SECONDARY FORESTS ASSOCIATED WITH THE REHABILITATION OF DEGRADED LANDS IN TROPICAL ASIA: A SYNTHESIS

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CHOKKALINGAM, U., BHAT, D. M., & VON GEMMINGEN, G. 2001. Secondary forests associated with the rehabilitation of degraded lands in tropical Asia: a synthesis. Rehabilitated secondary forests constitute a potential new and emerging resource requiring changes in policy favouring the rehabilitation of the large areas of degraded land in tropical Asia. Conversion of degraded lands into rehabilitated secondary forests rather than into monoculture plantations of exotics may be better for meeting the diverse product needs of local people, other stakeholders, and changing markets, as well as for environmental amelioration. It is also a relatively inexpensive method, suitable for rehabilitation by local people. Government and other stakeholder interest in and scope for rehabilitating degraded lands to secondary forest systems tend to increase along a proposed land use intensification model. Attempts to rehabilitate degraded lands in the intensive exploitation stage because of international pressures or funding availability are often not viable because the underlying socio-economic and institutional causes of degradation may continue to operate. In the forest depleted stage, the biophysical and socio-economic situation is more ripe for policy changes and implementation favouring rehabilitated secondary forests. The driving forces behind the rehabilitation efforts tend to shift from large-scale timber production to local livelihood, more diverse local market and environmental needs coinciding with the depletion of forest resources. However, the development of rehabilitated secondary forests may still be constrained by degraded site conditions, the persistence of chronic disturbances and lack of incentives. Rising international and national commitment to biodiversity conservation, community-based management, forest rehabilitation, timber certification and climate stabilisation could as well focus more on secondary forest regeneration and management in protected areas and as community forests, serving both conservation and production goals.

Key words: rehabilitation - degraded land - secondary forest - tropical Asia - community participation

CHOKKALINGAM, U., BHAT, D. M., & VON GEMMINGEN, G. 2001. Hutan sekunder yang bersekutu dengan pemulihan tanah usang di tropika Asia - suatu sintesis. Hutan sekunder terpulih mengandungi sumber-sumber baru yang berpotensi dan memerlukan perubahan polisi yang menyokong pemulihan tanah-tanah usang yang luas di tropika Asia. Pengalihan daripada tanah usang kepada hutan sekunder terpulih berbanding ladang monokultur untuk dagangan mungkin lebih baik bagi memenuhi keperluan mempelbagaikan keluaran untuk penduduk tempatan, pemegang amanah yang lain, dan perubahan pasaran, serta pemulihan alam sekitar. Ia juga merupakan kaedah yang murah, sesuai untuk pemulihan oleh penduduk tempatan. Minat kerajaan dan pemegang-pemegang amanah lain serta skop dalam pemulihan tanah usang kepada sistem hutan sekunder cenderung untuk meningkat bersama-sama model pengintensifan penggunaan tanah yang dicadangkan. Cubaan untuk memulihkan tanah usang di peringkat eksploitasi intensif, yang disebabkan oleh tekanan antarabangsa atau pembiayaan, selalunya tidak berdaya maju kerana sebab-sebab pendegradan dari segi sosio-ekonomi dan institusi mungkin akan terus beroperasi. Pada peringkat penyusutan hutan, situasi biofizik dan sosio-ekonomi adalah lebih sesuai untuk pertukaran polisi dan pelaksanaan yang memihak kepada hutan sekunder terpulih. Faktor pendorong di sebalik usaha pemulihan lebih cenderung berubah daripada pengeluaran balak secara besar-besaran kepada mata pencarian penduduk tempatan, pasaran tempatan yang lebih luas dan keperluan alam sekitar yang selaras dengan penyusutan sumber-sumber hutan. Bagaimanapun, pembangunan hutan sekunder terpulih masih terhalang oleh keadaan tanah usang, gangguan kronik yang berterusan, pengurusan yang berasaskan penduduk, serta kurangnya insentif. Komitmen di peringkat kebangsaan dan antarabangsa yang meningkat terhadap pemuliharaan biodiversiti, pengurusan yang berasaskan penduduk, pemulihan hutan, pensijilan balak dan penstabilan cuaca, seharusnya turut menumpu lebih kepada pemulihan dan pengurusan hutan sekunder di kawasan lindungan dan sebagai kawasan hutan penduduk, demi pemuliharaan dan pengeluaran.

