HOUSEHOLD CHARACTERISTICS AND COMMON PROPERTY RESOURCE MANAGEMENT: A MODEL FOR HOUSEHOLDS DEPENDENCY ON LOCAL COMMONS 1

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Abstract: In recent years, the relationship between socio-economic characteristics and dependency of households on forest resources has become a growing concern in issues of local level collective action. On the one hand, it has often been argued that poor people extract more resources from the commons due to their greater reliance on natural resources. On the other hand, it is claimed that compared to non-poor, the poor may depend more on the commons in relative terms, but in absolute terms their dependency is lower. In this study I advance this argument by formally modelling household production systems to explore how socio-economic characteristics influence household dependency on local commons in reference to community-based forest management in Nepal. The analysis is based on field data from 309 households from the mid-hills of the country. Econometric analyses suggest that household labour allocation decisions for forest product collection are dictated by various socio-economic and demographic variables. In general, it appears that household land and livestock holdings, gender, ethnicity and education of household head exert more influence on household labour allocation decisions for extraction and gathering activities than other factors. The results show that women are not the sole collectors of forest products as conventionally accepted. Based on this analysis, it can be concluded that poorer households are currently facing limited and restricted access to community forestry than relatively better off households. Policy measures that aim to reduce heterogeneity among user households along with non-timber forest products (NTFPs) oriented management regimes in community forestry help to increases income of the poorer households from the local commons.

1. Introduction

Ever since the publication of Hardin's article 'The Tragedy of the Commons' there has been a growing debate on common pool resources, property rights, and resource degradation. The concept has been used to explain overexploitation of forests, fisheries, overgrazing, abuse of public lands, and other problem of resource misallocation (Stevenson, 1991). It was thought that resources held under common property regimes are inherently inefficient since individuals do not get proper incentives to act in a socially optimal way. Since the important goal of managing natural resources is to maximise the long-term economic rent, until recently many scholars believed that community-based management generated little or no rents. As a consequence scholars have long questioned the incentive for efficient use of common pool resources under CPR regimes (Gordon, 1954; Scott,

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1955; Hardin, 1968) and solutions were proposed either as state control and management (Hardin, 1968) or privatisation of the commons (Demsetz, 1964). An increasing number of scholars, nonetheless, advocate that Hardin's tragedy of the commons often results not from any inherent failure of common property, but from institutional failure to control access to resources, and to make and enforce internal decisions for collective use. They posit that decentralised collective management of CPRs by their users could be an appropriate system for overrating the 'tragedy of the commons' (Berkes, 1989; Wade, 1989; Jodha, 1986; Chopra et al., 1989; Ostrom, 1990, 1994). More careful analysis of the foundation of CPR regimes in developing countries has shown that local institutional arrangements including customs and social conventions designed to induce cooperative solutions can overcome the collective action problem and help achieve efficiency in the use of such resources (Ostrom, 1990; Gibbs and Bromley, 1989; Wade, 1988). The recognition of community-based resource management leads to devolution of natural resources to local user groups and this has become an integral part of natural resource management policy in many developing countries in recent years. This shift in policy is no more than a belated recognition that local level resource management is only possible through strong community participation, where the local community are often the ones with the greatest stakes in sustainability of resources and institutions (Agrawal, 2001).

Like in other developing countries, the recognition of community-based resource management leads to the devolution of natural resources from centralised government management to local user groups in Nepal. Devolution of forest management has been underway since 1990 under which national forests are handed over to forest user groups (FUG) under community-based property rights regimes. To date more than 9000 FUGs are managing about 660,000 hectares of community forest (CF) in the country (CPFD Database, 2000). Although local control over natural resources is now regarded as a win-win solution for environmental preservation and local development, the empirical evidence regarding the impact of CF is rather mixed. Some recent studies indicate that though the institutional change of resource management has brought significant positive impacts on the biophysical condition of forests, equitable access to and use of forest resources within the community has not been clearly demonstrated (Branney and Yadav, 1998).

Nevertheless, a significant and influential component of common property resource (CPR) literature claims that since poor people are more dependent on natural resources than non-poor households, they consequently derive higher economic benefits from the local commons. Some scholars, on the other hand, argue that compared to non-poor, poorer households may depend more on common property resources, but in absolute terms their dependency is lower (Dasgupta, 1993; Heltberg, 2001). There is a fair degree of misplaced optimism that every household in a community will gain egalitarian access to, and benefits from, collective action if a resource is held under community ownership. In contrast, experience from CF program in Nepal (and elsewhere) has so far indicated that poorer households are still marginalised even if resources are managed under community ownership. Since the level of wealth of individual users affects the leadership quality in the sphere of public decisions as well as the extent of resource exploitation and appropriation, large agricultural households may have higher access to commons compared to poorer ones (Richards *et al.*, 1999). Although poor households are relatively more dependent on these resources for fuel wood collection, the big farmers graze more animals and sell milk, which provides good market opportunities, (see Jodha, 1995) and derive higher economic benefits from these resources.

Scholars on CPR management argue that economic inequality in terms of private wealth (social and physical capital) among the members of a resource-using group might be associated with different degrees of control to and access over the local commons. The socio-economic status, gender, and ethnicity of individual community members may limit the opportunity available to weaker members

to participate and benefit in community decision-making. Adhikari (1996) argued that equitable and sustainable management of community forestry in middle hill of Nepal is dictated by the socioeconomic condition of the resource users. Given the more likely scenario of socio-political heterogeneity within spatially defined community groupings, participation in community decisionmaking can be skewed in favour of more powerful subgroups (Eder, 1987; Guggenheim and Spears, 1991; Loenen, 1993). Hissam *et al.*, (1991) argue that community-based projects are typically controlled by a small number of powerful individuals. Moreover, evidence from South Asia suggests that the socio-economic status of resource users may place stringent limits on the extent to which certain groups are able to participate and benefit from the collective action. The landless, agropastoralists, and other politically and economically marginalised users may not be able to take advantage of incentives for tree growing (Guggenheim and Spears, 1991). Participatory forest management in South Asia illustrates the sharp equity problem elsewhere since social structure itself is for the most part inherently unequal.

This paper discusses the wealth asymmetry and household level access to and control over the local commons. Though there is vast literature on the determinants of successful collective action as well as empirical studies on forest use and household labour allocation decisions, to my knowledge, none of these studies properly examine the possible relationship between household socio-economic variables and their dependency on local commons (exception Gunatilake, 1998). More precisely, the determinants of labour allocation and forest product consumption decisions of rural households, particularly those participating in some form of collective action, have not been systematically examined.

In this paper I seek to provide answers to the following question: What are the socio-economic attributes of households that determine labour allocation decisions for forest product collection and gathering activities? Here, my working hypothesis is that demand for forest products is a function of a number of characteristics that provide a measure of household dependency on the local commons. Biomass use is directly related to human or livestock population or the agricultural assets of households drive biomass use ((Reddy et al., 1986; Nadkarni et al., 1989). In line with recent CPR literature (Lele, 1997), I hypothesise that demand for forest biomass is primarily a function of a) cultivated land holdings and crop types (driving demand for mulch and manure) b) livestock assets (driving demand for fodder and cut grass) c) the number of people in the household (for both fuel wood production and consumption) d) education, ethnicity and caste of household (caste of an individual influences cultural attitudes towards food, bathing and rituals which might drive demand for fuel wood), and e) distance between forest and house (determines relative control as well as household behaviour regarding unauthorised harvesting). I further hypothesise that the use of grass and leafy biomass available to the household would depend upon (a) its direct ownership of cultivated lands (b) ownership of cattle, and (c) household demographic characteristics. In brief, this paper is intended to address household level economic conditions for exploiting the local commons. More specifically, it will examine the relationship between socio-economic conditions and constraints of households, in particular, ownership of land and livestock assets, and determinants of labour allocation decisions for gathering activities.

The rest of the paper is organised as follows. What follows are some accounts of problems associated with existing systems of community-based forest management in Nepal. Section three reviews some selected empirical literature on household production function and common property resource use. Section four conceptualises the theoretical household model that explains the relationship between socio-economic variables and households dependency on local commons. I will discuss empirical specifications of the model in the section five. Section six describes data

collection and survey methods. I will present the results of econometric analysis in section seven. Finally, the paper concludes in section eight with some conclusions and policy implications.

