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Forest Management and Forest Policy in India: A Critical Review

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This paper is based on a study meant to go into the merits and demerits of the Bastar Pine Plantation project which envisaged clear-felling of 40,000 hectares of deciduous forest dominated by sal to raise plantations of tropical pine as raw material for a paper industry. It appeared to us that the issue being raised had wider implications and that it would be desirable not only to go into the environmental consequences of this particular project of raising man-made forests on a large scale. We therefore requested and obtained full support from the office of the Inspector General of Forests to examine the experience of such plantation programmes in different parts of the country. This investigation was conducted over a period of 12 months beginning June 1981.

This study of plantations was preceded by an earlier 5-year study of the bamboo resources of Karnataka State taken up at the instance of the State Government (Prasad and Gadgil 1981: 340). This study primarily pertained to the management of stocks in natural forests harvested on a system analogous to selection felling. We also investigated in some depth the experience of three voluntary agencies engaged in programmes of afforestation in 1981-82.

Besides these investigations of production forestry, we have looked at the protective and nature conservation functions of the

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forests in a number of contexts since 1973. We have also been involved in studies of the environmental impact of river valley projects, particularly on forests in the catchment areas for several years (Gadgil 1979; Sharma and Sharma 1981: 340).

The present paper summarises the new material accumulated during these investigations, and reviews the other available material. After reviewing the functions of the country's forest cover and the extent to which these functions are being served today, we shall present a review of the current practices and consequences of forest management. We will then go on to analyse the social causes of the current difficulties, develop the rationale for a fresh approach to the management of our forest resources and outline an alternative forest policy that flows from this approach.

I FUNCTIONS OF FOREST COVER

That forests serve many valuable functions has been well known for a long time and has been reflected in both the National Forest Policy of 1982 and the Forest Conservation Act 1980. The major functions may be broadly grouped in four categories: as storehouses of living organisms of potential use, as regulators of rainfall, soil and water regime, as sources of many basic needs of the weaker sections of the rural population and as the mines of many industrial raw materials. This is of course in addition to a variety of aesthetic, moral and ethical considerations.

Biological potential

A most significant function of forests without doubt is the fact that they serve as storehouses of biological diversity. A systematic study of various plant types found in natural forests is expected to yield (i) *New food plants* such as cereals, roots and tubers, vegetables and fruits (Anon, 1975: 189). (ii) *New medicinal plants*: tropical forests especially evergreen forests, have high concentrations of alkaloids, tannins, protease inhibitors and other chemicals of potential pharmaceutical value in their leaves, bark and fruit. A study of tribal medicine in the Attapadi valley of Kerala showed that the tribals used the roots of 39 different species, fruits of 15 species, leaves of 30 species, stems and bark of 12 species each, latex and flowers of 2 species each and 9 species of entire plants, for different medicinal purposes, including treatment of fever, cuts, burns, pain and skin diseases (KFRI, 1980: 235). The study team also discovered abortifants and antifertility preparation being used by the tribals in Kerala and in Bastar. Most of the preparations used here are unknown to modern medicine, and it is likely that a detailed analysis will produce new drugs of significant value, in the same way as *Rauwolfia serpentina*

was discovered by modern medicine a couple of decades ago. (iii) Forest plants are also potential sources of new types of gums, resins, scents, colourants and pesticides (Anon 1980: 81) and provide alternate sources of hydro-carbons for fuel (Khoshoo 1982). (iv) India's forests are rich in wild relatives of cultivated plants ranging from *ragi* and wild rice through pepper and cardamom to mango. These wild relatives are valuable reservoirs of genes vital for continuing productivity of our crops, especially for resistance to new varieties of diseases and pests (Pal 1981).

We have as yet hardly begun to tap these resources. As things stand, every hectare of forest that is lost to cultivation, river valley projects, and conversion to plantations without being surveyed in detail means the risk of loss of one or more potentially valuable species forever.

Regulation of soil and water

It is a widely held popular belief that forests enhance rainfall. While the data on this score are equivocal due to statistical problems of discerning the influence of deforestation, recent numerical studies indicate that deforestation may indeed lead to reduced rainfall through change in soil moisture and albedo (Charney et al. 1977). What is quite well substantiated is that forest cover reduces soil erosion and regulates floods by reducing surface run-off. Compared to the evergreen forest, soil erosion is 20 times greater in cardamom plantations, 130 times greater in grassland and an astounding 3250 greater under annual crops (Puri 1960). We know that the Ganges now carries so much silt from the deforested Himalayas that new islands like the New Moore Island have started forming in the Bay of Bengal. There is abundant evidence of increase of floods due to deforestation (Gosh and Rao 1979).

Benefits to tribal and rural economy

Man has depended on the natural living resources from his forest environment for all his basic needs for all but a fraction of his evolutionary history. While the majority in the industrialised countries is no longer dependent on the natural living resources in this fashion, the bulk of the rural and a section of the urban population in India and the rest of the developing world continues this dependence, especially for their fuel needs. The forests also serve as sources of construction material like bamboo and fodder for the livestock for large fractions of the population. Finally forests are the home for a majority of the original inhabitants of the country, the tribals, who constitute some 7 per cent of the nation's population.

Industrial raw material

Finally, the forests have been and are increasingly becoming more important as sources of industrial raw material. Though timber has been used from ancient times, forest produce gained considerable commercial importance only after the British started laying an extensive network of railway lines using wooden sleepers Today forest produce support a number of major and minor industries such as saw mills, paper, plywood, polyfibres, match, turpentine, tannins and many drugs.

II. CURRENT STATUS

From India's total land area of 305 million ha for which statistics are available, about 21 million ha are in the high reaches of the Himalayas or Rann of Kutch i.e., a natural desert which could never bear any plant growth. Another 18 million ha are under human settlements and industry. A total of 266 million ha of our land surface is then devoted to biological production as farmland, pastures or forests. Of these 143 million ha are under cultivation, about 75 million ha are classified as forests, 8m ha as permanent pastures, 17m ha as culturable wastes and 23m ha as fallow.

However, while 83m ha may be classified as forests and permanent pastures, less than half of them namely 35m ha are actually under tree or grass cover. The remaining 48m ha plus 17 m ha of culturable wastes and 23m ha of fallow; i e., fully 88m ha are more or less completely unproductive. In addition, another 87m ha of agricultural land suffer from serious soil erosion, and at least 10m ha from water logging and salinity (Vohra 1980). A good part of this agricultural land thus suffering is then marginal for agriculture and better put under tree crops. While no definite figures are available, one can hazard a guess that this is so for at least one-third out of these 97m ha, so that the total land surface of the country needing to be afforested must be put at 120m ha out of a relevant area of 266m ha, or fully 45 per cent.