Introduction

The rehabilitation of degraded lands is a subject that is receiving increasing attention in many countries across tropical Asia (Evans 1992, Sayer 2001). The reasons for such interest include dwindling forest cover, environmental problems, the scarcity of forest products, pressures on remnant natural forests and large areas of potentially productive lands languishing in a highly degraded state. In countries across tropical Asia, roughly 15–47% of former forested lands exist in a highly degraded state as a result of over-exploitation and poor management (Table 1).

It is increasingly recognised that the traditional rehabilitation method—monoculture plantations of exotic species—may not be appropriate in all instances or for all purposes (Lamb & Tomlinson 1994, Perera 2000, Ramakrishnan & Kushwaha 2000), though silvicultural techniques are better established and short-term productivity and economic benefits may be high. The transformation of degraded lands into rehabilitated secondary forests (defined below) rather than into monoculture plantations of exotics may be more suitable in the following cases:

(1) To meet the diverse product needs of the local people, particularly where there are high local extraction pressures on the resource (Lamb & Tomlinson 1994, Bhat *et al.* 2000, Ramakrishnan & Kushwaha 2000).

(2) To supply valuable indigenous forest species as supplies decline with the depletion of primary forests (Hamzah *et al.* 1995).
(3) To restore ecological values including biodiversity, watershed functions, and soil stabilisation (Lamb & Tomlinson 1994, Ramakrishnan & Kushwaha 2000, Sayer 2001, Zaizhi 2000). Within protected areas where the primary focus is forest ecosystem restoration and conservation, rather than production.
(4) Where funding is a constraint. The facilitation of natural successional processes can be a relatively inexpensive method of reforestation and may therefore be particularly suitable for establishment by local people and where biophysical conditions reduce commercial viability (Lohman & Lieth 1993).

Table 1 Recent (1994-2000) estimates of area ('000 ha) and percentage of degraded land in countries across tropical Asia

Country	Land area	Natural forest area	% land area under forest	Plantation area	Degraded area	% forest land degraded
Indonesia	190 457[a]	121 100[b]	63.5	9 871[c]	34 000[d]	21
Malaysia[a]	32 975	19 148	58.1	91	At least 1 200[k]	At least 6
Lao PDR[e]	23 679	13 094	55.3	54[c]	7 240	35
Cambodia[c]	17 652	9 335	52.9	90	2 600[e]	22
Sri Lanka[c]	6 463	1 940	30.0	316	1 500[j]	40
Nepal[a]	14 718	4 268	29.0	133[c]	1 467	25[c]
Vietnam	32 550[c]	9 300[e]	28.6	1 711[c]	9 700[e]	47
Thailand[a]	51 312	12 972	25.3	500[c]	2 306[e]	15
Tropical China[f]	2 650	520	19.6	340	550	39
India[g]	329 000	63 700	19.4	12 000[c]	158 000[h] (only 35 000 under forest land)	39
Philippines[i]	30 000	5 500	18.3	600	4450	28

Sources:
[a] National sources as cited in FRA (2000)
[b] Kartawinata *et al.* (2000)
[c] FRA (2000)
[d] de Jong *et al.* (2000)
[e] National sources as cited in Gilmour *et al.* (2000)
[f] National sources as cited in Zaizhi (2000)
[g] National sources as cited in Bhat *et al.* (2000)
[h] Pathak *et al.* (1995)
[i] National sources as cited in Lasco *et al.* (2000)
[j] Garrity *et al.* (1997)
[k] Total of tin tailings (Majid *et al.* 1994), *Imperata* grasslands, and idle lands (Garrity *et al.* 1997)

Rehabilitated secondary forests can be defined (Chokkalingam *et al.* 2000a) 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". Thus to qualify as rehabilitated secondary forests, substantial natural regeneration is a pre-requisite; however, such regeneration could have been catalysed by planting efforts.