2. Community Forestry in Nepal: Problem and Prospects

Community forest management in Nepal has emerged as the top resource management priority as well as a major subject of discourse in development and environmental conservation for almost the last two decades. However, despite the most innovative policies to promote community-based resource management in place, community forestry so far has not been able to provide a significant contribution to the livelihoods of poor and marginalised people due to its failure to take into account broader socio-economic and institutional issues. Some scholars argue that recent policy shifts towards community-based forest management (from informal systems of management to more formal systems of management) with donor intervention do not have positive impacts on the livelihoods of the poorest sections of the community. Graner (1997) posits that institutional change regarding forest management has not helped needy people, but often works to their disadvantage. They are often not included in the forest users committee which influences forest management decisions, and so they have now lost even their traditional access to forest resources, as fuel wood sellers and livestock herders are not effectively represented in the operational regimes. While wealthier households are more interested in conservation oriented forest management regimes (that lead to production of more leafy biomass, which are primary inputs for farming systems), poorer households are more interested in non-timber forest products (NTFPs) that generate cash for their livelihoods. However, at present, the existing system of forest management is more oriented towards production of intermediate forest products in order to meet the livestock and farming input demands of large farm households rather than cash generation through NTFP management. Although the importance of NTFPs is being increasingly recognised for their role in income generation for poorer households and thus poverty alleviation, existing community forestry policies in general and NTFP regulations in particular seems to be incompatible in meeting these goals. Poor people and small enterprises based on NTFPs are often discriminated against and excluded from access to available incentives and other forms of support (Sharma, 1999) that significantly reduces the access of poor households to the local commons.

Poor and landless households were traditionally more dependent on cash products from local forests as they used to sell firewood and other NTFPs to the local market especially when there was no agricultural work available in the village. However, their access to forest resources has been reduced or has become more expensive after the introduction of formal systems of community-based forest management regimes. Poorer households neither can sell the intermediate forest products nor can they use leafy biomass as agricultural inputs since poorer households are usually deprived from land and livestock ownership. Even though markets exist for fuel wood, there is restriction on firewood collection. Commercial fuel wood collection is strictly prohibited and users are allowed to collect firewood only at certain times of the year. Moreover, trees and firewood cannot be cut without the permission of Forest User's Committee (FUC). In such scenarios, one can ignore the assertion that poorer household are more dependent on local level common property resources².

 $^{^2}$ I assume that if access to forest resources is unrestricted throughout the year, then poorer households can take advantage of this and can collect various forest products from community forests for their livelihoods. In cases where forests are closed the majority of the time and there are strict rules and regulations that prohibit unauthorized collection, it is very unrealistic to assume that poorer households derive more resources from the commons. Moreover, forest management is biased towards leafy biomass production, the product that can be used only by households with large land and livestock ownership. Though these products provide substantial benefits for better off households, poorer households could not internalise benefits generated from such forest products.

Some previous studies have indicated that the nature and degree of household dependency on forest resources is largely determined by the socio-economic characteristics of user households (Gunatilake, 1998). Household level marginal returns from the commons increases with private assets such as land, livestock, or individual ownership over productive assets. Private ownership over land, livestock and other assets increases the demand for biomass resources, creating both demands on and alternatives to forest biomass use, while also creating opportunities for more efficient or productive resource utilisation for some social groups (Lele, 1997). Cardenas (2001, p. 3)) points out that, "wealth inequality can affect the institutional settings, e.g., the rights one has to use a resource, or the set of rules and norms that govern how a group manages and uses the commons; in fact the level of enforcement of those rules, either endogenous or externally enforced and monitored, can vary depending on the wealth of the violator". Boyce (1998) argues that inequality may have a negative effect on local level collective action and may reduce access by poorer households to local commons since inequality may increase the scope for a powerful minority to impose rules of the game that benefit them at the expense of the large majority in the community.

Putting much emphasis on issues such as equity and distributional implications of CPR regimes, numerous authors have stressed that property rights regimes on common-pool resources are a necessary but not sufficient condition for the equitable and efficient use of environmental resources (Hanna *et al.*, 1995). This literature emphasises that sustaining the environmental resource is not dependent on a particular structure of property rights regime, rather on a well-specified regime and a congruence of that regime with its ecological and social context. Success of property rights regimes depends upon the congruence of ecosystem and governance boundaries, specification and representation of interests, matching of governance structure to ecosystem characteristics, containment of transaction costs, and establishment of monitoring, enforcement and adoption processes at the appropriate scale (Eggertsson, 1990; Ostrom, 1990; Bromley, 1991; Hanna, 1992; Hanna and Munasinghe, 1995). Regarding the institutional change to reduce common-pool resource problems, Libcap rightly pointed out the complexity associated with reallocation of property rights decades ago;

"Important differences across the parties in information regarding the resource, as well as in production cost, size, wealth and political experience will make the formation of winning political coalitions and a consensus on the proposed assignment or adjustment of property rights more difficult. In many common pool settings where the parties are heterogeneous and where customs have governed resource allocation use, the installation of more formal property rights may involve risk for some groups. Those parties who have had informal claims or have been unusually productive under the *status quo* may be made worse off by institutional change unless their claim or productivity are recognised (Libcap, 1989,pp: 22)".

As I discussed earlier, members of a resource using group will often have somewhat different preferences regarding resource management, or assign different priorities to the various objectives of resource management, either because of differing personal interest in the resource or differing degrees of involvement in the social group (Kant, 2000). Productivity enhancing and egalitarian CPR governance, in these circumstances, is difficult in light of these heterogeneities. The source of heterogeneities are diverse, and include differences in opportunity cost, appropriation skills, caste, gender, ethnicity, initial wealth, political influence, technology and physical location (Hackett, 1992) which might influence the household level access to the commons. An understanding of the relationships between socio-economic characteristics (heterogeneity) and household level access to

and control over local commons can help provide the necessary leverage for poor forest dependent communities so that their interests are fairly represented in forest planning and management decisions.

3. Empirical Application of Household Model: Review of Selected Literature

As pointed out earlier, rural farm households throughout the country derive a wide range of forest products from community forests (CF) and indigenous woodlands for their livelihoods. They typically rely heavily on self-collected environmental products such as fuel wood, leaf fodder, cut grass, leaf litter, and variety of non-timber forest products to meet their subsistence needs (Cook, 1998). Firewood is the most important non-commercial domestic fuel energy in rural Nepal, which is collected mostly from nearby forests. Feed materials like tree fodder, grass and plant residues collected from community forests supplement livestock feed requirements. Households also collect dry and unpalatable green leaf litter for animal bedding, which is later put onto agricultural fields to enrich depleted soil. The collection of forest products is thus a key input for agricultural production and the returns from the households agricultural activities constitute an important share of the wealth that household have available for consumption purposes (Amacher et al., 1999). A number of studies have highlighted the essential nature of indigenous woodlands to secure livelihoods of the poorest of the poor (see Bradley and McNamara, 1993; Arnold, 1995, Grundy et al., 2000). Many forest products are consumed within households with some proportion marketed in the informal sector contributing an important proportion of household income especially for the poor and land less households.

There are some empirical attempts at assessing the household labour allocation decisions and common property resource use by formally modelling the household production systems. Amacher et al. (1993) have developed a recursive household production model in order to explore household production and demand for fuel wood and fuel substitutes in two different mid-hill districts of Nepal. They also analyse the demand elasticities for fuel wood, combustible agricultural residues, and improved stoves (a technological substitute), by each household income group. The study shows that women and children are significant collectors for those households that rely on community forests for their fuel wood. Adult males, hired labour, and agricultural capital are also significant inputs for fuel wood production for households that produce large shares of their fuel wood on or adjacent to their own private agricultural land. Residues are more important substitutes for low-income households and improved stoves are more important substitutes for high-income households. Moreover, larger families consume more fuel wood. This study shows that larger landholders collect a considerable amount of residue (leaf litter etc.) from nearby forests, which are later put onto agricultural land to enrich depleted soil. They conclude that as household income increases, agricultural households may grow a significant portion of fuel wood on their private land while non-agricultural households will convert to substitute fuels and fuel wood technologies in response to their increasing income (Amacher et al., 1993).

Amacher, Hyde and Kanel (1996) have formulated and estimated a non-separable household model for fuel wood supply from local common forests using data from Terai and the mid-hill districts of Nepal. The aim of this study was to understand fuel wood purchase versus own-collection and estimate the unobserved shadow wage using a two-step procedure. They incorporate, as well as other biophysical variables, the following household characteristics in their model: land holding (household wealth), livestock ownership (proxy for capital), and family size (labour availability for fuel wood collection). The study postulates a positive relationship between fuel wood production, livestock holding, and family size. Land ownership reflects an increased opportunity for fuel wood production in the mid-hill districts. Economic measures of fuel wood scarcity such as fuel wood price or the marginal products of labour used in collecting fuel wood are much better predictors of local household demand and supply behaviour and, therefore, of pressure on the local resource stock. They conclude that market price, labour opportunities, the availability of substitutes, and measures of access to basic resources are the most reliable predictive variables for fuel wood production and consumption decisions (Amacher, Hyde and Kanel, 1996).

