

FORMATION AND RECOVERY OF SECONDARY FORESTS IN INDIA: A PARTICULAR REFERENCE TO WESTERN GHATS IN SOUTH INDIA

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BHAT, D. M., MURALI, K. S. & RAVINDRANATH, N. H. 2001. Formation and recovery of secondary forests in India: a particular reference to Western Ghats in south India. This paper analyses the underlying causes of secondary forest formation and recovery in India, particularly the Western Ghats region of south India, from pre-colonial times to the present. In the pre-colonial period, hunter-gatherers, shifting cultivators and settled cultivators were the dominant users of forest land, with some limited timber felling by local chieftains and kings. There was limited secondary forest formation following extractive activities by the communities and the State. The State takeover of forests for commercial timber exploitation during the colonial period, the resulting alienation of local community rights, and the over-exploitation of forest products from limited areas accessible to the community were key factors in the large-scale formation of secondary forests. In the post-independence period, the diversion of forestland for other purposes and industrial pressures led to deforestation and forest degradation. Currently, forest cover is relatively low and primary forests exist only in hilly tracts. However, forest cover has stabilised in spite of increasing population density. With the passing of the Forest Conservation Act of 1980, which banned forest clearing, forest conversion pressures were reduced. During the last decade, the rehabilitation of degraded secondary forests and the regeneration of secondary forest on degraded land by communities have contributed to the stabilisation of forest cover. The paper hypothesises that joint management of forests by governments and communities, as well as policies to reduce dependence on fuelwood, may have paved the way for this favourable development.

Key words: Secondary forests - Western Ghats - South India - plantations - forest regeneration

BHAT, D. M., MURALI, K. S. & RAVINDRANATH, N. H. 2001. Pembentukan dan pemulihan hutan sekunder di India: rujukan khusus kepada Ghats Barat di selatan India. Artikel ini menganalisis sebab-sebab pembentukan dan pemulihan hutan sekunder di India, khususnya di Ghats Barat, selatan India, dari zaman pra-penjajahan hingga sekarang. Dalam zaman pra-penjajahan, pemburu, petani pindah dan petani tetap merupakan pengguna tanah hutan yang utama. Terdapat juga penebangan balak yang terhad oleh ketua penduduk tempatan dan raja. Pembentukan hutan sekunder ekoran aktiviti pengekstrakan oleh penduduk dan kerajaan negeri adalah terhad. Pengambilalihan hutan oleh kerajaan negeri untuk pengkomersialan balak semasa zaman penjajahan, pemberian hak kepada penduduk tempatan, dan eksploitasi hasil hutan secara berlebihan dari kawasan terhad oleh penduduk tempatan merupakan faktor utama pembentukan hutan sekunder besar-besaran. Selepas merdeka, pengalihan penggunaan tanah dan tekanan perindustrian menyebabkan berlakunya pembasmian dan pendegradan hutan. Pada masa ini, litupan hutan adalah rendah secara relatif dan

hutan primer hanya wujud di kawasan laluan berbukit. Bagaimanapun, litupan hutan telah stabil walaupun kepadatan penduduk bertambah. Kelulusan Akta Pemuliharaan Hutan 1980 yang mengharamkan penebangan hutan mengurangkan tekanan pengalihan hutan. Pada dekad yang lepas, pemulihan hutan sekunder usang dan pemulihan hutan sekunder di atas tanah usang oleh penduduk menyebabkan penstabilan litupan hutan. Artikel ini membuat andaian bahawa pengurusan hutan secara bersama oleh kerajaan dan penduduk tempatan, berserta polisi untuk mengurangkan pergantungan terhadap kayu api, mungkin mendorong kepada perkembangan yang menggalakkan ini.

Introduction

India has a total land area of 329 million ha of which 43% is under cropping and 23% is classified under forests (Ministry of Environment and Forest 1999). Barren lands, land under non-agricultural use, and cultivable waste lands constitute 74.8 million ha. The National Forest Policy of India (1952) stipulated that India as a whole should aim at maintaining one-third of its total land area under forest for securing ecological stability, but forest cover at present is 63.7 million ha, or only 19.4% of the land area (Forest Survey of India 1999).

Most forests in India have been disturbed significantly through logging, clearfelling, grazing, fire, and the collection of fuelwood, fodder and non-timber forest products. Thus, most remaining forests in India are secondary, primarily post-extraction secondary forests arising after significant disturbance through large-scale and small-scale extractive activities. 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).

Also, large-scale plantation and rehabilitation programmes undertaken in the recent past allow for natural regeneration and have resulted in an increase in the area of rehabilitated secondary forests. 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). It is estimated that secondary forests occupy about 32 million ha and constitute about 45.8% of the forest area of the country (Chaturvedi 1992). In this paper we consider open forests (with crown cover of 10 to 40%) and scrub forests (with crown cover of < 10%) as secondary forests. In addition, we include disturbed and degraded forests, various forestry plantations that promote regeneration of natural species, and naturally regenerating forests under community control as secondary forests.

India's low per capita forest area of 695 m² results in a large gap between supply and demand for forest products. India has 2.5% of the world's land area and 1.8% of the global forest area, but supports 15.6% of the world's human population and 14% of the world's livestock population. It has a large rural population of nearly 700 million with a high population density of 2.57 persons/ha and 4.26 livestock/ha of forestland. This large population depends on forests for meeting diverse biomass needs. Secondary forests are thus very important for the supply of fuelwood, manure, raw materials for rural handicrafts and industries, among other products. They are potentially also very important for their environmental functions including soil and watershed conservation, flood control, and carbon storage.

With the passing of the Forest Conservation Act of 1980, which banned forest clearing, forest conversion pressures for agriculture and other infrastructural facilities were reduced. However, remaining natural forests (mostly secondary) continue to be subject to increasing local extraction pressures with growing populations and growing industrial and urban demand for forest products. Large areas of forest are degraded and converted into barren lands as a result (Ravindranath & Hall 1994). In the recent past, India has launched a massive afforestation programme, one of the largest in the tropics (Ravindranath & Hall 1995), which has led to increased secondary forest formation through the promotion of natural regeneration in plantation and community controlled areas.

