Forest Policy in India – in Retrospect and Prospect*

S. BALAJI

Director, Department of Environment
Government of Tamil Nadu
Panagal Building, Saidapet, Chennai – 600 015,
Tamil Nadu, India
E-mail: tndoe@md3.vsnl.net.in

Abstract

Forest policy in India has changed with the times. During colonial times, as in other countries in the Asia-Pacific region, the National Forest Policy was influenced largely by technical foresters striving to protect and manage forests for the national good and driven largely by a custodial attitude. They gave more consideration to the forests than did the people who used them. Nevertheless, Dietrich Brandis, the “father of Indian Forestry”, had the foresight to address the needs of the local forest dwellers even in the preparation of the First Indian Forest Policy in 1894. During the colonial era, Forest Management focused on maximum output of quality timber for export and sleepers for expanding railways. In Independent India, the impetus switched to industrial wood production. In order to extend tree lands outside reserves, Social Forestry programmes aimed to bring forest production closer to the people. However, forests throughout the country were degrading at an alarming rate due to population pressure and conversion of forestlands. The causes of forest degradation are not purely physical or biological but often sociological. Joint Forest Management is an attempt to integrate the physical measures of soil and moisture conservation with biological rehabilitation and socio-economic amelioration of the people. The National Forest Policy in 1988 made a very significant and categorical shift from commercial concerns to a focus on the ecological role of the forests and participatory management. With the onset of participatory forest management and with consequent collaboration, decentralization and democratization, the forestry sector has become pluralistic to varying degrees. It has multiple actors in addition to Forest Departments, such as other government departments, NGOs, universities, tree cooperatives, tree companies and local bodies, which has created new opportunities and challenges. At the global level, the Earth Summit in 1992 gave greater environmental responsibility in forestry development, besides emphasizing people-centered development. But it also created challenges for Governments to reconcile the priorities of national or local significance with global ones; of industry demands with community needs, of preservation with diversified management and use of forests. Achieving sustainable forest management in pluralistic settings is no doubt an enormous task. But is there any other choice? Integrating production objectives without sacrificing environmental and social concerns, demands from the foresters, technical innovation, consensus-building and a new set of negotiating skills. Forestry research and training are two vital functions in this regard, although the funding for these essential activities is inadequate and declining. Participation of the private sector and non-governmental organizations in research and training is required and needs to be strengthened. Client-driven forestry research is need of the hour. Like the Green Revolution, the “Brown Revolution” can be ushered in only through appropriate research, training, and extension support. Biodiversity enhancement through Participatory Forest Management has been recently documented. Policy research on biodiversity monitoring, identification of criteria and indicators for sustainable forestry, and biodiversity enhancement could be some of the priority areas. SWOT analysis of the emerging policy scenario in this pluralistic setting is discussed towards the end of the paper. The prospective policy should aim at scientifically sound forest management that is economically viable, socially relevant and ecologically sustainable.

* Paper presented at the IUFRO Science/Policy Interface Task Force regional meeting held in Chennai, India at the M.S. Swaminathan Research Foundation, 16-19 July 2002.
INTRODUCTION

In geographic area, India ranks as the seventh largest country in the world with a spread of 3287.3 thousand sq.km. It has a large population of over one billion, next only to China. In number of cattle and domestic animals it tops the list. The overall forest area as per the latest estimate stands at 640.70 thousand sq. km, or 19.49% of the country's geographical area, registering a marginal increase over the last inventory. However, the per-capita forest area is abysmally low at 0.075 ha. Forests and woodlands have a major role in contributing to the well being of the rural masses who represent about 75% of the country's population. The economy of rural people being basically biomass based, forests and forest produce contribute substantially to it, either directly or indirectly (ICFRE, 1993). Therefore, appropriate policy and scientific management of forests and trees is important for maintaining ecological balance as well as socio economic development in rural India.

The first scientific forest policy in India was formulated more than a century ago. The charter of Indian Forestry issued by the Government of India in 1855 heralded the beginning of forest conservancy in India. This charter, based on the recommendations of Dr. Mc Clelland, the then Superintendent of Forest, Pegu, imposed certain restrictions on unchecked exploitation of forests by private agencies. Forests were entrusted to the care of Forest Department. They were surveyed and scientifically mapped. Subsequently, Dr. Voelcker's report on 'Improvement of Indian Agriculture' 1893 included a special chapter on forestry. The first National Forest Policy of India published in 1894 was based on Dr. Voelcker's recommendations. The Policy classified forests with reference to their primary functions, as preservation forests, commercial forests, minor forests and pasturelands. While preservation forests included those forests essential for environmental purposes, the commercial forests were earmarked for exploitation for timber and other forest produce. Minor forests and pasture lands satisfied the needs of local people for fuel wood, small timber and fodder. Dietrich Brandis, the father of Indian Forestry had a lot of foresight in addressing the needs of the local forest dwellers during the preparation of first Indian Forest Policy 1894. The main objective of forest management was to promote the general well being of the country. The influence of forest over the physical and climatic conditions of the country was quite well recognized. However, realization of maximum revenue from commercial areas was given priority. (Negi 1986) Permanent cultivation was given preference as a land use over forestry; the policy did not make any provision for management of private forests. Due emphasis was not placed on Wild Life Management, catchment area management, forestry research, education and training. These lacunae were set right to some extent in the National Forest Policy in 1952 after India's independence. The two World Wars took a toll on the forests. New development projects such as river valley projects, industries and communication depended heavily on forest produce.