Amacher, Hyde and Kanel (1999) have formulated and estimated a household production model using household data from Nepal's two major populated regions to examine fuel wood consumption and production decisions. They found a significant relationship between labour time (total fuel wood collection time) and fuel wood production and concluded that fuel wood harvest and fuel wood shipment are labour intensive work. Labour reallocation in order to increase fuel wood collection would cause the more responsive hill households to search for labour-saving opportunities in other activities (Amacher, Hyde and Kanel, 1999). Moreover, they observed a positive and significant relationship between land holding and fuel wood collection in their Terai sample. However, their analysis shows a negative relationship between land holding and residue consumption. It is apparent that larger households consume fewer residues. Based on this observation they conclude that residue is an inferior good.

Heltberg, Arndt, and Sekhar (2000) have modelled domestic energy supply and demand in rural India. They examined the links between forest scarcity and household fuel collection in a non-separable household model. Households responded to forest scarcity and increased fuel wood collection time by substituting fuels from private sources for fuel wood from the forests. Households belonging to lower caste and poorer households appeared to consume less private fuels. They found that these households consume significantly more forest fuel wood and spend a longer time collecting it. Livestock ownership was found to increase private energy consumption. Farm size was negatively related to forest fuel wood collection, reflecting that larger landowners may substitute private fuels from private land for forest fuel wood. Both the number of adult men and the number of women and children had a positive and significant impact on fuel wood collection. They confirm that larger families usually have a greater demand for and more labour available for fuel wood collection.

Cooke (1996), using Nepal Energy and Nutrition Survey data from western Nepal, estimated the empirical links between resource scarcity (fuel wood, fodder, cut grass, drinking water) and household time allocation in order to understand whether households reallocate labour away from their own farm agriculture as fuel wood and fodder become more scarce. These models include cut grass, and leaf fodder shadow price, as well as the shadow prices for water and fuel wood. The yearly cross-sectional results indicate that a higher fodder shadow price significantly reduces male labour input. However, the shadow price for fuel wood is not significant although most values are negative. It appears that scarcity of environmental goods that are important seasonal livestock feeds has more of a negative impact on household farm labour allocation than does scarcity of fuel wood (Cooke, 1996). Household land holdings, household composition, and traditional gender roles in agriculture exert more influence on household agricultural labour allocation decisions than does an increase in the cost of collecting environmental products. Sample households in this study spend significantly more time collecting environmental products when shadow prices of these forest products were higher.

Linde-Rahr (2001) analysed the choice of fuel wood collection sources in rural Vietnam using a discrete model with randomly distributed parameters across households in his demand estimation. He estimated the shadow prices and profit for fuel wood collection from different sources (e.g.

common property forest, user right plantation forest and open access) based on separate production functions. Household size was directly related to the quantity of fuel wood collected from the common property forest. Moreover, the longer the household has to travel to the source (distance between forest and house) the lower the benefit they reap in terms of fuel wood collection. He found that households are optimising their choice of fuel wood sources and a relatively stronger substitution effect emerges between natural forest and open access areas. However, he suggests that poor households are likely to be more prone to accept some marginal responsibility for open access forest resources.

Heltberg (2001) undertook a study on the determinants and impact of local institutions for common resource management in a protected area in Rajasthan, India. He analysed the factors affecting inter-village differences in management institutions in a logit model. This study also intended to explore the relationship between household socio-economic characteristics and household dependency on common property resource use and thus forest outcomes. Determinants of a household's dependency reveal that land and livestock holdings are significantly related to grazing on the reserve. This confirms that grazing pressure in absolute terms rises with farm size. However, he observes that fuel wood dependency decreases significantly with land holding indicating substitution toward fuel wood produced on private land.

4. Theoretical Model of Household

The household production model was developed following the pioneering work of Becker (1965) and Lancaster (1966) on the theory of consumer choice. This approach is based on the observation that households derive utility from goods and services produced through combination of market purchased goods and household labour. The household can therefore be analysed as a producer, which combines purchased goods and time as inputs into a household production function to produce some commodity (see Hori, 1975). Since these models incorporate both the consumption and production aspects of household decision-making, they capture the essential considerations underlying the allocation of family time between leisure and work (Sicular, 1998). Agricultural household models are designed to capture these relationships in a theoretically consistent fashion so that the results of the analysis can be applied empirically to illuminate the consequences of policy interventions (Singh, Squire and Strauss, 1986). This approach provides a sound theoretical framework for analysis of household behaviour in conditions where non-marketed goods are important (Bocksteal and McConnell, 1981).

The household model constructed in this study is based on a neo-classical model of an agricultural household as described by Singh, Squire and Strauss (1986). As smallholder farmers simultaneously engage in production and consumption decisions, the farm household approach has become quite popular in modelling their economic behaviour (Barnum and Squire, 1979). Most of household models to date presume perfect input and output markets, and independence of production and consumption decisions (Shiferaw and Holden, 1997). However, small farmers in developing countries face enormous constraints, for example endogenous prices due to market imperfections, insecure land tenure and liquidity problems and non-profit motive labour allocation decisions. In this situation, the relevance of a separable household model is often questioned (de Janvry *et al.*, 1991, Shiferaw and Holden, 1997). Therefore, the non-separable household model provides a suitable framework for analysing household micro-economic behaviour in a situation of market imperfection. This model considers that a market for some products does not exist or functions badly. This indicates that specification of the production and consumption of subsistence households in most developing countries is interdependent and non-separable. This interdependency assumption and thus non-separabability implies that household resource allocation including forest

product supply, and demand, and on-farm and off-farm labour supply is decided simultaneously, rather than recursively (Heltberg *et al.*, 2000). The joint production and consumption of various non-commercial forest products suggests the use of a non-separable household model, rather than a pure demand model (Singh, Squire, and Strauss, 1986).

The theoretical model to be constructed in this study will be based on a conventional utility maximising household, which derives the highest level of utility by consuming various goods. In order to understand this, consider a representative farm household, which is assumed to maximise its utility function dependent on consumption of household goods X_H (meal) and other goods X_M . Household utility is assumed to be conditional on a vector of fixed demographic characteristics ϕ , including family size, and age of HH members, which may affect household preference.

$$U = U (X_{\rm H}, X_{\rm M}; \phi) \tag{1}$$

Household goods X_H are produced with forest product inputs i.e. fuel wood, E_f , which is mostly collected from CF. Household may also purchase fuel wood, E_p , and some households may sell fuel wood in the local market, E_s . This sold amount of fuel wood is deducted from the production function. Meal is produced with agricultural grain grown on-farm, g_q . Households may purchase agricultural grain, g_p , to produce meal. Some households also sell agricultural products, g_s and this amount is also deducted from the production function. These physical inputs are combined with household labour, L_m , to produce cooked meal. The production of household goods is also a function of the vector of household characteristics Ω pertaining to consumption such as type of house, stove technology etc. The production constraints for meals can be written as

$$X_{H} = X_{H} \{ L_{m}, (E_{f} + E_{p} - E_{s}), (g_{q} + g_{p} - g_{s}); \Omega \}$$
(2)

Agricultural grain, g_q , is produced on-farm, which is a function of household labour, L_g , land, K, number of livestock, N, which contribute to agricultural production by providing drought power and manure. For many households animal dung is the only source of fertiliser. Households also collect environmental goods from CF like leaf litter, E_{lf} , which is also a production input used to enrich depleted soil. So the agriculture production constraint is given by

$$g_q = g_q \{L_g, K, N, E_{lf}\}$$
 (3)

Though households collect a variety of products from the forest, few products have a significant impact on household economy. Subsistence forest products constitute a major proportion of the household level income from common property forestry and not from auxiliary non-timber forest products. It was found that households mainly collect four different forest products from CF such as fuel wood, tree fodder, cut grass and leaf litter. So only four production functions are defined in this model. Fuel wood, tree fodder, cut grass and leaf litter production technology is given by a continuous quasi-concave production function that describes the collection forest products from common property forests. The variables L_{f} , L_{fo} , L_{gr} , L_{lf} and A denote labour and a fixed factor used in forest product collection respectively. It is hypothesised that forest product collection is also conditional on a vector of fixed household characteristics, ψ , (i.e., land holding size, number of cattle, ethnicity, caste, gender, education, and including forest stock and access condition, institutional regime, distance between house and CF, transaction costs, technology of harvesting etc.). Since the vector of household characteristics, ψ , differs across households, marginal productivity of labour will also differ across households. Production technology for fuel wood, E_{f} , fodder, E_{fo} , cut grass, E_{g} , and leaf litter, E_{lf} , is given by

$$E_{f} = E_{f} (L_{f}, A; \psi)$$

$$E_{fo} = E_{fo} (L_{fo}, A; \psi)$$

$$E_{gr} = E_{gr} (L_{gr}, A; \psi)$$

$$(4a)$$

$$(4b)$$

$$(4b)$$

$$(4c)$$

$$E_{lf} = E_{lf} \left(L_{lf}, A; \psi \right) \tag{4d}$$

Animal related goods are produced using household labour to collect tree fodder and cut grass from CF. Number of trees, Tp, on private land also complements the fodder and grass requirements for the household. Rural Nepalese households raise animals mainly for milk, manure, and drought power. So in this model the animal production function is treated merely as a technology that converts labour and forest products to produce the above-mentioned goods. Other functions of animals are not considered in this model. The animal production can be described as;

$$N = N \{ E_{fo} (L_{fo}, A; \psi), E_{gr} (L_{gr}, A; \psi), Tp \}$$
(5)

