

## Forests and forestry research in India

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**Abstract:** This paper in general way deals with problems and prospects of forestry in India. Stressing upon the need for linking the biophysical dimensions of the problem with the social, the paper sets the agenda for an action plan in forestry for the country.

**Resumen:** Este artículo trata de manera general los problemas y las perspectivas de la forestería en la India. Haciendo énfasis en la necesidad de relacionar las dimensiones biofísicas y sociales del problema, el trabajo establece la agenda para un plan de acción en la forestería del país.

**Resumo:** Este artigo aborda, de um forma geral, os problemas e prospectos da silvicultura na Índia. Acentuando a necessidade de ligação da dimensão biofísica do problema com a dimensão social, este artigo fixa a agenda para um plano de acção da silvicultura para o país.

**Key words:** Forestry, policy, resources, research strategy, status.

### Introduction

In view of the deteriorating forest resources and their importance to the national economy and environment, the Government has been emphasizing for the sustainable development of forest resources, as well as conservation of ecosystems. The first national level planning exercise in the forestry sector took place two decades ago when the National Commission on Agriculture (NCA) studied the situation in the country and made recommendations. But actions did not have the desired effect on the development of forestry. The Government revised the National Forest Policy in 1988 and emphasised on conservation and environmental stability. Later on, it decided to undertake the preparation of a National Forestry Action Programme (NFAP) with the aim of addressing the issues of the forestry sector in line with the National Forest Policy (NFP 1988).

Our forests have been transformed drastically and radically, and find it is hard to any undistributed forests as created by Mother Nature. In the present system, forests are unable to provide an intrinsic protection, the production of multiple products or environmental and human functions. Drastic changes are, therefore, warranted to avert an ecological disaster and the national catastrophe that would inevitably follow. Clear cutting has turned out to be a dangerous prescription unsuitable for tropical forests, not even for the European forests where it has originated. The tropical forests are inadequately understood at best and misunderstood at worst; the traditional management practices are the best suited. Forestry research in India is one of the oldest in the tropical world. It was not long ago looked upon as a model for other countries in the region. Guidelines for the preparation of working plans for a wide variety of high and coppice forest, yield regulations, preparation of

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yield and volume tables, thinning technologies and the like were among the outstanding achievements. Monumental works such as *Silviculture of Indian Trees* by Troup, *Forest Insect* by Benson, *Forest Floras* by Kanji Lal, Talbot Brandis, Mooney and others, speak for the high standard of work of Indian forestry research, which reflects the high degree of dedication.

### The present situation

(i) In India, forests meet nearly 40% of the energy needs of the country, of which more than 80% is utilized in the rural areas, and about 30% of the fodder needs of the cattle population. Forest products also play a very important role in the rural and tribal economy, as many of the non-wood forest products (NWFPs) provide sustenance to the rural poor and its accounts for some 70% of forest products and for some 40% of state forest revenues (Ahmed 1997). For landless families and marginal farmers, forest – related activities often represent the primary source of income.

(ii) India's forests are unable to meet its many needs. Ganguli (2000) reported a current round wood supply gap (excluding fuel wood) of some 26 million m<sup>3</sup>: The gap is expected to remain in future also.

(iii) It is estimated that about 270 million tonnes of fuel wood, 280 million tonnes of fodder, over 12 million m<sup>3</sup> of timber and countless non-wood forest products are removed from the forest annually. At a conservative level of pricing (Rs. 500 per tonne of fuel/fodder) the value of these commodities will amount to over Rs. 3,00,000 million per annum.

According to FSI (1999), in about 53% of natural forests, natural regeneration is either absent or inadequate. This situation is because of overgrazing in forests beyond their carrying capacity, which has troublesome implications for future growth. A comparison of the Indian situa-

tion with the regional and global situations is given in Table 1.