Biological diversity

Besides even in the 35m ha that are under tree cover the stocking, productivity and natural diversity are far from satisfactory. A recent compilation by the Forest Survey of India (1982:37) reveals that perhaps less than 6m ha out of these retain their primary character and therefore their complement of the original biological wealth of plant and animal species. Furthermore, an analysis of our forests by vegetation types shows that a number of vegetation types, particularly of the dry tracts, have totally disappeared, while even with the better preserved evergreen forest types only about 10 to 30 per cent retains its primary character (see Appendix) (Gadgil and Meher-Homji 1982:24).

With only about 2 per cent of the world's land surface, India possesses 5 per cent of the known species of plants and animals. The total number of these, at a conservative estimate must be around 1.25 lakhs. Modern ecological theory predicts that given the current state of reduction of our natural biological communities we are likely to lose as many as 85,000 of these species in the coming centuries (Gadgil and Meher-Homji, in press). While admittedly a crude estimate, this figure points to the serious dangers facing us.

Soil and water conservation

The loss of our forest cover has very serious implications for the conservation of our soils and water. It has been said that one of our country's most precious exports is its topsoil. Of course, not all of this leaves the country; much gets accumulated in reservoirs and river beds. The actual rates of our reservoirs are on an average 2.3 times greater than those predicted; so that the storage capacity of Nizamsagar was reduced by 63 per cent in 44 years, of Mayurakshi by 10 per cent in 20 years and Panchet by 12 per cent in 19 years. At the same time, the area of land affected by annual floods today stands at around 40m ha as against 25m ha 30 years ago. The economic costs of these are enormous; a sum of Rs 3180 crores was spent on just flood control in India between 1976-78 (Vohra 1980).

Tribal and rural economy

The enormous potential of forests for contributing to an uplift of our rural economy should be viewed in the context of grinding poverty and the country's dual society with the top ten per-cent getting most of the benefits of development.

The gravest problem facing the rural poor is that of lack of productive employment. As Dr M. S. Swaminathan (1982: 102) remarked, famines in India are not famines of food but of work. There are some 90 million jobless people in India with more than 7 million additional people entering the job market every year. Unfortunately, the pattern of industrialisation adopted by us absorbs barely 40 lakh of these new entrants leaving more than 6.5 million yearly to add to the already enormous pool of unemployed

As we will explore further, the only possible solution to this famine of work can come from land and water based jobs, which even today employ six times as many people as are employed in industry, trade and government together Unfortunately, the depletion of our forest resources is now contributing to further destruction of employment and standards of living of the rural poor. Bhatt (1981: 108) has documented that the depletion of bamboo stocks of Tamilnadu has reduced the earnings of basket-weavers from Rs 8 per day in the early

1970s to less than Rs 6 per day now Furthermore, presently, these basket-weavers are always under threat of sudden periods of unemployment of several weeks due to unavailability of bamboos: a situation they had never known till a decade ago.

Apart from such actual loss of employment, the rural populations have suffered considerable lowering of standards of living due to the much greater difficulty in obtaining their basic requirements such as fuel and fodder. Gavlis, a pastoral buffalo-keeping tribe of Western Ghats had to considerably reduce the number of animals they could maintain, and even switch from buffaloes to cattle and goat due to the deterioration of fodder resources following deforestation and soil erosion (Gadgil and Malhotra 1982).

Industrial raw materials

As George (1982) puts it, the country is already experiencing a shortage, not just of fuelwood but of industrial wood as well, a shortage, which would become a timber famine within a few years. As a result of depletion of bamboo resources, which we shall discuss later, capacity utilisation by the paper industries which was consistently around 90 per cent from 1951-70 is now down to 70 per cent (*Commerce:* 8th August 1981). Many smaller industries such as wooden toys, plywood, match and polyfibre are similarly facing serious problems.

The very evident continuing depletion of our forest resources and the increasing difficulties faced by our rural population and industries suggest that our forest cover is now quite incapable of meeting the demands imposed on it. While this is universally agreed upon, there is an inadequate data base to ascertain the precise extent to which our forests are unable to meet the demands imposed upon them and therefore undergoing a depletion of their capital stocks. The estimates for forest area in 1970-71 range from 74 8m ha according to the Central Forestry Commission to 66m ha according to the agricultural statistics (Govt of India, 1976). This report also does not clarify how much of this area was actually under tree cover, although the Dhebar Commission Report (1961) on Scheduled Tribes and Areas had already commented pointedly on treeless forests. This is only now being worked out, especially because of the availability of the Landsat imagery. We therefore have to work on the arbitrary figure of 35 million ha under actual tree cover (Vohra 1980). No reliable estimates of the growing stock of these resources is available, various estimates placing it at 1100 to 2600 million cubic metres (George 1982).

The next parameter of interest is the annual increment or rate of growth variously estimated at 16 to 70 million cubic metres, which should work out to 6.4 to 30 million tonnes (George 1982). This

suggests a very low productivity indeed of much less than 1 tonne/ha/year. As Seth, Kaul and Sharma (1972) point out, this implies that only about 4 per cent of the potential productivity of our forests is actually realised This agrees with a field study of our own in a very good rainfall area of Supa in Uttar Kannada district which showed an annual aboveground production of only 0.8 tonnes ha/while the potential for such an area is easily between 15-20 tonnes/ha/year.

Be that as it may, we must inquire as to how this annual production of 16 to 70 million cubic metres compares with the demand. The official volume of extraction from our forests is around 10 million cubic metres of industrial wood and 16m cubic metres of fuel wood (see Table 1). Assuming an average of 50 per cent removal of wood from tress cut, the total official harvest comes to 50 million cubic metres, much above the lower though below the upper estimate of annual production However, this leaves out totally the very substantial unrecorded extraction, especially for fuelwood, whose total demand in the country is today around 200 million cubic metres. For Gujarat, its Chief Conservator, Shri Karamchandani (1982: 32), estimates that of the total 6.07 million tonnes of fuelwood consumed in 1978, 0.16m tonnes was recorded and 1.03m tonnes were unrecorded removals from the forest, the remaining 80 per cent coming from agricultural lands, waste lands, etc. If we extrapolate this relation of recorded to unrecorded removal to the country as a whole, it suggests that over 106 million cubic metres of firewood are extracted from our forests. Adding to this the industrial wood, the total annual extraction of wood from our forests comes to 126 million cubic metres, well above even the upper estimates of 70 million cubic metres as annual increment to the standing stock.