Given the importance of and pressures on secondary forests in India, there is an urgent need to assess their extent and condition, as there is also for the underlying ecological, social, economic, policy and institutional factors leading to forest degradation and the regeneration of secondary forests. This will enable the development of appropriate management strategies to reduce the pressure on and use more sustainably the remaining natural forests, and to recover and maintain the country's environmental health and ecological stability through the reforestation of degraded lands. In this paper we provide a historical account of the degradation of primary forests in India from the pre-colonial to post-independence periods, and, more specifically, focus on the underlying causes for the formation and recovery of secondary forests in the Western Ghats section of southern India.

Formation of secondary forests in India

The degradation of primary forests and formation of secondary forest in most south Asian countries has passed through three phases: (1) the pre-colonial period, when dependence on forest was extensive, with less significant impact on forests; (2) the colonial administration and post-colonial period, when the intense use of forests had greater impact on forest vegetation and led to the large-scale formation of post-extraction secondary forests; (3) the recent recovery and regeneration of rehabilitated secondary forests on degraded lands due to dedicated efforts. India's experience has been similar to that of other south Asian countries and the following description shows the evolution of different secondary forest types in India.

The pre-colonial period (1000 B.C.–1800 A.D.)

The forests in India during the pre-colonial period were managed on a sustainable basis primarily because the ownership rested with the community (Gadgil 1990). There were three major groups that depended on forest vegetation and land, namely, the hunter-gatherers, shifting cultivators and settled cultivators. The resource-use patterns among these groups differed. Hunter-gatherers were mostly dependent on forests for their food, shelter and other subsistence needs. Their way of living had little or no effect on the formation of secondary forests. Shifting cultivators were partly responsible for the formation of secondary forests because they clearfelled the forests for cultivation, interspersed with long fallow cycles. However, these areas of cultivation were small and in patches. Settled cultivators were in small pockets and the extent of their use of forest area was limited, but they significantly disturbed these forests because they depended on them for their livelihood needs such as for fuelwood, fodder and other usufructs. The local rulers, chieftains or kings who owned the forests prior to colonial rule in India (300–1800 A.D.), made no specific rules or regulations for the extraction of forest products except for that of timber, which needed a permit from the local ruler. Although the extraction by kings or rulers was limited, it led to the formation of some secondary forests.

The colonial period (1800–1947 A.D.)

The colonial rulers started the process of the State takeover of forests under the pretext of the conservation and scientific value of forests. Their main focus however was to exploit and earn more revenue from the valuable timber. To reduce community control and to regulate the extraction of timber, forest laws were enacted in 1865 and revised in 1878, under which community rights were reduced to privileges, and free access to forests was replaced with restricted access. A large percentage of the land was brought under State control (Table 1). Certain forest areas such as minor forests and village forests were dedicated for community use. Some forest patches were marked as grazing lands.

Table 1 Forest area and ownership pattern in India during 1946-47

Ownership	Area (million ha)	% of total area
Government	26.16	65.5
Community and private	13.78	34.5
Total	39.24	100

Source: Lal (1989)

In spite of public opposition, the colonial rulers continued to take over forests and categorise them as reserve forests, protected forests and unclassed forests. State-controlled forests were classified legally in 1878 to derive benefits such as

timber from these forests (Table 2). About 96.79% of the forests were declared as reserve forests restricting the entry and usufructory rights of local people. These forests were only used for timber extraction or as the State desired. Protected forests included forests owned by individuals as in the north-eastern region, *betta* forests in the Uttara Kannada district of the Western Ghats in south India, from where the areca orchard owners had the privilege of collecting leaf manure. Wastelands belonging to private persons, the community and the State were included under the unclassified category.

Table 2 Area under different legal categories of forests in India during 1946-1947

Legal status	Area (in million ha)	% of total area
Reserve forest	25.32	96.79
Protected forest and unclassified forests	0.84	3.21
Total	26.16	100

Source: Lal (1989)

After consolidating the forests under their control, the colonial rulers prepared forest working plans to extract timber and manage the forest stands. They diverted forests to 'working circles'¹. The forest management objective of colonial rulers was primarily to extract commercial timber such as teak, rosewood, ebony, Sal and deodar from the forests to meet the timber and railway sleeper requirements. The demands of people at the local level were increasing, but their alienation from the forests and the restriction of their rights resulted in the over-exploitation of community forests, leading to secondary forest formation in a majority of the community lands. The people did not restrict themselves only to community forest lands for meeting their requirements but also encroached into the nearby reserve forests whenever they got an opportunity, leading to the degradation of forests (Gadgil 1989).

The supply of fuelwood to the urban centres was also the responsibility of the forest department. Fuelwood extraction also led to the formation of secondary forests. The sequential exploitation of selective softwood species (*Macaranga peltata*, *Holigarna arnootiana*, *H. grahamii*, *Ailanthus malabaricum*, *Vateria indica*, etc.) by industries caused the formation of secondary forests as well (Gadgil & Subash Chandran 1989). Apart from the community and industrial demand, two world wars put additional stress on Indian forests. Demand for wood for cantonment and shipbuilding activities during the Second World War, as well as post-war demands, were met from forest working circles, resulting in the degradation of large forest areas (Table 3). It was estimated that, during the Second World War, extraction was 65% more than in the pre-war period (Gadgil & Guha 1992). All of the above activities led to the formation of secondary forests on a large scale, although the extent of area is not very clear.

¹ A working circle is the area allocated to timber extraction under a "working plan" and which has a 30-y extraction cycle.

