Performance of Community Forest User Groups: Trade-off between Current and Future Forest Produce (Empirical Evidence from Fuel Wood Model)[1]

Bal Krishna Upadhyay, PhD
Associate Professor
Department of Economics
Tri-Chandra Campus,
Tribhuvan University
Kathmandu, Nepal

1. ABSTRACT

This paper addresses one of the unsettled and controversial issues in Community Forestry: How do the social choices/the political decision-making of the Community Forest User Group (CFUG) reflect its time preference or take care of the future of the Community Forest while deciding to withdraw forest produce for the current needs?

It develops a choice-theoretic model and from it observes that a typical household is in equilibrium if the three conditions hold well. They are: i) marginal rate of time preference between the current and future consumption of forest produce equals the marginal rate of transformation between the current and future forest produce from group activity, ii) marginal rate of time preference between future consumption of forest produce and the current consumption of leisure time equals the marginal rate of transformation between the future forest produce and current expenditure of labour in group activity, and iii) marginal rate of substitution between the current consumption of produce from alternative activities and future consumption of forest produce from group activity equals the marginal productivity of expenditure out of the produce from alternative activities in monitoring of forest use. The household's preference for forest products for the current needs is reflected through the political decision making of the group. The negative coefficients of the CFUG's management activism and future consciousness in the equation for the three years' average quantity of fuel wood distributed in the current period validate our hypotheses that a high index of management activism and the future consciousness of the household about the protection of the forest for the future make a CFUG perform better in terms of the distribution of a smaller amount of fuel wood in the current period so as to preserve more fresh fuel wood for a better regeneration of the forest in the future. The negative value of the future consumption of fuel wood with respect to current consumption of fuel wood in the equation to Marginal Rate of Substitution (MRS) indicates an increase in the current consumption of fuel wood by a thousand kilograms reduces the consumption of the same in the future. The reduced-form coefficient of the management activism is positive and it indicates that an improvement in the overall weighted average index of management activism enables CFUGs to supply larger amount of fuel wood in the current year consistent with the long time preference of the households. The positive marginal value of the future consumption with respect to the current consumption of fuel wood in the equation to Marginal Rate of Transformation (MRT) implies a reduction in the consumption of fuel wood in the current year is transformed into a protected forest with fresh fuel wood in the future.

2. INTRODUCTION

What role does Community Forest[2] User Groups' (CFUGs) political decision-making process play in the performance of CFUG in terms of the distribution of fuel wood? This question has surprisingly received little attention from academic research in Community Forestry.

A large literature on common property[3] considers the determinants of local organisations, whereas its authors focus on the interdependence or salience (on fuel wood, Gibson 1999, natural system, Gregersen eds. 1989 and Adhikari, D. 1998, and social system, Gelobter 2001), common

[1] I wish to thank Prof. Dr. V. R. Chitre, ex-director GIPE, Pune, India and Prof. Dr. S. K. Datta, Center for Manageemnt in Agriculture, IIM, Ahmedabad, India for useful comments.

[2] A Community Forest is an area of a national forest handed over to a user group to develop, conserve, use, and manage the forest in accordance with the operational plan. An autonomous and corporate legal body of households sharing the management responsibility of a national forest of definite size and distributing produce among them are called Community Forest User Group (HMGN 1998).

[3] Ciriacy Wantrup and Bishop R.C. (1975) define common property as 'a distribution of property rights in resources in which a number of owners are co-equal in their rights to use the resource'.

understanding (Gibson and Koontz 1997), group size (Olson 1965) and heterogeneity (Baland and Platteau, 1996 and Dayton-Johnson 2000) financial viability and proximity to the resource (Ostrom 1999, Das and Sheng 1998). A number of cross sectional and case studies from Nepal document rural people's knowledge and skills about the forest control systems or the protection of the forest, forest use rules, and socioeconomic characteristics of the rural people (Karki, Karki, and Karki 1994, and Dahal 1994) and influence of institutional rules on the condition of the forest (Varughese 1999). Heltberg (2001) from his study in India finds that active conservation rule reduces forest degradation. Currently, the focus of research on Community Forestry in Nepal has widened, involving the coverage of institutional rules and distribution of forest products (Chakraborty, Freir, Kegel, and Mascher 1997 and Bhim 2003). Edmonds (2003b) concluded that households without groups extracted a larger quantity of fuel wood compared to the households with groups. However, the data used by Edmonds does not state the institutional mechanism that lowered fuel wood extraction. Thus, he leaves unanswered the question as to why the forest user groups reduce the forest product collection. Hence, Community Forestry is likely to be sustained if the government has preferences about how a CFUG performs in terms of the distribution of fuel wood for its members' current needs or concerns about the protection of the forest resource by CFUGs while providing just adequate amount of forest products for their current needs.

This article studies the impact of Community Forest User Groups' (CFUGs) effectiveness or management activism, households' long time horizon or future consciousness on the current consumption of fuel wood and the impact of current consumption of fuel wood on its future consumption. One of the primary policies of the participatory development of the developing countries including Nepal is the devolution of central government programs to more localised institutions. There is more push for the establishment of local organisation as this organisation resolves exclusion and extraction difficulties inherent in such classical forest management (Kanel 2004). The stress on management is largely because of the incapacity of the government to protect national/public forest and supply forest products among the public. Insufficient budget for the Department of Forest and lack of roads in the hills aggravated the condition. Consequently, public forest converted into 'near open-access resource' (Chapagain, Kanel and Regmi 1999). Thus, the failure of institutional rule can be termed as the famous 'tragedy of the commons' (Runge 1981). Due to this, the need of a "bridge catalyst" and the three underlying characteristics of the forest such as renewability, seasonality and public perception[4] of the resource (Uphoff 1986) seemed relevant to community-based resource management prescription.

The local common property is being transferred to the local organisation throughout the world because of the critical importance of common-pool resources[5] for household well being and maintenance of environmental conditions (Beck and Ghosh 2000, Arnold 1998, Arnold eds. 1995, Ascher 1994, Colchester 1994, Jodha 1986, Bajracharya 1981) and its high international profile of environmental issues. The Forest Act (1993) and its byelaws (1995) grant authority to the Department of Forest to transfer the forests of hills and mountains to a group of household (HMG 1998). The discussion here is based upon the functioning mechanism of the government created forest user groups. The CFUGs formulate and enforce rules and thus coordinate the activities of their members. Legal, institutional and economic incentives ensure coordination backed by trust, reciprocity and credibility of the commitment to the rules crafted and agreed by users. Inclusive and equitable participation, rule of law, accountability, a representative body and above trust building process strengthen CFUGs.

[4] Fellizar (1992) says the extent of management initiatives by the community members depends upon people's 'public' or 'private' perception towards the forest resource. The choice between government involvement and local organisation is due to the renewability of the resources. This characteristic of a resource determines the type of organisational arrangements needed to correct drastic consequences of poor management. The need for flexibility and informality in institutional arrangement emerges because of the seasonality of the resource.

[5] Common-pool resources include in-shore fisheries, forests, pasturelands and irrigation systems that generate a number of common pool goods (Ostrom, Gardner and Walker eds. 1997). Forests can share with common-pool goods in terms of the characteristics of subtractability (for example, timber, fuel wood and fodder) and with public goods in terms of the characteristics of indivisibility and non-excludability (Gibson, Mckean, and Ostrom eds. 2000). The subsistence of hill people depends on forest goods (like fuel wood, fodder and leaf litter, Mahat 1987) and they cannot be excluded from the use of forest. Similarly, the use of Community Forest for fuel wood is a local public good because it is difficult to put value on such products in the hills (Price 1990).

The findings that the impact of a high management activism of the group and user members' long time horizon on the current distribution of fuel wood and impact of current distribution on future distribution of fuel wood have several implications. First, as CFUGs are given with the usufruct right over the use of the forest, it is necessary that they regulate the use of the forest. It means they decide to what extent a forest should be used, and what portion of the resource should be allocated to its potential users. When it comes to the question of scale the market obviously fails as a guide and the solution should be carried out by means of a democratic decision making process and finally an administrative standard. A controlled supply of forest products for current needs is essential to maintain these productive potentials while supplying forest goods and its services (Arnold 1998). Forest has a limited yield capacity or a limited reproductive capacity. The concept of reproducibility or the maximum limit of production has underscored the judicious use of the forest (Baland and Plateau 1996). If forest is used above this capacity, forest biomass cannot grow. Consequently, the supply of forest goods is curtailed and the natural system may face irreversible losses. Institutions can effectively function to supply the forest products among the households while protecting forest for the future. 'Institutions[6] provide the framework within which human beings interact' (North 1981) to safeguard the future of the forest. A number of authors from developing as well as developed countries argue that institutional development should be carried out near to the level of actual users so that they can effectively protect the resource and be accountable to the communities concerned (Swift 1995).

Second, compensation for the future is best achieved by ensuring the current generations leave the succeeding generations with at least as much capital wealth as the current generation inherited. The failure of economic and political institutions to achieve sustainability through the destruction of ecosystem is attributable to short time horizon, failures in property rights, concentration of economic and political power, immeasurability and institutional and scientific uncertainty.

Third, a large number literature on commons describes the success of the local organisation in terms of the design and characteristics of the local institutions. It implies success or failure of an organisation may differ depending upon the differences in the design and characteristics of the local institution (Bromely eds. 1992). Contrary to the arguments that poor have short sightedness/time horizon, they have high individual rate of time preference for current consumption of resources, their marginal rate of time preference increases as poverty goes up, they do not care in the protection of natural resources rather they extract more (Holden et al. 1998), this paper empirically finds that community forest users in the survey area have long time horizon. It provides evidence to the theory that the CFUGs distribute a smaller quantity of fuel wood for the current needs of their user members consistent with their long time preference while protecting the forest for the future.

In these contexts, the thrust of this paper is that the social choices/actions, resulting in from the decisions of the meetings of the User Groups, lead to the withdrawal of just adequate quantity of fuel wood for the current needs that the future of the Community Forest is taken care of, well. There is no market for fuel wood in the hills. Household preferences for the withdrawal of the forest products for the current needs, in this context, are reflected in the social choices/actions or political decision making by the CFUGs provided there is a representative and effective participatory institutional mechanism to determine the social actions. The political decision making process of the CFUGs has to decide upon the withdrawal of a small quantity of fuel wood to distribute among the user members in the current period if it has to reflect the concern of the user member households about taking care of the regeneration condition of the forest for the future. This, paper empirically examines this proposition by investigating the influence of the three central variables, namely, the impact of CFUG's management activism, its user members' future consciousness on the current consumption of fuel wood and impact of the current consumption on the future consumption of fuel wood.

The empirical work here is based on the institutional characteristics, households' long time horizon and distribution pattern of fuel wood across the 19 CFUGs of Kabhre district. Potentially, omitted differences across the CFUG could plague the conclusions on the performance of the CFUGs. To minimise the unobserved differences in the district, this paper explores its findings by focussing on the Community Forest User Group Committee (CFUGC) with varying management characteristics and

[6] According North (1991) institutions are defined as rules, norms, formal hierarchies, monitoring, and sanctioning which shape individuals' actions and expectations.

households' long time horizon. The selected CFUGs are located across the similar locality and households have similar pattern of forest use, characterise the middle hill districts.

The article is organised as follows. Section 3 presents background on forestry in Nepal. Section 4 deals with key concepts. Section 5 presents analytical framework of this paper the Section 6 introduces the data and methodology. Section 7 presents the determinants of performance of CFUG or collective action. Section 8 concludes this paper.

3. BACKGROUND OF FORESTRY IN NEPAL

Nepal, a landlocked Hindu kingdom, located along the southern slopes of the Himalayas between the arid Tibetan plateau of China in the north and fertile Gangetic plain of India in the south, is one of the smallest nations (0.3 percent of the Asian continental landmass, ADB/ICIMOD 1992).

Approximately, 98% of the rural households use wood as a primary fuel in the hills and mountains of Nepal (Edmonds, 2003a and b). Forest policy is on high profile in Nepal because of its forest dependant people and the potential value of its forest resources.