Table 1: Aggregate raw material requirement for 1980, under assumptions of high and low income growth (in thousand cubic metres)

Item	*Coniferous Wood*		*Hard Wood*		*Total Wood*	
	High	*Low*	*High*	*Low*	*High*	*Low*
Sawn wood	2,020	1,890	12,080	11,255	14,100	13,145
Panel products:						
Plywood and veneer	120	105	480	415	600	520
Fibreboard	20	15	75	70	95	85
Pulp and paper	1,100	965	3,075	2,710	4,175	3,675
Matchwood			535	535	535	535
Round wood	1,480	1,410	5,910	5,635	7,390	7,045
Total	4,740	4,385	22,155	20,620	26,895	25,005

When the harvest from a renewable resource like forest exceeds the increment, we begin to eat into the capital stock itself. As the

capital stock declines, the problems of overexploitation become all the more severe and the rate of depletion of the capital stock goes on accelerating. Our forest stocks today are unfortunately in this state, and our forest managers find themselves in the unenviable position of managing such a fast depleting resource. We shall now turn to an examination of how our forests are actually faring under these difficult conditions.

III. FOREST MANAGEMENT

Historical development

The climax vegetation of most of our subcontinent except in the higher reaches of the Himalayas and portions of the desert is some type of forest or other, and trees must once have covered almost all of our country. Large scale introduction of agriculture affected tree cover where the terrain was plain and water supply dependable as in the Gangetic plains. However, most of the hilly, dry and malarious tracts like the Terais appeared to have remained under a good forest cover till the arrival of the British

In great contrast to this apparent health of India's forest cover barring the land actually under cultivation was the near complete deforestation of England by the time the British established their Indian Empire. It is also well known that the British had totally deforested the eastern United States and South Africa over the 18th and 19th century. It is therefore quite wrong to believe that it was the British who introduced the notion of rational management of forests to India which were earlier being ruthlessly destroyed by its own inhabitants (Sagreiya 1967:239)

On consolidating their hold over India, the British began to lay down an extensive network of railway lines to facilitate the export of raw materials from and the import of finished goods to the remote corners of the country. Often these lines were deliberately routed through the richest areas, as for instance the diversion via Londa between Dharwar and Belgaum in Karnataka to tap the forest resources.

There are, however, a few exceptions, particularly when the unreserved forest was directly under the control of a cohesive village community, and not under the control of revenue authorities. Thus there are many *Vanpanchayat* forests in the Tehri-Garhwal areas of the Himalayas which are fully controlled by the local community and are better preserved than the Reserve forests of the tract Furthermore, the reserve forests themselves have not escaped considerable and often total depletion. In our fieldwork in the Mulshi, Velhe and Maval taluks of Pune district of Maharashtra we have come across large areas which on record are well stocked reserve forests, but on

ground are totally barren. In the Bangalore division itself, excessive demand for fuelwood has led to exhaustion of fuelwood stocks in six out of seven ranges (Chetty 1976:345).

As matters stand today most of the tree cover is on government reserve forests. In fact, the Government legislation has tended to disfavour maintenance of tree cover on private land because of the policy of nationalisation of such land.

Thus extensive forest tracts owned by private tea and coffee estates on the Western Ghats were converted to tea or coffee by the owners in the last few years, because they would otherwise have been taken over by the Government. The forest department itself promptly liquidates the tree cover while handing over land to other agencies, even its own Forest Industries Corporation. Thus in Karnataka several hundred hectares were so deforested near Balekoppa in Uttar Kanada district for setting up a great farm. Only a fraction of this area is utilised to this date, while the top-soil is being washed away in this region of high rainfall over a large tract of new barren land.

Rationale of management

On reservation of forests, the British introduced a modern system of forest management which was termed scientific. However, this is a misnomer for the essence of science is its grounding in empirical facts. Such an empirical basis is by and large quite lacking in our forest management. As examples we may note that as mentioned above, there is no firm information on aspects such as the control of forest department standing crop productivity, the removal of firewood etc.

While even this level of information is not properly available, scientific management of forests requires much more detailed information on the dynamics of the forest ecosystem. Consider, as an example, the working of tropical evergreen forests of Karnataka. These are prescribed to be exploited at the rate of ten trees per hectare every 35 to 40 years on the assumption that this would guarantee adequate regeneration and sustainable use. But Rai (1982) has pointed out that several effects have been neglected in drawing these prescriptions and that as a result these forests are definitely deteriorating and in the need of complete rest from all exploitation. The main point to stress is that the plans thus developed cannot be considered scientific, as they are based on guesses only, even though they are prepared in a very systematic fashion. Besides the main bias of the forest policy was and still remains urban and industrial as can be noted in its implementation.

Wildlife conservation

Though there had been considerable reduction of wildlife over

thickly populated areas when the British consolidated their hold, India was a hunter's paradise. This wildlife population began to be eliminated by hunters. In fact *shikar* was part of the British status symbol. Thus the Asiatic lion was hunted out in its entire range till it was saved in the lion sanctuary of Gir by the Nawab of Junagarh (Seshadri 1969:212). By the time of independence wildlife largely survived in such preserves or in a few till then inaccessible tracts such as Silent Valley or Agastyamalai on the Western Ghats.

Wild life conservation was seriously taken up only after independence, but its focus was the same as that of hunting preserves of Maharajas, namely, the conservation of a few game species like the tiger and rhinoceros. In fact many royal hunting preserves like Bandipur, Bharatpur, Simlipal and Ranthambor became modern wildlife sanctuaries. While a notable advance, this approach had a serious flaw in that it did not appreciate the value of preservation of biological diversity as a whole. Therefore, there have been no systematic attempt to protect the entire variety of the country's plant and animal life at all.

Apart from the narrow focus on a few species, our conservation effort also suffers from lack of commitment of many officials posted to the job. Furthermore, ringed as they are by masses of poverty stricken populations, these nature reserves offer great attraction to the people to make a living.

Thus, a large number of families in the village of Hangla on the border of Bandipur Tiger Reserve have no way of making a living except cutting fuelwood from the fringes of the Tiger Reserve and selling it in the market. Others take to poaching, and in the Periyar Tiger Reserve today the poachers hold such complete sway in the core area that hardly a tusker is left in the elephant population there. The Joint Director of Botanical Survey of India was held captive by the poachers at gunpoint when his party visited the area for scientific studies.

Social and water conservation

There is no clear policy relating to preservation of a minimum forest cover specifically for soil and water conservation at least on the slopes in geologically sensitive terrain or in catchments of water courses. It was only following the disastrous Alakanada floods of 1970 which took a heavy toll of human lives and property that these problems really came to the fore. An official enquiry committee later implicated excessive fellings in the geologically sensitive areas on steep slopes in the landslides that triggered off the floods, and all fellings in an area of Alakanada catchment were halted. But even now there is inadequate scientific information available on the vital issue of the

relation between deforestation and landslides in the Himalayas, and decisions on fellings to be taken up in these regions are being based merely on political pressures and counterpressures.

