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TROPICAL SECONDARY FORESTS IN NEPAL AND THEIR IMPORTANCE TO LOCAL PEOPLE

K. R. Kanel & K. Shrestha

Ministry of Forests and Soil Conservation, Kathmandu, Nepal

KANEL, K. R. & SHRESTHA, K. 2001. Tropical secondary forests in Nepal and their importance to local people. Most forests in tropical Nepal are secondary, resulting largely from episodes of large-scale timber harvesting in the past along with accumulated small-scale extraction of timber and non-timber forest products by local people over centuries. Currently in the Forest Depleted Stage, remaining tropical secondary forests are still very important for fulfilling the subsistence and economic needs of local people, as well as for biodiversity conservation, groundwater recharge, and the protection of lowland agriculture from landslides and floods. Protection of degraded lands by community forest user groups in places has led to the successful development and management of some rehabilitated secondary forests. In government-managed secondary forests with a production focus, people's participation in management is now being considered. Institutional, socio-economic, and ecological issues related to the sustainable management and use of secondary forests along with implications for action are outlined.

Key words: Nepal - Terai - Siwaliks - secondary forest - local people - community forest user groups

KANEL, K. R. & SHRESTHA, K. 2001. Hutan sekunder tropika di Nepal dan kepentingannya kepada penduduk tempatan. Kebanyakan hutan di tropika Nepal ialah hutan sekunder, terhasil daripada siri pengusahasilan balak secara besar-besaran pada masa lalu, berserta pengekstrakan balak dan hasil hutan bukan-kayu secara kecil-kecilan oleh penduduk tempatan sejak berabad-abad lamanya. Pada Tahap Penyusutan Hutan, hutan sekunder tropika yang ada masih penting untuk memenuhi keperluan sara hidup dan ekonomi penduduk tempatan, juga untuk pemuliharaan biodiversiti, pengisian semula air dalam tanah, dan perlindungan pertanian tanah pamah daripada tanah runtuh serta banjir. Perlindungan tanah usang oleh kumpulan penduduk pengguna hutan di beberapa tempat membawa kejayaan pembangunan dan pengurusan beberapa hutan sekunder yang dipulihkan. Di hutan sekunder yang diuruskan oleh kerajaan dengan tumpuan kepada pengeluaran, penyertaan penduduk dalam pengurusan sedang dipertimbangkan. Turut dibincangkan ialah isu-isu institusi, sosio-ekonomi dan ekologi yang berkaitan pengurusan mapan dan penggunaan hutan sekunder serta implikasi untuk tindakan.

Introduction

Forest lands constitute just 30% of the land area of tropical Nepal, with roughly half in protected areas. Most of the forests that exist outside of the protected areas are secondary forests. The successive use of forest resources by local people and the

government has led to the transformation of primary forests to secondary forests. Secondary forests are defined as "forests regenerating largely through natural processes after significant human disturbance of the original forest vegetation at a single point in time or over an extended period, and displaying a major difference in forest structure and/or canopy species composition with respect to nearby primary forests on similar sites" (Chokkalingam *et al.* 2000). There are 545 900 ha of forest outside protected areas in tropical Nepal, located in the Siwalik and Terai regions and comprising 16.05% of the total land area (Forest Research and Survey Centre 1994) (Figure 1). These latter are primarily secondary forests.

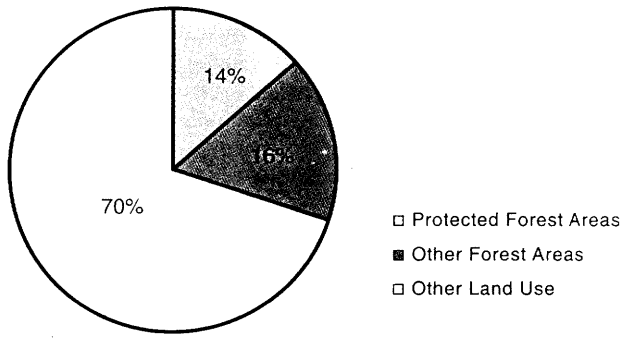

Figure 1 Percentage of protected forest area, other forest areas and other land use in tropical Nepal