Therefore, the focus shifted from production of timber and railway sleepers to industrial wood. The National Forest Policy of 1952 was formulated on the basis of the following paramount needs, viz.,

(a) The need for evolving a system of balanced and complementary land use.

(b) The need for checking denudation of mountains and regions on which the perennial water system depended, whose basins constitute the fertile core of the country.

(c) The need to check erosion along the riverbanks.

(d) The need to establish tree lands wherever possible.

(e) The need to ensure progressively increasing supplies of fuel wood, small timber and fodder.

The National Forest Policy of 1952, classified forests into protection forests, national forests, village forests and tree lands. The protection forests were meant for maintaining physical and climatic conditions, similar to preservation forests of the earlier policy. The commercial forests exploited for defence, communication and industry were called National Forests. The minor forests, which supply fuel wood and fodder for cattle, were called village forests.
Unlike the earlier policy, tree lands outside the scope of forest management were given special delivery through Vana Mahotsava programmes. Neighbouring areas were given preferential claim over forests and their produce but not at the cost of national interest. According to the policy agricultural requirements had preferential claim over the forests. It also recommended regulation of rights and restriction of the privileges of users depending upon the value and importance of forests. According to the policy, the rights and interests of future generations should not be subordinated to the imprudence of the present generation! Owing to their protective role in the national economy forests deserved an adequate share of land. Indiscriminate extension of agriculture and consequent destruction of forests has not only deprived the local population of fuel and timber but has also stripped the land of its natural defenses against dust storms, hot desiccating winds and erosion. Therefore, the National Forest Policy of 1952 emphasized complementary land use under which each type of land is allotted that form of use in which it would produce the most and deteriorate the least. Therefore the policy emphasized protection of forests, reconditioning of hills and river valleys and immobilization of the deserts of Rajputana. The role of the National Forests for attaining self-sufficiency in vital timber supply for defence, communication, etc., was stressed.

The importance of village forests for fuel supply on a sustained basis, extension of tree lands in the marginal lands, eroded river and village wastelands not suitable for agriculture was also emphasized. Unlike the earlier policy, wild life conservation and formation of National Parks and Sanctuaries found a place in this policy. The Central Board of Wild Life was constituted followed by enactment of exclusive Wild Life Law for the country called the Wild Life Protection Act 1972, for protecting rare and endangered species.

In order to discourage uncontrolled grazing, several measures were suggested in the policy such as rotational grazing, prohibition of grazing in regeneration areas and rationalization of grazing fees, exclusion of goats and creation of fodder reserves. The policy suggested the taungya system of cultivation of trees and agricultural crops as an alternative to shifting cultivation. However, the policy suggested replacing inferior tree growth with valuable species through a carefully planned afforestation programme. Sustained yield principle was emphasized wherein annual cut does not exceed annual increment. The policy also detailed the importance of training, research and introducing legislation for private forests. Common forest education was advocated for inculcating esprit de corps. The importance of maintaining professional standards in forest management by continuously updating of knowledge, through training, was emphasized.

Investigation into the biological aspects of forestry viz., silviculture, botany and entomology is dependent upon the cooperation of the forest departments of various states. Most of the state Forests Departments have research wings for this purpose. Maintenance of such a research organization in each state is in the interest of the efficiency of forest management in a country as a whole. On the other hand, research in utilization of forest products is conducted at the Forest Research Institute, Dehradun where special equipment for the purpose exists. This balanced arrangement of silviculture research at state level and forest product research at Dehradun ensures both efficiency and economy. According to the policy, as Forestry is a long-range enterprise, a steady flow of funds is indispensable. The immediate profit motive should be rigidly ruled out.

Following this policy several schemes were introduced to ensure production of fuel wood and fodder and attaining maximum sustained yield of timber for railways, defence, industries and communication. Forests, which were over exploited during world wars, were rehabilitated. In the second and third Five Year Plans commercial plantations for pulpwood were established. The number of sanctuaries and national parks increased over the next two decades.

The Indian National Forest Policy of 1988 (Anon 1988) gave conservation orientation and a human face to forestry. The Policy emphasized the protective role of forests in maintaining ecological balance and environmental stability. The basic objectives that should govern the National Forest Policy were enlisted as follows:-

- Maintenance of environmental stability through preservation and, where necessary, restoration of the ecological balance that has been adversely disturbed by serious depletion of the forests of the country.
- Conserving the natural heritage of the country by preserving the remaining natural forests with the vast variety of flora and fauna, which represent the remarkable biological diversity and genetic resources of the country.

- Checking soil erosion and denudation in the catchment areas of rivers, lakes and reservoirs in the interest of soil and water conservation, for mitigating floods and droughts.

- Checking the extension of sand dunes in the desert areas of Rajasthan and along the coastal tracts.

- Increasing substantially the forest/tree cover in the country through massive afforestation and social forestry programmes, especially on all denuded, degraded and unproductive lands.

- Meeting the requirements for fuelwood, fodder, minor forest produce and small timber of the rural and tribal populations.