Table 3 Forest area worked and timber and fuelwood extracted by colonial rulers during the Second World War

Year	Timber and fuelwood extraction (m cubic metres)	Area worked (million ha)
1937–38	7.6	16.0
1938–39	8.4	16.5
1939–40	8.2	16.5
1940–41	10.8	17.0
1941–42	8.7	17.0
1942–43	9.4	13.1
1943–44	10.5	12.9
1944–45	12.3	12.9
Total	75.8	12.2

Source: Gadgil & Guha (1992)

Post-independence period (1947–1980)

The assessment of area under forest and changes, particularly prior to 1947, is limited by a lack of reliable records and changes in geographical and political boundaries as present-day Pakistan, Bangladesh and Myanmar were all part of India. According to the Forest Survey of India (1997), at the time of independence in 1947, the recorded forest area of the country was 40 million ha. Prasad & Jahagirdar (1992) report that, barely a century ago, over 40% of the land area of British India was under forest. In British India in 1900, out of the total area of 202 million ha, 43% was under cultivation, 44% was kept for community use, and only 13% of the area (26 million ha) was notified as forest area. The notified area included reserved forest of 17 million ha (65%) and protected forest of 9 million ha (35%) (Ministry of Environment and Forest 1999). After independence and the reorganisation of the states and union territories, it has been possible to properly assess India's land and forest area. Reliable estimates of area under forests, with different crown cover, have been emerging from the assessment of satellite imagery from 1983–1985.

Changes in forest area since independence are given in Table 4. Area under forest increased after independence, particularly in area under State control. Area under common and private control has correspondingly decreased. This could be due to the addition of ex-princely states and ex-propriety forests and also due to the takeover of forests associated with the *zamindari*² system, after its abolishment.

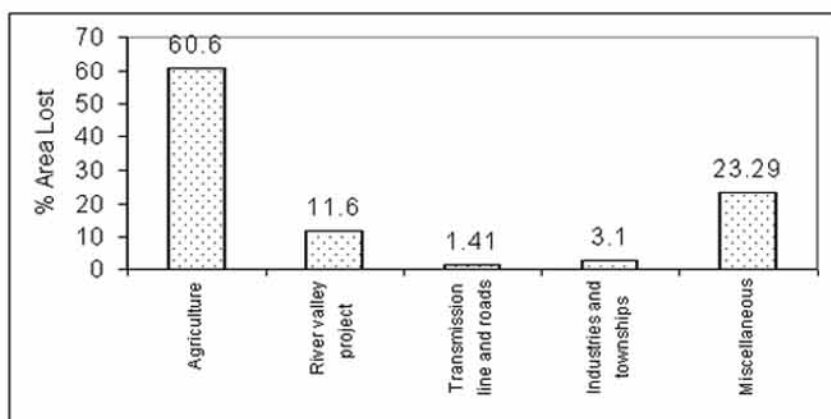
After independence, forests were subjected to greater pressure as a result of several policy decisions, which included the "Grow More Food" campaign, industrialisation, and developmental activities such as irrigation projects and hydroelectric projects. For meeting these requirements, forests were cleared and forestland was diverted to other purposes (Figure 1). With rising population

² *zamindari* system: Most of the economic and social activities in the villages were controlled by large landholders or *zamindars* and their families, who were treated like kings of the villages.

Table 4 Forest area (in million ha) in India from 1946–1947 to 1986–1987

Ownership	Forest area (million ha)		
	1946–1947	1950–1951	1986–1987
Government (% total)	26.2 (65)	53.8 (79)	66.7 (89)
Community and private (% total)	13.8 (34)	14.2 (21)	8.5 (11)
Total	39.9	68.0	75.2

Source: Lal (1989)

**Figure 1** Diversion of forest area for various purposes from 1951–1980 in India
(Source: Lal 1989)

pressures, the requirements for timber, pulpwood, fuel, fodder and manure also increased. Forestlands diverted for agriculture, river valley projects, roads and communication lines are irrecoverable and are considered lost as they cannot be regenerated or made into plantations in the future. However, intensive industrial exploitation, involving the selective cutting of preferred plant species, transformed primary forests or better-stocked forests into secondary forests. Similarly, miscellaneous lands, which mainly consisted of pastures, were recovered through plantations or regeneration programmes. These transformations led to the formation of about 1.1 million ha (26% of total area diverted to other use) of secondary forests.

During 1970–1980, there was an acute shortage of fuelwood and fodder for the rural poor, who depended on the forest to a great extent. This led to the over-exploitation of forests in rural India. Many forest-based industries faced severe raw material shortage and were on the verge of closure (Ministry of Environment and Forest 1999). In addition, people who were evacuated on account of the many development projects, such as river valley projects and industrial estates, were resettled in the forest areas. These people exerted additional pressure on the forests. All the above factors led to the degradation of forests, thereby contributing to the formation of secondary forests.

Recent period (1980 onwards)

With the advent of remote sensing techniques to prepare vegetation cover maps, it was possible to estimate the extent of forest cover in the country in the 1980s. According to the Forest Survey of India (1987), dense forests (canopy cover > 40%) accounted for 10.88%, open forests (canopy cover 10 to 40%) formed 8.41%, mangrove forests formed 0.12%, and coffee plantations formed 0.11% of the total geographical area of the country.

Forest cover in India has decreased by 1.2% over the 10-year period from 1987 to 1997 (Figure 2), but the main decrease was between 1995 and 1997. A higher proportion of forest cover loss was reported in states such as Andhra Pradesh, Madhya Pradesh and Maharashtra. According to data from the Forest Survey of India (1987, 1997), the decrease in forest cover from 1987 to 1997 amounts to just 0.02% (Table 5). Dense forests have increased by 2.7%, whereas open and scrub forests have decreased by 5.5 and 25.5% respectively. Figure 3 illustrates the changes in forest cover and source of secondary forest formation from 1995 to 1997. Of the dense forest, 1 945 600 ha (crown cover > 40%) has been converted to open forest (crown cover 10–40%), 39 200 ha into scrub forest (crown cover < 10%) and 312 900 ha to non-forest areas between 1995 and 1997. The conversion of dense forest to open and scrub forest is the source of secondary forest formation. Approximately 5% of the dense forests were converted to secondary forest and about 0.4% of the scrub forest type and non-forest area was converted back to dense forest.