As per the Master Plan for the Forestry Sector, existing land is divided into five physiographic zones based on the ecological characteristics of the country—High Himal, High Mountains, Middle Hills, Siwaliks and Terai (HMGN 1988) (Table 1). Tropical secondary forests are found in the Siwalik and Terai physiographic regions of Nepal. Main species of these forests are *Shorea robusta, Terminalia tomentosa, Adina Cordifolia, Bombax ceiba, Acacia catechu* (HMGN 1988).

Table 1 Land use in physiographic zones of Nepal ('000 ha)

Region	Natural Forests		Plant-ation	Enriched forests	Shrub & degraded forests	Grass-lands	Non-cultivated inclusions	Farm-lands	Other lands	Total
	Area	%								
High Himal	155	5	0	0	67	885	1	8	2234	3350
High Mountains	1629	55	5	5	176	508	148	244	245	2960
Middle Hills	1762	40	30	19	404	278	148	667	1223	4442
Siwaliks	1433	76	4	1	29	16	59	269	75	1886
Terai	445	21	30	0	30	58	123	1308	116	2110
Sub total	5424	37	69	25	706	1745	998	3052	2729	14 748
Percentage	37		0	0	5	12	7	21	19	100

Source: Carson *et al.* (1986)

The Siwaliks are the first and lowest ridges of the Himalayan mountain system that run the length of Nepal. They enclose several cultivated valleys, locally known as the inner Terai or duns, and some intricately dissected outwash plains. The zone occupies 13% of the country, at an elevation of 120 to 2000 m (HMGN 1988). Most of the Siwaliks ridges (76%) remain under forest (Table 1) because their coarse textured stony, shallow soils and steep slopes make them unsuitable for cultivation. The area is also very fragile and landslides are common. Local people plant bamboo, fruit and other useful shrubs and trees in the region for subsistence and sale.

The Terai is a plain region whose elevation ranges from 60 to 330 m, with a gentle southward slope of less than one percent (HMGN 1988). It is bounded in the north by the Siwaliks and in the south by the Indian border. It covers about 14% of the country. Along its northern edge lies the Bhabar, a subzone characterised by boulders, very finely-drained gravelly soils, and a deep watertable, which make it unsuitable for agriculture. About 0.5 million ha or 21% of the Terai is still under forest (Department of Forest Research and Survey 1999) (Table 1). Since most of the Terai forests are very accessible, most of them (except in the national parks and reserves) have been converted to secondary forest. The Terai is under high development pressure, both agricultural and industrial.

Secondary forests fulfil basic household needs for firewood, fodder, leaf litter, poles and timber for almost all people who live in the rural areas of Nepal. They are also important sources of wild vegetable such as ferns, mushrooms, nutritious nuts and medicinal plants such as *Emblica officinales*, *Terminalia bellirica*, *T. chebola*, and *Asparagus racemosa*. These secondary forests are also important sources of income for local people. Numerous forest products including firewood, poles, timbers, medicinal and aromatic plants, and other non-timber forest products like ferns, mushrooms, lacs, honey, dyes, and fruits are harvested and sold in the market. Although the quantum of income is small, it is crucial for local people, often the only source of income generation for many of them.

Secondary forests are also the main reservoirs of biological diversity in Nepal. Nepal is very rich in biological diversity despite its small size, containing a total of 118 ecosystems, 75 vegetation types and 35 forest types. The vegetation contains more than 6500 species of flowering plants and 4064 species of non-flowering plants including over 1500 species of fungi, and over 350 species of lichen. Equally diverse is the range of fauna (Maskey 1995). This diversity of species provides innumerable non-timber forest products, including medicinal and aromatic plants.