A recent study in Kerala has estimated the current average increments, in the natural evergreen and moist deciduous forests as 1.0 and 0.5 m<sup>3</sup> ha<sup>-1</sup> yr<sup>-1</sup> respectively. Yet another report suggests that the average productivity of Sal forests of India is at the level of 54.7 million m<sup>3</sup> ha<sup>-1</sup>. In fact figures are often quoted which would give Indian forest an annual productivity of 0.5 m<sup>3</sup> ha<sup>-1</sup>. If theoretical potential productivity could be achieved, this would increase to about 525 million m<sup>3</sup>ha<sup>-1</sup>yr<sup>-1</sup>. These estimates are indicative of a lack of proper management. It is to be understood that the result of management lapses is not limited to growth and yield of timber, but to the survival of critical ecosystems.

### Factors influencing productivity

For a given species or forest type, productivity is the function of habitat factors i.e. soil, nutrient status, rainfall and silvicultural management practices. Productivity with respect to forests can be expressed in term of mean annual increment (MAI). A natural forest, with a continuous cycle of growth grows on the products of its own decay (humus) through nutrient recycling. Productivity is influenced by special factors like removal or retention of litter, status of ground vegetation, density of stock on which further growth is to take place and protection form growth retarding agents.

It is understood that the MAI of natural forests tend to be lower than those of plantation forests raised with high level of inputs. However, the potential biological productivity of the natural forests of India is definitely higher than the figures mentioned earlier. Using Patersons index and based on rainfall, soil condition and length of growth period, the estimated productivity of these forests would range from 1.35 m<sup>3</sup> ha<sup>-1</sup> yr<sup>-1</sup> in the dry regions of India to 7.66 m<sup>3</sup> ha<sup>-1</sup> yr<sup>-1</sup> in the moist

**Table 1.** Comparison of productivity levels, 1990. Source: NFRP (2000).

Details	India	Tropical Asia	Asia-Pacific Region	Developing Countries	World
Growing stock of wood in natural forests (m <sup>3</sup> ha <sup>-1</sup> )	47	140	125	113	114
Biomass in natural forests (t ha <sup>-1</sup> )	93	181	171	169	131
Available volume of growing stock per capita (m <sup>3</sup> )	2.85	28.00	18.90	54.90	71.76
Available biomass per capita (t)	5.63	36.27	25.76	81.73	82.37

and wet regions with most other parts of the country producing around 4 to 5 m<sup>3</sup> ha<sup>-1</sup> yr<sup>-1</sup>.

### Forestry resources of India

Most of the forest ecosystems of India are fragile and reeling under an acute form of degradation. Each ecosystem has specific problems, which make the associated research dimensions vast, complex and demanding. The following factors are attributed to the present state of forest biocoenosis:

- (i) Loss of forest land to agriculture, industries and human settlements.
- (ii) Loss of forest due to multipurpose projects, construction of roads, erection of transmission lines, quarrying, slashing for shifting cultivation and clearing for encroachments for minerals etc.
- (iii) Degradation due to illicit felling, lopping for fodder and fuel wood, overgrazing, forest litter removal, forest fires, over felling, etc.
- (iv) Human and cattle population explosion around forest land.

The forests of India have a growing stock of 4,741 million m<sup>3</sup> with an annual increment of 87.62 million m<sup>3</sup>. Since 78% of the forest area is subjected to grazing, coupled with heavy removal of forest products and 51% subjected to occasional fire, the productivity of these forests is low. The performance of plantations, in terms of survival, growth and yield is also poor because of inadequate site selection, improper site species matching, poor quality planting stock, lack of post establishment protection and lack of timely silvicultural operations. The average MAI for plantations of the fast growing species under social forestry programme is only 4 m<sup>3</sup> ha<sup>-1</sup> yr<sup>-1</sup> against the expected 10 m<sup>3</sup> ha<sup>-1</sup> yr<sup>-1</sup>. According to a study of IIPA (1989), the average survival percentage in five Indian states was 66 per cent. Lack of plantation inventory, absence of yield improvement plans and rotation cycle and lack of post establishment management systems were some of the reasons. Yields obtained are far short of the potential. Research support is absolutely essential for realizing their true potential.

### Role of forestry sector in economy

#### *Contribution to GDP*

India, in spite of having 2.5% of the world's geographic area and 1.8% of the world's forests,

sustains 16% of the planet's human population and 18% of its livestock population. Forestry contribution is 1.7% of nation's GDP. This does not take into account unrecorded withdrawals (NWFP, fuel, wood, fodder etc.). Moreover, the environmental benefits of forests also remain to be quantified and calculated.