- Increasing the productivity of forests to meet essential national needs.

- Encouraging efficient utilisation of forest produce and maximising substitution of wood.

- Creating a massive people's movement with the involvement of women, for achieving these objectives and to minimise pressure on existing forests.

THE PRESENT SCENARIO

Unsustainable use
Population pressure, overgrazing, forest fires, encroachment and diversion for other uses etc., have lead to unsustainable use of forest in the developing world rendering a substantial extent of the forests degraded. For instance, Bangladesh loses 3% of its forests every year! (Rasheed, 1995). Overgrazing has been one of the major factors for forest degradation in India. India's forests have a carrying capacity for grazing by 22 million livestock, but support ten times this number. Another cause of degradation is the sweeping of the forest floor for fuelwood and manure. Studies in Brazil and South Africa show that one ha of forests requires 7 tonnes of forest biomass to be recycled every year to maintain forest growth (Chaturvedi, 1997).

Deforestation & Degradation
Unabated deforestation is the single most important issue in tropical forests. It includes the clearing of forests for other land uses such as for subsistence agriculture, growing construction of reservoirs, encroachment, etc. Tropical forests are being lost almost at the rate of 16 million hectares every year. The serious outcomes of this are felt in the displacement of the tribals and indigenous people, loss of biodiversity, destruction of forest ecosystems, loss of habitat for wild life, loss of forest capital, accelerated soil erosion and permanent loss in agricultural productivity. Quite often these forests are destroyed for undertaking subsistence agriculture. But the tragedy is that these lands are incapable of serving as agricultural lands or pastures on sustainable basis. Hence such destroyed forests bring untold misery for the local people and fail to perform their normal ecological functions. The destruction of forest cover in western parts of Madhya Pradesh particularly Jhabua and Khargone has created unprecedented water scarcity in Malwa plateau once described as 'a land where one found water and bread at every step' (Buch, 1981).

In India the diversion of Forest Lands for non-forest uses has been considerably checked by the promulgation of the forest conservation act of 1988. The amount of Forest Land diverted per annum has come down from 150,000 ha to 16,000 ha (Balaji, 2001). Population pressure, shifting cultivation, illicit cutting of wood for timber and firewood, forest fires and over grazing are other causes of degradation and depletion of the forests.

Deforestation has been a serious problem in Bangladesh for the past four decades. The main causes are illegal logging, demand for fuel wood and farmland encroachment. Bangladesh loses 3.3% of its Forest Lands every year (Rasheed, 1995).
Reversing the process of degradation
When vegetation does not satisfy the three conditions, viz., (i) exerting influence on the local climate; (ii) maintaining the water regime; and (iii) providing shelter for the wildlife, besides producing wood, it should be placed in the category of degraded vegetation (Meher-Homiji1997). Within this broad definition will be included several distinct physiognomies ranging from scattered shrubs in a "wasteland" landscape to thickets and scrub-jungles on the one hand to shrub-savanna and tree-savanna on the other. Watershed development of the degraded forests with the participation of the local people has paid rich dividends in reversal of the process of degradation.

Participatory Approach - Indian Scenario
Participatory Forest Management envisages better conservation and utilization of degraded forests with the active participation of the local people. Participation, collaboration, building village level institutions, decentralized micro-planning, capacity building, empowerment of women and the downtrodden are addressed in this approach. Moreover minimizing over-dependence of the people on forests through alternate income generation activities and sustainable use of forests are part of the Joint Forest Management Programme implemented in India. India has only about 0.075 ha of forest per-capita. Even this extent of forest is getting degraded day by day. The Joint Forest Management strategy making villagers partners in forest management has helped in arresting degradation to some extent. The Joint Forest Management programme in India is over a decade old now. There are 44,886 Joint Forest Management committees spread over 27 states covering an extent of 11.62 million ha (Katwal and Singh, 2002).

The local communities are increasingly involved in natural resource management and in regeneration of degraded forests (Ajaykumar and Kaul, 1996). There have been many programmes implemented around the globe for collaborative management of forest resources, to achieve the twin goals of development and conservation, such as community forestry, Joint Forest Management, participatory natural resource management, environmental stewardship, co-management of protected areas and integrated conservation development projects.

In Tamil Nadu, the Interface Forestry Programme with people's participation was quite successful in reclothing the degraded forests with the support of local people. Forests in Ayyalur, Salem and Thiruvallur where the programme commenced initially have regenerated well. There is also a perceptible improvement in agriculture due to an improved water harvest. An economic analysis of participatory forest management through the interface forestry programme in Jalluthupatti, India showed positive NPV and BC ratio of 1.77, improvement in agriculture, water availability, literacy and employment (Balaji, 1997b). However, the success of the programme was not uniform in all watersheds. Formulation of site specific micro-plans, silvicultural measures to achieve higher productivity of economically important species, development of sustainable institutions, capacity building, buffer zone development, alternate income generation activities, decentralised participatory execution of work and transparency in operation are some of the important concerns that need further attention.

Strategies which centered on joint forest management, having a watershed/cluster approach with the aim of enhancing land productivity, have proved a powerful tool in combating desertification and improving the socio-economic conditions of the people of Rajasthan (Upadhaya and Kapoor, 1997). There are number of such case-studies in India such as the Arabari experiment in West Bengal and the Harda experience in Madhya Pradesh, where participatory forest management has improved forest conservation as well as the quality of life of the people.

