303.2 (943.2)
	>20	75.0 (75.0)
Family size (Person)	<4	3312.3(1020.4)
	>4	3503.7(559.4)
Employment	Employed	2240.9 (1277.1)
	Non-employed	3538.1(510.7)
Labor allocation	High	4720.8(716.4)
	Low	2541.1(616.5)

Note: Figures in parentheses represent the standard error of mean

Table 7. Percentages of Households Allocating High Labor Input in Fuel-Wood Collection in Relation to Their Socio-Economic Status

Household characteristics		%
Income group	Rich	9.1
	Poor/Less poor	90.9
Landholding size (*Katha*)	>10	27.3
	<10	72.7
Family size (person)	<4	13.6
	>4	86.4
Distance (Km)	<3	72.7
	>3	27.3
Caste	Upper	40.9
	Middle/Lower	59.1
Employment	Employed	9.1
	Non-employed	90.9

Table 8. Socio-Economic Determinants of Fuel-Wood Collection from CF

Variables	Coefficients	P value
Constant	11.305(2.057)	0.000***
Rich	-0.420(0.479)	0.019**
Lower caste	+0.083(0.295)	0.600
Distance	-0.280(0.266)	0.083*
Landholding size	-0.155(0.142)	0.408
Family size	+0.072(0.310)	0.594
High labor allocation	+0.257(0.255)	0.066*
Employed households	-0.105(0.566)	0.433

R^2 = 0.492; F-test statistics = 4.291***; Breusch Pagan test statistics = 11.68

Note: *, **, and *** imply significance at 10%, 5% and 1% significance level respectively, standard error in the parenthesis

Table 9. Association between Caste and Income among the Sample Households (in percentage)

Income group	Caste groups		
	Upper	Middle	Lower
Rich	21	33	0
Less poor	67	39	40
Poor	12	28	60