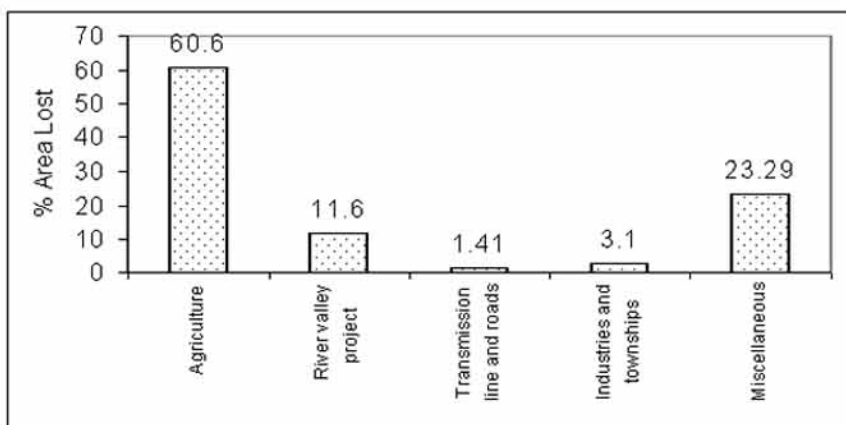
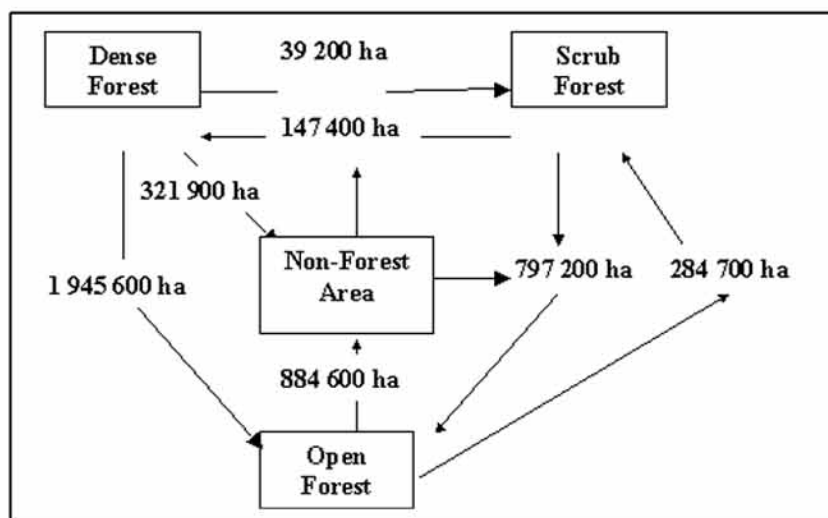


Figure 2 Forest cover in India in different assessment years
(Source: Ministry of Environment and Forest 1999).

Table 5 Change in different categories of forest (in million ha) from 1987 to 1997

Forest category	1987	1997	difference	% difference
Dense forest (crown cover > 40%)	5.7	36.7	+0.9	+2.7
Open forest (crown cover 10 to 40%)	27.6	26.1	-1.5	-5.5
Scrub forest (crown cover < 10%)	7.6	5.7	-1.9	-25.5
Non-forest	256.9	259.6	+0.3	+0.13
Total	328.8	328.7	-0.05	-0.02

Source: Forest Survey of India (1987, 1997)

**Figure 3** Diagram showing forest area conversion from one type to another from 1995–1997.

(Source: Ministry of Environment and Forest 1998)

The forests of India have been classified according to climate and vegetation type into 16 forest types. Of the 16 forest types, as per the Forest Survey of India (1987) assessment, the tropical moist deciduous forest forms the major percentage (37%) of total cover, and tropical dry deciduous forest area forms 29%. Changes in the area of different forest types over the period from 1987 to 1995 are given in Table 6. There is a decrease in important forest types such as tropical wet evergreen, semi-evergreen, montane wet temperate and subtropical pine forests on account of human interference. There has been an increase in tropical dry deciduous and tropical thorn forests. The conversion of evergreen and semi-evergreen forests to other types such as deciduous and thorn forest is an indicator of increased human disturbance leading to the formation of secondary forests. The depicted increase in overall forest area under different types of forests, by nearly 20% in 1995, is primarily because of the inclusion of some of the privately owned forests such as the Civil and Soyam forests of Uttar Pradesh and the customarily owned forestlands of the north eastern states. These areas were not considered for assessment during 1987, and most reports that have this exception include only forest under State control.

Table 6 Occurrence of various forest types in the country and their extent

Forest type	Area in million ha (% of total)		Change (%)
	1987	1995	
Tropical wet evergreen	5.1 (8.0)	4.5 (5.8)	-0.62 (12.10)
Tropical semi evergreen	2.6 (4.1)	1.9 (2.5)	-0.74 (28.03)
Tropical moist deciduous	23.7 (37.0)	23.3 (30.3)	-0.40 (1.68)
Littoral and swamp	0.4 (0.6)	0.7 (0.9)	+0.30 (75.00)
Tropical dry deciduous	18.7 (28.6)	29.4 (38.2)	+10.70 (57.22)
Tropical thorn	1.7 (2.6)	5.2 (6.7)	+3.50 (205.88)
Tropical dry evergreen	0.1 (0.2)	0.1 (0.1)	-0.04 (28.57)
Sub-tropical broad-leaved hill forest	0.3 (0.4)	0.3 (0.4)	+0.02 (7.14)
Sub-tropical pine forest	4.2 (6.6)	3.7 (5.0)	-0.54 (12.73)
Sub-tropical dry evergreen	1.3 (2.5)	0.2 (0.2)	-1.05 (84.00)
Montane wet temperate	2.3 (3.6)	1.6 (2.0)	-0.74 (31.62)
Himalayan moist temperate	2.2 (3.4)	2.6 (3.4)	+0.40 (18.18)
Himalayan dry temperate	0.0 (0.0)	0.2 (0.2)	+0.17 (566.67)
Sub-alpine and alpine	1.9 (2.9)	3.3 (4.3)	+1.44 (77.42)
Total	64.6	77.0	+12.40 (19.19)