The processes involved in the formation of rehabilitated secondary forests can be illustrated as follows -

Forest → Degraded land → Rehabilitation and Natural Regeneration

By degraded land, we mean formerly forested land severely impacted by intensive and / or repeated disturbance with consequently inhibited or delayed forest regrowth (Chokkalingam *et al.* 2000a). These include barren areas, grasslands, brushlands, and scrublands that were once forested lands. The causes of degradation include mining activity, repeated fires, excessive grazing, unsustainable cultivation, high-impact logging, failed plantations, and the overextraction of fuelwood and other forest products in high population areas. In this definition of degraded land, we do not include land in stages of uninhibited secondary succession such as that under sustainable long-rotation swidden fallows; a severe impact on forest regrowth is essential.

We recognise a gradient of forest degradation with disturbance, ranging from degraded forest ecosystems to severely degraded lands as defined in this paper. The rehabilitation of degraded forests to their original structure, composition, and functionality, versus the rehabilitation of severely degraded lands with inhibited forest regrowth may require very different strategies and levels of effort both socio-economically and biophysically. The rehabilitation of degraded forests may involve enrichment planting of low stocking areas and can be viewed as a management practice within an existing degraded primary or secondary forest ecosystem. In this paper, we focus specifically on the *rehabilitation of degraded lands* or regrowing new forests largely through natural processes on degraded lands now devoid of forest cover.

Degraded lands severely impacted by intensive and / or repeated disturbance as per our definition may still provide a wide range of products and services of value to local communities for subsistence and cash income. For example, in parts of Asia, grasslands are perpetuated by local people for grazing cattle or for making useful products such as baskets, and severely-degraded shrublands may still be a significant source of fuelwood and poles for local communities (Banerjee 1995, Potter 1997). *Imperata* grasslands in Indonesia, Malaysia and Thailand are fire-prone and often a menace to agriculture and cash cropping and may need to be rehabilitated, but local communities adapt to what is available and may find increasing uses for them (Kuusipalo 1996). However, there are extensive areas of degraded land in tropical Asia (Table 1), and in general most such lands provide limited goods and services as compared to the forests or land use systems that they replaced. The conversion of forests to degraded lands represents a potential loss of biodiversity, carbon stocks, watershed functions, soil structure and fertility, and agricultural productivity, and increased fire risk and hardship for the people of the immediate region (Aiken & Leigh 1992, Appanah & Nair 1999, Dennis *et al.* 2000, Lasco *et al.* 2000, Ramakrishnan & Kushwaha 2000).

However, the informal use of degraded lands by local communities is often impeded through planting and the establishment of government or industrial

control (Tomich *et al.* 1997). Caution therefore needs to be exercised in the identification of degraded land, its importance to local communities, and the need for and methods of rehabilitation and management. Rehabilitation, if required, should also seek to identify and enhance the ecological and socio-economic value of such lands to local communities and not deprive them of existing benefits.

Given the concerns for dwindling or low forest cover, forest product scarcity, environmental problems and pressures on remnant natural forests, there is increasing interest in rehabilitation of the vast areas of degraded lands into productive natural or semi-natural ecosystems. Such rehabilitated secondary forests, if successfully developed, could help fulfil a diversity of needs and services in the future. A spate of rehabilitation projects have or are being initiated across tropical Asia. Under the circumstances, it is important to review the nature of these various efforts, the circumstances under which they evolve and the likelihood of their meeting their planned objectives. In this paper, we synthesise the available information on rehabilitated secondary forests and the processes involved in their formation and transformation over tropical Asia using papers prepared for the "Tropical secondary forests in Asia: Reality and perspectives" workshop in Samarinda, Indonesia, April 10–14, 2000, working group discussions at the workshop, and other relevant literature on the subject. The constraints and opportunities for the successful development and management of rehabilitated secondary forests along a proposed land use intensification model (Chokkalingam *et al.* 2000b), and the potential for overcoming these constraints are outlined.

We emphasise here that the rehabilitation of secondary forests is only one of the many pathways for rehabilitation of degraded lands into functioning ecosystems. Rehabilitation efforts need to be part of an integrated land use plan at the landscape and regional scales whereby the flow of goods and services are optimised based on the needs of the region and linked to the sustainable management of natural resources. Land use plans may actually call for the conversion of degraded land to agriculture in areas with high population densities and land pressures, and to highly productive plantations for industrial needs on other suitable sites. A priority would, however, always be to break out of the cycles of degradation maintained by chronic disturbance or exploitation that depress productivity and human well being in the region.