There is also no systematic attempt at preserving the vegetation cover in the catchments of any of our river valley projects. On the contrary, these projects, by rendering the area accessible, often result in its rapid deforestation as documented by Gadgil (1979) for several cases on the Western Ghats.

Production forestry

The vast bulk of the forests of the country, except for the National Park, Project Tiger Reserves and a few inaccessible forests totalling around 9 lakh hectares or 1.2 per cent of the area under forest department control, is worked for productive purposes (Forest Survey of India 1982:37). This working of a renewable resource could be either to use it sustainably by harvesting just the increment, or by attempting to enhance its productivity through the introduction of fast growing or economically more valuable species. The former leads to various forms of selection fellings and the latter to plantation programmes.

The bulk of our forests are managed on the selection felling basis. Unfortunately, due to a variety of reasons such as lack of an adequate data base, failure to take proper account of rural demands, violation of prescriptions by commercial interests and excessive grazing and regular forest fires, this system does not lead to sustained yields as expected

We will consider here only one example, namely that of bamboo resources of Karnataka and Tamilnadu (Prasad and Gadgil 1981; Bhatt 1981:68). This plant of tremendous utility to the rural population was proscribed as a weed to be eradicated in the early working plans. It however assumed industrial importance with its use as raw material for paper beginning 1919. Initially, it was considered unlimited and made available practically free at rates like Re 1 per tonne to the industry. However, over the last couple of decades the projected supplies have failed to materialise. The West Coast Paper Mill in Karnataka, for example, realised only 40 thousand tonnes as against the expected supply of 150 thousand and has to go as far as Arunachal Pradesh to meet its raw material requirements. The paper mills are also violating silvicultural regulations in their attempts to meet their needs and worsening the situation in the process (Prasad and Gadgil 1981).

Apart from their failure to meet the objective of sustained yields, there are other problems, both environmental and social, with this type of working. To take but one example, the plywood and

match industries have exhausted most of the high statured trees from Karnataka's evergreen forests. This has led to the disappearance of a critical resource to many animal species—for instance safe nesting sites for the hornbills and hive building sites for the rock bees (Bhatt 1982:19). The depletion of rock bee-hives has had a significant effect on the local population for which collection of their honey was a significant source of livelihood in certain seasons of the year.

Teak plantations replacing the so-called miscellaneous forests have predominated the efforts at enhancing the economic productivity of the forests from early British times. Now the plantations are taken up with certain projected growth and survival of the selected species. While the programme is justified on the basis of these projections, there is little attempt to later evaluate whether the actual performance comes to the level of that expected.

Since no such published information was available, we undertook fresh fieldwork in several parts of the country to arrive at an estimate. Available data for 25 Forest Ranges of the Kanara circle show that actual yield varies from 14 to 41 per cent of the projected yield, the average being 33 per cent of the expectation. Less detailed observations on teak plantations of Madhya Pradesh and Maharashtra show the same trends.

What this means is that apart from the fact that no thought was given to rural requirements of fuel, bamboo, etc. This situation persisted till the rapid growth of paper, plywood, polyfibre, matchwood and such forest based industries particularly after and the subsequent shortage of raw materials. Eucalyptus was found particularly suitable to fill the gap since these industries required soft wood and it is quick growing and immune from grazing by animals. So large scale eucalyptus plantations were launched beginning in the 1950s (Chaturvedi 1976). The yields expected from these plantations were in the range of 7.4 to 14.8 tonnes per ha in average on poor sites (Kaikini 1967).

Our study for six years in six ranges of Haliyal Division—a region with good rainfall—showed yields ranging from 0.86 to 2.22 tonnes/ha/year with an average of 1.4 tonnes/ha/year i e , 10 per cent of the projected yield. The yields in Bangalore (a dry area) are 20 per cent of the projected yield. This is good record for eucalyptus plantations which were also taken up on a large scale by clearfelling excellent rain forests in many high rainfall tracts of the Western Ghats. These were everywhere attacked by a fungal disease known as pink disease wiping out extensive plantations whose productivity was then zero, and which merely served as an exercise to convert tracts of excellent rain forest into man-made deserts. Perhaps the best example of this is in the Parambikulam tracts of Kerala. The eucalyptus

'plantations of South Bastar were also largely total failures, with a survival rate of around 1 per cent.

Other species were planted in the Himalayas with one or more of the following: ash, deodar, cypress, chir, kail, walnut and horse chestnut. In the Badrinath Division, the percentage survival of the plantation is an average of 14.2 per cent. In Garhwal survival averaged 21.5 per cent and in Kedarnath Division around 20 per cent.

Reasons enumerated for this failure include wrong selection of planting sites and species, improper seed collection, incorrect nursery and plantation techniques, improper supervision of the plantation programme and widespread grazing by domestic livestock even in plantations fenced by barbed wire.

Whatever the cause, these plantation programmes have had serious environmental and social implications. Whenever a plantation is taken up, it destroys at a stroke many resources on which the local population depends and thereby often raises strong feelings of resentment Dhareshwar (1941) documents the protests of the rural population of Uttar Kannada when teak plantations were first taken up in this area, and these protests continue to this date, now often against the eucalyptus plantations. The tribals of Central Indian forest belt have often objected to replacement of sal forest by teak and other plantations and in fact the destruction of teak plantations in Singbhum has been part of the programme of the militant Jharkhand movement.

When plantations are taken up, it is desirable to maintain belts of natural forests in between. This is often not done, not even along the water courses. Thus no such belts have been left along Tambraparni river in Mundunthurai Widlife Sanctuary or near Kozhikamathi in Annamalai Sanctuary of Tamilnadu or along the Satyamangalam-Dimbam road in Chamarajnagar Forest Division of Karnataka.

The plantations are based on a very narrow choice of species. With our narrow choice we run serious risks of the plantations being wiped out by diseases This, for instance, has happened with the pink disease which has led to large scale failures of eucalyptus plantations in the high rainfall tracts of Western Ghats.

In some tracts the pink disease has led to total wiping out of the eucalyptus plantations converting the area which was once tropical evergreen forest to barren wasteland, for instance in the Parambikulam tracts of Kerala.

Finally, one may ask whether even those plantations which have not failed have enhanced the productivity of the land. In order to answer this we can compare the productivity of the eucalyptus plantations of Uttar Kannada with that of the natural forest. This can be done on the basis of Viswanathan's (1972) data on the growth of non-teak

species in plots clearfelled for raising teak plantation. He records an average volume per tree of 0.894 cubic metre at an age of 55 years with densities of about 400 trees per hectare. Hence, the annual increment is 6.5M³/ha or 2.8 tonnes/ha, This is twice as great as the average eucalyptus yields of Haliyal Division of 1.4 tonnes/ha/year; and comparable to the eucalyptus yields of Yellapur Division of 3 tonnes/ha/ year. The plantations, even of quick growing species, then are not an improvement over the low productivity of natural forests.