Representative households maximise their utility function subject to a set of budget and time constraints. Household leisure time is not modelled here since the labour-leisure margin is of not interest for this analysis. Households time constraints is given by

$$L_{T} = L_{f} + L_{fo} + L_{gr} + L_{lf} + L_{g} + L_{m} + L_{o}$$
(6)

The budget constraints is

$$p_{M}X_{M} + p_{f}E_{p} + p_{g}g_{p} = L_{o}W_{o} + p_{g}g_{s} + p_{f}E_{s} + E$$
(7)

The variables p_{M} , p_{f} , p_{g} , refer to the market price of other goods, fuel wood, and agricultural grains. L_{o} , W_{o} and E refer to off-farm labour, off-farm wage and household exogenous income from other sources respectively. The problem for the subsistence farm household is to maximise utility function 1 (a) subject to production constraints 2- 5 (b) time constraints 6 (c) budget constraints 7.

The lagrangian for an internal solution to the problem is;

 $L = U \{X_{M}, X_{H} [L_{m}, (E_{f} (L_{f}, A; \psi) + E_{p} - E_{s})), (g_{q} (L_{g}, K, N \{E_{fo} (L_{fo}, A; \psi), E_{gr} (L_{gr}, A; \psi), Tp\}), E_{lf} (L_{lf}, A; \psi) + g_{p} - g_{s})); \Omega]; \phi\} - \lambda \{L_{f} + L_{fo} + L_{gr} + L_{lf} + L_{g} + L_{m} + L_{o} - L_{T}\} - \mu \{L_{o}W_{o} + p_{g}g_{s} + p_{f}E_{s} + E - p_{M}X_{M} - p_{f}E_{p} - p_{g}g_{p}\}$ (8)

The endogenous variables in this model are L_f , L_{fo} , L_{gr} , L_{lf} , L_g , L_m , L_o , f_p , f_s , g_p , g_s , and X_{M} . Maximising the lagrangian with respect to these variables yields the following first order conditions.

$\partial L/\partial L_{f} = \partial U/\partial X_{H} \partial X_{H}/\partial E_{f} \partial E_{f} (.) /\partial L_{f} - \lambda = 0$	(8a)
$\partial L/\partial L_{fo} = \partial U/\partial X_{H} \partial X_{H}/\partial g_{q} \partial g_{q}/\partial N \partial N/\partial E_{fo} \partial E_{fo} (.) /\partial L_{fo} - \lambda = 0$	(8b)
$\partial L/\partial L_{gr} = \partial U/\partial X_H \partial X_H/\partial g_q \partial g_q/\partial N \partial N/\partial E_{gr} \partial E_{gr} (.) / \partial L_{gr} - \lambda = 0$	(8c)
$\partial L/\partial L_{lf} = \partial U/\partial X_H \partial X_H/\partial g_q \partial g_q/\partial E_{lf} \partial E_{lf}(.)/\partial L_{lf} - \lambda = 0$	(8d)
$\partial L/\partial L_g = \partial U/\partial X_H \partial X_H / \partial g_q \partial g_q / \partial L_g - \lambda = 0$	(8e)
$\partial L/\partial L_m = \partial U/\partial X_H \partial X_H/\partial L_m - \lambda = 0$	(8f)
$\partial L/\partial L_o = -\lambda - \mu W_o = 0$	(8g)
$\partial L / \partial E_f = \mu p_f$	(8h)

$$\begin{array}{ll} \partial L/\partial E_s = -\mu p_f & (8i) \\ \partial L/\partial g_p = \mu p_g & (8j) \\ \partial L/\partial g_s = -\mu p_g & (8k) \\ \partial L/\partial X_M = \partial U/\partial X_M + \mu p_M = 0 & (8l) \end{array}$$

Equations (8a–8g) give the conditions for optimal labour allocation by the farm household, which stated that in equilibrium the ratios of the marginal products of various activities are equalised with the relevant price ratios. Equations (8a–8d) show that household allocates labour for various forest product collection activities until the marginal product of labour used in collection activities equals the endogenous value of household labour. In other words, 8a-8d first order conditions indicate that a household equates the marginal utility of forest product collection to the shadow price of collecting these products, λ . The first order conditions (8h- 8i) show that those households that purchase and sell fuel wood face a market price. Differentiating the right hand side of the equation $8a - 8d [\partial E_f(.) /\partial L_f - \lambda, E_{fo}(.) /\partial L_{fo} - \lambda, \partial E_{gr}(.) / \partial L_{gr} - \lambda$ and $\partial E_{lf}(.) /\partial L_{lf} - \lambda_{j}$ with respect to exogenous variables like land and livestock holding and other exogenous variables, increases the marginal product (positive partial derivatives) of household labour (which shift upwards) from gathering activity. This is due to the fact that households allocate more labour to harvest forest products to meet their increasing demand for agricultural inputs.

5. Econometric Model

The postulated model shows that forest product collection is determined by socio-economic and demographic variables and labour opportunity costs of time as predominantly influenced by farm and non-farm operation. From the first order conditions, a set of reduced form equations is derived, showing fuel wood, fodder, cut grass and leaf litter collection as functions of all exogenous variables. Grazing was completely prohibited in all CF so animal grazing is not included in this model. Based on previous theoretical models, I developed four different econometric models for empirical estimation.

$f_c = f(L_f, A, \psi, \phi, \varepsilon)$	firewood production function	(9a)
$E_{fo} = f(L_{fo}, A, \psi, \phi, \epsilon)$	fodder production function	(9b)
$E_{gr} = f(L_{gr}, A, \psi, \phi, \varepsilon)$	cut grass production function	(9c)
$E_{lf} = f(L_{lf}, A, \psi, \phi, \varepsilon)$	leaf litter production function	(9d)

Where L_f , L_{fo} , L_{gr} , L_{lf} remain the household labour allocations for forest product collection, A is a fixed factor used in forest product collection, ψ , ϕ are the vectors of fixed household socioeconomic and demographic characteristics as defined earlier and ε is a mean zero error term. The final specification of the econometric model follows. Since households are currently deriving very low levels of tree fodder there are many zero observations for this dependent variable. So the fodder production function is collapsed into the cut grass production function for the econometric estimation.

 $\begin{aligned} \mathbf{f_c} &= \alpha + \beta_1 LANDHO + \beta_2 LIVESTO + \beta_3 ETHNI + \beta_4 EDU + \beta_5 HSIZE + \beta_6 SEX + \beta_7 MEMT + \\ \beta_8 DIST &+ B_9 TECH + B_{10} TP + B_{11} TRANSDAY + \upsilon_I \\ (10) \end{aligned}$

 $E_{\text{fogr}} = \alpha + \beta_1 LANDHO + \beta_2 LIVESTO + \beta_3 ETHNI + \beta_4 EDU + \beta_5 HSIZE + \beta_6 SEX + \beta_7 MEMT + \beta_8 DIST + B_9 TECH + B_{10} TP + B_{11} TRANSDAY + \upsilon_I$ (11)

 $E_{1f} = \alpha + \beta_1 LANDHO + \beta_2 LIVESTO + \beta_3 ETHNI + \beta_4 EDU + \beta_5 HSIZE + \beta_6 SEX + \beta_7 MEMT + \beta_8 DIST + B_9 TECH + B_{10} TP + B_{11} TRANSDAY + \nu_1$ (12)

Though the interest of this study is to estimate the profit function, lack of proper market prices for forest products leads us to use shadow wages in my estimation of prices of tree fodder, cut grass and leaf litter from the relevant production function, which are the main products available and constitute more than 70 % household income from community forest. I will fit these empirical specifications using a Cobb-Douglas production function. So the log-linear equation as counter part of equation (10), (11) and (12) can be specified as:

 $\ln f_{c} = \alpha + \beta_{1} \ln LANDHO + \beta_{2} \ln LIVESTO + \beta_{3} ETHNI + \beta_{4} \ln EDU + \beta_{5} \ln HSIZE + \beta_{6} SEX + \beta_{7} MEMT + \beta_{8} \ln DIST + B_{9} \ln TECH + B_{10} \ln TP + B_{11} \ln TRANSDAY + \upsilon_{I}$ (13)