Nepal's forest policy went through three major changes in the past. First, there was no policy implemented for the management of forest before 1956. Before, 1951, Nepal remained under Gorkha (1768-1846) and rana (1846-1950) rule (Regmi 1971). Land and its products were the principal economic resources during these periods. Though the state owned the forestland, the property rights and formal institutions to enforce these rights existed only in respect of agricultural land. There was no separate policy for the management of forest. Forest remained under "near open" access (Chapagain, Kanel, and Regmi 1999, and Regmi 1976). However, the hill people managed forests under traditional system. Under this system, village communities controlled access to and use of forest through informal rules (Fisher 1991). Thus, the frontier policy or revenue oriented policy of land use resulted in heavy deforestation in hills as well as in terai (Regmi 1971).

Second, the government brought out its first five year plan in 1956 for the centralised management of natural resources including forests. To implement the plan effectively, over 1.25 hectares of land in the hills and mountains were nationalised in 1957[7]. The government's initiatives are characterised by the concepts of bureaucratic centralisation forest governance, authoritative legislative strategies, and administrative attitudes and practices that have been borrowed from the temperate industrialised world and widely adopted in many less developed world (Poffenberger and Mcgean B. 1996). The government aimed at protecting the forest and supplying products among the village people. In 1966 and 1967, the government introduced Forest Act and Forest Protection Special Arrangement Act, respectively to strengthen the Forest Department's role in the monitoring of the forest use and distribution of forest products among the public. However, these initiations disrupted the centuries old traditional pattern of resource control and political rights (Bromley and Chapagain 1984). Villagers ceased to apply any traditional rules for the forest management and community responsibility for the protection of forest disappeared. People misunderstood the acts to mean that the government removed the rights of access and use of forests. The Forest Department was not effectively able to carry out these tasks because of inadequate staff and lack of access roads to the hill forest. Very little attention was given to the distribution of forest product among the local people (Kashio 1999). Consequently, there was widespread felling of timber and forests were heavily exploited (Bajracharya 1983a, 1983b and 1981). Until the mid-seventies, forest policy focussed on management from the national government.

Third, forest management was decentralised in 1977, and the tasks of forest protection and distribution of forest products were entrusted to the village panchayats or local elected bodies. However, panchayat officials were not able to effectively monitor the forest use, distribute forest products among the villagers and instil a feeling of cooperation among them. Therefore, the government introduced devolution in forest management in 1987 and a new Forest Act in 1993 and its byelaws in 1995 thereby instituted the concept of User Group in Community Forestry (Kanel 2004).

This new Forest Policy empowered the Community Forest User Groups to use and protect the forest for the future through the institutional mechanism under this system. The current policy provisions, dependence on the forest, and common understanding among the hill households about

[7] Centralised management of natural resources was adopted because it was believed that foresters know better and local ignorant people needed to be mobilised, educated and ordered (Blair and Olpadwala 1988).

intimate relationship between the forest and their subsistence make households conscious about the protection of the forest for the future while providing just an adequate quantity of fuel wood for the current period. The user members further their common interest in group activities and reflect their future consciousness by constructing barricades to protect the forest from landslides, effectively monitoring forest use, educating the traditional forest users to inculcate common interest, organising meetings regularly and attending meetings for consensus based decision making (Upadhyay 2003).

4. KEY CONCEPTS

The Forest Act (1993) and its byelaws (1995) provides the legal and institutional incentives; 'minimal recognition of the rights to organise' (Ostrom 1992) and economic benefits; benefits of forest products thus creating an "enabling framework" for effective participation in decision making and protection of the forest for the future while providing forest products for the current needs (Knox and Meinzen-dick 2001, Poffenberger and MacGean eds. 1996, Sarin 1996). The process of giving a group of household a formal shape is like this: Households form a group and the group desirous of developing and conserving forest and utilising forest products submits an application to the District Forest Office (DFO). The DFO develops a constitution for the group following the guidelines of the Act.

The group assumes its formal status after the approval of the constitution. The constitution defines the rules of the user group. It defines who the members of the user group are, how the executive body of user group is formed, functions or rights and duties of the group and executive committee, how disputes are resolved, how land territory and borders are defined, how the funds earned from the sale of forest products are to be managed, what types of sanctions or fines can be imposed on rule breakers, what types of rules are to be adopted for harvesting and distribution of forest products, etc. The group determines the representation of households from the castes of the group and gender from among the households. The executive committee prepares its management plan or operational plan with the assistance from DFO staff or a forest ranger. A national forest is handed over to a group after the constitution and operational plan are approved by the DFO. An operational plan is a rule for making rules. The operational plan describes the activities permissible on user group land. The plan specifies what products can and cannot be removed from the forest, who can remove them and when products are removed. The operational plan prohibits hunting and grazing on forestland. The operational plan gives details of punitive measures for rule breakers. It contains information about the location, area and physical condition of the forest. Thus, constitution and operational plan work as binding agreement between a Community Forest User Group (CFUG) and the government that follow the terms and conditions of the act and its byelaws. In fact, this binding agreement is a production and implementation plan for a CFUG. However, the operational plan is mostly social rather than being essentially technical. This binding agreement may incite village people's inducement to be involved in a CFUG (Seabright 1993). This binding agreement ensures village people's labour input and money involvement in risk sharing arrangement as CFUG. Thus, rights to use forest through formal organisation can strengthen the group's authority against non-member users from outside. It can enhance a sense of ownership and build up confidence. The users will be assured of the future benefits of the investment . (Bruce 1999). The Forest Act (1993) and its Byelaws (1995) also provide for the monitoring of the leaders. The Forest Act (1993) empowers CFUG to impose appropriate penalty on any person, if he/she is found working against the rules of the operational plan. This legal recognition is especially important for forest product allocation and conflict resolution.

The CFUGs are characterised to include the a) process of decision making, b) enforcement of property rights and c) monitoring of the implementation of the decisions (Upadhyay 2003).

The process of decision making consists of the procedures for making the CFUG representative of the concerns of the user members and for functioning effectively. It ensures sharing of information about group activity and the role of the protected forest among the members of the group. Specifically, the process of decision making is taken here to consist of the five components: a) representation of at least i) one household from each of the castes of the general members, and ii) one woman in the executive committee, b) four years' average of the total of the monthly and annual meetings, four years' average attendance of the executive committee members in the executive committee meetings, and d) whether or decision making is done for the harvest and distribution of fuel wood by the executive committee, or assembly, or both. In this paper, the weighted average of whether or decision making is

done for the harvest and distribution of fuel wood by the executive committee or assembly or both, representation of one household from each of the castes of the general members and one woman in the executive committee have been found explaining the performance of CFUG. Thus, the democratic process of organising CFUG and political decision making process ensures equity and justice in community forestry.

The enforcement of property rights denotes the effectiveness of the CFUG to ensure users' stake in Community Forestry. A CFUG is effective if property rights are enforced. The property rights are enforced if CFUG specifies membership fee, rules of harvest (including produce, day/date, time of entry into and exit from forest and quantity for withdrawal) and distribution of fuel wood. The three components of the weighted average of the enforcement of property rights namely membership fee, day and weighing have statistically significant influence on the distribution of fuel wood by CFUG among the member households.

The monitoring of the implementation of the decisions refers to the methods of keeping the forest intact, controlling forest use behaviour of the users, and strengthening the relationship among the user members. The monitoring of the implementation of the decisions includes the four aspects: a) use of forest guard/group patrol, b) application of punitive measures (or fines) against the rule breakers, c) harvest of produce in group, and d) mobilisation of fund (in rupees) in village level activities. In regression model given below, three of these components namely, weighted average of the forest guard/group patrol, fines and harvest of produce in group explains the performance of fuel wood in terms of the distribution of fuel wood.

5. ANALYTICAL FRAMEWORK

The analytical framework of this study takes the choice theoretic problem faced by a typical hill household. Hill households are assumed to maximise a utility function given by:

$$U = u\ (C_t, C_{t+1}, L_t) \qquad (1)$$

where, C_t = current consumption, C_{t+1} = future consumption, and, L_t = current leisure time.

Current consumption (C_t) includes forest produce from the group activities (P_{Gt}) and produce from alternative activities (P_{at}).

$$C_t = P_{Gt} + P_{at} \qquad (1a)^8$$

Similarly, for future period,

$$C_{t+1} = P_{Gt+1} + P_{at+1} \qquad (1b)$$

where, P_{Gt+1} = forest produce from group activities in future, and P_{at+1} = produce from alternative activities in future.

$$P_{Gt+1} = F\ (P_{Gt}\ , T_{Gt}, M_{Gt}) \qquad (1c)$$

where, P_{Gt} = produce from group activities, T_{Gt} = labour input to group activities for the future, and M_{Gt} = membership fee collected and expended on group activities.

Equation (1c) gives the technical production relation showing the transformation of current forest produce from group activities (P_{Gt}), current labour input (T_{Gt}) and expenditure of the membership fee in real terms (M_{Gt}) into future forest produce (P_{Gt+1}). Forest produce from group activities in future may depend upon the level of forest biomass in the current period. If households get more produce from group activities (P_{Gt}) at present, less may be available for the future. The level of current time devoted to the monitoring of the forest use (T_{Gt}) may determine the forest produce in future.

Households may pay membership fee for the group (M_{Gt}) out of the current produce from the time spent in alternative activities (T_{at}). Therefore,

$$P_{at} = f\ (T_{at}) - M_{Gt} \qquad (1d)$$

Substituting by 1 a), 1 c), and 1 d), into (1) and introducing time allocation by households, a typical hill household is assumed to maximise utility

$$U = u\ [(P_{Gt} + f\ (T_{at}) - M_{Gt,}\ F\ (P_{Gt}, T_{Gt}, M_{Gt}) + P_{at+1}, (T - T_{Gt} - T_{at})], \qquad (2)$$

with respect to P_{Gt} , T_{Gt}, T_{at}, and $M_{Gt,}$ where, T = total time (for leisure, group activities and alternative activities).

[8] Here, alternative produce / crop is taken to be the same as forest produce. Otherwise, I shall need to use separate prices for forest produce and crop output. Alternatively, I can take the two prices to be both equal to unity by arbitrarily adjusting the units of measurement of the two products appropriately.

If households use part of their leisure time and time for alternative activities in monitoring of forest use and participation in meetings, the forest may be protected for the future. Consequently, more fresh fuel wood and foliage may be preserved for a better regeneration of the forest in the future.

Substituting $F (P_{Gt}, T_{Gt}, M_{Gt})$ by P_{Gt+1}, household's utility maximisation problem is to maximise:

$$U = u (P_{Gt} + f (T_{at}) - M_{Gt}, P_{Gt+1} + P_{at+1}, (T - T_{Gt} - T_{at})) \quad (3)$$

subject to $P_{Gt+1} = F (P_{Gt}, T_{Gt}, M_{Gt})$.

In the above equations (2 and 3), a typical hill household can choose the levels of the following four variables.

1) current consumption of forest products from group activities (P_{Gt});
2) current expenditure of labour time in group activities (T_{Gt});
3) current produce from alternative activities devoted to the monitoring of forest use through the payment of membership fee (M_{Gt}); and
4) current expenditure of labour time (T_{at}) in alternative activities.

Therefore, the first-order conditions for maximising the utility function represented in equation (2) with respect to each of these four choice variables (or P_{Gt}, T_{Gt}, T_{at}, M_{Gt}) are as given below:

a) $u_1 + u_2 F_1 = 0$ (4)

b) $u_2 F_2 - u_3 = 0$ (5)

c) $-u_1 + u_2 F_3 = 0$ (6)

d) $u_1 f' - u_3 = 0$ (7)

First, u_1 and u_2 in equation (4) are the partial derivatives of utility with respect to the first and the second terms of u (or current and future consumption of forest produce). u_1/ u_2 is the rate of time preference of the households or the marginal rate of substitution between the current and future consumption of forest produce. F_1 is the marginal rate of transformation of the current forest produce into future forest produce. Therefore,

$$u_1/ u_2 = -F_1 \quad (4a)$$

This implies, MRS $C_t C_{t+1}$ = MRT $P_{Gt} P_{Gt+1}$

where, MRS $C_t C_{t+1}$ = marginal rate of substitution between the current and future consumption of forest produce, and MRT $P_{Gt} P_{Gt+1}$ = marginal rate of transformation between the current and future forest produce from group activities.