Secondary forests of tropical Nepal have great environmental importance. They are significant carbon sinks, possessing larger leaf-surface area compared to forests in the hills and mountains. Besides, the secondary forests of the Siwaliks act as buffer strips, protecting agricultural land in the Terai from the landslides and floods originating in the Middle Hills (Jackson 1994). They are also very important for recharging groundwater in the Terai (National Planning Commission 1995). The 25-year (1995–2014) Agricultural Prospective Plan of Nepal has given high priority to irrigation as the means of increasing food production (National Planning

Commission 1995). This plan makes the Siwalik forests, the main recharge source for groundwater in the Terai, very important, environmentally and economically.

The population pressure in tropical Nepal is very intense, with 47% of the 22 million people of Nepal living in the Terai and Siwaliks. For example, in the Siraha and Saptari districts of tropical Nepal, firewood demand per year is estimated at 210 000 tons against the estimated sustainable supply of 70 000 tons. The deficit is met through overcutting. In the present scenario, with limited efforts focused on forest resource management, income generation activities and alternative fuel supplies, it is estimated that the secondary forests of tropical Nepal will disappear in 17–20 years (Gunz 1999). This example illustrates the threats to the remaining secondary forest resource in tropical Nepal and the need for sustainable management. It is estimated that the 0.5 million ha of Terai forests can still be commercially managed as production forests to fulfil local and national need (Department of Forest Research and Survey 1999).

Thus, most forests in tropical Nepal are secondary and the remaining forests (particularly in the Terai) are threatened by urbanisation, conversion to agriculture, and population pressures for fuelwood and other forest products. These forests are vital for the continued fulfilment of local and national needs for forest products, income generation and environmental functions. In this paper, we describe the current status and dynamics, the socio-economic, institutional and ecological issues related to sustainable long-term management, and the use of tropical secondary forests of Nepal, as well as the implications for action.

Secondary forest formation in tropical Nepal

There are many types of secondary forests in Nepal but there is no quantitative data on exact extent. However, most forests that exist in Nepal today are post-extraction secondary forests. Post-extraction secondary forests are defined here as 'forests regenerating largely through natural processes after significant reduction in the original forest vegetation through tree extraction at a single point in time or over an extended period, and displaying a major difference in forest structure and/or canopy species composition with respect to nearby primary forests on similar sites" (Chokkalingam *et al.* 2000).

Post-extraction secondary forests

The history of Nepal, especially of the Kathmandu valley, goes back several thousand years. From time immemorial, most of the forests in the hills and the Terai have been heavily used by local people for firewood, fodder, grazing, leaf litter, poles, timbers, medicinal plants, and other forest products. Cumulative small-scale extraction of forest products for domestic consumption and sale over a long period of time was a significant factor in the conversion of primary forests to post-extraction secondary forests (Mahat *et al.* 1986a).

There were also several major episodes where larger-scale deforestation and transformation to secondary forests took place. The forests of the Sindhu Palchok and Kabhre Palanchok districts adjoining the Kathmandu valley were heavily used since the thirteenth century for constructing houses as well as Hindu and Buddhist temples (Mahat *et al.* 1986a, b). Following the earthquake of 1933, there was large-scale exploitation and degradation of forests around Kathmandu to rebuild the houses and buildings damaged by the quake. In the Rana period, or before 1950, there was large-scale harvesting of trees in most of the accessible Terai districts for railway sleepers exported to India (Thapa 2000). Even a government-owned company called the Timber Corporation of Nepal was established in 1960 to market the timber (Bajracharya 2000).

Post-abandonment secondary forests

With the unification of Nepal by King Prithivi Narayan Shah in 1769, land grants were given to soldiers as incentives and to increase food production for the growing number of soldiers (Mahat *et al.* 1986a). Reclamation of forests was open to anyone who cleared it and brought it under cultivation. Thus, natural forests were harvested and converted into agricultural land. However, during the mid-nineteenth century, considering the critical situation forests were in, the government promulgated strict orders for the conservation of forests and wildlife in the Kabhre Palanchok and Sindhu Palchok districts (Mahat *et al.* 1986b). This decree led to the regeneration and maintenance of post-abandonment secondary forests in some areas. Post-abandonment secondary forests are defined here as "forests regenerating largely through natural processes after total abandonment of alternative land use (plantations, agriculture, pasture, etc.) on formerly forested lands" (Chokkalingam *et al.* 2000).