Social forestry

By the 1950s the fuelwood crisis of the rural population was becoming increasingly acute and its significance in the very low productivity of our natural forests and plantations was becoming clear. The forest departments therefore began for the first time to consider these needs of the rural population and attempt to involve their cooperation in the raising of plantations. Out of this developed the social forestry programmes.

The early social forestry programme of the Tamilnadu Government was called farm forestry (Anonymous 1964: 46). It involved the raising of fuelwood plantations on tank bunds and other common land. While the plantations were to be raised by the forest department, they were guarded by a local villager whose job depended on the success of the plantations. Secondly, the village *panchayat* was to receive half the revenue on maturation of the crop. However, the blocks established of 40 ha per watchman were too large and the investment in the planting programmes inadequate. As a result, the productivity of these farm forestry programmes is still low, with an average of 1.15 tonnes/ha/ yr and 0.8 tonnes/ha/year for *Acacia nilotica* plantations of Madurai and Tirunelveli districts respectively. Furthermore, the wood produced is not made available to the rural poor, rather it is being cornered by the urban consumers.

By the 1970s the forest based industry in Karnataka which began to experience difficulties in satisfying its raw material requirements turned to private farmers and offered them remunerative prices. Thus, Harihar Polyfibre in Karnataka began to buy eucalyptus from farmers at Rs 300 per tonne since the supplies from Government at Rs 120 per tonne were inadequate. The farmers in drought affected areas like Bangalore, Kolar and Tumkur found it advantageous to shift to tree crops, mostly eucalyptus, since these are less affected by vagaries of the monsoon and require lower labour inputs.

This experience reveals a remarkable contrast between the cost incurred and the production achieved for the Government plantations and plantations on private farms. Our survey of these districts shows that the government spends Rs 2000 per hectare to achieve yields of

under 2 tonnes/hectare/year while the farmer spends a mere Rs 500-1000 per hectare to achieve yields of over 10 tonnes/ha/year. Moreover the overheads by the Government in maintaining the infrastructure are not included in the cost of Rs 2000 per hectare. A similar picture emerges in Tamilnadu (Shetty 1982).

Gujarat, with only about 5 per cent of its area under effective forest cover and famous for its enterprising businessmen and farmers, has launched the most innovative social forestry programme of all (Karamchandani 1982). There were several components to this programme such as strip plantations along roadsides, canal banks and railway lines with village *panchayats* promised 50 per cent of the net profits on maturity. By 1981, some 2000 village woodlots have been created covering 17,000 hectares. The lots are raised at Government expense, but the *panchayat* will receive 50 per cent of net profits on maturity.

This highly imaginative programme involves landless families in the planting and protecting operations in a manner that ensure them both a regular income and a share in the net profit from the harvest. Each family is assigned 37.5 ha of degraded forest to be planted at the rate of 2.5 ha/year over a period of 15 years. Each family is committed to provide 40 mandays of work a month and in return is paid a fixed monthly remuneration of Rs 250, housing material free of charge, minor forest produce and 20 per cent of the net profit from the harvest at the end of 15 years.

This innovative programme encourages farmers to put degraded and marginal farmland under tree crops by furnishing free seedlings and an additional subsistence allowance of Rs. 250 per year, provided that the survival is above 70 per cent. A modification of this programme has been applied to the tribal tract in the Dangs.

By 1980, 605 farmers had taken to planting eucalyptus and obtained yields of well over 20 tonnes/ha/year on irrigated land replacing cotton, leading to net annual profit of Rs 6000 to Rs 10,000 per hectare.

Non-Governmental organisations

The Gujarat experiment of assigning degraded forest land to private individuals for raising plantations is a pointer to a possible solution of our twin problems of unproductive lands and unemployed people. Three non-governmental agencies have also successfully addressed themselves to the challenge of rendering productive barren lands and proven that this is feasible.

At Alakananda in the Himalayas Shri Chandiprasad Bhatt of the Dasholi Gram Swarajya Mandal has motivated villagers to take up afforestation of totally barren land, often with landslides on it

(Kunwar 1982: 102.) The success of these plantations with real participation by people has been good with survival exceeding 70 to 90 per cent as compared to 20 to 50 per cent in Government plantations of the same region.

At Auroville near Pondicherry a group of volunteers was settled on some 2000 acres of degraded land. The volunteers soon discovered that this land was unfit for cultivation and was best put under tree crops. They have therefore conducted serious experiments in afforestation of this land coupled with soil and water conservation measures, employing a round-the-clock watchman, developing a live fence and irrigating where possible. Their inputs are therefore substantial, of the order of Rs 5000-6000 per hectare, but the experiment has been successful and the tree crop is now doing well and can be shown to be a profitable investment in monetary terms alone, apart from the other ecological benefits. Current indications are that the yield will be between 6 to 20 tonnes/ha/year depending on the quality of the soil.

The third experiment is that by the Bhagavatulu Charitable Trust in Vishakapatnam District of Andhra Pradesh. Here the attempt has been to develop a balanced combination of tree crops, animal husbandry and agriculture on barren, hilly tracts in a very low rainfall area. The attempt was found to be clearly viable.

It cannot be gainsaid that the tree cover of the country, its natural wealth of living organisms and even its very mantle of soil is in great difficulties. The land and the forest has had its productive capacity profoundly depressed by the pressure being put on it, so that we are today realising only a fraction of what it is capable of producing. The biological diversity is on the way to near total annihilation in the coming decades.

It can, however, be argued that the problems are man-made and could be solved if only society could gear itself to tackling them. It is therefore appropriate at this stage to analyse the social forces that are behind what is happening to our forests, soil and nature.

IV. SOCIAL FORCES

Three segments of our society are intimately concerned with what is happening to our forests; namely, the rural poor, industry and the Government machinery. Unfortunately, the self-interests of none of these sectors are served by a proper maintenance of the tree cover (Sharma 1978: 25). The rural poor can at best derive very low wages by workin as forest labourers or by selling firewood, and since they do not share in the profits made from the forest produce these wages always remain low at the subsistence level. Thus while the industrial labour of the West Coast Paper Mills earns Rs 20 or more

per day with facilities such as leave, job security, housing and medical care, the bamboo extraction labour working under far more difficult conditions earns just Rs 7 per day. Further, their wages do not change whether the bamboo stocks go up or down and hence they have no stake in its preservation.