Second, u_2 and u_3 in equation (5) are the partial derivatives of the utility with respect to the second and the third terms of u (or future consumption of forest produce and current consumption of leisure time respectively). F_2 is the rate of transformation (or marginal productivity) of current labour input devoted to the monitoring of the community forest use for the protection of the forest for the future. Therefore,

$$u_3/ u_2 = F_2 \quad (5a)$$

Implies, MRS $C_{t+1} L_t$ = MRT $P_{Gt+1} L_t$

where, MRS $C_{t+1} L_t$ = marginal rate of substitution between the future consumption of forest produce and the current consumption of leisure time, and MRT $P_{Gt+1} L_t$ = marginal rate of transformation between the future forest produce and the current expenditure/application of labour in the group activity.

Similarly, MRS $C_{t+1} L_t$ ($\partial C_{t+1} / \partial L_t$) gives the change in the future consumption of forest produce of a typical household for a change in the use of current leisure time in the group activity. MRT $P_{Gt+1} L_t$ (or $\partial P_{Gt+1}/\partial L_t$) shows the future forest produce that will result from additional application of current labour input in the group activity.

For hill households, leisure is an enjoyment that gives utility. Thus, a unit use of leisure time in other activities causes a reduction in leisure time with a consequent loss in utility (Barrow 1997). Therefore, use of leisure time for work should be compensated by more consumption so that utility from consumption is equal to the loss of utility from the use of leisure time in work. The use of current labour input in the monitoring of forest use can improve the regeneration condition of the forest, thus making more forest produce available in future.

Third, u_1 and u_2 in equation (6) are the partial derivatives of the utility with respect to the first and the second terms of u (or the current and future consumption of forest produce). F_3 shows the rate of transformation of current produce from alternative activities devoted to the monitoring of forest use

through payment of membership fee into future forest produce from group activities. Alternatively, F_3 is the marginal productivity of membership fee expended on monitoring. Therefore,

$u_1 / u_2 = F_3$ (6a)

The marginal rate of substitution between the current and future consumption equals the marginal productivity of expenditure on monitoring of the forest use for the future.

That is, MRS $M_{Gt}\ P_{Gt+1}$ = MRT $M_{Gt}\ P_{Gt+1}$

where, MRS $M_{Gt}\ P_{Gt+1}$ = marginal rate of substitution between current produce from alternative activities devoted to the monitoring of forest use through payment of membership fee and future produce from group activity, and MRT $M_{Gt}\ P_{Gt+1}$ = marginal rate of transformation of current produce in alternative activities devoted to the monitoring of forest use through payment of membership fee into future forest produce in group activity.

Thus, a typical hill household is in equilibrium if the following three conditions hold good.

a) MRS $C_t\ C_{t+1}$ = MRT $P_{Gt}\ P_{Gt+1}$ (1)

This implies that marginal rate of substitution (MRS) between the current consumption (C_t) and future consumption (C_{t+1}) of forest produce equals marginal rate of transformation (MRT) between current produce (P_{Gt}) and future forest produce (P_{Gt+1}) from group activities.

b) MRS $C_{t+1}\ L_t$ = MRT $P_{Gt+1}\ L_t$ (2)

Or, the marginal rate of substitution between the current application of labour input and the future consumption of forest produce equals the marginal productivity of labour input for monitoring of the forest use.

c) MRS $M_{Gt}\ P_{Gt+1}$ = MRT $M_{Gt}\ P_{Gt+1}$ (3)

That is, the marginal rate of substitution between the current produce from alternative activities (that is, M_{Gt} or membership fee) devoted to the monitoring of forest use and the future forest produce equals the marginal productivity of expenditure on monitoring of the forest use.

Fourth, u_1 and u_3 in equation (7) are the partial derivatives of utility with respect to the first and the third terms of u (that is, current consumption and leisure). f ` is the marginal productivity of labour in alternative activities.

Rewriting equation (7), we have:

$f` = u_3 / u_1$ (7a)

That is, the marginal productivity of labour in alternative activities (f `) equals the marginal rate of substitution between the current consumption of produce from alternative activities and leisure. Furthermore, households can produce more from alternative activities if they use part of their leisure time in alternative activities. Consequently, households may be able to pay membership fee for the group activities.

Introducing T_{at+1} and M_{Gt+1}, in equation (3), the basic optimization model of a typical hill household is assumed to maximise utility when:

$U = U (P_{Gt} + f(Tat) - M_{Gt}, P_{Gt+1} + f(T_{at+1}) - M_{Gt+1}; T - T_{Gt} - T_{at})$

Subject to $P_{Gt+1} = F (P_{Gt,} T_{Gt}, M_{Gt})$

One of the necessary conditions for this is

MRS $C_t, C_{t+1} = F_1$

Or, $P_{Gt+1} = H (P_{Gt}, T_{Gt}, M_{Gt}, T_{at}, T_{at+1})$ and $P_{Gt+1} = F_1 (P_{Gt}, T_{Gt}, M_{Gt})$

where, H gives the Marginal Rate of Substitution (MRS) between C_t and C_{t+1} and F_1 the Marginal Rate of Transformation (MRT) between P_{Gt} and P_{Gt+1}.

Thus, P_{Gt+1} is influenced by two factors associated with the characteristics of households and forest. Therefore, we estimate simultaneously the following two equations for the slope coefficient of P_{Gt+1} with respect to the current consumption of forest products, the components of Management Activism (MA) and the household, and the forest related characteristics as additional variables to see whether the empirical results of these models validate 'efficiency' on account of Community Forestry or participatory process involved in Community Forestry.

$P_{Gt+1} = H (P_{Gt}$, Process, Enforcement, Monitoring, $H_1, H_2, \ldots)$

$P_{Gt+1} = F_1 (P_{Gt}$, Process, Enforcement, Monitoring, $F_1, F_2, \ldots)$

where, $H_1, H_2, \ldots$ and $F_1, F_2, \ldots$ are the relevant household and forest related characteristics, respectively.

In order to estimate these two equations by Two- stage Least Squares Method, we estimate the following two equations;

$P_{Gt+1} = H (P_{Gt}$, Process, Enforcement, Monitoring,$H_1, H_2, \ldots)$ and

$P_{Gt+1} = F_1 (P_{Gt}$, Process, Enforcement, Monitoring, F 1, F 2, …)

where, P_{Gt} is the predicted value from P_{Gt} from the following equation (the regression results of which are given in table 1):

$P_{Gt} = G$ (Process, Enforcement, Monitoring, FUTCON, $H_1, H_2, \ldots, F_1, F_2, \ldots$).

The estimable equation for MRS (the regression results of the equation are given in tables 2) function is:

$P_{Gt+1} = h_0 + h_1 P_{Gt} + h_2 P^2_{Gt} + h_3$ PROCESS + h_4 ENFORCEMENT + h_5 MONITORING + $h_6 H_1 + h_7 H_2 + h_8 H_3$ …

The estimable equation for MRT function (the regression results of this equation are given in table 3) is:

$P_{Gt+1} = f_0 + f_1 P_{Gt} + f_2 P^2_{Gt} + f_3$ PROCESS + f_4 ENFORCEMENT + f_5 MONITORING + $f_6 F_1 + h_7 F_2 + h_8 F_3$ …

where, MRS from utility Indifference function < MRT from Transformation function .

Then, equating P_{Gt+1} from the two equations and solving for $P_{Gt,}$ we have:

$P_{Gt} = q_0 + q_1$ PROCESS + q_2 ENFORCEMENT + q_3 MONITORING + $q_4 H_1 + q_5 H_2 + q_6 H_3 + \ldots + q_7 F_1 + q_8 F_2 + q_9 F_3$ …

where, $q_i = (h_i - f_i)/(f_1 - h_1) \quad < 0$.

6. STUDY AREA AND DATA

This paper employed data[9] collected from 19 functioning[10] CFUGs of the Kabhrepalanchowk district and 306 randomly selected CFUG member[11] households. The Kabhrepalanchowk, a middle hill district, which received substantial support from the government and also Development Assistance from the Australian Government to foster Community Forestry (1978) was chosen for field study because forests handed over to the groups in this district are in the production stage, it has a sufficient data base in terms of the number of groups formed and the forest handed over to the group, CFUG management and fuel wood use pattern in this district represents central hill and this district is easily accessible from Kathmandu. This researcher had no intention of selecting neither successful nor unsuccessful CFUG. Viewed in terms of the biotic pressure (forest production collection) and management characteristics of the CFUGs in Kabhre district, the review reports carried out by others such as Livelihoods Forestry Project and Nepal Swiss Forestry Project demonstrate similar situation in broad terms.

[9] Data were collected by this author together with two field assistant for 12 months spread over two phases: the first phase initiated on 6 December 1999 and ended in August 2000. The second phase initiated on 1st January and ended in March 2001. The information about each of the aspects of the management activism of the CFUG and observation of forest use were gathered during this phase.

[10] A CFUG distributing fuel wood among its members for the three fiscal years (that is, 1999/98, 1998/97 and 1997/96) is defined as a functioning one. At the outset, the executive committee members were requested to provide information on the annual quantity of fresh fuel wood distributed among the user members. The information about the supply of fresh fuel wood (in kilogram and bundles as well) for the fiscal years of 1996/1997, 1997/1998 and 1998/1999 was noted down from the office records of the CFUG. Fuel wood was considered an indicator of functioning CFUG because it is consumption good. The 19 CFUGs, which were having the data on the quantity of fuel wood distributed among the user members, including 17 located in the six Village Development Committees (VDCs) (a Village Development Committee is similar to a panchayat and has nine wards) and two in one municipality were selected. The 19 CFUGs selected for this study are mostly located within the altitude range of 800-2000 metres and this selection represents density of population in the district. However, this range in the study district (as well as in the other districts located in central hills), perhaps, covers most of the population of the central hills.

[11] A household can be defined as a member of CFUG in two ways: a household is a member because its name is in the register of CFUG and its dues for the current year on account of membership have been cleared by a date preceding the survey. The former type of household is known as member of CFUG in this study

Keeping the analytical issues of this study in mind, this research used three types of data collection techniques[12], namely, interviews (with open-ended and closed-ended questions), checklist (or guidelines for discussions utilised at executive and general assembly meetings and other village gatherings) and observations (that is, forest user behaviours). The interview schedule collected information relating to household characteristics (e.g. quantities of fuel wood received by each child and adult of the household from the community and government forest and own farmlands, future consciousness, sex and literacy and number of members in the family, number of livestock and area of khet (or lowland) and bari (upland) land owned and the quantities of the major crops produced from cultivated land). Group level data were derived using checklists (such as distribution of fuel wood by CFUG, calendar of fuel wood collection, average weight of the backloads of fuel wood, management activism, forest, personal characteristics of the leaders).

This research used three methods to arrive at the average weight of bundle[13] of fuel wood: weighing (with a spring balance for 4 CFUGs), office records (2 CFUGs noted down from the records of the committee) and recall method (13 CFUGs through interview with executive committee members) (Godoy, Lubuwski, and Markandya 1993).

Pairwise computation of Karl Pearson's Correlation Coefficient[14] Method was used to determine the preliminary relationship between performance related (like three years' average quantities of fuel wood) and other variables (one at a time), namely, the management activism, community forest area and forest types, and households' characteristics.