ALTERNATIVE MODELS
Apart from Joint Forest Management involving the local people certain alternate models are discussed below:

Ecological Stewardship
The involvement of private sector and industries in afforestation of degraded forests and waste lands is being discussed in India. The ecological stewardship project in the USA and management of forests for multiple use by
Timber Companies of Sweden and User Group Forestry, Nepal are some of the alternative models. The Ecological Stewardship Project (ESP) of the USA encourages a public-private partnership to develop a common reference for ecosystem management. The principal objective of the ESP is to develop an information framework to help federal agencies implement ecosystem approaches to natural resource management on public lands. Nearly 400 researchers and natural resource managers from Government, industry, Universities and Non-Government Organisations (NGOs) are involved in 60 author teams that are documenting the current state of scientific knowledge and management experience related to ecosystem management (Sexton et al., 1997).

Close to Nature Forest Management in Sweden
Sweden with less than 1% of the world's closed forests accounts for 4% of world's paper production (Hagglund, 1996). Economic development has been accompanied by a steady increase of forest resources; Part of the reason for this success is that Swedish Forestry has evolved in an environment that is largely characterised by positive industrial, economic and social conditions; the Swedish strategy for the conservation of biodiversity is based on a combination of multiple use forestry and protection of areas. Alternative harvesting methods are applied mainly in areas with high economic value, where final felling should be avoided due to considerations for nature (National Board of Forestry, Sweden, 1996).

Integration of production and conservation in Australia
The integration of production and conservation objectives is taken care of in Australia. In East Gippsland, minimum levels of protection of 30% to 90% have been set for each of the 44 vegetation classes according to their rarity in the landscape. Buffers are left between logging coupes and rain forests. The highest level of protection is provided in sub-catchment areas and sensitive faunal species.

The forest resources of Nepal after continuously dwindling for the last four decades are showing signs of rejuvenation. A new type of forest management system called User Group Forestry, based on Nepal's indigenous system of assigning local people the full authority for managing the resources has been introduced; more than 3000 user groups are currently engaged in managing forests. (Karki, 1995).

SWOT Analysis of Emerging Scenario
The Forest Department, which used to perform in isolation is now subjected to a pluralistic environment with the involvement of local people, NGOs, environmentalists, universities, other departments and local bodies. There could be a number of perspectives about the role of the forest ecosystem and its management in the pluralistic environment. What is the role of technical managers when the conflicting interests of the community do not match the rate of growth of the forests? One perspective could be that the foresters as technical managers should give a range of possibilities within the limits of sustainability. A decision could be arrived at with the concurrence of the local people and in consonance with the principles of sustainability.

The pluralistic environment has strengths and weaknesses and provides opportunities as well as threats. The strength of the pluralistic setting is its wider perception of realities and its positive synergistic effect, which could offer a better level of forest conservation as well as better quality of life. With the application of technological innovation, India with the advantage of tropical climate could emerge as a net timber exporter by 2020 rather than being net importer at present. Increased production of timber and Forest Produce and their downstream processing could bring about accelerated employment and socio-economic development in rural areas. Its weakness emanates from the fact that it quite often tends to over emphasize socio-economic development at the cost of sustainability. The carrying capacity of the forests and sustainable yield could be predicted by the technological methods. But under a participatory approach where the interests of the people, non-governmental organizations and environmentalists could vary, is there any threat to the concept of sustainable yield? Are there any alternate management plans apart from those calculated traditionally by the foresters? Its strength lies in arriving at a new equation among different actors such as foresters, NGOs, loggers and the local inhabitants. Its weakness is that integration of conflicting objectives is quite often easier said than achieved.
KEY ISSUES AND CHALLENGES

Integrating production objective without sacrificing environmental concerns under social milieu demands from the foresters, high quality technical innovation, consensus building and a new set of negotiating skills. Forestry Research, Training and Extension are quite vital in this regard. The current trends and the future perspective are discussed in the form of two broad policy issues viz., production issues and conservation issues.

Production issues

Key issues to be considered under production are:

1) Use of frontier technology to achieve productivity enhancement,
2) Management of fire, pests and diseases,
3) Low impact harvesting.
4) Involvement of NGO’s and Private sector

Use of New Technology. Natural forests in most developing countries are of low productivity. The productivity of Indian Forests is generally low with 1.36 M³/ha compared to the world average of 2.1 M³/ha/year. Hence, there is a need to increase per hectare productivity of timber and non-timber forest products by improving the management and increasing the recovery of finished products. Frontier technologies such as information, space and biotechnology must be suitably blended with the ecological prudence and practices of local communities to achieve better forest management. Emerging technologies like tissue culture, biotechnology, etc., can play an important role in increasing production. Space technology and GIS will be useful in forest inventory. Information technology should be used for better forest protection and fire control.

Productivity Enhancement. A key point in a reforestation programme is to have superior genetic material. A tree improvement programme through mass selection, hybridization and genetic engineering is vital for enhancing production. Tropical and sub-tropical regions offer good opportunities for high quality, fast growing forestry plantations with competitive costs. In the productivity of clonally propagated Eucalyptus, production could be as high as 20 to 40 M³/ha/year compared to 4-5 M³ in traditionally raised plantations. Aracruz Florestal in Brazil achieved magnificent productivity improvement. Plantations of synthetic hybrids (Eucalyptus grandis into Eucalyptus urophylla) reach quite high increments (70 cu.m/ha/year) when the clone and soil interact well (Campinhos, 1996).