While the rural poor gain little by protecting the tree crop, they have always been so far able to establish their ownership over a patch of land by cutting down the trees and putting it to the plough. This is why as many as 2.5 million ha of forest land has been lost the to cultivation between 1951 to 1976 (see Table 2) (Pillai 1981).

Table 2: The loss of forest area for various purposes between 1951-1976

Purpose	Area (thousand ha)
River valley projects	479.1
Agricultural purposes	2506.9
Construction of roads	57.1
Establishment of Industries	127.2
Miscellaneous purpose	965.4

Source: Pillai (1981).

The industry and timber merchants gain nothing at least in the short run, by preserving the forest stock Instead they can maximise immediate profit by concentrating on minimising the present cost of resources This is what they do, and in the process often resort to violations of forestry regulations Furthermore, they have been given little incentive for investing in the preservation of resources. The very low prices, well below replacement costs, at which they had access to resources meant that they had no motivation to invest substantially in resource regeneration. They also had no land of their own on which to attempt this Of course, in recent years when cheap resources from the Government are drying up they have turned to helping the private farmers, grow the resources by providing them a remunerative price and facilities such as loans But by and large the industry has so far concentrated only on exploiting newer and newer species and more remote areas as the currently used resources have been exhausted one by one.

Our whole bureaucratic apparatus with diffusion of responsibility and lack of any accountability provides no motivation to a good officer for proper management of resources under his charge, nor disincentives for those who mismanage. As a consequence, there is little commitment on the part of the bureaucracy towards good husbanding of the resources they are in charge of.

Human beings rarely act in any but self-interest and we must therefore so direct social forces that individuals will gain by working

towards the social good. The social good in this case is the proper maintenance of the productivity and diversity of our living resources.

One force that we can harness towards this is the immense unemployed labour force of the rural poor (Ranganathan 1979:34). Obviously, if only we can wean this human resource away from the presently destructive activities that they have been forced into by poverty, and towards a constructive task, much could be accomplished, and the present tide of degradation turned around.

V. A NEW APPROACH

Not a revenue generating sector

It would be fruitful at this juncture to take an entirely fresh look at how we may manage our forest resources in light of the considerations mentioned above. One may approach this question from three different angles, namely conservation, enhancing production and more efficient use. The forest cover is providing services such as water conservation and amelioration of the climate which cannot be measured in monetary terms. Forests are also providing much needed inputs to the rural sector in the form of fuelwood, construction material, fodder etc., which do not appear as revenue to the state. It is nevertheless a real economic benefit to the society as a whole

We should therefore cease treating the forestry sector primarily as a revenue generating sector for, if we do so, and if for instance, the Planning Commission urges the states to raise resources anyhow, there is a temptation to raise these by liquidating the capital assets of the standing forest crops.

This also has been a serious constraint on the functioning of the forest development corporations. These corporations have been forced to raise capital by clearfelling forests, a process that has had many undesirable consequences.

There is however no escaping the fact what we cannot conserve our forest cover without substantially enhancing the production of the forestry sector. The demands of the rural, urban and industrial sectors on forest produce will undoubtedly go on increasing in future, further worsening the current deficits. Unless we can solve this problem by substantially stepping up our production, the shortfall will inevitably be made up by further eating into the standing capital of the forest stock.

Tree production

What then is the best strategy for stepping up our production from the forestry sector? There are two related questions involved: the type of land we should employ to enhance the production, and the nature of the agency entrusted with this task. As Table 3 shows, there

are a large number af alternatives before us. The land to be used for enhancing tree production could be land with a good standing crop of trees, degraded forest land, waste land under Government control, waste land communally owned by a village, marginal farm land owned by individual farmers, or good farm land owned individually.

Table 3: The relative merit/demerit of using different kinds of land and different agencies for enhancing tree production. The merit or demerit is indicated for the following five points of view: (a) investment required; (b) probable level of productivity; (c) likely social conflicts; (d) employment generation; (e) environmental consequences. + denotes desirable; o neutral; and — undesirable.

Agency / Land	Government department					Industry					Co-operative					Individual				
	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e
Good miscellaneous forest	+	—	—	—	—	+	+	—	+	—	+	+	+	+	—	+	+	+	+	—
Degraded forest	—	—	o	+	+	+	+	—	+	+	+	+	+	+	+	+	+	+	+	+
Government or communally owned wasteland	—	—	o	+	+	+	+	—	+	+	+	+	+	+	+	+	+	+	+	+
Individually owned barren land or marginal farmland	—	—	—	+	+	+	+	—	+	+	+	+	—	+	+	+	+	+	+	+
Good farmland	+	—	—	—	o	+	+	—	—	o	+	+	—	—	o	+	+	—	—	o

The agency involved could be the forest department, other Government departments, private industry, cooperatives of tribals, landless labourers or farmers or individual tribals, landless labourers or farmers The merits of the programme will have to be judged on five criteria, namely, (a) the investment required, (b) the level of productivity likely to be achieved, (c) the kinds of social conflicts that may ensue, (d) the level of employment likely to be generated, and (e) impact on biological diversity, land and water resources.

Clearfelling

Perhaps, the main option currently favoured for stepping up forest production is the replacement of good forest by plantation of fast growing species. The rationale is that tracts of miscellaneous forests of slow growing uneconomic species are best converted to plantations of fast growing species by agencies such as forest development corporations, to step up production.

The results of our investigations mentioned above clearly indicate that the primary aim of stepping up productions is not being

realised; that given the constraints on the government machinery, the cost of such programmes is much higher than for say, a farmer; that these programmes have not generated any large scale year round employment; and that they have led to serious social conflicts in many places where the taking up of the plantation has led to the destruction of vital fuel, fodder and other resources to the local population.

Furthermore, the area of land with a good standing cover of trees has very much shrunk in our country and is now no more than 10 per cent of the land. Again, as was documented above, many such plantations replacing good forest have failed and further added to the barren land which now covers a third of the country's relevant surface. It is therefore clearly undesirable on all counts to continue the present practice of clearfelling a good standing crop of forests to raise new plantations, whether it is practised by the goverment, industry or individuals.

Private individuals and in particular the landless, are encroaching on good forests to bring the land under cultivation. This is either traditional as with the shifting cultivation system of the tribals in the North-East or because of the absence of alternative means of subsistence as with the tribals of Central India engaged in movements like 'Jabaran Jot.' In all these cases the viable alternative is to provide these people with other means of making a living. Thus creation of rural employment will necessarily have to be a prerequisite of successfully stepping up forest production.

Degraded forest land

The second class of land which may be considered in terms of stepping up forest productivity is land under forest department control but with a degraded forest cover. The extent of such land appears to equal if not exceed the extent of land with good forest cover.