7. DETERMINANTS OF COLLECTIVE ACTION

Different authors suggest a number of explanatory variables that determine the collective action and institutional arrangements (Bromely eds. 1992). Since the sample size is small and variation across the CFUG (in terms of the distribution of fuel wood) is negligible, the study takes of the sample of those relevant variables in the regression analysis. Because of this, this paper focuses on the impact of a small number of explanatory variables on the dependent variable, whose importance have been discussed in the theoretical framework of this paper and theoretical literature. This section examines the impact of the characteristics of the Natural Resource Management Institution or CFUG, users and forest on the consumption of fuel wood econometrically. The definitions of the dependent and independent variables are given in table 1 below.

[12] The data collection instruments were pre-tested with a view to finding out missing questions, inappropriate, inadequate, confusing response categories in the interview schedule and necessary adjustments were made in the questionnaire and in this way the questionnaire was finalized.

[13] The bundle of fresh fuel wood is called dori. In principle, a bundle is measured with a rope of approximately 1-meter length and the length of the fresh fuel wood branch is approximately 1.5-meter. Two CFUGs (that is, Thuliban and Vasmepakha) supply weighed fuel wood among their members.

[14] The Karl Pearson's Correlation Coefficient determines the magnitude and significant relationship between dependent and independent variables. If the relationship between the dependent and the independent variables is negative, then an increase in the magnitude of the independent variable causes a reduction in the dependent variable. Alternatively, if the relationship between the dependent and the independent variable is positive, an increase in the magnitude of the independent variable causes an increase in the dependent variable.

DEFINITIONS OF THE DEPENDENT AND INDEPENDENT VARIABLES

The definition of the dependent and independent variables are given in table below.

Table 1: Dependent and Independent Variables and their Definitions

Variables		Description
Dependent Variable		
Fuel wood (Pik)		Three years' average quantity of fuel wood[15] received by ith household from kth CFUG
Fuel wood (Pik97/98-98/99)		Two following year's average quantity of fuel wood received (in thousand kgs) by the ith household from the kth CFUG consisting of fresh fuel wood and twigs added together after correction of moisture contents
Independent Variables		
PROCESS	Decision making	1 for decision making by the committee/assembly or both, otherwise 0. Weighted average of the decision making for the harvest and distribution of fuel wood and twigs in percentage was derived by multiplying 1 or 0 by the corresponding weight (or 5) and 100; and then dividing by the aggregate of the weights (or 15).
	Caste	1 for representation of at least one household from each of the castes of general members in the executive committee, otherwise, 0. Weighted average of the representation of at least one household from each of the castes of the general members in the executive committee in percentage was derived by multiplying 1 or 0 by the corresponding weight (or 2) and 100; and then dividing by the aggregate of the weight (or 15).
	Woman	1 for representation of at least one woman in the executive committee, otherwise, 0. Weighted average of the representation of at least one woman was derived by multiplying 1 or 0 by the corresponding weight (or 1) and 100; and then dividing by the aggregate of the weight (or 15)
ENFORCEMENT	Fee	1 if membership is specified, 0 otherwise. Weighted average of the membership fee in percentage was derived by multiplying 1 or 0 by the corresponding weight (or 4) and 100; and then dividing by the aggregate of the weight (or 21)
	Day	1 if day for the harvest and distribution of each fuel wood and twigs is specified, otherwise 0. Weighted average of the day in percentage was derived by multiplying 1 or 0 by the corresponding weight (or 1) and 100; and then dividing by the aggregate of the weight (or 21).
	Weigh	1 if fuel wood to be distributed is weighed, otherwise 0. Weighted average of the weighing in percentage was derived by multiplying 1 or 0 by the corresponding weight (or 2) and 100; and then dividing by the aggregate of the weight (or 21).
	Quantity	1 if quantity for the harvest and distribution of fuel wood and twigs is specified in the meetings of CFUG, otherwise 0. Weighted average of the quantity in percentage was derived by multiplying 1 or 0 by the corresponding weight (or 6) and 100; then dividing by the aggregate of the weight (or 21)
	Produce	1 if produce (or fuel wood or twigs) for the harvest and distribution is specified in the meetings of the CFUG, otherwise, 0. Weighted average of the produce in percentage was obtained by multiplying 1 or 0 by the corresponding weight (or 5) and 100; and then dividing by the aggregate of the weight (or 21)
MONITORING	Group harvest	1 if each fuel wood and twigs is harvested and distributed in group, otherwise, 0. Weighted average of the group harvest in percentage was derived by multiplying 1 or 0 by the corresponding weight (or 4) and 100; and then dividing by the aggregate of the weight (or 10)
	Guard	1 if the CFUG has a hired forest guard/group patrol, otherwise, 0. Weighted average of the forest guard or group patrol was derived by multiplying 1 or 0 by the corresponding weight (or 3) and 100; and then dividing by the aggregate of the weight (or 10)
	Fines	1 if the CFUG has the record of fines collected from rule breakers. Weighted average of the fines was derived by multiplying 1 or 0 by the corresponding weight (or 2) and 100; and then dividing by the aggregate of the weight (or 10)
fuel wood 96/97		Predicted quantity of current year fuel wood (for 1996/97) received by ith household from kth CFUG (in '000' kgs)
Forest		Community forest area in hectares
Plantation forest		Plantation forest of pines (1 if plantation forest, otherwise, 0)
Family size		Number of members in the family of ith household
crop		Ith household's net income from crops in NRs. 1000
LU		Livestock including cattle, buffalo and goat in standard units
CFUG1		Shift dummy or dummy for Vakundebessi CFUG (or CFUG 1). 1 for CFUG 1, otherwise 0.
CFUG 2		Shift dummy or dummy for Naubisegeruwapakha CFUG (or CFUG 2). 1 for CFUG 2, otherwise, 0.
CFUG 5		Shift dummy or dummy for Khawakoratmate CFUG (or CFUG 5). 1 for CFUG 5, otherwise, 0.
CFUG13		Shift dummy or dummy for Baserithuloban CFUG (or CFUG 13). 1 for CFUG 13, otherwise, 0.
CFUG14		Shift dummy or dummy for Byangdhungathulopakha CFUG (or CFUG 14). 1 for CFUG 14, otherwise, 0.
CFUG 15		Shift dummy or dummy for Sanobanamaldol CFUG (or CFUG 15). 1 for CFUG 14, otherwise, 0.
CFUG 16		Shift dummy or dummy for Sanobandandal CFUG (or CFUG 16). 1 for CFUG 16, otherwise, 0.
CFUG 18		Shift dummy or dummy for Indresworthalpu 'ka' CFUG (or CFUG 18). 1 for CFUG 18, otherwise, 0
C FUG 19		Shift dummy or dummy for Jyalachiti CFUG (or CFUG 19). 1 for CFUG 19, otherwise, 0
FUT CFUG 1		Slope dummy or dummy for the responses of the future consciousness of the households of Vakundebesi CFUG (or FUT CFUG 1). CFUG 1* future consciousness of the ith household of CFUG 1.
FUT CFUG 11		Slope dummy or dummy for the responses of the future consciousness of the households of Dharapanikhareti CFUG (or FUT CFUG 11). CFUG 11* future consciousness of the ith household of CFUG 11.
FUT CFUG 14		Slope dummy or dummy for the responses of the future consciousness of the households of Byangdhungathulopakha CFUG (or FUT CFUG 14). CFUG 14 * future consciousness of the ith household of CFUG 14.
FUT CFUG 16		Slope dummy or dummy for the responses of the future consciousness of the households of Sanobandandal CFUG (or FUT CFUG 16). CFUG 16 * future consciousness of the ith household of CFUG 16.

[15] Aggregate quantity of fuel wood in this study includes fresh fuel wood (including branches plus wood obtained from singling/thinning of trees) plus fresh sita or twigs. Fresh fuel wood and twigs contain varying proportion of moisture. Therefore, fresh fuel wood and sita are added together after correcting moisture contents in them. The moisture content of fresh fuel wood and twigs is corrected following the method adopted by Levension (1979) and Bajracharya (1981). Bajracharya (1981) following Levension (1979) suggests that fresh fuel wood contains 75% moisture (that is, 0.74 g/ml) compared with that of the oven dry wood. He assumes that sita has 40% (that is, 0.61 g/ml) moisture content compared to that of the oven dry wood. This study adopts this approach.

A number of methods were adopted to develop estimable equations and perform regressions based on them. First, household level data such as the current consumption of fuel wood, number of members in the family, livestock owned in standard units and net income from crops are placed in spread sheet. Then, group level data (such as the each of the components of process, enforcement and monitoring, forest area and types of Community Forest-natural forest without plantation, natural forest with plantation of pines and plantation forest of pines) are entered as continuous variable across the household level data. Next, dummy of the CFUG taking the value 1 is created if ith household receives forest products from the corresponding CFUG, zero otherwise. The dummy for the responses to households' future consciousness taking the value 1 is created multiplying the corresponding CFUG if the household is future conscious, zero otherwise. Then, multiple regression exercises are carried out using PC (Personal Computer), Statistical Package for Social Sciences (SPSS).

The regression results are given in Tables 2, 3, and 4. For current consumption of fuel wood, the predicted values are estimated on the basis of first-stage regression in appendix table 1. The means and standard deviation of the variables used in the regression are also given in the tables. In Table 2, the determinants of the performance of the CFUG are analysed, where the endogenous variable is the three years' average quantity of fuel wood (in '000' kgs) received by ith household from kth CFUG. In Table 3, the determinants of the Marginal Rate of Substitution (MRS) between current and future consumption of fuel wood are analysed, where the dependant variable is the two following years' consumption of fuel wood. In Table 4, the determinants of Marginal Rate of Transformation (MRT) are analysed, where the dependent variable is the two following years' consumption of fuel wood. In appendix table 1, the determinants of current consumption are analysed, where the dependent variable is the current consumption of fuel wood. Within the sample frame, the parameters can be expressed as marginal changes in the performance of the CFUG/NRM institution with respect to the corresponding exogenous variables. Out of the 306 observations, 256 are correctly predicted by the regressions. The regression results comply with the implications of the equations 4, 5 and 6. The coefficients have the same signs as we expected.

7.1 DETERMINANTS OF CURRENT CONSUMPTION

The implication of equation (5) is that if households possess high time preference for forest produce for the future they use their current leisure time in collectivity. In Community Forestry, households use their current labour in group activities for the selection of general members for the assembly. The CFUG members spend their time in the meetings and form an executive committee with the representation of general members from different castes and gender. They make a tentative estimate of household demand for fuel wood and visit forest to make a guess estimate of an appropriable quantity of fuel wood. On doing these, the executive committee members share information about these issues, discuss among them and reach in consensus to appropriate a quantity of fuel wood and distribute the same to the households in an equal amount. Then, the committee calls general assembly meeting. Each general member is informed about the date, time and venue of the general assembly meeting. The executive committee puts its agenda in the general assembly meeting and the members reach in consensus after discussion by the members. The general members reach in consensus and decide to harvest and distribute a predetermined amount of fuel wood. This paper argues that the decisions of the CFUGs reflect the households' preference for their current needs while keeping forest product aside for the future. The implication is that a typical hill household intends to withdraw a small but an adequate amount of fuel wood in the current period at a high index of the process of decision of the CFUG so that fresh fuel wood is protected for the future.

For example, the aggregates of each of the 3 parameters of PROCESS (-0.16) has negative sign, indicating an increase in the weighted average index of PROCESS by a percent, reduces the availability of fuel wood by 160 kgs per annum per household. The possible reasons are as follows:

The Forest Act (1993) and its byelaws (1995) state that villagers can form an autonomous body of their own with the provision of selecting members by themselves. Thus, the process of decision making refers to the procedures for making Community Forest User Group Committee (CFUGC) representative so as to reflect the members' concerns and for functioning effectively. The procedure involves time for the selection of general and executive members. A gathering of households prepares

name lists of potential general members. Eligible households can be members on payment of registration charge for the group with due clearing of membership fee after tendering an application of interest to join in the group. Then, the group selects its chief and members for the executive committee. A group becomes autonomous body after it is registered with the District Forest Office and national forest is handed over to it. Consequently, as forest users spend their time in the day to day affairs of the group, they may get more benefit out of that (following equation 5). A better process should make CFUG a representative organisation, which will be the case if all the traditional forest users are recognised as members from the beginning of its establishment. Consequently, the group may be able to further common interests among all members.