Agroforestry systems based on traditional knowledge systems with water management as an integral component would be more effective for rehabilitation of degraded community lands. Supplemental irrigation increases the survival percentage to 39% in Albizzia lebbeck (Maikhuri et al., 1997).

Bio-Fertilizers. Use of Eco-friendly bio-fertilizers, must be encouraged to augment the productivity of the plantations. Rhizobial strains such as ALM 16, AMFM 17, ANM 18, APM 19, LLC 20, SRC 21, SSM 22 AND VUC 24 have been isolated at Tamil Nadu Agricultural University from trees such as Acacia nilotica, A. leucophloe, Acacia planifrons, Acacia ferruginea, Albizia lebbeck, Hardwickia binata, Samanea saman, etc. Such tree specific bio-fertilizers can enhance growth of these trees when applied in the nursery. In Dharmapuri and Salem districts of Tamil Nadu, rhizobium-inoculated seedlings showed a 65.1 to 214.8% height increase and a 25 to 50% increase in plant girth in the first year (Rangarajan et al., 1985). Tamil Nadu Agricultural University of India, Glasgow University of the UK and Munich Technological University of Germany under a collaborative project funded by the European Economic Commission under the STD Project, identified promising strains of symbiotic Frankia sp. that could be profitably used in plantations of Casuarina equisetifolia grown along the coast for augmenting growth and yield. (Wheeler et al., 1994).

Fodder Development. Given India’s large and growing live stock population and the pressure it exerts on lands and forests, there is a need to limit the quantity of live stock through selective breeding while promoting pasture and
fodder management. The live stock population is expected to stabilize around 585 million by 2019. The Indian Grass Land and Fodder Research Institute, Jhansi has selected high yielding grasses and fodder trees in this regard. Fodder could also be augmented through agroforestry and Joint Forest Management.

**Management of Fire.** Forest fires, insects and diseases, to a limited extent bring about change and are integral to forest dynamics. However, in larger dimension, they can disrupt the flow of goods and services from forests by affecting tree growth and survival, water quality and yield, biodiversity, forage for domestic animals and recreation. Thus measures to protect forests from fires, insects and diseases must be an integral part of sustainable forest management. Fire destroys regeneration and seriously impairs biodiversity in the eastern and western ghats of India. Tropical deforestation and associated burning are occurring at a record rate of 15.4 million hectare/year (FAO, 1994). Fire management encompasses three activities viz., fire prevention, pre-suppression and suppression.

**Management of pests and diseases.** Intensively managed plantation forestry and agroforestry are subject to damage by pests and diseases. Defoliating teak, various bark beetles in coniferous forests cause substantial damage to the trees and reduce the yield. More research on use of biopesticides, biological control and pheromone mediated pest control in economic forest trees is warranted.

**Harvesting methods.** A low impact harvesting system has been recommended for sustainable management (Leslie, 1994). This includes the regulated harvest of very few trees per ha by selection, negligible damage to the residual stand and regeneration, retention and protection of shrubs, vines, palms, etc., that have commercial and handicrafts value as well as ecological or cultural significance. No heavy machinery for skidding is to be used. A set of criteria and indicators could be the basis for certifying timber coming from sustainably managed forests.

**Role of Private Sector and NGOs.** Involvement of the private sector and NGOs in forest development and agroforestry is necessary. The National Forest Policy of 1988 declared that forest based industries shall increasingly meet their requirements from private lands. An estimated 5% of net sown area i.e. up to 8 million ha can be used for growing tree crops. Despite the emphasis placed on agroforestry and strip plantations by the National Forest Policy of 1988 the linkage between forest, industries and farmers remains rather week. Another 3 million ha can be planted under strip plantations along road sides and canal banks. Lack of adequate accessible credit facilities, weak forestry extension and cumbersome timber transit rules has discouraged tree cultivation in dry lands. The private sector has not adequately responded to the development of forestry. Protection of forest based industries through supply of wood at subsidized prices had long made these industries less efficient on the one hand while causing revenue loss to the state on the other. Productivity had been the casualty in the process. Inadequate agroforestry models to suit different types of agro-climatic zones, non-availability of quality planting materials and poor transfer of technology are due to lack of adequate research and extension support. (Balaji 1997a) Strategies for promoting agroforestry should focus on removing local barriers to bringing about market reforms, fostering farmer-industry linkages and ensuring the overall profitability of agroforestry. Eucalyptus Cloves developed by I.T.C. Bhadrachalam Paper Boards Ltd., yields 20 to 40 M$^3$ of wood/ha/year. It can yield up to 150 tonnes of wood in 7-year rotation. The yields can be substantially higher under irrigated conditions. WIMCO, a forest based industry, supply superior clones of poplars in Punjab, Haryana and Uttarpradesh. The Institute of Forest Genetics and Tree Breeding (IFGTB), Coimbatore successfully implemented clonal propagation on a large scale with the Andhra Pradesh Forest Department, under a World Bank assisted forestry project. The National Chemical Laboratory, Pune and Forest College Research Institute of Tamil Nadu Agricultural University, Coimbatore successfully tested tissue culture plantlets of teak, neem and eucalyptus with some success. Though all these research achievements are appreciable, they are inadequate considering the enormity of the problem of low productivity.