Source: Ministry of Environment and Forest (1999)

India currently has only 19.4% of its land area under forest cover, despite the Forest Policy (1952) stipulation to keep 33.3% of the total geographical area under forest cover. However, forest cover appears to have stabilised with only a 0.02–1.2% decrease from 1987 to 1997, as mentioned above. Increasing forest cover was observed in many states ranging from 0.016% in Himachal Pradesh to 3.3% in Punjab. This increase could be due to plantation establishment.

Pressures on secondary forests

Existing secondary forests in India are subject to numerous degradation and conversion pressures. Degradation pressures include shorter rotation swidden agriculture, grazing, fire, and the accumulated small-scale collection of fuelwood, timber, fodder, leaf manure, and other non-timber forest products by the local people. Conversion pressures have reduced since 1980, namely, since the Forest Conservation Act of 1980 was passed. During the 5-y period between 1991 and 1995, the annual conversion rate was 15 500 ha and nearly 48% of the land diverted was for the resettlement of people evacuated on account of development projects, and encroachment for agriculture and its legalisation. We describe here the extent and intensity of these different pressures.

Swidden agriculture

Swidden agriculture was banned in 1848 and completely stopped in Orissa and the southern states after the Wildlife Protection Act of 1974. However, it is still practised in the north-eastern states of India, and fallow lengths are becoming shorter with increasing land pressures, leading to land degradation. Ramakrishnan

and Kushwaha (2000) provide a detailed account of swidden agriculture and related secondary forests in the north-eastern states.

The collection of fuelwood and small-scale extraction of other forest products

India depends largely on fuelwood for meeting domestic energy needs. Fuelwood use in India was expected to have risen from the previous figure of 250 million m³ to 310 million m³ by the year 2000 (Ministry of Environment and Forest 1999). The collection of fuelwood affects the regeneration and standing biomass stock of the secondary forests, leading to their degradation. Besides fuelwood collection, the small-scale extraction of timber, fodder, leaf manure and other non-timber forest products by the local people continues to have an impact on the forests. There are no estimates as to how much forest is disturbed and degraded due to the small-scale extraction of fuelwood and other forest products.

Grazing

India has the largest livestock population in the world, estimated at 445 million in 1987. It was estimated that in 2000 it will have exceeded 500 million. Of these, 270 million cattle graze on forest land, leading to its degradation.

Forest Fire

Nearly 35 million ha of forests experience annual burning in India. Most states experience fire on nearly 50% of their forest area (Ministry of Environment and Forest 1999). The fires are mostly low-intensity ground fires causing little or no damage to trees or the canopy and thus not giving rise to secondary forest formation. However, these low-intensity fires affect the regeneration of forests and lead to forest degradation.

Resettlement following development projects

During the 5-y period from 1991 to 1995, 7440 ha of forest land per year was diverted for the resettlement of people evacuated on account of development projects. Of the 15 500 ha of secondary forests annually converted, 20% were used for hydroelectric projects, 9% for mining, and the remaining 23% for power transmission lines and roads (Ministry of Environment and Forest 1999).

Encroachment

Encroachment and its legalisation have been major problems in India. It is estimated that 1.5 million ha of forest land has been encroached on since 1997 (Forest Survey of India 1997). Encroached lands are largely converted to agriculture.

Forest conservation and the regeneration of secondary forests on degraded lands

Realising the need for forest conservation and regeneration, several policies and programmes have been implemented by the Government of India. The Forest Conservation Act of 1980 was enacted by the Government of India to check the loss of forest area. Under the provisions of this act, approval by the Central Government is necessary for the states to divert forest for non-forest purposes. Under the same act, there is a clause that compensatory forest should be raised by the State, equivalent to the area being diverted. As already noted, the rate of diversion of forests to non-forest purposes has declined drastically to around 15 500 ha per annum, compared to 150 000 ha per annum prior to 1980 (Ministry of Environment and Forest 1999).

Apart from this act, India launched the Social Forestry Programme in 1980 in order to reclaim degraded forests and village commons and to meet biomass demands. Subsequently, the Government of India also took the initiative to involve local people in forest management, conservation and benefit sharing. To involve local people in the forestry programmes, provisions were made to form village forest committees to manage the forest under the Joint Forest Management (JFM) programmes. These programmes are explained in detail below.

Social forestry to regenerate degraded forest lands

In order to reclaim degraded forests and village commons and to meet biomass demands, India launched the Social Forestry Programme in 1980, on the recommendation of the National Commission on Agriculture (1976). This was an innovative programme aimed at meeting the biomass needs of communities and industries largely through community wood lots or plantations. It intended to provide employment, and to reduce the pressure on other forests by providing local needs such as fuel and fodder from the plantations raised on community forests, wastelands and canal banks. The area covered under various afforestation programmes from 1951 to 1998 is given in Figure 4.