 $lnE_{fogr} = \alpha + \beta_{1}lnLANDHO + \beta_{2}lnLIVESTO + \beta_{3}ETHNI + \beta_{4}lnEDU + \beta_{5}lnHSIZE + \beta_{6}SEX + \beta_{7}MEMT + \beta_{8}lnDIST + B_{9} lnTECH + B_{10} lnTP + B_{11} lnTRANSDAY + \upsilon_{I}$ (14)

 $lnE_{lf} = \alpha + \beta_{l}lnLANDHO + \beta_{2}lnLIVESTO + \beta_{3}ETHNI + \beta_{4}lnEDU + \beta_{5}lnHSIZE + \beta_{6}SEX + \beta_{7}MEMT + \beta_{8}lnDIST + B_{9} lnTECH + B_{10} lnTP + B_{11} lnTRANSDAY + \upsilon_{I}$ (15)

Where,

Ethnicity (ETHNI) =Measured by caste (dummy, if untouchable caste =1) Gender (SEX) =Sex of respondents (Male = 1) Education (EDU) =Education of respondents measured as number of school years Landholding (*LANDHO*) = Land area under household management ($Ropani^3$) Livestock (*LIVESTO*) = Number of livestock owned by a household Distance (DIST) =Distance between community forests and house (km) Transaction days (TRANDAY) = Number of days spent in various obligatory forestry activities Technology (TECH) =Tools used in forestry operation (proxy for technology) Household size (HHS) =Number of people in work force Trees on private land (TP) = Number of trees grown on private land for fuel and fodder Type of membership (MEMT) = Dummy (If member of executive committee = 1)

6. Study Site, Data Collection and Survey Methods

This study was undertaken in two selected districts of the mid-hills of Nepal where community forestry programs have been implemented for the last two decades. From the lists of user groups in these two districts, 8 user groups were randomly selected. The survey was based on stratified random sampling. A stratified sample of households was chosen by compiling a census of village households with participatory rural appraisal (PRA) techniques. Participants of the PRA exercise were asked to categorised all households into three different stakeholder groups i.e. poor, middle wealth and richer households based on certain criteria that villagers think important while assessing an individual's socio-economic position in the village. Main criteria used were the amount of land

³ 20 *Ropani* = 1 Hectare

owned, the number of livestock owned, loans given and taken, and income from off-farm agricultural activities. Poor households own between 0 to 5 *Ropani* of land, with a mean of 2.95 *Ropani*. Middle-wealth households own between 5.5 to 15 *Ropani*, with a mean of 10.12 *Ropani*. Richer households own between 15.5 to 85 *Ropani*, with a mean of 26.65 *Ropani*.

Household questionnaires were designed to elicit forest use information from the respondent households. Pre-testing of the questionnaire was undertaken in one of the randomly selected villages outside the sample frame. The response to pre-testing of the questionnaire resulted in the revision of sensitive questions such as gender bias in forest product extraction. The focus of the survey was to value the contribution of forest products to the household economy. Forest products are defined as products found and used by local people in community forest areas. These include wood products as well as non-timber products such as leaf and bark for medicinal purpose, medicinal plants and other plant products. However, only few products i.e. firewood, tree fodder, grass fodder, and leaf litter have been found significant to the household economy after the household survey.

A total of 20 per cent of households were randomly selected from each stakeholder group. So the household level data for this analysis comes from a survey of 309 households belongs to three different stakeholder groups. Questions were asked to obtain information on four general areas: 1) demographic information; 2) land holding, tenure and off-farm production systems; 3) natural resource management and utilisation; and 4) household awareness/participation/policy issues in community forest management. Questionnaire surveys were conducted in order to gather information on the household size, land and livestock holdings, firewood, grass and tree fodder and leaf litter collection and utilisation pattern. Since both on-farm and off-farm agricultural activities are seasonal, care was taken to consider allocation of family labour seasonally. The data on biomass use are a combination of the survey questionnaire data and monitoring of actual use carried out by the research team in the study sites. Firewood was weighed at the sample household. On the day of measurement, the sample households were asked set aside the amount of firewood that would be used in that day. The wood was weighed and left next to the door. Households were asked to burn only the weighed wood or asked to remember if extra wood was burnt. On the following day the research team returned to each sample household and weighed the remaining wood or amount of firewood estimated to have been burnt. Since the amount of tree fodder, grass fodder and leaf litter use is highly seasonal; respondents were asked to state their daily average consumption of these products both from community forests and private source. This was elicited mainly from questionnaire (recall) survey.

6.1. Age Distribution of Respondents

The age distribution of sample households is presented in the following graph. The unit of analysis is the household. Household head (generally husband and in some cases wives) was chosen as the respondent since they are the decision-makers on behalf of the family. The predominant ethnic groups in the study site are *Brahmin*, *Chhetri*, *Tamang*, *Damai* and *Sarki*. Mean household size was 6.38 persons. The average household size for the sample is greater than that of Nepal's average of 5.3 members per household (CBS, 1995). Most interviewees could speak Nepali but some women belonging to some ethnic groups could not speak Nepali well. They spoke their own local dialect. The mean age of the interviewees was 43.7.

Graph 1 Age distribution of respondents



6.2. Household Labour Allocations

Household labour allocations in four areas included in the analytical model (firewood, tree fodder, grass fodder and leaf litter collection) are presented in Table 2. In most of the sites, gathering activities include collecting firewood, tree and grass fodder, leaf litter; and some herbal plants for medicinal purposes. However, the only ones of significant economic value are firewood, tree and grass fodder, and leaf litter. Biomass inputs in this analysis are broadly categorised as tree woody biomass (for fuel wood and construction/fencing), tree leafy biomass (mulch and manure), shrub biomass (manure), and grass (mainly fodder/forage). Firewood includes freshly cut wood (*kacho daura*), dead branches and twigs (*sukay daura*) and crop and plant residue (*jhikra*) as described by Bajracharya (1980). Firewood is the main source of energy and is used mainly for cooking household meals and snacks; animal feed preparation (*kudo* preparation for working oxen and lactating animals), space heating, some occupational use like firewood consumed by blacksmiths or the local *raksi* (alcohol) maker and performing household ritual activities.

In most of the study sites, *Kacho Daura* is distributed once a year from February to April after the major thinning and pruning operation. This is a feasible time to undertake various forestry operations (i.e. bush cutting, thinning, and pruning) and cutting of firewood, since it corresponds with a fall in agricultural activities. This period is also good for drying green firewood given that it is the hottest period of the year. During this time, user households participate in various forms of forestry activity. Unwanted trees and shrubs are cut, chopped into burnable sizes and distributed to local users through the decisions of the Forest Products Distribution Committee (often office bearer of forest user's committee). *Sukay Daura* and *Jhikra*, especially dead branches and fallen twigs, are collected throughout the year. However, user households are not allowed to chop the standing trees (both green and dry) and gather firewood from CF.

Ground grass or grass fodder (*ghas*) refers to all non-woody herbaceous plants cut for animal feeding. It includes members of the grass and sedge families, a variety of legumes, and other broad leaf plants (Jefferson, 1983). Tree fodder comes from a wide variety of trees found on private land and community forests. Tree fodder collection in community forests occurs primarily at the end of the dry season, mainly from April to June. During this period, crop residues from the preceding year has been exhausted and less grass fodder is available on private land or in community forests

due to very low rainfall and relatively dry weather.

Since most of the households face severe constraints on the use of chemical fertilisers for maintaining soil fertility, collection of leaf litter from CF for animal bedding and mulching is a common practice. Households in the study area use a combination of dry leaf litter, non-palatable green vegetative materials, crop residues and the remains of the uneaten fodder as animal bedding. The majority of bedding materials originate from forests, shrublands and grasslands. It is harvested by lopping and is gathered as litter. Many user groups allow more or less unrestricted collection of dry leaf litter even though the use of other products is rigidly controlled. Although the actual harvested quantities of this product may be low, they are important to a subsistence economy since they remain a major source of compost fertiliser in maintaining soil productivity. Dry wood was used in all forest user groups and could be collected throughout the year. There were no limits on quantities and no fees had to be paid for this product. Harvesting of green wood, however, was in all cases limited to a specific season of the year. Green firewood harvesting is a collective activity and households are required to pay fees for the green firewood allocated to them by the forest user groups.

It is noteworthy that households might directly use only fuel wood and timber; all other biomass goes as input into some productive assets: paddy fields or livestock. This implies that households use of biomass appears to be driven primarily by agricultural land holding and cattle ownership. Villagers have varying degrees of access to, and control over, biomass resources that can be used as inputs into agricultural or livestock systems, or for other domestic uses. While some portion of the grass and fodder may be obtained from private agricultural lands, varying but substantial fractions of grass and fodder requirements are met from community forests for those households keeping larger animal herds. Landless households benefit mostly from fuel wood collection.