Before 1957, families of Rana rulers owned substantial tracts of the forests of tropical Nepal, called *Birta* land. Owners used to get income from these forests by selling timber, poles and firewood to the local people, and at times from exporting forest products to India. They also had open patches of agricultural land within these forests. With the enactment of the Forest Nationalization Act in 1957, these forestlands reverted to government ownership. The abandoned agricultural fields regenerated into secondary forests.

Eucalyptus and tropical pines were planted extensively in the early sixties and seventies through the Sagarnath and Ratuwa Mai Forestry Projects in the Terai. However, for many reasons, many of the plantations failed and were abandoned, with natural regeneration taking over.

Rehabilitated secondary forests

Degraded patches in the Siwaliks and the Terai were handed over to community user groups for rehabilitation in the face of soil erosion, landslides and floods. Some of these areas have now developed into rehabilitated secondary forests with

protection and management by users. Rehabilitated secondary forests are defined here as "forests regenerating largely through natural processes on degraded lands, often aided by rehabilitation efforts, or the facilitation of natural regeneration through measures such as protection from chronic disturbance, site stabilisation, water management, and planting" (Chokkalingam *et al.* 2000). Degraded lands are defined as "formerly forested lands severely impacted by intensive and/or repeated disturbance (such as mining, repeated fires, or overgrazing) with consequently inhibited or delayed forest re-growth. These include barren areas, *Imperata* grasslands, brushlands, and scrublands". Generally, the formation of secondary forests in Nepal can be illustrated as in Figure 2.

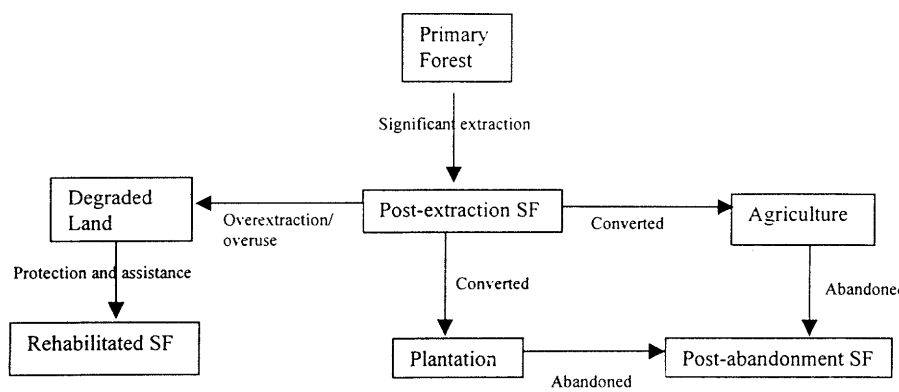

Figure 2 Formation of different secondary forest (SF) types in Nepal

Tropical secondary forests by ownership and use

Secondary forests managed by the Government

There are 0.5 million ha of mostly post-extraction secondary forests in large patches located in the Terai and inner valleys that are owned and managed by the government. The Department of Forests is obliged to manage these forests for the sustained yield of forest products and environmental services for local and national needs, as well as to provide support to agriculture and tourism (Ministry of Forests and Soil Conservation 2000). Use is informal and light. Trees are felled and used only in the area allocated for development purposes. There are also plenty of dead and fallen trees, which are used to fulfil urban and commercial demand. However, these forests are reducing at the rate of 1.3% per year (Department of Forest Research and Survey 1999). These government-managed secondary forests in the Terai are like open-access resources and local people enter the forest to collect various products. Although the government has some regulatory power to restrict the collection of forest products, its enforcement is very weak. The forests adjacent to the villages have suffered excessive pressure resulting in heavy damage. Some of these forests have also been illegally encroached by squatters and migrants.