The cost of bringing such land under a successful tree crop is likely to be greater and its productivity likely to be lower than when a good forest is clearfelled and brought under plantation. It is however important to note that what is relevant is not just the productivity of the new plantation raised on such land but the enhancement of the total productivity of our land due to this plantation.

Should we grow luxury timber?

Productivity may be defined in economic rather than biological terms. Since a timber like teak fetches exceedingly high prices, a teak plantation could always be argued to improve economic productivity of that land. An important point to consider here is that teak does not fulfil any irreplaceable function. Its price is already sufficiently high so that metal, hardboard or chipboard provide

equally desirable functional alternatives. The value of teak is therefore primarily as a luxury timber which now only the rich can afford. The real functional material that may be produced on the same land to replace teak will then be wood that can be converted into chip board or fuel which may supply energy for processing metals. It is these that should receive primacy of consideration.

Developing wastelands

We may then further explore the possibility of tree production on degraded forest land, waste land under revenue or other control and marginal farm land. We have an abundance of such land considerably in excess of good forest land. The experiences of voluntary agencies mentioned above have demonstrated that it is possible to render such land productive However, to do so would require considerable labour input and long term intensive care. While the Government machinery is not geared to provide such care, the private individuals are able to do so. A large proportion of our population is in fact squeezing out small yields of cereal grains of a few quintals per hectare by culivating such land with considerable effort. These and many other rural people similarly placed would be willing to put such poor land under tree crops provided that they can economically afford to do so For the moment, they connot do so and instead cultivate cereal crops only because the cereal crops provide quick yields while tree-planting is a long-term investment which few can afford.

Some progressive social forestry measures in Gujarat attempt to do just this. They include the provisions for a salary for 10 or 15 years, provided they carry out a certain defined quantum of work in terms of planting and protection of the tree crop, and a share in the profit derived from the tree crop on its maturity.

Such a programme will make it possible for the farmers to wait for the period of time required for the tree crop to mature, which is the main difficulty today in the way of the rural population taking seriously to the cultivation of tree crops. Such a programme would also minimise social conflict for any land that would be alienated from local people for uses such as grazing will be handed over to many of the same population for tree farming. Finally, this programme has the potential of generating employment for the rural population on a very large scale and is therefore highly desirable. This programme is also highly desirable from an environmental viewpoint.

The land envisaged to be put under tree crops with this programme ranges from individually owned marginal farm land, through village goacher or grazing land, communally owned t.ibal tracts, and

revenue forest areas to degraded tracts of reaserve forest. The organisation of the local society may again range from a well knit tribal society of some states in the Northeast, to landless labour belonging to oppressed castes in states like Bihar. The precise pattern of the organisation of tree farming will therefore have to be flexibly adapted to the local conditions if such a programme is to be implemented successfully.

Another major option to be considered for tree production would be to assign barren or degraded areas to specific industries for generating their own raw materials. As mentioned above, the present practice of subsidising raw materials gives no incentive to industries to replace the forests. But we have also shown that they are capable of doing it when required.

Such a programme would however require very large tracts of land to be handed over to these industries if they were to grow their own raw material. Given the present adverse land to man ratio in India there are no large tracts of land which are currently not being used by the rural population to meet its own needs of fuel, fodder and so on. If the industries are given control over such lands they will naturally tend to close these for rural use. This could lead to serious social conflicts as happened with the West Coast Paper Mills when it tried to fence off large parts of its concessional aras to protect the bamboo crop. The industries may also tend to go in for capital intensive technologies for tree production and thereby reduce the potential for employment generation. These problems may however be surmounted by insisting that the industry generate a certain quantum of fuel and fodder on part of the land leased to it for industrial wood production, and also guarantee a certain minimal level of employment to the local population.

The last option is the production of tree crops by farmers on good farm land. Since because of wood famine the industries began to purchase soft wood such as eucalyptus which is at Rs 300 or more per tonne, growing eucalyptus (or other crops such as casuarina) became profitable to farmers. As a result, cultivation of tree crops has been taken up both under rainfed conditions and under irrigation. The increasing switch over to such crops in areas such as Karanataka and Gujarat proves their economic viability. Such a shift however, reduces rural employment and may also lead to conflicts. The Tamil Nadu Government in fact, has been contemplating banning such tree crop cultivation on this ground.

Generation of rural employment

As Table 4 shows, therefore, the best option for stepping up tree production would appear to be through cooperatives or individuals

from the weaker segments of the rural population on degraded forest land, other barren land and marginal farm land. As mentioned earlier there must be as many as 120 million hectares available for tree production through such a programme. The quantum of land assigned to each family will have to be worked out on the basis of the quality of land and the structure of the local society. Depending on the choice the programme will generate jobs for between 3 to 120 million families. It is only the generation of employment on such a scale that can make a dent in our grave problems of rural unemployment.

The programme would also call for investment of the order of Rs 1000 per hectare per year for these 100 or more million hectares. The investment will take between 5 to 15 years to yield dividends. One may, however, expect from such a programme yields of the order of 5 tonnes per hectare per year after the initial gestation period. If we can add to our economy this tree production of the order of 500 million tonnes per year, it would make a tremendous impact on the nation as a whole

Efficient resource use

Only such massive enhancement of tree production can take away the pressures from the existing forests and make their conservation possible. At the same time we have to seriously explore more efficient use of our forest resources to reduce the level of demand. Firstly, we can altogether give up non-essential uses. Thus wood need not be used for railway sleepers which are already being manufactured from concrete on a large scale. Secondly, we can improve the quality of products such as plywood so that their increased life significantly reduces the demand (George 1982). Government policies everywhere should provide incentives to the industrial sector for more efficient use of wood products.

The other major use of wood is as fuel. There is a tremendous scope for reducing fuelwood requirements by propagation of more efficient *chulas* and alternative fuels such as biogas. City sewage could be tapped to generate biogas on a large scale to meet urban fuel requirements. Massive investment in such programmes would be entirely justified.

Finally, industry today has not been motivated to make efficient and sustainable use of its resources. The picture will change the moment industry is supplied raw material at the replacement cost and thereby motivated to induce its production. This would best be achieved through a Central excise with the generated revenue being returned to the states.

A change in the attitude of the industry is already apparent and

the rayon industry in Karnataka is offering farmers loans and other facilities to generate the raw material. This development is also welcome in that it is beginning to bring some benefits of the forest based industry to the rural population. Otherwise, the only way in which the rural population benefits from the industry is through the very poor wages paid to the forest labourers. One might in fact explore in the future the possibility of forest labourers and tree farmers actually being given shares in forest based industries.