Respondents were asked about their labour allocations in four areas included in the analytical model: labour allocated for fuel wood, fodder, cut grass and leaf litter collection. Although survey questions based on the recall approach are likely to suffer from biased and unreliable responses, valid answers can be expected if households are engaged in regular patterns of collection activities (Juster and Stafford, 1991), a situation that can be expected within a given season in most part of the mid-hills of Nepal. Labour allocation decisions of households for forest product collection efforts are presented in the following tables. Poorer households on average allocated a total of 115, 16, 178, and 328 hours annually for fuel wood, tree fodder, leaf litter and grass fodder collection respectively. Richer households on average allocate 143, 29, 871, and 960 hours annually for fuel wood, fodder, and leaf litter and grass collection. From the table it is evident, forest products i.e. tree and grass fodder and leaf litter are highly wealth sensitive. It appears that households with larger endowments extract more intermediate forest products than poorer households in the study area.

Activities	Ν	Minimum	Maximum	Mean	Standard Dev.
Poor stakeholder					
Fuel wood collection	81	0.00	864.00	115.78	125.73

Table 2 Labour allocations for forest product collection (differentiated by stakeholder group)

Fodder collection	81	0.00	240.48	16.42	49.96
Leaf litter collection	81	0.00	1710.00	178.01	313.82
Grass collection	81	0.00	3240.00	328.49	502.24
Medium wealth stakeholde	r				
Fuel wood collection	136	0.00	547.50	114.87	110.69
Fodder collection	136	0.00	450.00	13.79	50.77
Leaf litter collection	136	0.00	3125.00	393.90	540.16
Grass collection	136	0.00	6480.00	679.48	1052.76
Rich stakeholder					
Fuel wood collection	92	0.00	720.00	143.97	149.11
Fodder collection	92	0.00	675.00	29.00	105.43
Leaf litter collection	92	31.37	4320.00	871.17	979.24
Grass collection	92	0.00	5800.00	960.45	1029.40

6.3. Perceptions of Households towards Different Aspects of Forest Management

Table 3 presents the key descriptive statistics on perceptions of households towards forest management, distribution of products and their participation in various aspects of community forest management. Most of the respondents think that quality of the forests improved remarkably after the implementation of CF. It appears that the condition of forest resources is improving in all areas where community forestry is well established. This is confirmed by good natural regeneration, dense forest under layers and a good recovery of shrubland observed during the field survey. Protection, sound management and controlled harvesting were seen as the main reasons for this improvement. Activities like planting were highly integrated in forest management, and rules for protection were closely related to the process of improving the resource base of community owned forests. All FUG members are aware of the relationship between forest condition, species composition and the type of harvesting. Based on existing management institutions, together with the present condition of community forests, it can be concluded that management of community forests is being done on a sustainable basis by the forest user groups (FUG).

There is a fair degree of participation of households in various aspects of collective action. Frequent meetings are held to make sure that every user household understands its role and compliance towards decisions made. However, it is apparent that the elite tend to be adequately represented in the meetings and the decision-making process is largely dominated by socially and economically privileged sections of the community. In many cases, poorer households may be under-represented because they may not manage to come to the meetings or they fail to put their voice forward in an effective manner even if they manage to take part in community meetings. There seems to be a kind of patron-client relationship, as poorer households tend to see the local elite as a potential source for counselling and arbitration during periods of socio-political difficulty or dilemma. At the time of the interviews, some people mentioned that since the formation of forest user groups there is some degree of conflict among villagers on issues like; distribution and harvesting of products, grazing, involvement in decision-making and management activities. Most of the FUG members think that community forestry so far has not been able to contribute significantly to poverty alleviation in rural forest dependent communities.

Breaches of agreed rules about forest use often do not seem to exist. The distribution system in the FUG depends on the availability of the products, the kind of product, and the purpose for which the product is being used. In the all systems, use was made of fixed amounts of products that could be harvested, fees on some products, seasonal limits, or prohibiting the harvest of some important products. Controlled harvesting was expressed through fixed amounts of fuel wood, which could be harvested by each household in certain intervals of the year under the supervision of committee members. Timber and some other products had to be requested from the committee and collectors were charged nominal fees.

In most of the group, concern towards equity issues is very apparent. Moreover, there is also an on going debate as to what is equitable and what is not. Arnold (1991) posits that user groups should better attempt to diversify tree resources so that they are better able to meet the diverse needs of households for forest products. He does not see that it is worthwhile for them to attempt to address the equity issues within the community. He argues that addressing equity may jeopardise local interest in forestry activities owing to external attempts to elicit change. Though being critical on the issue of equity, Hobley (1990) discusses that inequity is a generic feature associated with hierarchical societies and equity may not be achievable in the existing socio-political scenarios. Gilmour and Fisher (1989), however, argue that to ignore equity in community forestry is to ignore a key objective of the programme, which is essentially oriented towards poverty alleviation through better management of local commons. The critical issues raised were whether the operation of forest user groups reflects the needs and interests of all sections of the community, and whether these needs and interests are adequately represented in the group functioning. A more common problem seems to be an ignorance of the needs and interests of these groups by the decision-makers, ignorance that leads them to decisions, which take no account of these needs and interests (Soussan et al., 1998).

Table	3	Descriptive	statistics	on	perceptions	of	households	towards	forest	management,
distrik	outi	ion of produ	cts and the	eir p	oarticipation	in (CF			

Questions	N	Mean	Standard
			Deviatio
			n
What is changing trend of the forest in the last 10 years, increasing	309	1.6699	0.5931
= 1, constant $=$ 2, decreasing $=$ 3			
What is changing trend of the pasture in the last 10 years,	309	2.8282	0.4025
increasing = 1, constant = 2, decreasing = 3			
What is changing trend of the forest tree species in the last 10	309	1.1003	0.3317
years, increasing = 1, constant = 2, decreasing = 3			
What is changing trend of the source of drinking water in the last	309	1.5372	0.6467
10 years, increasing = 1, constant = 2, decreasing = 3			
Do you participate in users annual/monthly assembly? yes = 1	309	0.9644	.1856
Are any women members from your household represented in	309	0.0679	0.2521
users committee? yes $= 1$			
How do you evaluate the performance of users committee? (1)	309	1.8803	0.4718
highly satisfactory (2) satisfactory (3) neutral (4) not			
satisfied			
How do you evaluate the rate of your and family members	309	1.7735	0.7857
participation in FUG activities? (1) strong participation (2)			
occasional participation (3) not very often (4) hardly ever			

How do you know when to collect various forest products? (1)	309	2.2880	1.1779
Attending committee meeting (2) Informed by committee			
members (3) Informed by neighbours (4) FUG assembly			
How forest products are distributed? (1) Family size/equity	309	0.2913	0.4551
(2) Equality			
Do you think that FUG membership fee and fuel wood collection	309	0.7896	0.4082
fee is in accordance with individual's ability of pay? Yes = 1			
Are you satisfied with existing distribution process? Yes = 1	309	0.9191	0.2731
Community forestry program increases access to resource base,	309	1.8964	0.6363
strongly agree = 1, agree = 2, disagree = 3, strongly disagree =4			
Community forestry brings threat alternative livelihood, strongly	309	2.4951	0.6377
agree = 1, agree = 2, disagree = 3, strongly disagree = 4			
Unnecessarily protection oriented management regime, strongly	309	2.7411	0.5074
agree = 1, agree = 2, disagree = 3, strongly disagree =4			
Excessive forest product collection charge, strongly agree = 1,	309	2.8252	1.8060
agree = 2, disagree = 3, strongly disagree = 4			
Community forestry helps reduce poverty, strongly agree = 1,	309	2.6731	0.8098
agree = 2, disagree = 3, strongly disagree = 4			
Community forestry is able to meet the household demand,	309	2.1650	0.7615
strongly agree = 1, agree = 2, disagree = 3, strongly disagree =4			
Community forestry program decreases the access to resource	309	2.6926	0.5916
base, strongly agree = 1, agree = 2, disagree = 3, strongly disagree			
=4			

7. Econometric Results 7.1. Determinants of HH Labour Allocation for Fuel Wood Collection

Table 4 presents the Cobb-Douglas estimate of fuel wood production from CF. Fuel wood consumption by a household depends not only upon the number of people in the household, but also upon additional requirements for agricultural related activities (in this case preparation of animal feed), the availability of alternatives, and the technology of fuel wood use. The fuel wood regression explains annual fuel wood collection from community forestry in *bhari*⁴ as a function of various socio-economic variables. As discussed earlier, the econometric model used to fit the production function is a log-log 2SLS model. The Cobb-Douglas production function is commonly used in economic analysis. It measures the output elasticity of one variable holding the other variables of the equation constant. A strict Cobb-Douglas function exhibits constant return to scale. While a generalised Cobb-Douglas function exhibits increasing return to scale and decreasing return to scale (Dowling, 1980). Constant returns to scale are a possibility for these empirical equations as one cannot rule out the null hypothesis that the sum of coefficient estimates is equal to one. All of the variables but one have expected signs. Five estimates are significant in the decision equation. In addition to the constant; ethnicity, gender, education, transaction costs days and technologies used in forest product harvesting are statistically significant.