Local people depend on these secondary forests for subsistence and cash income. Firewood is a particularly essential product, required for cooking, heating, and lighting. It is also sold for urban or industrial consumption. Wild foods such as nuts, berries, tubers, bamboo shoots, mushrooms and ferns are some of the important sources of nutrition for rural people, especially the poor who reside near the forests. Leaf litter is important as fertiliser. Leaves of different trees are used for animal bedding during the winter, and as compost the following summer. About four tons of organic manure is used per hectare of agricultural land. A survey on different sources of nutrients available for livestock showed that about 50% is obtained from forests (Pande & Pradhan 1997). Other forest products of importance to local people include handles for agricultural implements, bamboo for houses and furniture, medicinal plants, various spices, lacs, wax, gums, tannin, resin, and dyes used for household consumption and for some cash income. These benefits are particularly important to the poorest of the poor because they largely depend on these forest products for their livelihoods. The cash income, though low in absolute amount, is critical for the local people.

The government collects about US$5.3 million per year of revenue from the sale of various forest products and services. Income generated by local people from the collection of these products, depending upon species, is many times higher than the revenue generated by the Department of Forests. Recent studies by the World Bank showed that government-owned secondary forests in the Terai yield a net economic benefit of US$40 per hectare per year under the present situation (protection-oriented management and illegal forest use) (Hill 1999). This could be increased to US$72 per hectare per year if forest management is intensified.

Management plans were prepared in the early sixties, but not implemented due to the lack of government commitment and resources. In the late nineties, Operational Forest Management Plans (OFMPs) were prepared for 18 Terai districts, but again not implemented due to the lack of resources and a large volume of unsold timber already being available. Recently, the government has prepared a concept paper to manage these forests by identifying and securing a restricted forest area, and involving local people in their management. Local people would be allowed to use forest products required for free, or at nominal rates, and would also get a share of the revenue obtained from the proceeds of the sale of major forest products such as timber and firewood (Ministry of Forests and Soil Conservation 2000). However, this concept is yet to be implemented. Fragile areas of the Siwaliks will be declared as protected forests according to the present Forest Act of 1993, with a focus on watershed management and productivity enhancement (Ministry of Forests and Soil Conservation 2000).

Secondary forests managed by Community Forest User Groups

There are about 100 000 ha of community-managed forests in the Terai and Siwaliks, some of which have developed into rehabilitated secondary forests. Community forests are owned by the government but handed over to local people organised into Community Forest User Groups (CFUGs) to be managed by them

for their benefit. The number of and area in community forests in tropical districts of Nepal has been rising steadily (Figure 3). More than 90% of these forests were initially in degraded condition, including scrublands, grasslands, and barren lands. With the handing over of these areas to CFUGs, grazing, fires and encroachment have been reduced (Jackson *et al.* 1998). Community protection and management has resulted in the conversion of some degraded areas into more productive forest ecosystems (Baral & Subedi 1999), some into plantations and agroforests, and others into rehabilitated secondary forests with a large natural regeneration component. Specific management objectives vary depending on the CFUG, and management practices range from protection to extraction, manipulation and planting.

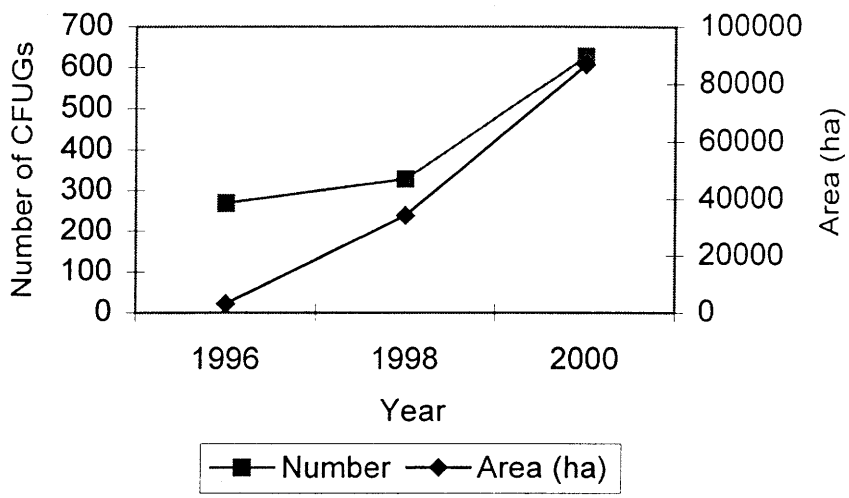

Figure 3 Number of Community Forest User Groups (CFUGs) and area managed by them from 1996–2000 in tropical Nepal