Besides augmenting the supply base, another important aspect in achieving sustainable use of timber is demand side management. It includes all measures that increase the efficiency of timber use and development of alternatives and substitutes. Financial assistance in the form of soft loans or tax incentives could be provided to the industries to promote efficient technologies.
Conservation issues

India is one of the twelve mega-biodiversity areas of the world. It has 45000 species of plants of which 18% are endemic. Exceptional diversity exists in the case of ferns with 900 species and orchids with 1082 species. India is also home to 77000 faunal species (Kothari 1994; Balaji and Rai 1998). The National Forest Policy of 1988 emphasized the conservation of natural forests for environmental stability. The Convention of biological diversity, in 1992 enhanced interest in biodiversity conservation. A number of sample plots were laid for observing population dynamics of flora and fauna in selected locations in India as early as 1920.

Threats. According to the Red List of threatened plants, 19 species are extinct and 1236 species are threatened. Besides these, 152 species are endangered, 102 are vulnerable, 251 are rare and 690 are of indeterminate status. India ranks among the top 5 countries with regard to the number of endangered mammals and birds. The most recent estimates indicate that 86 species of mammals, 70 species of birds, 3 species of amphibians and 25 species of reptiles are endangered along with 23 species of invertebrates (IUCN 2000).

Conservation Initiatives: Clear understanding of ecological processes and conservation of the habitat is required for biodiversity conservation. Currently the country has 87 National Parks, covering 4.06 million ha and 485 sanctuaries covering 11.54 million ha together accounting for 4.75% of the country’s geographic area (FSI 2000). Despite several threats, project tiger has been a success story in conservation of the Bengal tigers. The population of tigers, which was 1800 in 1970, had increased to 4000 by 1990. Community conservation is well known in several pockets of India. When Pelicans arrive at Kokkare Bellur village in Mandya district of Karnataka, the villagers consider them a good omen and the harbinger of a bountiful monsoon. For the Bishnois of Rajasthan, conservation of Khejdi trees and black buck is enshrined in their religion. The lion-tailed macaque, or LTM, represents one of the unique and highly endangered primate species endemic to the Western Ghats, inhabiting dense evergreen or semi-evergreen forests at elevations mostly between 800 and 1300 metres in the States of Tamil Nadu, Karnataka and Kerala (Kumar 1987). Fragmentation of habitats due to developmental projects such as hydro-electric projects has lead to the deleterious effects of inbreeding and high infant mortality. In biodiversity conservation, population surveys and assessments for creating database are essential. Adequate data on species diversity, populations, location, extent of habitat and major threats to different species need to be documented. Given our extensive diversity ecological surveys and taxonomic investigations need to be intensified, especially for plants and insects. The global biodiversity information facility has brought about CDs of internet-based databases containing information about the world's living organisms from bacteria to plants and animals. The information management required to improve the collection analysis and communication of forestry information may be undertaken by the Botanical Survey of India and Zoological Survey of India.

Bio-diversity enhancement due to Participatory Management. Biodiversity conservation by communities should be suitably recognized. Joint forest management of degraded reserve forests with people’s participation can help in biodiversity enhancement. The impact of the programme on bio diversity status was studied after 10 years, between 1997-2000. The results indicated significant improvement of flora, as well as their bio indicators, microorganisms, birds and butterflies. Application of bio diversity indices such as the Shannon-Wiener Index, Simpson’s Index and the Important Value Index brought into focus the superior floristic richness of the watershed treated under IFP. Valuable Santalum album, Chloroxylon swietenia, Albizia amara and Ixora pavetta were the dominant species. There was perceptible improvement in the available soil organic matter, organic carbon and macro nutrients concurrent to the improvement in soil nutrients. The population of microorganism also increased in JFM areas. Butterflies were found to be a good indicator of the species richness of the forests while birds that of species abundance. The crown cover has almost doubled within ten years. The growing stock has increased from 1.60m$^3$ ha$^{-1}$ in control to a modest 30.06m$^3$ ha$^{-1}$ in Ayyalur. The programme has not only enriched the floristic diversity but also the overall biodiversity status of the treated area in terms of birds, butterflies and microorganisms. The enhanced biodiversity status of the area has considerably contributed to the improvement in economic status, employment level and quality of life of the people. Forest restoration in this way, could engineer socio-economic development. Mainstreaming biodiversity
consideration in JFM will help to strengthen both the livelihood and ecological security of the vast areas adjoining forests in India and other developing countries (Balaji 2002).

**Non Timber Forest Produce.** Tropical forest resources will be depleted if their entire range of values is not fully recognized and integrated into decision making by individuals as well as Governments (WCMC 1992). Over 120 chemicals extracted from 90 species of plants are used throughout the world (WCMC, 1992). Non Timber Forest Produce (NTFP) such as forest fruits, oil seeds, leaves and resins can play a useful role in providing annual benefits to the local people on a sustainable basis. Though there are nearly 3000 NTFP species are found in India, only 126 species are commercially exploited at present.