Land degradation and rehabilitation with forest/ land use intensification

The land use intensification stages identified by Chokkalingam *et al.* (2000b) which take into account numerous factors such as the extent of forest cover, industrial development, and the intensity of pressures for forest products and agricultural land, are used here to understand the processes of formation of degraded land, and the importance of and motives behind rehabilitation attempts. Government and other stakeholder interest in, policies for, and commitment to rehabilitation tend to increase along this intensification continuum in response to deteriorating environmental conditions, widespread poverty, and increasing empowerment of

local communities. The driving forces for rehabilitation appear to shift from timber production- or national economy-based concerns to environmental and local livelihood concerns. Thus in the advanced stages of land use intensification, there is somewhat increased scope for rehabilitation to secondary forest systems as well besides to plantations.

Intensive exploitation stage

Large areas of degraded land often come into existence during the period of intensive exploitation of forest resources in a given region and can be related to various socio-economic, institutional and political factors. Large-scale developments such as timber concessions, plantations and mining companies tend towards poor management and exploitative use of forest resources, often leading to land degradation. The reasons for unsustainable management and use include limited control and monitoring, insecure land tenure in the long term, corruption, perverse fiscal incentives, and a lack of reckoning for environmental costs (Barbier 1997). Once the forest lands are opened up by large-scale activities, poor migrant rural households often follow and practice short-rotation agriculture and extract forest products in these marginal areas (Kummer & Turner 1994). Poverty, restricted credit availability, open access and insecure land tenure reinforce short-term production and land degradation versus long-term land management (Barbier 1997). Limited resource availability, high pressures on the same and land use conflicts among numerous stakeholders with overlapping tenure claims lead to further mismanagement and degradation. Degradation generally tends to move upslope and to more remote sites with increased resource pressures from commercial activities and/or the subsistence needs of rising populations (Shi & Li 1999, Mittelman 2000).

This process has already occurred in most of tropical Asia and can be seen now in regions going through the intensive exploitation stage at the current time, i.e. parts of Borneo, Sumatra, West Papua, Cambodia and Lao PDR. In coastal parts of East Kalimantan, former forest land is kept in a cycle of degradation by large-scale intensive logging that opens up more of the landscape, frequently-occurring fires, and the soil-exhaustive pepper cultivation practices of migrant communities (Kartawinata & Vayda 1984). In the Philippines, commercial logging in the uplands is followed by repeated fires and continuous cultivation, ranching and fuelwood collection by migrants, with resultant soil degradation and conversion to grasslands (Lasco *et al.* 2000).

Generally, policies and commitment with regard to the rehabilitation of degraded lands and sustainable forest management tend to be low but are emerging in regions undergoing intensive exploitation of forest resources and still containing relatively plentiful forest resources. In these regions, a large percentage of forest land is degraded but attention remains focused primarily on exploiting the still-plentiful forest resources. Degraded lands in this stage are often ignored in policy and developmental activities, or viewed as land available for conversion to non-forest use or into highly productive plantations. However, in this stage, commercial

plantations are established more often after clearing existing forests, rather than on degraded lands (Aiken & Leigh 1992, Kartawinata *et al.* 2000). Under these conditions, there is limited policy interest in, commitment to and scope for the development of commercial plantations or rehabilitated secondary forests on degraded lands, though the former is more likely to occur than the latter. The establishment of commercial plantations on degraded lands could result in a loss of existing local benefits. Except in remote areas abandoned after exploitation, repeated disturbances and open-access conditions tend to inhibit natural successional processes.

In Borneo and Sumatra, the driving forces behind the limited rehabilitation efforts are primarily to the desire to increase wood, oil palm and other estate crop production, enhance economic gain, provide employment opportunities, and take advantage of funds available (Potter 1993, Kartawinata *et al.* 2000). In Cambodia and Lao PDR, national and global attention is moving towards stemming further rampant and unsustainable exploitation of forests and to stabilise and restore forest cover (Gilmour *et al.* 2000). In Lao PDR, a Vision 2020 was produced in 1997, which includes the reforestation of 0.5 million ha through extensive small farmer planting on their own lands (Gilmour *et al.* 2000). Funding for such efforts may be available from multilateral aid agencies, or through global initiatives such as certification or carbon trading. Most projects are still in the pilot stages, and tend to result in the establishment of commercial plantations.