Sources:
1996 data from ANSAB (1997).
1998 data from Forest Research and Survey Centre (1998).
2000 data from Community and Private Forestry Division (2000).

Community-managed forests were envisaged in the National Forest Plan 1976, which was enacted in 1977 by amending the Forest Act of 1961, and by formulating rules in 1978. The programme is currently implemented through the Forest Act of 1993 and Forest Rules of 1995, recognising forest user groups as self-governing independent entities and giving traditional forest users more rights to perform other development activities. Needs for benefit-sharing and participation in decision-making in the management of forest resources were recognised. In community forests, use is limited to members of the community forest user group, which are primarily those households that have traditionally used these forests. In some cases, non-member households may be identified as secondary user groups and given

limited use rights including NTFP collection and road access. Users of community forests normally share costs and benefits equally. At times, special privileges are also given to socially disadvantaged people such as women or the poor.

Community forests also provide forest products including firewood, fodder, leaf litter, timber, agricultural implements for subsistence, and also income and employment to local people. CFUGs now manage about 11% of the national forest in Nepal as a whole, and also obtain some revenue from the sale of forest products. With the income generated, CFUGs are building irrigation canals, protecting water sources, and constructing drinking water canals, schools and health posts. Some CFUGs have also started selling timber (Pokharel 2000).

Institutional Issues

There are established institutions within the Ministry of Forests and Soil Conservation for managing government-owned secondary forests. Operational Forest Management Plans have been prepared for almost all the Terai districts. These plans have identified potential area, species and composition, status of regeneration, estimated growing stock, and estimated harvest volume of timber and firewood. There are suggestions that these plans may have been more useful if local people had been involved in their preparation. Modality for people's participation and benefit-sharing in government-managed secondary forests is still unclear and hinders sustainable management.

There is also a need to strengthen the institutional capacity for the management of government-managed secondary forests. District forest offices are understaffed and under-equipped, while responsible for a range of forestry activities, including protection forestry and support to community forestry. Besides managing the forests for timber and firewood, the Department of Forests is also responsible for the management of non-wood forest products such as medicinal plants and the over-all biodiversity conservation in the forests. However, there are no special divisions or wings to support and facilitate these functions effectively. There is also a need for better motivation and career development opportunities for forestry staff to enhance their commitment to sustainable management.

There is good legislation on and support for community forest management, which could lead to the development and sustainable management of some rehabilitated secondary forests. There are already 627 forest user groups in the Terai districts and they are managing 86 642 ha of community forests. Some of these user groups have been very successful in implementing and benefiting from this programme.

However, as of now, government-managed forests still predominate in the Terai. There is a lack of a consolidated district plan regarding when to hand over national forests as community or leasehold (by groups of poor farmers) forests, and when to manage them as government forests. Moreover, these forests need to be managed to complement each other. Lack of a consolidated and integrated district forest plan is inhibiting the sustainable management of all types of forests. Potential forest types (like community or protection forests) identified by Operational Forest

Management Plans in the Terai districts are arbitrary and the plans are not followed either (Baral & Subedi 1999).

Besides, there is inadequate institutional capacity in the Department of Forests to support the large number of CFUGs. The situation is worse in the Terai region of Nepal, where CFUGs need more support in resolving conflicts on boundary issues, and need clear guidance for user identification and defining potential community forests more accurately (Chhetri & Sigdel 1999). There has been increased grabbing of forestland in the Terai as community forests in anticipation of their value, irrespective of need for CFUGs (Baral & Subedi 1999).