In India, the annual area afforested was 1.37 million ha during 1980 to 1998 compared to 0.12 million ha afforested prior to 1980. This is one of the largest afforestation programmes in the world (Ravindranath & Hall 1995). The social forestry afforestation programme was dominated by monocultures of exotic species such as *Acacia auriculiformis*, *A. mangium*, *Eucalyptus* spp., and *Casuarina* spp. The programme was implemented wholly by the State Forest Department with minimal participation of the local communities. One of the major criticisms of the social forestry programme was that it did not meet its objectives. The programme was helpful to the farmers who are market-oriented (such as those in Gujarat, Punjab and Haryana) but less helpful to meet the subsistence biomass needs such as fuelwood, fodder and NTFP (Ravindranath *et al.* 1997) of rural poor and tribal communities. Therefore, the natural forests continued to be disturbed. Efforts were therefore initiated to enhance forest cover through a participatory process

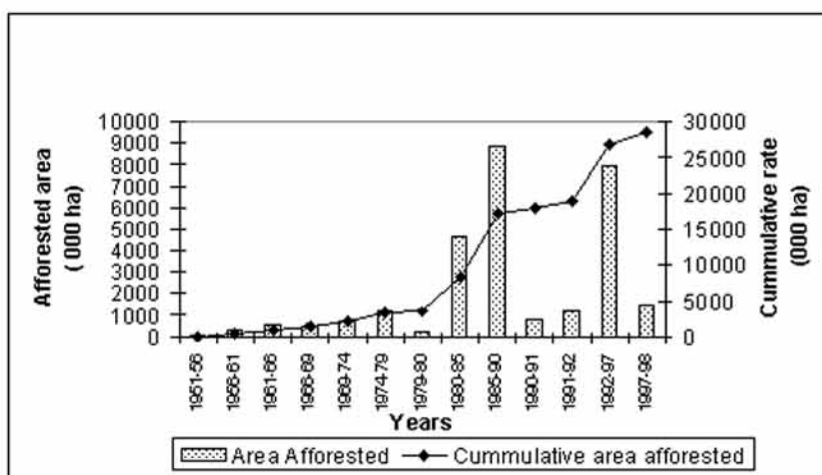


Figure 4 Extent of area under afforestation programmes in Independent India under the 5-year plan
(Source: Ministry of Environment and Forest 1999)

where people derive benefits and yet protect forests. The launching of such a process came from the experiences of participatory forestry projects in the Arabari area of West Bengal (Chatterji 1996).

The social forestry programmes, which undertook large-scale plantations on degraded lands and village common lands, were not intensely managed as in the case of farm forestry or commercial forestry. The protection provided for these plantations during their initial years (3–5 years) promoted the natural regeneration of vegetation, leading to the formation of secondary forests. Natural regeneration was reported in teak plantations in the Panchmahal district of Gujarat state and the pattern of regeneration was comparable to that of natural forests in the Valsad area of that state (Shah 1996). Similarly, studies in the Uttara Kannada district in the Western Ghats region of the state of Karnataka in south India, also indicate that the natural regeneration of species in the plantation is good and similar to that in natural forests (Table 7).

Table 7 Regeneration of natural species in man-made plantations in the Panchmahal district of Gujarat state and the Uttara Kannada district in the Western Ghats of Karnataka state compared with the total species composition of natural forests of the Valsad area of Gujarat. All values indicate the number of species per hectare.

Life forms	Teak plantation in Panchmahal ¹	Natural forest in Valsad ¹	<i>Eucalyptus</i> plantation in Uttara Kannada ²	Teak plantation in Uttara Kannada ²
Tree species	88	67	25	24
Shrub and herb species	19	17	11 + 7	10 + 8
Climber species	14	17	1	2
Grass species	16	9		
Total species	137	110	44	44

Sources: ¹ Shah (1996)

² Bhat *et al.* (1984)

Joint forest management and formation of secondary forest

The Government of India passed an order in June 1990 to enable a participatory forestry programme in India primarily to cater to the aspirations of the communities living in and around the forests. Under the joint forest management program, the community and the Forest Department were to jointly develop forests, manage them and share the benefits so derived. Since then, several states have initiated the JFM programme leading to the formation of village forest committees and large areas have been brought under joint management. Nearly 35 000 village forest committees have been formed in the country in 15 states, managing over 7 million ha of forest land (Ministry of Environment and Forest 1999) constituting nearly 11% of the total forest area. All forests brought under JFM are secondary forests regenerated on degraded lands and extraction is permitted to meet local biomass demands.

Secondary forests in the Western Ghats region, south India

A close look at ecologically sensitive regions would help us formulate better management strategies at the micro level by understanding the causative factors for the formation, use and maintenance of secondary forests. In India, four eco-sensitive areas have been identified: the Himalayan region, the Thar desert, and the Western and Eastern Ghats. The Western Ghats covers a geographical area of nearly 14 million ha. It extends from the southern tip of the Indian peninsula (8° N) northwards about 1600 km to the mouth of the river Tapti (21° N), and is spread out over five states (Goa, Karnataka, Kerala, Maharashtra and Tamil Nadu). Forestry is the second largest land use category, occupying 30% of the land area while agricultural land accounts for 45%. The Western Ghats area harbours 3500 species of flowering plants, which constitute 27% of the total plants listed in India. There are as many as 1932 taxa which are endemic and have large representation in the Western Ghats (Ravindranath *et al.* 1997). According to the Forest Survey of India (1987), 1 127 100 ha of the area of the Western Ghats is covered by national parks and sanctuaries, which is roughly 21% of the total forest cover of this region (Tewari 1995). As per the legal status of forests, nearly 75% of the total forest area is under reserved forest and 9% under protected forest. Thus, over 80% of the forest is under State control (Table 8).

Like other parts of the tropics, with the growing demand for land and forest products, extensive deforestation and forest degradation has taken place in the Western Ghats region during the last 100 years (Menon & Bawa 1997) and most remaining forests are secondary. The Forest Survey of India (1987) data show that only 35.6% of the total geographic area of the Western Ghats is under forest cover. Also, as per the Forest Survey of India (1987), the actual forest cover in different states of the Western Ghats ranged from 13.6 to 32.6% (Table 8). According to Tewari (1995), approximately 10% of the total forest area can be classified as forests with a canopy of over 80%. Around 30% of the total forest has only 20% canopy cover and is under various stages of degradation. The remaining 60% has canopy cover ranging from 40–80%, which is also under various stages of degradation.