Forest depleted stage

In regions in the forest depleted stage with minimal forest cover (Chokkalingam *et al.* 2000b), degradation may be further intensified by acute pressures on the remnant degraded resource from local populations highly dependent on it for sustenance. Such pressures could include excessive grazing, fodder and fuelwood collection as well as short-rotation swidden agriculture on open-access land (Lanh 1994, Banerjee 1995, Schmidt-Vogt 2000). Poor rural households only have access to resources that are degraded with rents dissipated. Richer farmers promote short-fallow swiddening in order to secure tenure on cultivable land or obtain quick profits as in Orissa, India and the dry zone of Sri Lanka (Banerjee 1995). The government and local communities are perhaps the dominant players in this stage with the private sector not very active because of the much-diminished resource base.

Regions approaching and in the forest depleted stage such as Thailand, Philippines, Vietnam, most of India, tropical Nepal, tropical China and Sri Lanka have low percent forest cover, and a large percentage of that is degraded (Table 1). Possible exceptions are more productive wet areas, e.g. Kerala, Java and the wet zone of Sri Lanka, where most available land is used for agriculture, agroforests and home gardens in this stage (Persson 2000). In the other areas, there tends to be high dependence by the local population on the remnant degraded resource and concern for lost biodiversity and environmental functions of forests. These regions are further along in terms of government and other stakeholder interest in, policies

for and commitment to the rehabilitation of degraded lands to meet local and environmental needs (Moad & Whitmore 1994). The driving forces responsible for interest in the rehabilitation of degraded lands tend to shift to:

(1) regreening / reclaiming degraded areas and upland watersheds,
(2) developing biological diversity,
(3) ameliorating environmental problems such as soil erosion, flooding and drought, and / or
(4) providing forest products such as fuelwood and fodder for local communities and reducing subsistence pressures on other forests.

These driving forces, along with increasing local empowerment, enhance the interest in and scope for rehabilitating some degraded lands to secondary forests that may be better suited to serving local community and environmental needs, as compared to monoculture plantations of exotics. However, such needs could be and are often met by establishing mixed plantations of species (both native and exotic as desired), though silvicultural knowledge on mixed species plantations is still limited. Low availability of funding to communities, the lack of a perceived need for intensive management, and the usefulness of secondary forest species may lead to the establishment of some rehabilitated secondary forests.

In India and tropical Nepal, rehabilitation efforts started earlier on in the late 1970s or early 1980s and are continuing to date, with the support of the state and international aid agencies and NGOs (Bhat *et al.* 2000, Kanel & Shrestha 2000). Tropical China had a massive regreening program in the 1980s for environmental purposes with funding support from the government (Zaizhi 2000). Rehabilitation efforts for environmental purposes and to meet local needs have been ongoing in Sri Lanka since the 1980s with the support of international aid agencies and NGOs (Perera, pers. comm.). The Philippines has had reforestation efforts on *Imperata* grasslands funded by international aid agencies in various periods from the 1970s to the 1980s (Lasco, pers. comm.). Large areas of plantations have been established since the late 1980s in Vietnam as part of the rehabilitation activities. In the early 1990s, a program to regreen the barren hills was initiated and followed by the five million ha reforestation program in 1998 for which international aid is being sought (Gilmour *et al.* 2000). There have been government efforts at rehabilitation and reforestation for watershed protection in northern Thailand from the mid-1990s, aided by strong royal interest in and funding of rehabilitation efforts.

However, most of these efforts have resulted in very limited areas of rehabilitated secondary forests at the current time except in tropical Nepal and India, where secondary forests are developing on degraded lands rehabilitated through community-based forest management and joint forest management projects respectively. Most past rehabilitation efforts on degraded lands involve plantations, and of exotic species (Lasco *et al.* 2000, Perera 1994, Gilmour *et al.* 2000, Zaizhi 2000). Plantations established for industrial purposes by the private sector or the government are mostly managed on a high-intensity basis and are not likely to

develop a large natural vegetation component. Plantations established by the government for environmental purposes are mostly managed on a low-intensity basis, presumably allowing natural vegetation to grow. Many regreening projects are, however, constrained by numerous technical and social factors such as inadequate species-site matching, inadequate monitoring, corruption, social conflicts, limited value to the local people, and uncertainties regarding benefit-sharing.