In this paper, representation of at least one household from each of the castes of the general member (it means representation of at least one household from backward communities in CFUGs with members from multiple castes) in the Community Forest User Group Committee is one of the indicators of a mechanism to reflect their concerns, and thus a component of the index of process. Such a process empowers households of each of the castes. As a result, they develop sense of ownership and realise the collective benefits from commons. Collective interests among all members of different castes may be able to appropriate more fuel wood in the current period consistent with their long time horizon. For example, the parameter of the three years' average quantity of fuel wood with respect to the weighted average of caste (in percentage) has positive sign (0.05) and is significant at the 1% level of significance. That is, if one household from each of the castes of the general members is represented in the executive committee, the availability of fuel wood increases by 50 kgs per annum per household.

A key aspect of women's empowerment is their participation in formal political structures. The CPR literature stresses that women have equal role to that of male in the judicious use of forest and canvassing community members on the critical role of common resources for the future. Inclusion of women in local level institutions provides them equal access to and full participation in the power structures, as well as to increase women's capacity to participate in decision-making and leadership. Studies have shown that issues of access to and control over resources by women are critical in mountain areas. Equity is embedded in fairness that implies that people have equal opportunities for realising their full rights and potential to contribute to national, political, economic, social and cultural development and to benefit from the results (ICIMOD 2003). Women are the real users of forest products in the hills. Thus, if a woman is represented in the executive committee, she can be instrumental in providing information about forest product use. Such a representation makes communication with all the general members easier. In consequence, it may facilitate sharing of information with all the members about the critical role of hill forest and rules of forest product harvest and distribution. Thus, a better process can develop better common understanding among members resulting in trust in the group activity. This may contribute to the women's understanding that forest protection is essential for future. For example, the coefficient of weighted average of the representation of one woman (in percentage) in the executive committee is negative (-0.160) and is statistically significant at the 1% level of significance. It indicates a weighted average percentage point increase in the representation of a woman in the CFUG executive committee reduces the supply of fuel wood Community Forest in the current period consistent with their long time horizon thus ensuring its future availability.

Decision making for the harvest and distribution of fuel wood involves democratic decision making, bargaining and consensus or compromise. It can generate common understanding among the members that forest should be judiciously used so that it is protected for the future. A protected forest ensures the availability of product in the future and is essential to the protection of the natural system. The parameter of the weighted average of whether decision making for the harvest of fuel wood is taken by the assembly or executive committee or both (in %) has negative sign (-0.05) and is statistically significant at the 1% level of significance. It implies that if CFUGs adopt democratic decision making by assembly or executive committee or both the availability of fuel wood from CFUG reduces by 50 kgs per annum per household. If a CFUG functions smoothly, that is, it has an executive body, holds meeting; members attend as per the quorum rule and as a result there is common consensus in the meetings regarding the harvest and distribution of fuel wood, then the members are assured of receiving a portion of the cake. This assurance is transformed into a social capital or trust. Consequently,

collective decision making for the harvest and distribution of fuel wood enables CFUGs to distribute a small amount of fuel wood.

The aggregates of the weighted average of the process of decision making has negative sign (that is, -0.160). It indicates an increase in the weighted average of the process of decision making by a percentage point reduces the current withdrawal of fuel wood by 160 kgs per annum per household.

Next, stability of a CFUG requires that it be credible on the eyes of its user members (Chakraborty 2001). Credibility strengthens if its members devise rules of harvest and distribution of forest products and enforce them effectively. If CFUGs specify and implement harvest rules, users cannot appropriate in excess of the politically decided amount of forest products. Consequently, CFUG may be able to store more fresh fuel wood in the forest. If CFUG distributes weighed fuel wood, members can receive a fair amount in proportion to the membership fee paid and voluntary labour contributed for the same. From equation (6), we concluded that if a typical household's time preference for the current produce from alternative activities is low, then he/she should invest in the group as membership fee (in real terms). High time preference means impatience (Dasgupta and Heal, 1979). The implication is that if households invest in group in the form of membership fee, they can get more forest produce. Furthermore, households can produce more from alternative activities if they use part of their leisure time in alternative activities (following equation 7). Consequently, households may be able to pay membership fee for the group activities. Membership fee, if effectively enforced may strengthen the sense of ownership on the part of the user members and consequently serve as a measure of restricting non-paying villagers from the use of the Community Forest. Note that investment of membership fee in the group activity requires that the typical hill household should have high preference for the protection of the forest for the future. For example, the marginal value of the weighted average of membership fee has negative sign (-0.15) and is statistically significance at the 1% level of significance. It implies that withdrawal of fuel wood from CFUGs reduces by 150 kgs per annum per household if CFUG members pay membership fee. CFUGs can establish fund out of the membership fee paid by households. CFUGs can utilise fund to hire forest guard, which can ensure effective monitoring of forest thus reducing current withdrawal of fuel wood so that fresh fuel wood and foliage is protected for the future.

Next, equation (5) shows the marginal rate of transformation between future consumption of forest produce and current consumption of leisure. The implication is that if households use their current leisure time in group activity, CFUG can improve its index of enforcement of property rights. Alternatively, if CFUG members weigh fuel wood and distribute it, then it transform as a common understanding on them that they have awarded as per their contribution. Such a credible task creates an environment for the protection of forest for the future while providing just an adequate amount of fuel wood in the current period. For example, the parameter of the weighted average of WEIGHING (in percentage) has negative sign (that is, -0.46) and is statistically significance at 1% level of significance. It indicates if fuel wood is WEIGHED and distributed then supply of fuel wood from CFUG reduces by 460 kgs per annum per household.

Stability of a CFUG requires that it be accountable (Chakraborty 2001). Alternatively, if it formulates rules of entry into and exit from the forest then it is accountable on the eyes of the members. If it does so it can create an atmosphere of trust among the members as members know when to enter into and exit from forest. Strict enforcement of such harvest rules checks unauthorised use of forest. Thus, forest user may receive more products in the current period without spoiling the regeneration condition of the forest for the future. For example, the parameter of the weighted average of DAY (in percentage) has positive sign (0.61) and is statistically significant at the 1% level of significance. It indicates that if CFUGs specify the day for the harvest and distribution of fuel wood current withdrawal of fuel wood from CFUG increases, that is, by 610 kgs per annum per household.

One of methods of controlling illegal withdrawal of forest products is the deployment of forest guard or patrol of forest use by group members. If CFUGs hire forest guard or members patrol the use of forest in group, the forest may be protected for the future. For example, the parameter of the weighted average of FOREST GUARD (in percentage) has negative sign (-0.01) and is statistically significant at the 1% level of significance. It indicates that if CFUGs deploy forest guard or user

members keep vigil on forest use, current withdrawal of fuel wood reduces by 10 kgs per annum per household.

Another method of keeping vigil at the forest use behaviour of the user member is the harvest of produce in group. Alternatively, if fuel wood is harvested in group it can limit the current withdrawal and ensure the availability of fresh fuel wood and foliage in the forest for the future. For example, the marginal value of the weighted average of the harvest of fuel wood in group or GROUP HARVEST is negative (-0.02) and significant at the 1% level of significance. It indicates if CFUGs adopt harvest and distribution of fuel wood in group, it will be able to supply small amount of fuel wood by 20 kgs per annum per household.

Application of punitive measure checks the unauthorised use of forest and can ensure an increased availability of fuel wood if fuel wood is supplied by CFUG. For example, the parameter of the weighted average of FINES (in percentage) has positive sign (0.06). It indicates that application of fines on the rule breakers enables CFUGs to supply an increased amount of fuel wood by 60 kgs per annum per household.

The marginal value of the aggregate of the three components of MONITORING of the implementation of the decisions has positive sign (that is, 0.30). It indicates an improvement in the weighted average index of the monitoring of the implementation of the decisions in percentage results in the current withdrawal of fuel wood from CFUG by 30 kgs per annum per household.

The aggregates of the weighted average of the marginal values of the three components of management activism (that is, PROCESS, ENFORCEMENT AND MONITORING) has negative sign (that is, -0.130). It indicates an improvement in the weighted average of the management activism reduces the current withdrawal of fuel wood by 130 kgs per annum per household.

Equation (4) shows the marginal rate of time preference between the current consumption and future consumption of forest products. Intuitively, if households consider that the forest can supply a finite amount of fuel wood because of its maximum carrying capacity, they may have low time preference for the withdrawal of fuel wood in the current period. If household has high time preference for the current consumption relative to the future consumption, then more of the produce that can be consumed in the future is withdrawn. The implication is that a typical household should be future conscious for the protection of the forest for the future. The conclusion derived from equation (5) is that future conscious households use their current labour input for the promotion of knowledge about the protected benefits of community forest. Note that if a typical household is future conscious, he/she intends to receive a smaller amount of fuel wood in the current period to preserve more fresh fuel wood and foliage for a better regeneration of the forest in the future. For example, the parameter of future consciousness of the ith household which takes the value 1 or 0, has negative sign (-0.05) and is significant at the 10% level of significance. It means a future conscious household expects to obtain a small amount of fuel wood by 50 kgs per annum to obtain more of the same in the future.

The coefficients of the dummy for CFUG 1, 13 and 19 have negative values and they are statistically significant at the 1% level of significance. It implies, households of these CFUGs intend to receive a smaller amount of fuel wood (that is, smaller quantities of 2790, 2650 and 1070 kgs per annum per household), the values of other explanatory variables remaining the same, compared with the similarly placed households in other CFUGs with similar attributes of the management activism. The parameter of the dummy for CFUG 14 has positive value and is significant at the 1%.

The coefficients of dummies for the future consciousness of the households of CFUG 1, 11, 14 and 16 are positive. These coefficients indicate that the future conscious households of these CFUG are willing to receive a larger quantity of fuel wood from these CFUGs by 60 kgs, 70 kgs, 50 kgs and 20 kgs respectively in contrast with similar future conscious households, from the CFUGs in general, which are willing to receive a smaller quantity of fuel wood by 50 kgs per annum per household. The possible reasons are as follows. The field research team could not properly explain the interviewees about the meaning of future consciousness. Consequently, respondents misunderstood it for the CFUG under reference. Second, interviewees responded positively due to the fear that if they reported otherwise their rights of community forest use could be taken away by the government. Third, if the amount of fuel wood received by the typical household is not adequate, it may intend to receive more even if it is future conscious. For example, some households of CFUGs 1 and 2 told us that the amount

of fuel wood received from these respective CFUGs is inadequate. Next, if households own relatively fewer number of farm trees and obtain less fuel wood from own farmlands, they may intend to receive more from community forest even though they are future conscious. For example, households of CFUG 14 and 16 told us that they have very few trees on their farmlands, and consequently, they have to depend on community forest for fuel wood.

Table 2: Regression Coefficients, their Standard Error and t-ratio and their level of Significance, mean values of X and Y.