First, ethnicity is negatively associated to the fuel wood production function. This indicates that lower caste households extract less firewood from the commons. Caste of an individual influences cultural attitudes towards food, bathing and rituals which might drive demand for fuel wood, and

⁴ 1 *Bhari* green fuel wood = 50 kg

attitudes towards milk and meat influencing livestock numbers and management (Lele, 1997). Secondly, fuel wood collection shows an interesting gender pattern as female-headed households extract less from CF than that of male-headed households. This result is similar to Kohlin (1998) who observed that males contribute significantly to fuel wood collection than females. However, this is in contrast with traditional view that producing energy is mainly a female activity. During field observations, I observed that female-headed households on average are poorer and they are obviously low on male labour. One of the important policy observations from the production analysis is that women and children are not the only labour force engaged in fuel wood collection. This observation is also similar to that of Amacher et al. (1993), who observed that women are not the sole collectors of fuel wood.

Thirdly, it is evident that those households involving in various forms of decision-making activities (measured by transaction costs days in such activities) produce more fuel wood. This might be due to the information gained through various forms of community meetings about when to collect and where to collect fuel wood from CF. Fourthly, education shows a negative relationship with fuel wood collection from the commons as increasing educational level makes fuel wood collection increasingly unprofitable. This finding is similar to Gunatilake (1998), who concludes that education level of the family is negatively related to forest dependency. Lastly, technology used in forest products harvesting is significantly and positively associated with fuel wood production since advanced technology makes household labour more productive and marginal productivity of labour increases with advanced technology used in collection.

Though it is not statistically significant, land and cattle ownership is positively associated with fuel wood production. Households with larger livestock and landholding are more inclined to use CF for their increasing demand for fuel wood. Since this is a log-log equation, the coefficients also provide a measure of elasticity between dependent and explanatory variables. The coefficient of distance to the forest is positive, which is opposite what was expected before. Though it is not significant, it appears that distance could not explain the effort for fuel wood collection. This seems an unreasonable finding. However, this may be due to that fact that households residing near to the forests could not harvest unauthorised forest products since there are strict rules and penalties for the rule violators. Though not significant, household size is positively associated with fuel wood collection. A family with a larger labour force can mobilise household labour in collecting more dry woody materials and forest extraction activities than households with a smaller labour force. In most of the FUGs, products of a very subsistence nature like dead twigs, leaf litter and forage grasses can be collected either during certain periods or all year round. There is no restriction on the number of people from a single household who can harvest such products. In this case, households with more members tend to collect a larger portion of such products.

Independent Variables	Expected	Coefficient	Standard Error	t-ratio	P-value
	Sign	Estimate			
Constant		1.63	0.45	3.65	0.003
Landholding	+	0.06	0.08	0.78	0.434
Livestock unit	+	0.05	0.09	0.59	0.554
Household size	+	0.21	0.14	1.56	0.120

Table 4 Determinants of HH Labour allocation for fuel wood collection

Ethnicity	-	-0.39	0.17	-2.27	0.024
Gender	+	0.64	0.19	3.34	0.0008
Education	-	-0.43	0.11	-3.87	0.001
Transaction cost days	+	0.08	0.06	1.37	0.17
Distance between forest and HH	-	0.08	0.05	1.71	0.088
Technology	+	0.15	0.07	2.26	0.025
Trees in Private Land	-	0.02	0.05	0.45	0.65
Fodder and grass collection time	?	0.13	0.09	1.38	0.170
Log-Log 2SLS Regression	F (1	11, 252) = 6.07	$R^2 = 0.21$		

7.2. Determinants of HH Labour Allocation for Leaf Fodder and Grass Collection

The following Table presents the model of leaf fodder and cut grass collection effort from CF. Within the category 'grass' long grasses like '*Babio*' and '*Khar*', which are used for covering roofs of houses and stables, are included. Small branches, leaves, herbs and shrubs are collected as tree fodder. The empirical estimation is presented in Table 5. Most of the variables incorporated into this model are statistically significant. So are the expected signs. It appears that households with large numbers of livestock spent a lot of time on fodder collection effort. This is not surprising for wealthier households who usually maintain large livestock herds, and collect much of their animal feeds from the nearby forests. Landholding is also significantly associated with grass and tree fodder collection effort. Ethnicity has again a negative effect and is significant. This indicates that since lower caste households do not have more animals they extract less from CF. As discussed earlier, gender is negatively associated with fodder and cut grass collection though it is not significant. This is also contrary to traditional thinking that female members spend more time on grass collection effort. Women also have other household responsibilities that might affect gathering activities.

With regard to the 'transaction costs day' variable, households who spent a lot of time on decisionmaking and implementation activities often appear to spend more time on fodder collection effort. Households get correct information by engaging in the decision-making process about when and where to collect. This might increase the household's collection effort. The numbers of people in a family has positive impacts on fodder and grass collection though not significantly in this model. These findings are similar to Heltberg (2000) and Kumar and Hotchkiss (1988), who concluded that a larger family implies more labour available for fodder collection. Distance again shows the negative relationship with fodder and grass collection effort. The reason is already explained earlier. Number of trees on private land has a negative impact on fodder and grass collection. However, this is just the opposite of what was expected. It was expected that households that have planted a large number of fodder trees on their private land would spend less time on fodder collection in CF. It appears that most of the farmers have started tree planting only after the introduction of CF, which used to distribute free tree seedlings to the local farmers. I observed that these trees are still very young and not at a stage to provide leaf fodder. The positive sign of trees planted on private land in this production function is therefore not surprising.

Independent Variables	Expected	Coefficient Estimate	Standard Error	t-ratio	P-value
Constant	orgi	1.85	0.52	3.57	0.000
Landholding	+	0.18	0.09	2.07	0.039
Livestock unit	+	0.41	0.11	3.93	0.000
Ethnicity	-	-0.21	0.20	-1.00	0.316
Gender	+	1.07	0.21	5.02	0.000
Education	-	-0.31	0.13	-2.39	0.017
Household size	+	0.07	0.16	0.47	0.638
Transaction cost days	+	0.14	0.06	2.29	0.023
Number of trees in private land	-	0.06	0.05	1.05	0.294
Distance between forest and HH	-	0.09	0.06	1.54	0.125
Technology	+	0.25	0.08	3.26	0.001
Time for fuel wood collection	?	-0.13	0.14	-0.87	0.384
Log-Log 2SLS Regression	F (11, 248) = 12.38	$R^2 = 0.35$	1	1

Table 5 Determinants of HH Labour allocation for leaf fodder and grass collection

7.3. Determinants of HH Labour Allocation for Leaf Litter Collection

Table 6 shows the estimates of household leaf litter collection from community forests. Given the purpose for which leafy matter is used, one would hypothesises that land area and its quality, would primarily influence the extraction levels of leafy matter for mulch and manure, with the later also being influenced by livestock holding, since it is usually used as animal bedding prior to dumping in the manure pot (Lele, 1997). In most of the sites, users collect leaf litter as animal bedding materials for compost preparation. The importance of bedding material and compost was apparent amongst the sample; all households (except landless) used composted bedding materials in crop production regardless whether or not they used inorganic fertiliser.

Group discussions indicated that FUG valued leaf litter from their indigenous forest so highly that even the use of organic fertiliser does not reflect a reducing trend of leaf litter or bedding material

collection from nearby forests. In areas where plantations have been established, pine needles are often used for animal bedding. Pine needles are not a favoured bedding material but are often easily collected in large quantities when few alternatives exist (Collett *et al.*, 1996). Most of the respondents indicated that dry leaf litter is the most scare forest product. According to an estimate done by Mahat *et al.* (1987), the rate of application of composted leaf litter to agricultural fields is 2.9-tonnes/ hectare (based on a basket of manure weighing an estimated 15 kilograms). Where leaf litter and bedding materials are not collected this is mainly due to a lack of tradition of doing so. Some plant residues are also considered to be fuel wood substitutes as they are used in household heating and cooking activities.

The following table shows the determinants of leaf litter collection from community forests. The positive signs of land and livestock holding indicate, once more, that livestock and land apparently act as major sources for residue consumption. That is, larger (wealthier) households extract more leaf litter from the commons. This is particularly important in the mid-hills where leaf litter is a major source of compost. This finding is similar to the observation made by Collett et al. (1996), who observed that the rates of use of composted bedding material in crop production in the same area vary between crops, land type (irrigated land uses more than non-irrigated land due to higher intensity of cropping), households (land area and animal numbers) and sites.