**Equity in Bio-prospecting.** Bio-prospecting of *Trichopus zeylanicus* (called Jeevani) by Kani Tribals and the Tropical Botanic Garden and Research Institute of Kerala is a unique example of recognizing and rewarding local technical knowledge. Kani tribals traditionally eat fruit of this plant for energetic working. The Arya Vaidya Pharmacy, Coimbatore has obtained the license to manufacture Jeevani as a drug for a period of 7 years. The tribals would receive 50% of the license fee of one million rupees as well as 50% of the royalty obtained by TBBGR from the sales of the drug.

**RESEARCH AND TRAINING**

**Present Scenario**

Forestry research and training are two functions, which central government forestry institutions carry out in nearly all countries of Asia and the Pacific. Early forestry education institutes in the region were established in Dehra Dun, India, Los Baños in the Philippines and Rangoon in Burma during the colonial era. After the Second World War forestry skills were established in other countries such as Indonesia, Thailand, Malaysia, Nepal, Sri Lanka and Papua New Guinea. State of the art facilities for instruction and research have been established throughout the region. The FRI, Dehra Dun, trains personnel from Asia and Africa, in tropical forest management, agroforestry and social forestry. But, selected institutes in three industrialized countries and those in Malaysia, Indonesia, the People's Republic of China and India have adequate skill and reputation. For example, successful development of technologies for utilization of rubber wood and medium density fiberboard from oil palm fruit bunches by the Forest Research Institute of Malaysia (FRIM) is noteworthy.

According to the National Forest Policy of 1988, with the increasing recognition of the importance of forests for environmental health, energy and employment, emphasis must be laid on scientific forestry research, necessitating adequate strengthening of the research base as well as new priorities for action.

Some of the broad priority areas of research identified include:

- Increasing the productivity of wood and other forest produce
- Re-vegetation of barren/marginal/waste/mined lands and watershed areas.
- Effective conservation and management of existing natural forest ecosystems.
- Research related to social forestry for rural/tribal development.
- Development of substitutes to replace wood and wood products.
- Research related to wildlife and management of national parks and sanctuaries

But for both research and training, there is considerable evidence that manpower and financial support are inadequate.
The Indian Council of Forestry Research and Education, Dehradun is the apex forestry research organization in the country. Its objectives include:

- To undertake, aid, promote and coordinate forestry education and research and its application.
- To develop and maintain a National Library and information centre for forestry and allied sciences.
- To act as a clearing-house for research and general information relating to forests and wildlife.
- To develop a forestry extension programme and propagate the same through mass media, audio visual aids and extensive machinery.
- To provide consultancy services in forestry research, education, training and allied science
- To do other things considered necessary to attain these objectives.

The Council has eight research institutes and three advanced centres located in different parts of the country. There are:

1) Forest Research Institute, Dehradun
2) Institute of Forest Genetics and Tree Breeding, Coimbatore
3) Institute of Wood Science and Technology, Bangalore
4) Tropical Forest Research Institute, Jabalpur
5) Institute of Rain and Moist deciduous forests Research, Jorhat
6) Tropical Forest Research Institute, Jodhpur
7) Himalayan Forest Research Institute, Shimla
8) Institute of Forest Productivity, Ranchi

The three advanced centres are:
1) Centre for Forestry Research and HRD at Chhindwara
2) Centre for Social Forestry and Eco-rehabilitation at Allahabad
3) Centre for Forestry Research, Hyderabad

The Institute of Wood Science, Bangalore and the Indian Plywood Industries Research and Training Institute take care of forest utilization research. Corrugated bamboo board has been developed by the IPIRI, Bangalore. Under the World Bank assisted FREEP project most of the state universities and state forestry research wings were provided Rs.100 million for undertaking 158 specific applied research projects. Under the Forestry Research Extension strategy, seventeen technologies have been prioritized by ICFRE out of 33 based on the clients’ demand for extension. Under this programme, apart from culling 910 ha of seed production areas, 156 ha of clonal seed orchards, 340 ha of seedling seed orchards and 52 ha of vegetative multiplication centres were established.

The Wildlife Institute of India, Dehradun offers specialized research in Wildlife Management. The thrust areas in wildlife research include ecological, biological, socio-economic and managerial aspects of wildlife conservation. The Forest Survey of India uses remote sensing technology along with conventional methods for monitoring forest resources.

In India fourteen agricultural universities are offering Bachelors’ Degrees in forestry; six universities provide facilities for Post Graduation; Tamil Nadu Agricultural University, Coimbatore and the University of Horticulture and forestry at Solan provide facilities for Doctoral programme.

Forestry Research in Tamil Nadu dates back to 1918 when a state silvi culturalist was appointed for the erstwhile Madras Presidency. The concerted efforts of Tamil Nadu Forest Department resulted in a 60% increase in productivity in Eucalyptus in TAFCORN plantations in Pudukkottai, Karaikudi, Salem and Marakkanam. Seed Orchards have been established for several species including Teak, Eucalyptus and Casuarina. Post harvest technology
using preservatives and seasoning is given due importance. Secondary timber like *Acacia suma, chloroxylon switien*a is used for developing quality timber after seasoning and ammonic fumigation. (TNFD 2002)

India has the opportunity to provide specialized training and for institutions to develop complementary programmes and curricula. Fields with growth potential include sustainable forest management, assessment and utilization of biological diversity, greening of waste lands, non-wood forest product technologies, processing of non-forest fibres and research on secondary timber and medicinal plants. There is a need for better networking of the state forest institutes with the universities, ICFRE institutes and ICAR institutes for sharing information and avoiding duplication.