Endogenous variable: three years' average consumption of fuel wood

Exogenous Variables		Coefficients	Std. Error	t-ratio	Mean of X	Standard deviation of Y
	CONSTANT	3.60	0.09	38.2*		
PROCESS	DECISION MAKING	-0.05	0.00	-17.0*	14.0	13.4
	WOMAN	-0.160	0.01	-14.3*	5.0	2.89
	CASTE	0.05	0.00	11.9*	8.3	6.46
	MEMBERSHIP FEE	-0.15	0.00	-35.6*	16.7	6.31
ENFORCEMENT	WEIGHING	-0.46	0.02	-19.4*	0.29	1.15
	DAY	0.61	0.03	16.9*	1.63	1.83
MONITORIING	GUARD	-0.01	0.00	-2.9*	24.37	11.73
	GROUP HARVEST	-0.02	0.00	-11.5*	16.25	16.18
	FINES	0.06	0.00	17.4*	10.00	10.01
FOREST	FOREST	0.01	0.00	23.4*	40.21	40.69
HOUSEHOLD	FUTURE CONSCIOUSNESS	-0.05	0.03	-1.7***	0.59	0.49
	FAMILY SIZE	0.01	0.00	2.9*	6.92	2.84
	LU	0.02	0.00	3.6*	3.65	2.06
	NET CROP INCOME	-0.01	0.00	-2.9*	35.15	28.50
DUMMY	CFUG1	-0.81	0.11	-7.2*	0.06	0.24
	CFUG13	-0.95	0.09	-10.0*	0.06	0.24
	CFUG14	0.63	0.09	6.9*	0.06	0.24
	CFUG19	-2.53	0.11	-21.7*	0.06	0.24
	FUT CFUG 1	0.11	0.10	1.0	0.04	0.21
	FUT CFUG 11	0.12	0.09	1.3	0.02	0.16
	FUT CFUG 14	0.10	0.10	1.0	0.02	0.13
	FUT CFUG 16	0.07	0.11	0.64	0.05	0.21

R = 0.983, R^2 = 0. 967, Adjusted R^2 = 0.964,
Standard Error of the Estimates = 0.1772,
Durbin-Watson Statistics = 2.180 (The decision rule of DW d test says, no autocorrelation, positive or negative: du < d< 4-du, when k = 20 and n = 200, du = 1.896 and dl = 1.462 at 1% level of significance, therefore, DW statistics is significant at the 1% level of significance)
Regression F = 307.430 (P = 0.000) (Significant at the 1% level)
df1 = 22, df2 = 233
** t-statistics denotes at the 1% level. *** t-statistics denotes at the 10% level.
Mean of Y = 1.39, Standard deviation of Y = 0.92
N = 256
Source: CFUG and household survey, 1999-2001

7.2 Determinants of MRS function of fuel wood

According to the choice-theoretic problem, a typical hill household should have a low time preference. That is, a household should choose just an adequate or a low level of current consumption to have larger amount of the same in the future. MRS C_t C_{t+1} (or $\partial C_{t+1} / \partial C_t$) shows the quantity of future consumption (or C_{t+1}) that must be given up per unit of current consumption (C_t) if the typical household is to continue to derive the same level of utility. Alternatively, it shows the typical household's time preference or preference for current consumption relative to future consumption. If $\partial C_{t+1} / \partial C_t$ is high in absolute value, the typical household has a high time preference or a high preference for current consumption relative to future consumption. Then, more of the produce that can be consumed in future (or P_{Gt+1}) is withdrawn for current consumption. Alternatively, the MRS C_t C_{t+1} which we estimate in the under given second stage regression for MRS, should have a negative sign. For this, we use predicted values of the current consumption of forest products as one of the additional independent variables in the equation for fuel wood and following two years' average consumption of fuel wood as the dependent variable to measure the marginal rate of time preference of the households.

The predicted values for the current consumption (or P_{Gt}) are derived using all the exogenous variables of the first stage equation and their corresponding proxy or the instrumental variables of the exogenous variables and the current consumption of the forest products as the dependent variable (Table 5). In the second stage regression, we develop one equation for MRS, which estimate the slope coefficient of dependent variable (or following two years' average consumption of forest products) with

respect to the predicted values of P_{Gt}, components of management activism and household related variables) for fuel wood model. We have adopted 2SLS because P_{Gt} appears as a right-hand side variable in each of the MRS and MRT related equations. The results of the 2sls, which reflect households' low time preference for the current consumption of forest products, validate our hypothesis that an increase in the current consumption of forest products results in the corresponding decreases in the future consumption of the same.

The weighted average of the index of the 3 components of management activism (that is, process of decision-making, enforcement of property rights and monitoring of the implementation of the decisions) shows the preferences of the households between the present and future consumption of fuel wood. Households' low time preference is reflected through CFUGs' high index of management activism. An improvement in the index of management activism means low time preference of the households given that households obtain just an adequate amount of fuel wood for their current needs.

The overall marginal value of P_{Gt+1} (that is, following two years' average consumption of fuel wood) with respect to management activism (i.e. the sum of the coefficients of the three components – PROCESS, ENFORCEMENT and MONITORING) has negative value (-0.089). It implies that an improvement in the CFUG's management reduces the time preference of the households keeping the current consumption of fuel wood unchanged. Each of the values of the components of PROCESS (that is, DECISION MAKING, CASTE and WOMAN), ENFORCEMENT (MEMBERSHIP FEE, WEIGHING and DAY) and MONITORING (GROUP HARVEST, GUARD and FINES) are statistically significant at the 1% level of significance.

The marginal value of P_{Gt+1} with respect to predicted P_{Gt} (current consumption of fuel wood) is negative (-0.572) and significant at the 1% level of significance. It indicates that an increase in the current consumption of fuel wood by a thousand kilograms reduces the consumption of the same by 572 kilograms per annum per household in the next years (taken with certainty).

Table 3: Regression Coefficients, Standard Error of the Estimates and t-ratio and their level of significance, mean and standard deviation of X and
Endogenous Variable: Two following years' average consumption of fuel wood (in '000' kgs)

	Exogenous Variables	Coefficients	Std. Error	t-ratio	Mean of X	Standard dev of X
	CONSTANT	2.917	0.10	28.69*		
PROCESS	DECISION MAKING	-0.033	0.00	-20.47*	14.06	13.43
	CASTE	-0.017	0.00	-9.46*	8.33	6.46
	WOMAN	0.038	0.00	7.88*	5.00	2.89
ENFORCEMENT	MEMBERSHIP FEE	-0.086	0.00	-42.67*	16.66	6.31
	WEIGHING	-0.186	0.01	-18.05*	0.29	1.15
	DAY	0.132	0.01	11.50*	1.63	1.83
MONITORING	GROUP HARVEST	-0.007	0.00	-5.90*	16.25	16.18
	GUARD	0.009	0.00	5.04*	24.37	11.7323
	FINES	0.037	0.00	23.86*	10.00	10.01
	PREDICTED FUEL WOOD FOR 96/97	-0.572	0.05	-10.11*	0.92	0.44
	FAMILY SIZE	0.0022	0.00	0.664	6.92	2.84
	LIVESTOCK IN STANDARD UNITS	0.0089	0.00	1.679	3.65	2.06
	NET CROP INCOME	0.0001	0.00	0.371	35.15	28.50
	CFUG1	-0.965	0.04	-19.74*	0.06	0.24
	CFUG18	-0.486	0.04	-9.87*	0.06	0.24
	CFUG19	-1.825	0.05	-31.77*	0.06	0.24

R = 0.980, R^2 = 0.961, Adjusted R^2 = 0.958, Standard Error of the Estimates = 0.1276,
Durbin-Watson Statistics = 2.129 , df1 = 16, df2 = 239 (The decision rule of DW d test says, no autocorrelation, positive or negative: du< d< 4-du, when k = 16 and n = 200, du = 1.847 and dl = 1.507 at 1% level of significance, therefore, DW statistics is significant at the 1% level of significance)
Regression F = 365.031 (significant at the 1% level, p = 0.000)
* denotes t-statistics significant at the 1% level. Mean of Y = 1.00, Standard Deviation of Y = 0.62
N = 256 households

Source: CFUG and household survey, 1999-2001

7.3 Determinants of Marginal Rate of Transformation (MRT)

In the second stage regression, we develop one equation for MRT involving dependent variable (following two years' average consumption of fuel wood) and independent variables (that is, the current consumption of fuel wood, components of management activism and forest related variables) for fuel wood model. MRT P_{Gt} P_{Gt+1} (or $\partial P_{GT+1} / \partial P_{GT}$) shows the quantity of future forest produce (P_{Gt+1}) that

results from the transformation of a unit of current forest produce which is not consumed in the current period. Furthermore, if $\partial P_{Gt+1} / \partial P_{Gt}$ is high, large future produce results from a small sacrifice of current consumption of forest produce. Likewise, if households withdraw smaller amount of forest products in the current year more may be available, thus transforming into a well stocked forest, for the future. Alternatively, from the results of the equations for MRT (MC PGt+1/MC PGt), which we describe below, we conclude that the current withdrawal of forest products takes care of the regeneration condition of the forest so that the stock of the forest is well maintained for the future.

The overall marginal value of P_{Gt+1} with respect to the 3 components of MA is negative (that is, -0.094). It implies, given the low time preference of the households for the current consumption of fuel wood, CFUGs characterised with a high index of Management Activism intend to ensure the availability of unchanged amount of fuel wood.

The marginal value of predicted fuel wood is positive (that is, 0.25). It indicates an increase in the extraction of fuel wood by a thousand kilograms in the current year increases the extraction of the same by 250 kilograms per annum per household in the next years because of the efficiency of the CFUGs consistent with the time preference of the households.

The marginal value of P_{Gt+1} with respect to PLANTATION FOREST is negative and is statistically significant at the 1% level of significance. It indicates that if CFUG owns plantation forest the consumption of fuel wood reduces in the next years.

Table 4: Regression Coefficients, Standard Error of the Estimates, t-ratio and their level of significance and mean and standard deviation of X variables

Dependent Variable: Two following years' average consumption of fuel wood received by the ith household from kth CFUG

	Exogenous variable	Coefficients	Std. Error	t-ratio	Mean of X	Standard deviation of X
	CONSTANT	2.81	0.19	14.4*		
PROCESS	DECISION MAKING	-0.04	0.00	-9.2*	14.06	13.43
	CASTE	-0.05	0.00	-16.3*	8.33	6.46
	WOMAN	0.11	0.00	18.3*	5.00	2.89
ENFORCEMENT	MEMBERSHIP FEE	-0.13	0.00	-37.6	16.66	6.31
	WEIGHING	0.119	0.01	8.8*	0.29	1.15
	DAY	-0.133	0.02	-5.3*	1.63	1.83
MONITORING	GROUP HARVEST	0.020	0.00	11.9*	16.25	16.18
	GUARD	0.020	0.00	3.8*	24.37	11.73
	FINES	-0.01	0.00	-5.8*	10.00	10.01
FOREST	PLANTATION FOREST	-0.05	0.02	-2.1**	0.18	0.39
	PREDICTED FUEL WOOD FOR 96/97	0.25	0.10	2.5*	0.92	0.44
	CFUG 2	0.48	0.06	7.7*	0.06	0.24
	CFUG 15	1.25	0.16	7.6*	0.06	0.24
	CFUG 16	-1.57	0.14	-11.2*	0.06	0.24

$R = 0.981$, $R^2 = 0.963$, Adjusted $R^2 = 0.961$, Standard Error of the Estimates = 0.1235, Durbin-Watson Statistics = 2.280 (The decision rule of DW d test says, no autocorrelation, positive or negative: du< d< 4-du, when k = 20, n = 200, du = 1.896 and dl = 1.462 at 1% level of significance. Therefore, DW statistics is significant at the 1% level of significance)

df1 = 14, df2 = 241,

Regression F = 446.12 (significant at the 1% level, p = 0.000)

* denotes t-statistics significant at the 1% level. ** denotes t-statistics significant at the 1% level

N = 256 households.

Mean of Y = 1.00, Standard deviation of Y = 0.62.

Source: CFUG and household survey, 1999-2001

Equating MRS and MRT equations and solving for $P_{Gt\ 96/97,}$ we have $P_{Gt96/97}$ (-0.825 = q_0 CONSTANT (0.107) + PROCESS (-0.025) + ENFORCEMENT (0.004) + MONITORIN (0.36)

That is, the reduced-form coefficient shows an improvement in the overall weighted average index of management activism enables CFUGs to supply larger amount of fuel wood in the current year consistent with the long time preference of the households.

Equation to MRS (MU C_t /MU C_{t+1}) = -0.575 (This is following á/ áx (xn) nx n-1. Since we do not have other term of P_{Gt}, the partial derivatives of the other coefficients in the equation are zero).