In the Philippines since 1995, there has also been a deliberate move towards assisted natural regeneration (ANR), i.e. attempts to stimulate and promote natural regeneration, on selected sites but there is no evaluation of success or failure yet (Lasco *et al.* 2000). In Vietnam, one million ha of the five million ha program are targeted for rehabilitation through natural regeneration for environmental purposes (Gilmour *et al.* 2000). Natural successional processes are being studied to facilitate the same and restore natural forests on degraded lands within reserves in China. Thus there is a likelihood that many of the ongoing and planned future efforts to rehabilitate degraded lands may lead to the development of rehabilitated secondary forests in the future. Currently, many projects are in the initial stages and it is too early to gauge the success or failure or direction of development, or there have only been limited trials with no evaluation yet.

Rehabilitated secondary forests in tropical Nepal and India

In tropical Nepal, initial rehabilitation efforts by the government involved the establishment of plantations of fast-growing species, with some international funding and forestry programs. The concept of community-managed forests was envisioned in the late 1970s and has been enacted since, with the devolution of management control and use rights to identified community forest user groups (CFUG). Since then, community protection and management, and the availability of markets for forest products has led to the establishment and management of both plantations and rehabilitated secondary forests on degraded lands, and helped enhance local livelihoods (Kanel & Shrestha 2000). Specific management objectives vary depending on the CFUG, and management practices range from protection to extraction, manipulation and planting. Research and implementation has been a collaborative effort among forest user groups, donors, the Department of Forestry, national and international development projects and donors.

The concept of community forestry in Nepal was originated with the need to fulfil the subsistence needs of the local communities, However, now many CFUG have valuable well-stocked forests and are beginning to sell the surplus timber on the market (Kanel & Shrestha 2000). Meanwhile, many villagers near these forests who have not been included in the CFUG have restricted access and are not getting enough timber. The role of subsistence versus commercial use needs to be considered and mechanisms devised for more equitable cost-benefit sharing and prevention of resource degradation.

India launched the Social Forestry (SF) Programme in 1980 in order to reclaim degraded forests and village commons, meet the biomass needs of communities

and industries, and reduce the pressure on other forests (Bhat *et al.* 2000). Community wood lots or plantations of mainly monocultures of exotic species were established. The programme was implemented wholly by the State Forest Department with minimal participation of the local communities, and did not help meet the subsistence needs of the latter.

Subsequently in 1990, the Government of India involved local people in forest management, conservation and benefit sharing under the Joint Forest Management (JFM) Programme (Bhat *et al.* 2000). The JFM Programme has since then been implemented in many states covering over seven million ha of forest land. NGOs have helped in the implementation of the participatory approach to forest management. The JFM and SF plantations on degraded lands and village common lands were not intensively managed. Protection from fire, grazing and fuelwood collection during the initial few years has facilitated the regeneration of natural species in these plantations, and led to the development of some rehabilitated secondary forests after the removal of the planted (largely exotic) species. Most of these areas have the potential to develop into rehabilitated secondary forests in the future. Extraction is permitted to meet local biomass needs.

The rehabilitated secondary forest approach

The conditions under which rehabilitation efforts have resulted in the development and maintenance of rehabilitated secondary forests so far include:

(1) Adequate consideration of social and economic aspects.
(2) Development and management as community forests or with the participation of the local people.
(3) High local need and dependence on forest resources, and products as well as services provided by the secondary forests are valued by the community and markets.
(4) High costs and labour inputs are a constraint for intensive plantation establishment,
(5) Consistent land use policies, and clarity of tenure or a common perception of ownership.
(6) Concerted national interest and efforts and funds available.
(7) Specific interest in generating biodiverse secondary forests versus establishing monoculture plantations for environmental and economic reasons, such as product diversification and risk minimization.
(8) A change in the policy vision of forest departments from purely plantation forestry to the establishment and management of more natural forests.

