INDIA: BRINGING A THIRD OF THE LAND UNDER FOREST COVER

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1. General Information

India is a land of unparalleled diversity, diverse in physical features, in climatic conditions, in its flora and fauna, and diverse in the people that inhabit this vast land. It is a land of many races, cultures, faiths, ethnicity, languages and traditions. The topography ranges from the highest of mountain peaks in the north to sea coasts in the south, from the driest deserts in the west to the wettest rainforests in east and from near equatorial tree line in the deep south to the cold deserts high in the Himalayas.

1.1 Physiography

The country's geographical area of 328 million ha forms about 2.4% of the world's total area. It has a land frontier of 15,200 km and coastal length of 6,100 km. The main land extends from 8^o to 37^o N latitude and from 68^o to 97^o E longitude, measuring 3,214 km between extreme latitudes and 2,963 km between extreme longitudes. India's mainland comprises four broad geographical areas: the Northern Mountains comprising the great Himalayas, the vast Indo-Gangetic plains, the southern Deccan peninsula bounded by the Western and the Eastern Ghats, and the coastal plains and islands.

The Northern Mountains the comprising Himalayas embrace three almost parallel ranges interspersed with large plateaus and valleys and extend in the north of the country over a distance of about 2,000 km. The physical dominance of the Himalayas is evident from the large number of world's highest mountain peaks. The basin of three distinct river systems - the Indus, the Ganga and the Brahmaputra - forms the Great Plains, also known as the Indo-Gangetic plain. The Plains extend from Rajasthan in the West to Brahmaputra valley in the East. These plains comprise one of the world's greatest stretches of flat and deep alluvium and are one of the most densely populated areas of the world (more than 456 persons per km^2). The Deccan Peninsula covers the whole of South India. The Indo-Gangetic plains and the peninsular plateau are separated by mountain and hill ranges known as the Aravali, Vindhya, Satpura, Ajanta and Maikala ranges. The peninsula is flanked on either side by the Eastern Ghats and the Western Ghats. The western coastal plains lie between the Western Ghats and the Arabian Sea in the west, whereas the eastern coastal plains face the Bay of Bengal in the east. This is also a region with very high-density population (more than 349 persons per km^2).

Table 1: *Physio-geographic Zones of India*

Physio-geographic Zone	Area (km^2)	% Area
Northern Himalayas	322,158	10.50
Great Plains	730,955	22.20
Deccan Plateau	1525,279	49.76
Coastal Plains and Islands	486,635	15.38

(Source: MoEF, 2001)

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Soil: India has a wide range of soils, each type being specific to the locality. Alluvial soils cover about 78 million ha (about 24%) of the total land and occur in the great Indo-Gangetic Plains. These soils are excellent for the production of wheat, rice, other cereals, pulses, oil seeds, potato and sugarcane. The black cotton soils cover about 51.8 mha and are also good for cultivation of cotton, cereals, pulses, oil seeds, citrus fruits and vegetables. In addition, red soils cover about 51.8 million ha and are suitable for rice, ragi (millet), tobacco and vegetable cultivation. Laterite and lateritic soils occur over 12.6 million ha and desert soils in 37 million ha. These soils are not suitable for agriculture.

River Systems: The country is divided into 20 river basins comprising 12 major river basins, each having a catchment area exceeding 20,000 km^2, and eight composite river basins (Sharma and Paul, 1999). In addition, other water resources include reservoirs, tanks, ponds and lakes, which cover about 7 million ha of the surface area of the country. India has 14 major river systems that may be classified as: Himalayan rivers, peninsular rivers, coastal rivers and, rivers of inland drainage basin. Because of uneven precipitation, the availability of renewable freshwater varies enormously in different river basins. The Himalayan rivers are generally snow-fed and perennial. The peninsular rivers are rain-fed and, therefore, fluctuate sharply in volume. The coastal rivers are short in length with limited catchment areas. The rivers and tributaries of the peninsular and coastal rivers are intermittent and non-perennial in nature. The streams of the inland drainage basins of western Rajasthan are few and with little water holding capacity.