Table 8 Legal classification of forest area in the Western Ghats

State	Total forest area in the Western Ghats (ha)	% area under forest to total geographical area of the state	% area under		
			reserved forest	protected forest	unclassified, private and village forest
Goa	100 700	32.6	9.5	76.4	14.0
Karnataka	2 175 600	16.9	82.0	9.4	8.6
Kerala	923 200	26.6	86.6	1.4	11.9
Maharashtra	1 408 100	14.3	62.0	6.0	32.0
Tamil Nadu	676 700	13.6	80.0	18.0	2.0
Total	5 284 300	35.6	75.8	9.5	14.4

Source: Western Ghats Sub-Regional Plan, prepared by Town and Country Planning Organisation, Ministry of Works and Housing, Government of India, 1983

Deforestation and degradation arose from the expansion of hill slope agriculture (coffee and cardamom plantations, legume and millet cultivation), valley agriculture (areca and coconut orchards and rubber plantations, paddy cultivation in the valleys), fire, clearfelling, grazing and encroachment. Shifting cultivation was prevalent in the early independence period, but is not in practice currently.

In recent times, forest cover and quality has stabilised and increased slightly in most of the Western Ghats region, except for Maharashtra (Table 9). In Maharashtra, open and scrub forest increased by 120 000 ha while dense forest decreased by 66 200 ha. The natural regeneration of secondary forests after a long period of protection by local people is reported from villages such as Alalli, Hunasur and Kugwe, in Karnataka (Ravindranath *et al.* 1996)

Considering the fragile ecosystem of the Western Ghats region, including its secondary forests, and its importance in harbouring a variety of flora and fauna, including many endangered species, the Planning Commission introduced a special scheme called the Western Ghats Development Programme during the Fifth Five-Year-Plan (1975–1979). The main objectives were improving the economic well-being of the hill people and regulating the exploitation of the resources of the hill region. Several measures were taken to stop the degradation and to restore the forest cover over the forest area.

Table 9 Forest change from 1993–1997 in the Western Ghats (area in km²)

Western Ghats state	Dense forest (canopy cover > 40%)			Open forest (canopy cover 10 to 40%)			Scrub forest (canopy cover <10%)		
	1993	1997	Change	1993	1997	Change	1993	1997	Change
Goa	995	995	Nil	249	252	+3	16	16	Nil
Karnataka	24 386	24 390	+4	4937	4960	+23	4629	4566	-63
Kerala	8414	8447	+33	1915	1880	-35	83	83	Nil
Maharashtra	6042	5380	-662	8245	9312	+1067	7250	7380	+130
Tamil Nadu	3951	3964	+13	2491	2499	+8	2806	2832	+26
Total	43 790	43 176	-614	17 837	18 903	+1066	14 784	14 877	+93

Source: Forest Survey of India (1993, 1997)

Under the Forest Conservation Act of 1980, states were asked to undertake compensatory afforestation for forest area lost through diversion. With financial assistance from the national government, large-scale plantations (again with substantial natural regeneration) were taken up under social forestry programmes to regenerate disturbed and degraded areas. The area to be regenerated to improve forest productivity and the target set and achieved as a part of the compensatory forestry programme in the states of the Western Ghats are given in Table 10.

In the Western Ghats, all states but Goa have passed the JFM resolution and started implementing it. Karnataka has made headway in undertaking large-scale afforestation programmes through the formation of Village Forest Committees. In Karnataka, 738 committees have been formed with over 55 000 ha of area brought under protection under the JFM programme (SPWD 1998). The other states have started implementing the programme recently and have made marginal progress.

Table 10 Forest area in Western Ghats and the compensatory forestry programme achieved in different states as of 31 December 1998

Western Ghats states	Forest area diverted (ha)	Compensatory afforestation stipulated (ha)	Compensatory afforestation achieved (ha)	% area covered	Forest area to be regenerated (million ha)
Goa	163	94	93	98.93	0.03
Karnataka	29 426	21 426	20 553	95.92	3.09
Kerala	30 263	58 069	22 756	39.18	0.14
Maharashtra	37 864	70 327	61 021	86.76	2.68
Tamil Nadu	4855	1051	1137	108.18	0.33
Total: Western Ghats	102 571	150 967	105 560	69.91	6.27
Total : India	446 860	535 919	319 197	59.56	26.43

Source: Ministry of Environment and Forest (1999)

Secondary forest formation in the Uttara Kannada district, Western Ghats: a case study

The Uttara Kannada district of the Karnataka state in south India, with 80% of the land area under forest, is one of the least industrialised districts in the Western Ghats. The developmental projects in this area which were harmful to the local environment gave rise to environmental movements, which successfully stopped the Bedthi and Aghanashini hydro-power projects. Recently, this district has attracted international donor agencies, such as the Department for International Development (DFID), United Kingdom, to invest in an afforestation programme in collaboration with the State Forest Department, and involving the local people.

The population of the Uttara Kannada district was 1.2 million (1991 census) of which 75.8% was rural. The tribal population consists of *Bhil*, *Nayak*, *Gowli* and *Gond* communities, who gather a larger variety of forest products for their subsistence and economic use. According to Ravindranath *et al.* (1997), income being generated through NTFPs in different forest types is Rs.1801 ha⁻¹ in evergreen, Rs.1404 ha⁻¹

in dry deciduous and Rs. 864 ha⁻¹ in moist deciduous forests. Out of the total forest area of 0.83 million ha, reserved forests form 93.19%, protected forests form 6.55%, village forests form 0.24% and unclassified forests form 0.02%. Area under reserved forests constantly increased at the cost of area set apart to meet the needs of the village population. Most of the protected forests are *soppina betta* lands (leaf manure forest), privileged land given to areca orchard owners for the extraction of leaf for manure, and are highly degraded with severe exploitation over long periods.