The relevance of forestry education and research and the effectiveness of their delivery to users are frequently called into question. Critics point to the fact that industries rarely help to fund research. There appears to be considerable opportunity for making forestry research more client driven as in Malaysia, Australia and New Zealand. There is also a lack of boldness in the forestry sector research community compared to agriculture. In a country that paved the way for the green revolution in rice production, there is no apparent comparable product through any forestry research.

Several forestry networking efforts have been initiated in Asia and the Pacific in which India is also a member. Some of these networks are the Forestry Research Support Programme for Asia and Pacific (FORSPA) based in Bangkok, Asia and Pacific Assessment on Forestry Research Institutes (APAFRI), the Forest Tree Improvement Programme based in the Philippines, TEAKNET based in Yangon, Myanmar, the Asia-Pacific Agroforestry Network (APAN), the Regional Wood Energy Development Programme for Asia and Pacific (RWDEP). The International Network for Bamboo And Rattan (INBAR) in China facilitates exchange of information and research findings on bamboo.

Around the world privatisation and deregulation of economies are the orders of the day. But the private sector is not generally interested in producing socially oriented, non-revenue generating goods and services, which quite often dominate forestry. Hence the private sector could lead in the production of marketable forest products while the state concentrates on more socially and environmentally oriented outputs. There are a number of symbiotic opportunities where Government and the private sector can work together. Such an innovative collaboration on sustainable forest management is exemplified by Sabah, Malaysia. The State Government of Sabah in September 1997 established 27 forest management units each over an extent of 100,000 ha given on lease to private companies with a secured tenure of 100 years. FMUs are generally logged over areas or those under logging. Forest management plans must be prepared and approved by the Forest Department. In the process, the private sector is not only involved in logging but also sustainable resource management. Small forest owners can form cooperatives or associations for mutual support for promoting their interests. In the case of the Republic of Korea such an association forms the third pillar in forestry development alongside Government and commercial firms. In India, tree growers’ cooperative societies have been established in Maharashtra and Karnataka. Their success, though not as good as milk co-operatives, is yet worth better attention to ensure a fair return to the tree farmers.

Involvement of NGOs is slowly increasing in forestry and environmental activities in recent times. There are 200 NGOs in Tamil Nadu involved in tree planting, environmental education, awareness and amelioration.

**Future perspective**

The major challenges will be:

(a) To arrest deforestation, with a burgeoning population and to reclothe forest areas with suitable indigenous fast growing species

(b) Ability to promote better consensus, cooperation and sustainability in Joint Forest Management in conservation areas.

(c) Extensive Biodiversity monitoring
(d) Selective bio-prospecting to benefit the rural poor
(e) Increased involvement of private sector and NGOs in production forestry.
(f) Technological leapfrogging to achieve "brown revolution" in forestry.
(g) Increasing investment in forestry to at least 1% of the National GDP through enhanced financial allocation at central, state and local level.
(h) To establish new or improved mechanisms for dealing with emerging areas of forestry activity such as urban forestry and ecotourism.
(i) To enhance international cooperation: Key opportunities for developing countries like India include, emerging trade conditions and agreements e.g. investments from carbon offsets and the clean development mechanism under the Kyoto Protocol. These mechanisms provide avenues for securing international funding investment and new technology.
(j) To exploit opportunities that exist for participating in research and training networks at national, regional and international level.

CONCLUSION

India, endowed with a congenial tropical climate and accomplished manpower could emerge as a major player in the forestry sector of Asia and the Pacific, with the adoption of technological innovations and active participation of the stakeholders viz. people, Government, NGO's and the private sector. According to one estimate, the forest cover of India is expected to rise to 92 million ha by 2047 from the present level of 71 million ha. Consumption of fuel wood will decline to 78 million M³ (TERI 2001). Timber production is expected to go up to 15 million M³ from the present level of 26 million M³ (TERI, 2001). Biodiversity conservation on the one hand and bio productivity enhancement on the other alone can sustain the ecosystem services of forests to the mankind. Better delivery of technologies from lab to land with focus on silviculture, utilisation and selective biodiversity prospecting of non-timber forest products could usher in a much needed brown revolution in forestry. The commitment of the Government and the private sector towards this goal could make India a major green power in the region and bring about ecological security and socio economic prosperity.

REFERENCES


Kothari Ashish, Neema pathak, Anuradha and Bansuri yarreja 1999 Communities and conservation - Natural resources management in south and central Asia, Sage Publishers- New Delhi.

Kumar. 1987. The ecology and population dynamics of the Lion- tailed macaque in south India. doctoral thesis Cambridge University.


Leslie, A.J 1996. Sustainable management of tropical moist forests for wood In Readings on sustainable forest management IBH Dehradun. P 17-32


Rasheed, K.B.S. 1995. Participatory Forestry – As a strategy for reforestation in Bangladesh, Geojournal, 37(1) 39-44.