The forests contribute 1.7% to the GDP of the country (NFAP 1999 a & b). Due to problems associated with the valuation of forests and services, unrecorded removals, illegal harvesting, etc. the exactness of the contribution has not been established. A large part of the forest production consisting of fuel, fodder, medicine and food are removed without payment and without any record by the rural and tribal people. According to Ahmed (1997), the total annual value of India's harvest of all forest produce is estimated to be Rs. 300,000 millions (compared to the investment of Rs. 8000 in the sector). The low estimate of contribution to the GDP resulted in low priority for forestry investments in five-year plans. Efforts are needed for monitoring the services provided by the forests so as to appreciate their contribution to human well being. Over 50% of the revenue earned by the forest departments comes from NWFPs. Their growth is generally 40% higher than timber (MOEF 2000). Nearly 350 million people living in and around forests in India depend on NWFPs for their sustenance and supplemental income which is worth Rs.400 billion annually (Tewari 1994). Studies in Orissa, Madhya Pradesh, Himachal Pradesh and Bihar have indicated that over 80% of forest dwellers depend entirely on NWFPs. Similarly 17% landless depend on daily wages related to the collection of NWFPs. 39% people are, however, involved in NWFPs collection as a subsidiary occupation. It has been estimated that many village communities derive as much as 17-35% of their annual household income from the sale of NWFPs (Tewari 1994). NWFPs provide 50% of the income to about 30% rural people. The average income realized through the sale of NWFPs by households in the state of Madhya Pradesh constituted 34 to 55 percent of their total income. As per estimates made in West Bengal, an average return of Rs 2270 ha yr<sup>-1</sup> is obtained from NWFPs, which is 25% more than the polewood harvest, which fetches Rs 16,000 per ha after 10 years. There is, thus suf-

ficient evidence to believe that the collection of NWFPs is a crucial part of the population's life support system, especially of the tribals.

#### *Employment generation*

Of the total wage employment in the forestry sector, NWFPs account for more than 70% of the opportunities for self-employment for the forest dwellers as farm mechanization has not developed well in India. According to an ILO estimate, one hectare of forest plantation creates nearly 630 mandays, from the raising of nurseries to the harvesting stage. 70% of the budget allocated to plantations or afforestation is spent on providing direct wages to the workers and only 30% goes towards purchase of seeds, planting materials, equipment etc. It would not be out of place to mention that 50% of the workforces on forest plantations are women and tribal. Rural women use 70-80% of the mandays in collection of NWFPs, fuel and fodder. Activities related to NWFPs provide employment during slack periods and a buffer against risk and household emergencies. In the remotest areas, sometimes the forest is the only source of employment and income. Research is needed to evolve forest based entrepreneurial endeavours to produce multiplier effects through the forward and backward linkages.

#### *Markets*

The dependence of the producer on intermediaries and his limited access to markets has a direct effect on prices. The price of a product whether sold to consumers directly or through intermediaries, has no bearing on the expenditure incurred on the labour, inputs and transportation. Under direct sales, the localized activity for localized markets creates a supply position in excess of local demand. Traders control the market and dictate the prices during the season and in the off-season. The sale of produce during the flush season and in the off-season is different. In the case of sale through intermediaries, the producers have absolutely no control over the prices. Studies show that the poor primary producer's income always remains low. The need for market related studies has always been felt, and includes research on the market information system and the scope of value addition like bioprospecting, Intellectual Property Right (IPR) etc.

#### *Growing pressure on forests*

The present ecological conflicts have created many economic compulsions and sociological stresses due to changing consumption patterns, scarce availability of land and other natural resources. To make a trade off between demand and availability of forest produce is a big challenge according to the wood budget of the year, 1996 presented below in Table 2.

Out of the total requirement for wood, 70% is for fuel wood and 30% for timber. Thus, forests have at least 5 times more pressure than what they can withstand. This is in addition to the 30% contribution to the fodder requirement of the country in the form of 178 million tonnes of green fodder and 145 million tonnes of dry fodder.