Gender and ethnicity once again show negative and significant relationships with leaf litter collection. As was noted earlier, men from the socio-cultural elite of the community dominate many forest user groups and such traditional decision makers often dominate management regimes. This might also influence the forest management regime in such a way that it serves the interests of the wealthier households. Technology used in leaf litter collection is positively and significantly associated with consumption of leaf litter. Household participation in various stages of meetings and decision-making through transaction costs days spent in CF enhances the amount of leaf litter collection. Awareness of the potential gains achievable through the public good may be enhanced by regular meetings (executive committee) and discussions through which relevant information is conveyed or even generated (Gaspart et al. 1999). Distance has a negative, albeit insignificant, impact on leaf litter collection. This implies those households residing adjoining to the forest area collect more leaf matter than those living far away from the community forest. In many forest resource systems, users who live closer to the forest have a more secure and accessible supply of produce regardless of whether or not there are allocation rules in place (Varughese, 1998). Families living close to the forest have the advantage of less time being required to reach a particular forest resource. Their links with forests are, therefore, expected to be high (Gunatilake, 1998).

Independent Variables	Expected	Coefficient	Standard Error	t-ratio	P-value
	Sign	Estimate			
Constant		2.08	0.67	3.01	0.002
Landholding	+	0.61	0.11	5.28	0.0000
Livestock unit	+	0.23	0.14	1.65	0.100
Ethnicity	-	-0.62	0.26	-2.35	0.011
Gender	+	0.25	0.28	0.90	0.368

 Table 6 Determinants of HH Labour allocation for Leaf litter collection

Education	-	-0.26	0.16	-1.59	0.11
Fodder and grass collection time	?	0.38	0.16	2.39	0.018
Transaction cost days	+	0.11	0.08	1.36	0.183
Distance between forest and HH	-	-0.01	0.07	-0.19	0.85
Technology	+	0.26	0.01	2.60	0.001
Log-Log 2SLS Regression	F (9, 267) = 14. 04	$R^2 = 0.32$		

Most of the variables show the signs expected by the postulated model. Results from the household model confirm that labour allocation decisions of rural households are largely dictated by their socio-economic attributes. Though, more equitable distribution of resources is a prerequisite for poverty reduction and social justice in forest dependent economy, disparities inherent in the social and economic structure of most Nepalese villages automatically raise concern as to whether the distribution of benefits in CF management is egalitarian. It is in this context important to initiate campaigns that promote the discussion of a wider range of potential management options for equitable distribution of benefits from community forestry among community members.

8. Conclusions

The relationship between socio-economic attributes of user households and dependency on local CPR is getting more attention in recent years in issues of local level collective action. In this paper I have examined the determinants of household labour allocation decisions for extraction and gathering activities from common property forestry. The main thesis in this paper was that access to common property forests is almost inextricably associated with household characteristics, which influence the household labour allocation decisions and nature and extent of resource appropriation and exploitation. In other words, variations between amount harvested and forest product entitlement and use can be explained by socio-economic attributes of the user household. I have constructed a household model that explains household fuel wood, fodder and cut grass collection and leaf litter collection are a function of a number of socio-economic variables. The empirical analysis of household data offers affirmative answers to the questions posed above.

The study shows that household dependency on community forests in most of the study sites is for fuel wood, fodder, leaf litter and to some extent auxiliary non-timber forest products with a major proportion of household benefit contributed by fuel wood, tree fodder and cut grass and leaf litter. As I hypothesised, econometric analysis suggests that labour allocation decisions for forest extraction activities are functions of various socio-economic and demographic variables like; land and livestock holding, sex and gender, education, and some other local differences. The results show that women are not sole collectors of fuel wood since access to community forestry is somehow influenced by gender of respondents. Indeed, household access to CF is different for household land and livestock holdings, household composition, gender, education, and household participation in community decision-making processes exert more influence on household labour allocation decisions for extraction and gathering activities than other factors.

I have also found evidence of differences in access to commons between caste groups. This is likely to be a combined effect of low level of influence (leadership quality) of lower caste households in decision-making processes and cultural attitudes towards food and rituals of participating households. As was noted before this variable might influence household access to CPR, drive forest product needs and influence labour allocation decisions. The qualitative analysis part of this study also tried to examine the issues such as actual benefits and actual flows of resources from community forestry to the household. This especially explores a number of issues such as distribution of forest products, equity aspects of resource distribution, whether community forestry is able to meet local needs, whose priorities are promoted, trends in decision-making on FUGs, and the burden on poorer users from forest closure after the introduction of formal systems of CF. Limitations to the management regimes and restrictions on access for many FUG members are reflected in the impacts of community forestry on the livelihoods of different stakeholders groups. Some respondents argue that community forestry actually threatens their livelihoods since fuel wood sellers and local liquor makers are forced to abandon their trade because they are not allowed to use community forests to fulfil fuel wood demand. This is particularly significance for poorer households with little or no land, as they are less likely to fulfil their needs from their private sources.

It appears that more conservation oriented forest regimes favour the larger and wealthier households as they produce intermediate forestry products that are inputs into forestry-based farming systems. Poor households in general cannot internalise benefits generated from these products. As a consequence, poorer households are forced to search for off-farm work in villages and nearby towns since community forestry contributes very little to the total household income. This implies that the community forestry program so far has not been able to contribute significantly to the livelihoods of very poor and vulnerable sections of society. Changing the institutional arrangements on common pool resources, therefore, may alter the direction of incentives, which might induce negative affects on the access of poorer and marginalised households to the local commons.

It should be noted that my argument does not mean that poorer users are not benefiting at all from community forests. Poorer households benefit equally from products like fuel wood. It is evident from the Table 2 that poorer households allocate labour for fuel wood collection as much as that of wealthier households. However, poor stakeholders are proportionally benefiting less from CF because the equity and distributional aspects of community forestry are not satisfactory. One of the important implications of this study is that intervention seeking to reduce poverty in a forest dependent rural economy through community forestry may have limited impact unless the underlying factors causing inequitable access to the resource base are addressed. Since poor people are unable to internalise benefits generated from intermediate forest products, forest management regimes need to be oriented towards production and management of NTFPs, which can contribute significantly to the economy of poorer and land less households. Equally important is to improve both the productivity of forests and distribution systems. Regarding the impacts of government policies to control and manage forest use, Arnold and Perez point out that;

"Government policies can also constrain local efforts to realise more of the potential that NTFPs can contribute to households livelihoods. Because they give high priority to conservation objectives, many governments have set in place forest and environmental policies and regulations designed to limit rather than encourage production and sale of NTFPs (Dewees and Scherr, 1995). Restrictions placed on forest use in order to protect forests brought into community forestry schemes, and put them under sustainable forest management, can impose costs on local people, which reduce their incentive to become

involved. ... It is in fact difficult to find programmes that have not had at least a transitional adverse impact on those who have had to cut back or give up earlier gathering or grazing activities (Arnold and Perez, 2001 pp: 443)".

Policy measures to this end include the empowerment of women and politically marginalised users, more representation of weaker sections of community in the decision-making process, non-timber forest product oriented management systems, and distribution of leadership roles to all community members. To this end, the challenge is to develop management institutions that are efficient, equitable and ensure egalitarian access to the resource base. Since patterns of forest use differ among rural households, CF policy in this respect should be directed towards diversifying the products that meet the demand of different interest groups within the community. Arnold and Perez (2001, p. 445) point out, 'it may often be necessary in designing and implementing policy and other institutional interventions to distinguish between those who can improve their livelihoods through NTFP activities, and those who have no other option but to continue to gather NTFPs in order to survive'.

Local management institutions appear to have positive impacts on the biophysical aspects of forest resources management. North (1984) defines institutions as a 'set of constraints on behaviour in the form of rules and regulations' and 'moral, ethical and behavioural norms' of a society, which help to overcome numerous economic problems and thus enhance performance of an economy by their effects on costs of exchange and production. Since institutions help to guide human behaviour, they serve a number of important economic functions like facilitating market and non-market transactions, co-ordinating the formation of expectation, encouraging co-operation and reducing transaction costs. Clear rules regarding access and use of common resources appear to be important variables, as they have been described as key to successful community-based resource management by different scholars (see Wade, 1988, Ostrom, 1990). Though I did not incorporate institutional variables in my model, field observation and group discussions suggest that clear rules reduce overexploitation of forest resources through influences on human behaviour. Despite this, distributional aspects of CF management still deserve further attention. Though conservation oriented management regimes improve biophysical aspects of local commons, very little is known about those households displaced from villages after the introduction of community-based forest management. Understanding the condition under which equitable distribution of economic benefits from community forestry is possible and the constraints facing participatory forest management are important avenues for future research. Moreover, the livelihood implications of community forestry especially for those who loose their profession after the initiation of formal systems of communitybased resource management seems to be an important topic for further research.

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