It indicates an increase in the consumption of fuel wood by a thousand kilograms in the current year reduces the availability of the same by 575 kilograms per annum per household in the next years. Alternatively, if user members have a high preference for fuel wood consumption in the current, they may get less for consumption in the future.

Equation to MRT (MC P_{Gt} /MC P_{Gt+1}) = 0.250

It implies a reduction in the consumption of fuel wood by a thousand kilogram in the current year is transformed into a protected forest with fresh fuel wood by 250 kilograms per annum per household in the future.

8. CONCLUSIONS AND POLICY IMPLICATIONS

This paper finds that the determination of the typical hill household's equilibrium requires simultaneous choice of optimal current and future consumption of produce from forest user group and alternative activities, investment of labour input for future produce in group and alternative activities and investment of real produce through payment of membership fee devoted to the monitoring of forest use for the protection of the forest for the future. According to the choice-theoretic problem, a typical hill household should have a low time preference. That is, a household should choose just an adequate or a low level of current consumption to have larger amount of the same in the future.

The stability of a local institution (like CFUG) depends on the extent to which is capable of addressing adequately the current needs of the user members for fuel wood while protecting the forest for the future. If a CFUG adopts an effective political process, then it can perform better. Regular meetings with the representation of all the interest groups (including household from each of the castes of general members and women in the executive committee) and free sharing of ideas in the meetings can strengthen the political decision making process. Consequently, users may be able to assess the condition of the forest and decide about the withdrawal of the forest products accordingly.

The parameter of the three years' average quantity of fuel wood with respect to the weighted average of CASTE (in percentage) has positive sign and is statistically significant. That is, if one household from each of the castes of the general members is represented in the executive committee, the CFUGs can supply larger amount of fuel wood per annum per household.

The coefficient of three years' average quantity of fuel wood with respect to the weighted average of the representation of one WOMAN (in percentage) in the executive committee is negative and is statistically significant. It indicates a weighted average percentage point increase in the representation of one woman in the executive committee of the CFUG reduces the supply of fuel wood in the current period consistent with their long time horizon thus ensuring its future availability. The implications of this finding are as follows. Inclusion of women in local level institutions provides them equal access to and full participation in power structures thus increasing women's capacity to participate in decision-making and leadership. Equity is embedded in fairness that implies that women have equal opportunities for realising their full rights and potential to contribute to national, political, economic, social, and cultural development and to benefit from the results (ICIMOD 2003). Consequently, women members will be able to share the critical importance of hill forest for their subsistence and to the maintenance of the hill natural system.

The parameter of the weighted average of whether decision making for the harvest of fuel wood is taken by the assembly or executive committee or both (in %) has negative sign. It implies that if CFUGs adopts democratic decision making the availability of fuel wood from CFUG reduces. If a CFUG functions smoothly, that is, it has an executive body, holds meeting; members attend as per the quorum rule and as a result there is common consensus in the meetings regarding the harvest and distribution of fuel wood, then the members are assured of receiving a portion of the cake in the future. This assurance is transformed into a social capital or trust. Consequently, collective decision making for the harvest and distribution of fuel wood enables CFUG to distribute a small amount of fuel wood and receive a larger amount of the same in the future.

The aggregate of the weighted average of the three components of the PROCESS of decision making has negative sign. It indicates an increase in the weighted average of the PROCESS of decision making by a percentage point reduces the current withdrawal of fuel wood per household.

Forest management at the local level is an on-going process. Therefore, the CFUG should be able to formulate and enforce rules as per the changing situations. The marginal value of the three years' average quantity of fuel wood received by ith household from kth CFUG with respect to the weighted average of membership fee has negative sign and is statistically significant. It implies that withdrawal of fuel wood from CFUGs reduces if CFUG members pay membership fee. CFUGs can establish fund out of the membership fee paid by households. CFUGs can utilise fund to hire forest guard, which can

ensure effective monitoring of forest thus reducing current withdrawal of fuel wood so that fresh fuel wood is protected for the future.

The negative parameter of the three years' average quantity of fuel wood with respect to the weighted average of WEIGHING indicates if CFUGs distribute fuel wood following weighing then supply of fuel wood from CFUG reduces per annum per household.

The positive parameter of three years' average quantity of fuel wood received by ith household from kth CFUG with respect to the weighted average of DAY (in percentage) denotes if CFUGs specify the day for the harvest and distribution of fuel wood current withdrawal of fuel wood from CFUG increases per annum per household.

The negative parameter of the three years' average quantity of fuel wood with respect to the weighted average of FOREST GUARD/GROUP PATROL (in percentage) indicates that if CFUGs deploy forest guard or user members keep vigil on forest use, current withdrawal of fuel wood reduces per annum per household.

The negative marginal value of the three years' average quantity of fuel wood with respect to the weighted average of the GROUP HARVEST or the harvest of fuel wood in group indicates if CFUGs adopt harvest and distribution of fuel wood in group, it will be able to supply small amount of fuel wood per annum per household. Alternatively, if fuel wood is harvested in group it can limit the current withdrawal and ensure the availability of fresh fuel wood in the forest for the future.

The parameter of the three years' average quantity of fuel wood with respect to the weighted average of FINES (in percentage) has positive sign. It implies application of fines on the rule breakers enables CFUGs to supply an increased amount of fuel wood annum per household. Application of punitive measure checks the unauthorised use of forest and can ensure an increased availability of fuel wood CFUG.

The positive marginal value of the three years' average quantity of fuel wood received by ith household from kth CFUG with respect to the aggregate of the three components of monitoring of the implementation of the decisions indicates an improvement in the weighted average index of the monitoring of the implementation of the decisions (in percentage) increases the current withdrawal of fuel wood from CFUG per annum per household.

The negative value of the marginal coefficient of three years' average quantity of fuel wood received by the ith household from kth CFUG implies an improvement in the weighted average of the management activism of the CFUG reduces the current withdrawal of fuel wood per annum per household.

One of the implications of the beneficial effects of high management activism is that an appropriate constitution of an institution (like CFUG) can be an effective mechanism for forest governance and management. The local communities, who have more knowledge about the forest and forest use behaviour of the people, can generate realistic ideas and visions, which can facilitate the smooth development of an organisation and lead toward success. They can establish an effective mechanism for dialogue, debates and consensus among the members. Credibility of a CFUG strengthens if its members devise rules of harvest and distribution of forest products enforces them effectively.

The negative parameter of three years' average quantity of fuel wood with respect to the future consciousness of the ith household denotes a future conscious household expects to obtain a small amount of fuel wood from CFUG per annum to obtain more of the same in the future.

The positive coefficients of three years average quantity of fuel wood with respect to the dummy for CFUG 1, 13 and 19 imply households of these CFUGs intend to receive a smaller amount of fuel wood (that is, smaller quantities of 2790, 2650 and 1070 kgs per annum per household), the values of other explanatory variables remaining the same, compared with the similarly placed households in other CFUGs with similar attributes of the management activism. The parameter of the dummy for CFUG 14 has positive value.

The results of the 2sls, which reflect households' low time preference for the current consumption of forest products, validate our hypothesis that an increase in the current consumption of forest products results in the corresponding decreases in the future consumption of the same.

The weighted average of the index of the 3 components of management activism (that is, process of decision-making, enforcement of property rights and monitoring of the implementation of the decisions) shows the preferences of the households between the present and future consumption of fuel wood. Households' low time preference is reflected through CFUGs' high index of management activism. An improvement in the index of management activism means low time preference of the households given that households obtain just an adequate amount of fuel wood for their current needs.

The overall marginal value of $P_{Gt+1}$with respect to management activism (i.e. the sum of the coefficients of the three components; PROCESS, ENFORCEMENT and MONITORING) has negative value. It implies that an improvement in the CFUG's management reduces the time preference of the households keeping the current consumption of fuel wood unchanged. Each of the values of the components of PROCESS (that is, DECISION MAKING, CASTE and WOMAN), ENFORCEMENT (MEMBERSHIP FEE, WEIGHING and DAY) and MONITORING (GROUP HARVEST, GUARD and FINES) are statistically significant.

The marginal value of P_{Gt+1} with respect to PLANTATION FOREST is negative. It indicates that if CFUG owns plantation forest the consumption of fuel wood reduces in the next years.

The reduced-form coefficient indicates that an improvement in the overall weighted average index of management activism enables CFUGs to supply larger amount of fuel wood in the current year consistent with the long time preference of the households.

The equation to MRS (MU C_t /MU C_{t+1}) shows a negative value of C_{t+1} with respect to C_t. It indicates an increase in the consumption of fuel wood by a thousand kilograms in the current year reduces the availability of the same per annum per household in the next years. Alternatively, if user members have a high preference for fuel wood consumption in the current, they may get less for consumption in the future.

The equation to MRT (MC P_{Gt} /MC P_{Gt+1}) has positive value. It implies a reduction in the consumption of fuel wood by a thousand kilogram in the current year is transformed into a protected forest with fresh fuel wood and foliage in the future years. Alternatively, from the results of the equations for MRT (MC PGt+1/MC PGt), we conclude that the current withdrawal of forest products takes care of the regeneration condition of the forest so that the stock of the forest is well maintained for the future.

REFERENCES

ADB/ICIMOD (1992). 'Nepal: Economic policies for sustainable development' Kathmandu: Asian Development Bank (ADB)/International Centre for Integrated Mountain Development (ICIMOD).

Adhikari, Bhim (2003). 'Poverty, property rights and collective action: understanding the distributive aspects of common resource management', *Environment and Development Economics,* : 7-31

Adhikari, D. (2001). "Utilisation pattern of forest resources in Nepal: a case study of Khoplang VDC of Gorkha, West Nepal', Unpublished Master's Thesis, Institute of Forestry, Tribhuvan University, Nepal.

Agrawal, Arun (2001). 'The regulatory community: decentralisation and the environment in the Van Panchayats (Forest Council) of Kumaun, India', *Mountain Research and Development,* Vol. 21. No. 3: 208-211.

Agrawal, Arun and Gibson Clark C. (1999). 'Enchantment and disenchantment: the role of community in natural resource conservation'. *World Development*, Vol. 27. No.4:629-649.

Arnold J.E.M. and Dewees, P. (eds.) (1995). 'Tree management in farmers' strategies: responses in agricultural intensification'. Oxford: Oxford University Press.

Arnold, J. E. M. (1992). 'Community forestry: ten years in review. Food and Agricultural Organisation (FAO), Rome: FAO.

Arnold, J.E. M. (1998). 'Managing forest as common property'. Food and Agricultural Organisation (FAO), Forestry Paper No.136. Rome:FAO.

Ascher, William (1994). 'Communities and sustainable forestry in developing countries'. San Francisco: Institute for Contemporary Studies.