#### *Supply and demand scenario of forest raw materials*

The current demand of timber is around 30 million m<sup>3</sup>, out of which 8.3 million m<sup>3</sup> is needed for paper, pulp and panel products and 15.4 million m<sup>3</sup> for saw milling i.e. housing, packaging, furniture, etc. The total timber requirement is estimated to grow to a level of 60 million m<sup>3</sup> during the next five years (20.5 million m<sup>3</sup> for paper, pulp and panel products and 27 million m<sup>3</sup> for saw milling). Therefore, during 1994 -1995, nearly US\$ 600 million worth of wood and wood products were imported. Similarly, the current requirement of fuel wood is around 280 million tonnes, which is likely

**Table 2.** Growing pressure on forests. Source: MOEF (1999).

Fuel wood Demand (million ton)	201
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Supply (million ton)	
From forests	17
From farm forests and other wood lands	98
Total	115
Deficit	86
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Timber Demand (million m <sup>3</sup> )	64
Supply (million m <sup>3</sup> )	
From forests	12
From farm forests and other wood lands	31
Total	43
Deficit	21

to rise to 356 million tonnes. As such, there is an ever enlarging gap in the supply against the current sustainable yield of only 12 million m<sup>3</sup> of timber and 21 million tonnes of fuel wood.

Despite the low consumption and production, shortage has been the history of the India's forestry industry sector. India is, therefore, supplementing its wood with bamboo and agriculture wastes. The trend, due to poor transport economics force Mills to be small and within the transport radius. The situation of Indian paper mills, depending on the sugar mills is within the 100 km radius, for cool-fired boilers for their own heat needs. To spare the bagasse for sale as pulping raw material there is severe pollution in pulping agriculture radius and poor quality paper relative to wood fiber material. This trend is likely to continue if there is no reform in the forest policy linking biophysical, demand, research and marketing. As regards with the fodder availability, it is seen that its requirement is increasing year by year in comparison to its availability shown in the Tables 3 & 4.

### Medicinal plants

The NWFPs play a very important role in the modern economy. They form the basic raw mate-

**Table 3.** Estimated fodder requirement projections (million tonnes).

Year	Dry fodder (million ton)	Green fodder (million ton)
1985	780	932
1990	832	992
1995	890	1064
2000	949	1136

Source: Report of Committee on Fodder and Grasses, NWDB (1987).

**Table 4.** Estimated fodder availability, requirement and gap.

	Dry fodder (million ton)	Green fodder (million ton)	Concentrate (million ton)
Availability	398.68	573.50	41.98
Requirement	583.52	744.73	79.40
Gap	184.84	171.23	37.42

Source: Policy Advisory Group, MOF (1993).

rial for the phytopharmaceuticals and various other industries (Table 5). Herbal medicines in use today are derived from nearly 8,200 species of medicinal plants. In developing countries, more than 80% of the population depends on traditional plant based medicine, and even in the USA, 25% of the prescription drugs are still based on phytochemicals. NWFPs offer an excellent potential international trade. Ahmed (1997) reported 8 categories of NWFP, some are important from the point of tribal indigenous groups such as West Bengal where tribal groups collect 27 commercial products, 39 plant food, 47 medicines. NWFPs account for 70% India's exports and the demand for phytochemicals is expected to increase in future as a new frontier for trade and sustainable commercialization of biological resources at international level with secured intellectual property right.

The manufacturers and the practitioners of traditional medicines depend solely on the procurement of MFP plants from the wild, as cultivation of most of these plants barring the spices has not gained momentum. The methodology of extraction of phytochemicals from the forest products has gained attention of researchers. The value additions may be done through percolation methods using extraction of plants, spray drying, distillation, effleurage or cold fat extraction, maceration or hot fat extraction and solvent extraction. Oleoresins are obtained conventionally by extraction of the powdered spice with solvents, but notable differences in the yield and in aroma flavour and pungency of the final product can be achieved by varying the geographical type of the spice, the age at which it is harvested, the choice of solvents and the method of extraction. To make this possible a determined investment in technological capacity building, biophysical research and development, market research is crucial.