Intensive exploitation stage

In the intensive exploitation stage, socio-economic aspects, local community needs, tenure issues and environmental concerns tend to be sidelined, thus reducing the scope for the development of rehabilitated secondary forests. However,

rehabilitation of degraded lands to secondary forests may be appropriate and could perhaps be promoted successfully on some sites, i.e. within protected areas with community involvement, and in traditional community-managed areas with devolution of secure tenure and use rights. However, existing constraints need to be overcome, primarily addressing the underlying causes of degradation which could otherwise continue unabated. In protected areas, these include open access and high local extraction pressures on the resource, limited funding for protection, conflicts with traditional claims and use rights, repeated fires as well as a lack of local involvement and stakes in rehabilitation. In traditional community-managed areas, constraints include open access and high extraction pressures on the resource with in-migration following large-scale development, conflicts among multiple stakeholders, repeated fires, and the breakdown of traditional institutions and processes.

For state-driven and controlled rehabilitation projects, other general constraints are the limited silvicultural knowledge on rehabilitation towards natural (secondary) forests and inadequate species-site matching, with resultant limited survival of planted stock and lack of natural regeneration. Institutional frameworks set up to operate in past policy settings with more of a focus on plantation development may be unable to deal with new dogmas such as assisted natural regeneration. Besides, there tends to be limited supervision, follow up and / or evaluation activity through the rehabilitation process. There is little monitoring of ecological progress or social interactions with the resource in most projects (Lamb & Tomlinson 1994, Lasco *et al.* 2000). Many projects are started with a spurt of local or foreign funds, and interest and follow up are abandoned at the end of the project.

Opportunities for overcoming at least some of these constraints in the intensive exploitation stage are suggested by:

(1) Increasing commitment and funding available from the national and international sources for reforestation and biodiversity conservation. This could be used to establish rehabilitated secondary forests (which tend to have greater biodiversity value than plantations) on degraded lands in both protected areas and community-use areas. Such funding could potentially also be used for longer-term follow up activities and for enhancing silvicultural knowledge on rehabilitation towards natural (secondary) forests.

(2) The global paradigm shift in forest governance from centralised to decentralised management with recognition of local needs, and trends towards community participation. International funding available for community-based management could be used to establish community-managed rehabilitated secondary forests, given the strong local demand for products that come out of secondary forests and traditional knowledge with regard to secondary forest management. Such commitment and funding could potentially also be used for establishing rehabilitated secondary forests in protected areas with local community involvement in management and benefit sharing, and for further follow up activities.

Forest depleted stage

In the forest depleted stage, with low forest cover and concern for environmental and local livelihood needs, most of the conditions for the establishment and sustainable management of rehabilitated secondary forests are increasingly present. The policy environment is more favourable both for community participation and environmental conservation, and incentives may be available (Persson 1996, Wiersum 1997). There are trends towards better rationalisation of land use and clarification of tenure, including traditional use rights, as a result of increasing demands from local communities, NGOs, and the international community (Moad & Whitmore 1994). There tends to be concerted national interest and efforts and available funds. Market access and potential is generally more developed in depleted forest areas, which are normally closer to the centres. The niche for rehabilitated secondary forests in this stage may also lie primarily within protected areas and as community-managed resources, where natural succession and secondary forest products and functions are likely to be more valued, and investment capacity is a constraint. However, existing constraints need to be overcome.

Open access and high local extraction pressures on the resource (as in China, Nepal and Philippines), and persistence of chronic disturbance such as grazing / browsing (as in India and Sri Lanka) are important causes of degradation and constraints to rehabilitation. Rehabilitation efforts may fail to meet or provide alternative products to satisfy local livelihood requirements or to consider short-term prospects, resulting in the lack of a local stake in the success of the effort (Lamb and Tomlinson 1994). Often the rehabilitation focus is on biological aspects and inadequate attention is paid to the socio-economic viability of the system (Gilmour *et al*. 2000, Ramakrishnan & Kushwaha 2000). The species chosen for the facilitation of natural regeneration and the forest type established may have limited value for meeting the subsistence, environmental and market needs of local people (as in Thailand and India).