The regeneration of secondary forests: the Uttara Kannada district, with nearly 80% of the area under forest is also experiencing large-scale afforestation on degraded lands. Nearly 6500 ha have been afforested annually in the post-1980 period, indicating the formation of potential secondary forests in the future. Large-scale plantations were established on degraded lands under various afforestation programmes including the Social Forestry Programme (Bhat & Ravindranath 1994). The success of plantation programmes in the Uttara Kannada district, through high survival rates and higher productivity, reduced the dependence on natural forests, particularly for fuelwood and small timber. This paved the way for the conservation and development of natural forests. In Uttara Kannada, over 12 000 ha of degraded forest lands have been brought under protection by local people, with 308 village forest committees under the JFM programme. About 77 924 ha of degraded forests were brought under enrichment planting between 1985 and 1995 through the Social Forestry and Western Ghats Development programme. In addition, about 5300 ha of forest was placed under the artisan forestry model (plantations with species used by local artisans such as basket/mat weavers and other cottage industry-dependent people) to help forest-dependent artisans of the district. In the Uttara Kannada district, there has also been large-scale campaigning for the use of various alternative fuels and energy-saving devices. Over 8800 improved stoves and over 650 biogas plants have been installed in this district alone, to reduce dependency on fuelwood from the forest.

Plantations in the Uttara Kannada district are dominated by monocultures of exotic species, *Acacia*, *Eucalyptus* and *Casuarina*, which do not meet the local NTFP needs. However, protection accorded to the areas in the initial years has promoted the regeneration of naturally occurring species, thus making way for the formation of more-locally-useful secondary forests. In a study in Uttara Kannada, significant natural regeneration was observed under 6-y-old JFM plantations (Table 11), which were enclosed with barbed wire fences and cattle-proof trenches for the first three years. Intense protection, watch and ward improved the natural regenerative capacity of the forest lands. Apart from Forest Department plantations, farmers have also taken up afforestation programmes in their *betta* lands under the *Betta* Land Development Programme in some parts of the Uttara Kannada district, further contributing to the formation of secondary forest. *Soppina betta* lands (leaf manure forest) are privileged land given to areca orchard owners for the extraction of leaf for manure.

Forest recovery through protection and afforestation in the last 20 years has been phenomenal in the Uttara Kannada district. The declaration of some of the areas as national parks and sanctuaries has helped the recovery of degraded

secondary forests. Further, the Social Forestry and JFM programmes have set the pace for recovering degraded forest lands through afforestation. Thus, the formation of secondary forest through the maintenance of partially disturbed forests and through the regeneration of degraded or barren lands has been progressing in a big way. Now, strategies need to be developed to manage these secondary forests to extract timber and non-timber forest products on a sustainable basis.

Table 11 Natural regeneration in 6-y-old JFM mixed-species plantations in the Uttara Kannada district, Western Ghats, South India

Village	Total density tree ha ⁻¹	Species planted		Species naturally regenerating	
		No. of species ha ⁻¹	Tree density ha ⁻¹	No. of species ha ⁻¹	Tree density ha ⁻¹
Kalgadde	2003	5	1455	21	548
Nidgod	1274	10	1071	22	197
Illumane	1708	12	1658	20	50
Hukli-Shiavlmane	1900	11	1630	28	270
Hulibailu	1545	6	1473	12	72

Summary and conclusion

India currently has 63.7 million ha or only 19.4% of its land area under forest cover, despite the Forest Policy (1952) stipulation to keep 33.3% of the total geographical area under forest cover. These remaining forests are subject to high degradation pressures. There is a need to develop appropriate management strategies to reduce the pressure on and to use more sustainably the remaining natural forests, and to recover and maintain the country's environmental health, and social as well as ecological stability through the reforestation of degraded lands.

Most remaining forests in India are post-extraction secondary forests, having been subject to significant disturbance and degradation through small-scale accumulated extraction for long periods and some large-scale exploitation events. Pristine forests are left only in inaccessible pockets of the country. During the pre-colonial period, the forest-use pattern was extensive and sustainable with many conservation practices such as sacred trees and sacred groves. When India came under the administration of rulers and kings, the ownership of the forests was vested with them and the privileges of the local people were reduced. The formation of post-extraction secondary forests probably started at a minimum level at this stage in India. The formation of post-extraction secondary forests on a large scale began during the colonial period, primarily through the logging of forests for commercial purposes and to meet post-war external demands. Due to the loss of ownership and restricted access to the forest, people began to over-exploit the small patches that were available to them. People also exploited reserved forests under State control whenever the opportunity arose, and had no stake in their conservation.

The Forest Conservation Act of 1980 was enacted to reduce forest diversions and to raise compensatory forests for the diversions already made. Further, a large social

forestry programme was initiated in 1980, with the objectives of providing employment to the rural poor, meeting their fuel and subsistence needs, and promoting ecological stability. It resulted in the afforestation of large areas. However, this programme did not involve local people and the species planted did not meet their subsistence requirements, such as for NTFPs. Therefore, the pressure on forests continued. A people-oriented participatory forest management programme, called Joint Forest Management (JFM), was introduced through a government order during 1990. In the last 10 years, under the JFM programme, large areas have been afforested with multipurpose species, and degraded areas have been regenerated through protection. The decentralised system of management may prove effective in the coming years because the protection offered is promising.

Policy decisions at the national level have great impact at the regional and micro levels, as is clearly seen in the Western Ghats region and the Uttara Kannada district. Forest diversions have decreased, and compensatory afforestation, afforestation through social forestry and JFM programmes have either checked degradation pressures on existing forests or enhanced the regeneration of secondary forests on degraded lands. NGOs have been instrumental in bringing together the local people and the Forest Department to manage the forests through a participatory approach.

Protection from fire, grazing and fuelwood collection in JFM and SF plantations during the initial few years has helped the regeneration of natural species in these plantations. These regenerating individuals could form future tree-stands, after the removal of the largely planted (exotic) species. Through succession, these areas have the potential of developing into rehabilitated secondary forests in the future.

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