The major task before the country, therefore, is to rehabilitate the degraded forests and to enhance the area under forest/tree cover to 33% of total area as envisaged in the National Forest Policy (1988). Despite continuous efforts the desired results could not be achieved because of the ever-increasing demand for forest products and the limited funds available (less than 1% of the total Plan allocation). To reverse the process of degradation and to achieve the goal of the National Forestry Policy (1988), the government formulated the National Forestry Action Programme (NFAP), a com-

**Table 5.** Estimated annual consumption of some gums and resins by various industries.

Name of the industry	Item used	Approx. consumption in industrial units in the country (ton)
Food, chocolate, confectionery, ice creams etc.	Gums	50
Textile	Gums & Resin	5000
Artificial leather and oil clothes	Gums & Resin	500
Paper for packing	Gums & other pastes	1000
Drugs and pharmaceuticals	Gums & Resin	700
Lithography in map publications	Gums	NA
In oil industry as drilling fluids in ore flotation of gums, Mining industries	Carbohydrate polymers of gums	NA
Surgical and medicinal products	Resin	200
Paper industries	Resin	2500
Tyres and tubes	Resin	500
Rubber footwear	Resin	300
Paints, varnishes and lacquers	Resin	5000
	Resin	250
	Turpentine	7 x 10 <sup>6</sup> l

Source: Shiva (1994).

prehensive strategic plan to address the key issues underlying the major problems of the forestry sector in line with the National Forest Policy (1988).

### Research priorities

In the policy document (GOI 1988) a number of priority areas of research and development, needing special attention have been identified as a research strategy to achieve the objectives of the National Forest Policy. These are:

- Increasing the productivity of wood and other forest produce per unit of area per unit of time by the application of modern scientific and technological methods.
- Revegetation of barren/marginal/ waste/ mined lands and watershed areas.
- Effective conservation and management of existing forest resources (mainly natural forest ecosystem).
- Research related to social forestry for rural/tribal development.
- Development of substitutes to replace wood and wood products; and
- Research related to wildlife and management of national parks and sanctuaries.

In the light of the sector review (GOI), the strategic issues for forestry research are identified as follows:

- Increasing forests and tree productivity.
- Enhancing peoples participation in forest management.
- Saving the biological diversity: in-and-ex-situ conservation.
- Rehabilitating degraded lands.
- Strengthening institutional and human capacity; and
- Improving forestry research policy and setting priorities.

### Goal and objectives

- Increasing productivity from less than 1 m<sup>3</sup> ha<sup>-1</sup> yr<sup>-1</sup> to 5 m<sup>3</sup> ha<sup>-1</sup> yr<sup>-1</sup> expanding forest/tree cover to achieve national goal of 33% of geographic area.
- Extending protected area network for biodiversity conservation.
- Planting of fuel wood species on non-forest wastelands.
- Producing pulp wood and other industrial wood through agro-forestry.
- Encouraging and strengthening of JFM.

- Developing NWFPs and generating rural employment through value addition.
- Promoting development, harvesting, processing and marketing of medicinal plants for income generation.
- Strengthening infrastructure for forest inventory, research and development.
- Augmenting research capabilities of state forest departments.
- Building the capacity and training of personnel engaged in forestry through well conceived HRD planning.
- Building the capacity for proper monitoring and evaluation of forestry projects at the state and central levels.
- Rationalizing investment for the sustainable development of forests.

In the early part of this century, forestry research concentrated on botany, taxonomy, phenology, silviculture, logging and wood utilization. However, in the present day context the scope of forestry research covers not only biological and technological aspects (forestry, forest products, conservation and wildlife), but also the wider spectrum of economic and sociological researches leading to policy formulations.

### Conclusions

In developing countries like India, an increase in the population of humans and cattle results in an increase in demand for forest produce, where there is scope for cultivation of forestry species in wasteland and other forest land because of the drastic decrease in per capita land availability. Forest produce has to be increased from the land already available and stress sites have to be cultivated to meet the demand. Under these circumstances the research should be linked with the ongoing programmes on tree management. Improvement studies should be given priority in order to achieve meaningful results. This approach is sadly lacking in many developing countries includ-

ing India, where research and development in forest and improvements yet to show meaningful results.

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