District forest offices and CFUGs also lack technical capacity and practical experience in commercial forest management, including silviculture, economic analysis and business management. As a result, some secondary forest management programmes are poorly implemented and monitored.

Currently, the Department of Forests is not able to protect the forest against degradation and deforestation. It is estimated that about 0.1 million ha of government forest (forest not yet handed over) is encroached in the Terai and inner valleys. Forest in the Terai has decreased at the rate of 1.3% per year from 1978/79 to 1990/91 (Department of Forest Research and Survey 1999). There is also widespread illegal harvesting in government-managed secondary forests. There are inadequate financial resources for the management of government-owned forests, and local participation may be a key factor in promoting effective management. Effective institutional arrangements, including the participation of CFUGs and village and District Development committees, need to be devised and implemented to protect, manage and share the benefits from these forests.

Socio-economic issues

People residing near the secondary forests are mostly poor and landless, and depend on these forests for their livelihood. They obtain subsistence products and sell timber, poles and firewood for some cash income in almost all the Terai districts. Managing the forests in the face of such pressures is very challenging unless alternative employment opportunities are generated.

The concept of community forestry originated with the need to fulfil the subsistence needs of the local community as the priority objective of forest management. However, with the expansion of community forestry in the last 20 years, many community forest user groups have obtained well-stocked forests worth millions of Nepalese rupees. These CFUGs want to sell the surplus forest products in the market. On the other hand, many villagers near these forests who have not been included in CFUG are not getting enough timber. If the CFUGs sell their surplus forest products, should they not be taxed as enterprises? What is the optimum size of a community forest and a CFUG? The role of subsistence versus commercial use in community forestry is an issue that needs to be resolved, especially with respect to the forests of the Terai.

The equal sharing of benefits in community forestry maintains pre-existing inequalities among local people. It also increases inequalities among CFUG

members and non-members in the area. There is a need for enhancing inter-group and intra-group equity in community forestry programs. Donor-driven community forestry projects also emphasise the need for incorporation of the interests of traditionally disadvantaged groups, such as women and the poor, in benefit-sharing and decision-making. However, the means to attain this objective is not very clear. A study done by Leeds University in community forestry management in Nepal recommends subdividing the large heterogeneous user groups into small homogeneous interest-overlapped or *tole* groups, to incorporate the interests of disadvantaged members (Springate-Baginski *et al.* 1998). This issue needs to be resolved clearly.

In the districts of the Terai and Siwaliks, forest patches are large. The households that have been using these forests are numerous and spread out over a large area. Management of these community forests with the participation of all users is practically impossible and alternative strategies need to be devised. Also, given that users could be located several kilometres away from the forest, including Kathmandu residents, the identification of traditional users for the establishment of community forest user groups is very difficult.

Ecological issues

The tropical part of Nepal is under-researched and the ecological data and information on secondary forests are limited. However, on the basis of existing literature, some ecological issues are presented.

From 1978 (Carson *et al.* 1986) to the present, there has been increased deforestation and degradation due to human disturbance and conversion to alternative use (Department of Forest Research and Survey 1999). Forest area has declined from 38 to 29%, and shrubland area has increased from 4.7 to 10.6%. However, compared to 1964, growing stock has increased from 85 to 131 m^3 per hectare, and the number of stems has increased from 313 to 408 per hectare (Department of Forest Research and Survey 1999), suggesting that forest re-growth is occurring. Main tree species in terms of stem volume are *Shorea robusta, Quercus* sp., *Terminalia* sp., *Pinus roxburghii, Abies spectabilis, Rhododendron* sp. *and Alnus nepalensis* (Department of Forest Research and Survey 1999).

Operational management plans in government-managed forests focus basically on timber production, and not on products of importance to local people who live near the forests, such as firewood, fodder, agricultural implements and poles. In community-managed forests, there is more emphasis on subsistence products, but the forests face problems of limited regeneration and growth. There is a need for further ecological information to sustainably manage these forests.