Another major resource supplied today by the forest areas is fodder for the livestock. As of today large tracts of our forest areas are heavily overgrazed with consequent low productivity. An important component of improving the efficiency of the use of forest resources will have to be more rational management of the livestock. The only long term solution is to reduce the livestock population in a phased manner by slow genetic upgrading and switchover to stall feeding.

Even after pressure on forests is reduced by enhancing production and inducing more efficient use, and by finding alternate energy resources, the local population near the forest areas will continue to depend on the forest for many of their basic requirements. Their pressure would be best regulated by making them partners in forest management Once the industrial pressure is taken away from the forest areas they would basically be dedicated to meeting the local requirements It should then be possible to get their full cooperation in rational management of the forests by evolving some machanism for their participation.

There can be no two opinions about the desirability of protecting the forest wealth from excessive and illegal exploitation However, one must distinguish between this kind of loot by commercial interests and the harvest of forest produce by the rural population which has traditionally depended on these resources. Many of them have no alternative to grazing in the forest area, cutting of fire wood or cultivating a patch of marginal forest land to derive a subsistence. While the approach to the illicit activities of the commercial interests should be to deter them with the strong force of law, the approach to the subsistence activities of the rural population should be to provide them with alternative avenues of employment.

There should also be stronger legal provisions for penalizing the erring officials and politicians who may be involved in illicit exploitation of forest wealth Today there is no proper mechanism for an ordinary citizen who detects such involvement to bring the culprit to book. One must seriously think of developing a system on the model of *lokpals* or bomudsmen to whom appeal can be made by the citizens against erring officials.

Conclusion

The rationale that has guided our nature conservation effort needs considerable reorientation. We now understand conservation as an effort to preserve the overall biological diversity of the country. We must therefore identify nature reserves to represent each of the biological community types of India over an area sufficiently large to maintain the community on a long term basis. This approach immediately implies a considerable change from the current approach of wildlife sanctuaries where extensive destruction of the original biological community is permitted to continue through practices such as clearfelling and extensive selection felling

The present approach towards protection of the Wildlife Sanctuaries and National Parks is through the force of arms. This again has to be changed and the cooperation of the local population must instead be obtained by vigorously developing programmes of employment generation such as tree farming around the nature reserves

While developing such a forest policy it is necessary for us to mould the policies to local circumstances. Thus the conditions prevalent in tribal areas, such as Mizoram, would be quite different from those prevalent in the Garhwal Himalayas dominated by farmers and shepherds or the semi-arid tracts of the Deccan Plateau where the forest has disappeared quite some time ago.

The National Forest Policy enunciated in 1982 advocates maintenance of fully one-third of the geographical area of our country under forest cover Efforts need to be made to reach this level of vegetation. But while working for this growth of tree cover, the criteria of ecological balance, supporting the rural economy, reducing rural unemployment and industrial raw materials have to be borne in mind. Ultimately, one needs to remember that forests can be preserved only through people's participation and by creating in every sector of the population a vested interest in afforestation as against the present situation that encourages deforestation.

Appendix : Present status of different vegetation types of India

Vegetation type	Potential area (in thousand hectares)	Parcentage remaining close to climax	Percentage remaining under other physiognomies
I. Wet evergreen forests of West-Coast Western Ghats			
1) Cullenis-Mesua Pallaquium	2150	18	30
2) Dipterocarpus, Mesua, Pallaquium	2250	9.5	51.8
3) Persea-Holigarna-Diospyros	1075	28.8	60
4) Montane shola	356	7.9	34.6
5) Memecylon-Syzygium-Actionodaphne	675	11 9	25
6) Bridelia-Syzygium-Terminalia-Ficus	275	41	77
II. Wet evergreen-Teak ecotone			
1) Tectona-Lagorstroemia-Dillenia-Terminaria-Paniculata	4975	17.5	24.9
2) Tectona-Terminalia-Adina-Anogeissus	1625	26 6	33.2
III. Teak Zone			
1) Anogeissus-Terminalia-Tectona	36090	4.7	18.4
2) Tectons-Terminalis	17250	15 4	45
IV. Teak-Sal Transition zone			
1) Terminalia-Anogeissus latifolia	11975	5 5	16 3
2) Terminalia-Anogeissus-Cleistanthus	10375	8.1	27.9
V. Sal Zone			
1) Shorea-Buchanania-Cleistanthus	8375	13 5	38.5
2) Shorea-Cleistanthus-Croton	10750	6 8	13.9
3) Shorea-Buchanania-Terminalia	100	15	90
4) Shorea-Terminalia-Adina	19510	37.1	47.0
5) Shorea-Dillenia-Pterospermum	1875	5.9	9.0
6) Shorea-Syzygium operculate-Toona	3950	24.5	86 3
7) Toona-Garuga	1000	17.2	17.2
VI. Hardwickia zone			
1) Hardwickia binata-Albizzia amara	12125	11.8	12.5
VII. Albizzia amara zone			
1) Albizzia amara-Acacia	15350	4.9	5.6
2) Anogeissus latifolia-Chloroxylon-Albizzia amara	2725	0 4	0.6
3) Manilkara-Chloroxylon	2750	0 2	4.8
VIII. Anogeissus pendula zone			
1) Acacia senegal-Anogeissus pendula	3460	1.2	4.3
2) Acacia catechu-Anogeissus pendula	15805	7.8	10.6
3) Anogeissus pendula-Anogeissus latifolis	5000	2.41	5.1
IX. Deccan Thorn Forest			
1) Acacia-Anogeissus latifolia	9780	0	0.27
X. Deccan-Indian desert			
1) Acacia-Capparis	17250	0	0

Vegetation type	Potential area (in thousand hectares)	Parcentage remaining close to climax	Percentage remaining under other physiognomies
XI. Indian Desert			
1) Prosopis-Capparis-Ziziphus-Salvadora-Calligonum	30875	0	0
XII. West Himalayas			
1) Subtropical evergreen sclerophylloas forest	1340	—	23.3
2) Alpine steppe	5600	—	4.1
XIII. Himalayas			
1) Subtropical pinus roxburghii	4900	—	19.2
2) Temperate mixed oak and confierous forest	2360	—	54.6
3) Temperate coniferous forest	912	—	13.6
4) Subalpine forest	5076	—	3.8
5) Alpine scrup	512	—	9.4
XIV. Eastern Himalayas—Northeastern India			
1) Tropical wet evergreen forest	5860	—	14.7
2) Tropical moist deciduous forest	5472	—	32.6
3) Subtropical broad leaved hill forest	300	—	49.3
4) Montane wet temperate forest	2828	—	6.4
XV. Andaman and Nicobar Islands			
1) Tropical wet evergreen forest	684	80	80
XVI. Coastal			
1) Mangrove	550	—	—

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