Bajracharya, Deepak (1981). 'Implications of fuel and food needs for deforestation: an energy study in a hill village Panchayat of eastern Nepal'. Unpublished Ph. D. Thesis. UK: The University of Sussex.
Bajracharya, Deepak (1983a). 'Deforestation in the food/fuel context: historical and political perspectives from Nepal' *Mountain Research and Development.* Vol. 7: 227-240.
Bajracharya, Deepak (1983b). 'Fuel wood or forests? dilemmas in a Nepali village'. *World Development*. Vol.11. No. 12:1057-1074.
Baland Jean –Marie and Platteau Jean-Phillippe (1996). 'Halting degradation of natural resources: is there a role of rural communities?' Oxford: Food and Agricultural Organisation of the United Nations and Clarenden Press.
Bardhan, Pranab (1993). 'Symposium of management of local commons'. *Journal of Economic Perspective*, Vol. 7. No. 4: 87-92.
Bardhan, Pranab (2001). 'Water community: an empirical analysis of cooperation on irrigation in south India' Berkeley: University of California.
Barrow, R. J. (1997). 'Macroeconomics'. 5th edition. London: MIT press.
Beck, T. and Ghosh Madan G. (2000). 'Common property resources and the poor: findings from western Bengal'. *Economic and Political Weekly.* Vol.35. No. 3: 147-153.
Blair, H. W. and Olpadwala P. D. (1988). 'Forestry in development planning: lessons from the rural development experience.' Dehradun, India: International Book Distributors.
Bromely D.W. (eds.) (1992). 'Making the commons work: theory, practice and policy'. San Francisco, USA: Institute for Contemporary Studies Press.
Bromley, D. W. and Chapagain D.P. (1984). 'The village against the centre: resource depletion in south Asia'. *Journal of Agricultural Economics.* Vol.66. No. 5: 868-73.
Bruce, J. W. (1999). 'Legal bases for the management of forest resources as common property' Community Forestry Note 14. Rome: Food and Agricultural Organisation.
Chakraborty, R.N. (2001). 'Stability and outcomes of common property institutions in forestry: evidence from the terai region of Nepal'. *Ecological Economics*, Vol.36:341-353.
Chakraborty, R.N., Freir, Iness, Kegel, Feriederike and Mascher Martina (1997). 'Community forestry in terai region of Nepal: policy issues, experience and potential'. Berlin: German Development Institute.
Chapagain, D. Kanel K.R. and Regmi D. C. (1999). 'Current policy and legal context of the forestry sector with reference to the community forestry program in Nepal'. Kathmandu: Nepal-UK Community Forestry Project.
Colchester, Marcus (1994). 'Sustaining the forest: the community-based approach in South and South East Asia'. In: development and environment: sustaining people and nature. ed. by Ghai Dharam. UK: Black Well Publishers: 69-100
Dahal D.R. (1994). 'A review of forest user groups: case studies from eastern Nepal'. Kathmandu: ICIMOD.
Das, T. K. and Sheng Teng, Bing (1998). 'Between trust and control: developing confidence in partner cooperation in alliance' Magazine: the Academy of Management Review, Vol.23. Issue 3: 491.
Dasgupta, P. S. and Heal, Georffrey M. (1979). 'Economic theory and exhaustible resources'. Welwyn, England: James Nishet and Company and Cambridge Univesrity Press.
Dayton-Johnson, Jeff (2000). 'Determinants of collective action on the local commons: a model with evidence from Mexico'. *Journal of Development Economics.* Vol. 62: 181-208
Dev Om Prakash, Baginski Oliver Srpingate and Karn Ajeet Kumar (2004). 'Understanding livelihood impact of participatory forest management implementation strategy in Nepal'. In: Kanel ed. twenty-five years of community forestry, proceedings of the fourth national workshop on community forestry, 4-6 August, 2004, Kathmandu: Department of Forest: 208-217.
Edmonds Eric V. (2003a). 'Building community institutions to manage local resources: an empirical investigation'. http://fm www.bc.ed.RePEC/es2000/0558.pdf.March.
Edmonds Eric V. (2003b). 'Development assistance and the construction of government initiated community institutions'. *Economic Development and Cultural Change* : 897-928.
Fellizar, Jr. F. P. (1992). 'Community-based resource management as a strategy for sustainable development'. *Asia-Pacific Jouranl of Rural development.* Vol. ii, No. 2:15-35

Fisher, R. J. (1991). 'Studying indigenous forest management systems in Nepal: toward a more systematic approach'. Working Paper, HAWAii, USA: East-West Centre.

Gelobter, Michel (2001). 'Integrating scale and social justice in the commons'. In: protecting the commons: a framework for resource management in Americas. Burger J. ed. Washington: Island Press: 293-326.

Gibson, Clark C. (1999). 'Dependence, scarcity and the governance of forest resources at the local level in Guatemala'. Paper presented at the workshop in political Theory and Political analysis. Bloomington, Indiana University. W99-16.

Gibson, Clark C., Mckean, Margaret A. and Ostrom E. (ed.) (2000). 'People and forests: communities, institutions and governance.' Cambridge: The MIT Press.

Godoy, R., Lubuwski, R. and Markandya, A. (1993). 'A method for the economic valuation of non-timber tropical forest products.' *Economic Botany.* Vol. 47. No. 3: 220-233.

Gresen, Hans, Draper Sydney and Elzer Dieter (eds.) (1989). 'People and tress, the role of social forestry in sustainable development'. Environment Development Institute Seminar Series. Washington D. C.: The World Bank.

Hardin, Garret (1968). 'The tragedy of the commons.' *Science*. Vol. 62: 1243-48.

Heltberg, R. (2001). 'Determinant and impacts of local institutions for common resource management'. *Environment and Development Economics*. Vol. 6: 183-208

(HMGN 1998). 'Ban ain 2049 (Forest ACT 1993) tata ban niyamabali 2051 (Forest byelaws 1995).' Kathmandu: His majesty's government of Nepal, ministry of forest and conservation, forest development project.

His Majesty's Government of Nepal (1976). 'Rastriya Van Yojana, 2033' (National Forest Plan, 1976). Kathmandu: Ministry of Forest and Soil Conservation.

Holden, S. B. Shiferaw and Wik, M. (1998). 'Poverty, market imperfections and time preferences: of relevance for environmental policy?' *Environment and Development Economics* Vol. *3*:.105-130.

ICIMOD (2003). 'Annual Report'. Kathmandu: International Centre for Integrated Mountain Development (ICIMOD)

Jodha, N. S. (1986). 'Common property resources and rural poor in dry regions of India. *Economic and Political Weekly.* 21/27: 1169-82.

Kanel, K. R. (2004). 'Twenty five years' of community forestry: contribution to millennium development goals'. In: Kanel K. R. (ed.) twenty-five years of community forestry, proceedings of the fourth national workshop on community forestry, 4-6 August, 2004, Kathmandu: Department of Forest, Pp. 4-18.

Karki, Madhav, Karki, J. B-S and Karki N. (1994). 'Sustainable management of common forest resources: an evaluation of selected forest user groups in western Nepal'. Kathmandu: ICIMOD.

Kashio, M. (1999). 'Some movements towards sustainable forest management in Asia and the Pacific' In: proceedings of an international seminar on sustainable forest management, Mathema, P. (ed.). Pokhara: Institute of Forestry, Tribhuvan University, Nepal: 15-25.

Knox, Anna and Meinzen-dick R. (2001). 'Collective action, property rights and devolution of natural resource management: exchange of knowledge and implications for policy'. A workshop summary paper no. 11. Washington D.C.: International Food Policy Research Institute

Levension, B. (1979). 'Fuel wood utilisation: a case study of the demand and the available fuel wood resources at six selected villages'. Kathmandu: Phewa Tal Technical report. No. 9.

Mahat, T. B. S. (1987). 'Forestry-farming linkages in the mountains'. Occasional Paper no. 7, Kathmandu: International Centre for Integrated Mountain Development/FAO.

Mahat, T. B. S. (1985). 'Human impact on forest in the middle hills of Nepal' Unpublished Ph. D. Dissertation. Canberra, Australia: The Australian National University.

Mahat, T.B. S. Griffin, D.M. and Shephered K.R. (1986). 'Human impact on some forests of the middle hills of Nepal-1: forestry in the context of the traditional resources of the state.' *Mountain Research and Development.* Vol.6. No.3: 223-232.

North D. (1981). 'Structure and change in economic history'. New York: W. W. Norton and Co.

North D. (1990). 'Institutions, institutional change and economic performance.' Cambridge: Cambridge University Press.

Olson, Mancur (1965). 'The logic of collective action'. Cambridge, Mass: Harvard University Press.
Ostrom, Elinor (1992). 'Crafting institutions for self-governing irrigation systems'. San Francisco: Institute for Contemporary Studies.
Ostrom, Elinor (1999). 'Self-governance and forest resources'. Occasional paper. No. 20. Indonesia: Centre for International Forestry Research,
Price, M. F. (1990). 'Temperate mountain forests: common-pool resources with changing, multiple outputs for changing communities'. *Natural Resources Journal*, Vol. 30: 685-707.
Ostrom, E., Gardner Roy and Walker J. (1997). 'Rules, games and common-pool resources'. Ann Arbour, USA: The University of Michigan Press.
Poffenberger, M. and MacGean, B. (eds.) (1996). 'Village voices, forest choices: Joint forest management in India'. New Delhi: Oxford University Press.
Regmi M.C. (1971). 'A study of Nepali economic history'. New Delhi: Manjusri.
Regmi, M.C. (1976). 'Land ownership in Nepal'. Berkeley, USA: University of California Press.
Runge, C. (1981). 'Common property externalities: isolation, assurance, resource depletion in a traditional grazing context'. *American Journal of Agricultural Economics.* Vol. 63: 595-96
Sarin, M. (1996). 'From conflict to collaboration: local institutions in joint forest management.' In: Village voices and forest choices: joint forest management in India. New Delhi: Oxford University Press: 165-209.
Seabright, P. (1993). 'Managing local commons: theoretical issues in incentive design'. *Journal of Economic Perspectives* Vol. 4: 113-134
Swift J. (1995). 'Dynamic ecological systems and the administration of pastoral development'. In: Scoones, I. (ed.). Living with uncertainty: new directions in pastoral development in Africa. London: Intermediate Technology Publication Ltd.
Upadhyay, Bal Krishna (2003). 'Economic performance of the user groups in community forestry: an approach to the study of participatory development with reference to Kabhrepalanchowk district, Nepal' Unpublished Ph. D. Thesis. Pune, India: Gokhale Institute of Politics and Economics.
Uphoff, Norman (1986). 'Local institutional development: an analytical course book with cases'. New York: Kumarian Press.
Varughese, G. (1999). 'Villagers, bureaucrats, and forests in Nepal: designing governance for a complex resource'. Unpublished Ph.D. Dissertation. Bloomington, IN: Indiana University.
Wade, R. (1994). 'Village republics: economic conditions for collective action'. San Francisco, USA: Institute for Contemporary Studies.

Appendix Table 1: Regression Estimates Coefficients, Standard Error and their t-ratio and Level of Significance

Dependent Variable: current consumption of Fuel wood (for 1996/1997)

	Exogenous Variables	Coefficients	Std. Error	t- ration	Mean of X	Standard Deviation of X
	CONSTANT	3.55	0.02	135.5*		
PROCESS	DECISION MAKING	-0.028	0.00	-90.8*	14.06	13.43
	CASTE	-0.01	0.00	-36.8*	8.33	6.46
	WOMAN	0.06	0.00	59.5*	5.00	2.89
ENFORCEMENT	QUANTITY	-0.03	0.00	-61.9*	15.18	3.46
	MEMBERSHIP FEE	-0.02	0.00	-5.5*	16.66	6.31
	PRODUCE	-0.05	0.00	-61.7*	22.32	5.77
MONITORING	GROUP HARVEST	0.01	0.00	58.2*	16.20	16.18
	GUARD	-0.04	0.00	-168.9*	24.37	11.73
	FINES	0.03	0.00	119.8*	10.00	10.01
FOREST	PLANTATION FOREST	-0.719	0.01	-70.9*	0.18	0.39
	FOREST AREA IN HECTARE	-0.03	0.00	-26.4*	40.21	40.69
HOUSEHOLD	FAMILY SIZE	0.00	0.00	0.68	6.92	2.84
	LIVESTOCK IN STANDARD UNITS	0.00	0.00	0.60	3.65	2.06
	NET CROP INCOME	0.00	0.00	0.42	35.15	28.50
DUMMY	CFUG 14	0.86	0.01	63.0	0.06	0.24
VARIABLES	CFUG 16	-0.20	0.01	-14.3*	0.06	0.24
	CFUG 19	-0.72	0.01	-73.5*	0.06	0.24

$R = 0.998$, $R^2 = 0.998$, Adjusted $R^2 = 0.997$, Standard Error of the Estimates = 0.0279, Durbin-Watson Statistics = 2.032, Regression F = 5727.5** (p = 0.000) df1 = 17, df2 = 238

N = 256

* denotes t-statistics significant at the 1% level.

** denotes F statistics significant at the 1% level.

Mean of Y = 0.92, standard deviation of Y = 0.44

Source: CFUG and household survey, 1999-2001