Non-timber forest products—such as Sal seed, the fruits of *Terminalia* sp., *Emblica* sp., and *Madhuca* sp., and many kinds of ferns, mushrooms and medicinal herbs such as *Rawalfia* sp. and sikkakai—are important to local people for subsistence and generating cash income. However, there is very limited ecological knowledge available for the management of non-timber forest products compared to conventional forest products.

In dry Siwalik Sal (*Shorea robusta*) forests, annual human-initiated fires are a common phenomenon, fuelled by the annual leaf litter accumulation (Sharma 1996). These fires are not catastrophic giving rise to post-fire secondary forests, but light surface fires. Sixty-four percent of the fires are deliberate, and are ignited for hunting, for regenerating grass for grazing, for killing snakes and scorpions, and for enhancing the growth of edible vegetables such as nihur (edible fern), mushrooms, and curilo (*Asparagus racemosa*) (Sharma 1996). These fires damage and inhibit Sal regeneration (Kayastha 1976) and cause some loss of valuable forest products. About 85% (40 104.5 ha) of the forests of the Bara district of tropical Nepal are affected by fire. Annual sawlog loss due to fire is estimated at 85 200 cubic feet per year, which is equivalent to US$335 000 (Gentle 1997). Fires also have negative impacts on the supply of non-timber forest products like Sal and bhorla leaves used to make plates, tendu leaves used as cigarettes, and thatchgrass used in roofing. However, fire appears to play an important role in the ecology of the Sal forests of tropical Nepal. In most Sal forests, overgrazing inhibits Sal regeneration.

Conclusion

Current forest cover in tropical Nepal, namely in the Terai and Siwaliks, is limited to 30% of the land area, half of which is in protected areas. The remaining are secondary forests arising primarily from episodes of large-scale timber harvesting in the past along with accumulated small-scale extraction of timber and non-timber forest products by local people over centuries. These secondary forests are of critical importance to local people, who depend on them for their subsistence and income needs. Although the absolute amount earned is small, it is still significant for these people because it is often the only source of income generation. Moreover, secondary forests provide a safety net in times of need. These secondary forests of tropical Nepal may also be very important for their ecological and environmental functions including biodiversity conservation, groundwater recharge, and the protection of lowland agriculture from landslides and floods.

Tropical Nepal has limited remaining forest cover, with high environmental and local importance, and intense population pressures on the same. Steps are being taken to promote more sustainable management through community participation. Around 100 000 ha of forestland in tropical Nepal has been handed over to community forest user groups for their management and use with decision-making and benefit-sharing rights. Security of tenure, community protection and the management of degraded lands in places has led to the successful development and management of some rehabilitated secondary forests. This has led to the fulfilment of subsistence needs and started providing substantial cash income to the users as well. In some areas, tree planting on farms and off-farm income have also led to the gradual reduction of the dependency of the local people on forest. These factors have also led to the gradual improvement of forests. In the interests of equity, strategies have to be devised to manage community forests to incorporate the interests of traditionally disadvantaged groups of users such as women and the poor, and also the needs of non-members in the area. With the successful

implementation of community forestry in the Terai, the role of subsistence versus commercial use needs to be considered and resolved.

However, most secondary forests of the Terai are still under government management and subject to degradation and deforestation pressures. People's participation is now considered a key factor in promoting effective management, and the modality of such participation needs clarification. Further, there is a need for strengthening the institutional capacity of the forest department to work with local people and effectively manage forests under its control, also providing for fuelwood and non-wood forest products of importance to local people. A consolidated and integrated district forest plan is required to guide the allocation of government forests to CFUGs, and to identify traditional users who in the Terai are often located at great distances from the forest.

There is also a need for more ecological information on secondary forests in tropical Nepal to promote sustainable management. Information is particularly required on the management of firewood and non-timber forest products of importance to local people. In managing the secondary forests of tropical Nepal, it is very important that policies and programmes are formulated in favour of local users who can contribute to improving the condition of the forest while deriving benefits from effective management.

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