The lack of other social and economic preconditions also plays an important role in inhibiting the rehabilitation process. These include the lack of secure and clear tenure, markets and marketing development for products, and equitable cost and benefit sharing. Policies such as overtaxation of wood may act as a disincentive to sustainable development and management (Zaizhi 2000).

Again, limited silvicultural knowledge on rehabilitation towards natural (secondary) forests may pose a constraint, along with unfavourable climate or site conditions that may inhibit regeneration in certain areas, for example in the dry zone of Sri Lanka (Perera 1994). Limited supervision, follow up and / or evaluation activity of the social and ecological factors through the rehabilitation process tends to occur in this stage as well. Institutional frameworks set up to operate in past policy settings with more of a control function need to be updated to work with community-based management and assisted natural regeneration.

However, in general, the constraints are less pronounced in the forest depleted stage and there is a more favourable policy climate for rehabilitated secondary forest development on degraded lands to favour local and environmental needs.

Practical details and techniques need to be ironed out and fine-tuned. The rehabilitation process needs to be monitored longer-term for ecological and socio-economic success. Silvicultural, ecological, and socio-economic indicators are required at different stages of the program against which progress can be assessed.

International and national interest in and funds available for biodiversity conservation and community based management could be used to define the role of rehabilitated secondary forests within the respective regional development frameworks, for related institutional development, and for rehabilitated secondary forest-related product and market development and promotion. Such funding could also be directed at monitoring and evaluating existing projects, learning from past experiences, and expanding into new areas. Additional possibilities for financial transfer in this stage exist through mechanisms such as timber certification and carbon trading which may also be used to establish rehabilitated secondary forests managed by and benefiting local communities.

Conclusion

Rehabilitated secondary forests are a potential source of new secondary forest formation, especially in more arid, less-productive regions, with protection and rehabilitation of degraded lands through community and state forestry projects. Increased government and other stakeholder interest in reforestation to enhance the productivity of degraded lands and in natural/mixed regeneration for environmental and local livelihood needs catalyses this process, along with the lack of funds to plant and manage on a more intensive basis. Rehabilitated secondary forests may be more suitable than traditional plantations of exotic species for restoring ecological functions and meeting the diverse product needs of the local people and changing markets. The development of rehabilitated secondary forests is also an inexpensive way of rehabilitating large areas of degraded lands by facilitating and accelerating the natural regeneration potential of the site, through measures such as water management and enrichment planting with desirable species (Lamb & Tomlinson 1994).

Interest in and scope for the development of rehabilitated secondary forests on degraded lands increases with the depletion of forest resources, loss of products and environmental services, and the empowerment of the local people. The driving forces behind the efforts tend to shift from large-scale timber production to local livelihood and environmental needs with forest land use intensification. In order to successfully develop and manage rehabilitated secondary forests on degraded lands where appropriate, the rehabilitation strategy needs to be based on a holistic approach, addressing the social, economic, institutional, political, and technical dimensions of the problem (Ramakrishnan *et al.* 1994). Attempts to rehabilitate degraded lands in the intensive exploitation stage because of international pressures or funding availability are often not viable because the underlying socio-economic and institutional causes of degradation such as corruption and overlapping land tenure claims may continue to operate. However, increased international commitment to and funding available for biodiversity conservation and community-

based management may be useful for secondary forest regeneration and management in protected areas and in traditional community-managed areas, if clear functions are assigned and market opportunities are available.

In the forest depleted stage, the biophysical and socio-economic situation is more ripe for policy changes and implementation favouring biodiversity conservation, sustainable management, improved local livelihoods, and environmental services and thus rehabilitated secondary forests. However, successional processes may be inhibited by highly-degraded site conditions, chronic disturbances and inadequate incentives for protection. Preparation for rehabilitation involve identifying and correcting the underlying causes of degradation which usually involves socio-economic factors and therefore local peoples' participation in protecting and managing the forests. Nepal and India provide examples of some rehabilitated tropical secondary forest development on degraded lands through community protection and management. International and national interest and funds available for biodiversity conservation, community-based management, forest rehabilitation, timber certification and climate change could be directed at secondary forest regeneration and management in protected areas and as community forests, serving both conservation and production goals.

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