Climate: India is mainly a tropical country but due to great altitudinal variations, almost all climatic conditions from the driest to the rainiest, and very hot to very cold, exist. The climate of India may be broadly described as tropical-monsoon over most parts and montane temperate in the Himalayas. The monthly spread of four seasons can be categorized as: winter (December-February), summer (March-June), southwest monsoon season (June-September), and post monsoon season (October-November). The maximum temperature of the year occurs in May or early June and starts decreasing rapidly from October and reaches the minimum of the year in December or January.

India has a highly seasonal rainfall pattern, with 50% of precipitation falling in just 15 days. India receives annually about 4,000 km^3 of water through precipitation. About 80% of the country's annual rainfall is mainly in the form of southwest monsoon from June to September, followed by northwest monsoon from November to December. It varies from as low as 100 mm in western Rajasthan to as high as 9000 mm in Meghalaya in northeast India. Monsoon rainfall is usually torrential in intensity. This high intensity run-off results in intense soil erosion (Sharma and Paul, 1999).

1.2 Demographics

India has a human population of 1.03 billion comprising 193 million households living in about 600,000 villages and more than 5,000 towns (GoI, 2001). The decennial growth rate (1991-2001) of population is estimated to be 21.97%. Urbanization is significant and increasing rapidly, with 28.7% of the population living in urban areas. The average density of population has increased from 267 in 1991 to 325 per km^2 in 2001. The age composition of the population is given in Table 2.

Table 2: ***Proportion of Population by Broad Age-groups***

Age group (years)	Persons	Male	Female
0-14	35.3	35.6	35.1
15-34	33.8	33.7	33.9
35-59	23.1	23.3	22.9
60+	7.4	7.1	7.8
Age not stated	0.3	0.3	0.2

(Source: GoI, 2001)

Although it is difficult to accurately predict population growth rates for the next 20 years, the population is expected to be about 1.33 billion by 2020, despite continuous efforts to reduce fertility rates (Gupta, 2002). India is in the process of a demographic transition from high fertility, high mortality and unstable population to low fertility, low mortality and stable population. Falling mortality rates have been accompanied by a steady decline in birth rates, but this decline has not been as steep as the fall in death rate. Even after reaching the replacement fertility rates, the population will continue to grow because of large numbers of young person entering the reproductive age group.

The largest growth of population will be in the 15-64 year age group, which is estimated to expand from 604 million in 2000 to 883 million in 2020. This rise will accentuate the need of increasing employment opportunities. The elderly population is also expected to rise sharply from 45 to 76 million and their share in the total population would rise from 4.5 to 5.7 per cent. As a consequence of these changes in population, the age-dependency ratio (ratio of non-working age population to working age population) is expected to fall from 67% in 2000 to 46% in 2020 (Bhatt, 2001).

1.3 Economic Situation

India is presently the second fastest growing economy in the world and fourth largest economy in the world in terms of purchasing power parity (World Bank, 2008). The Indian economy has experienced dynamic economic growth with the gross domestic product (GDP) growing by 9.4% in fiscal year (FY) 2005-06, 9.6% in FY 2006-07 and 9% in FY 2007-08 (ES, 2008). Agriculture contributes 16.6% per cent to GDP, compared to 28.4% by the industry and 55% by the service sector (ES, 2008). The major part of agriculture land in the country is rain-fed, extending to over 87 million ha and constituting nearly 61% of the net cultivated area. The wide variation in rainfall and potential evapo-transpiration decides the actual land-use and vegetation cover. Presently a large percentage of area under cultivation of coarse cereals (90%), pulses (81%), oil seeds (76%), cotton (65%) and rice (50%) is rain-fed (NAPCD, 2001). Agriculture supports the livelihood of 67% of the population (HDR, 2007). Even though the contribution of agriculture to the national economy has been rapidly shrinking over the years (MoA, 1996), the displacement of agriculture, animal husbandry, forestry and fishing as the main source of employment has been relatively slow. The work force in these occupations was 71.8% in 1961, declining to just 67% in 2005. The service sector accounts for 20% and the industrial sector accounts for livelihood of 13% of the population. The productivity of agriculture and allied activities needs to increase rapidly to improve the living conditions of the majority of the people.

India had a Human Development Index (HDI) value of 0.619 in 2005, and was ranked 128th worldwide in terms of HDI (UNDP, 2008). In the year 2005 the GDP per capita was US$ 3,452 (PPP) and its Human Poverty Index was 31.3%. As many as 28.6% of the population lives below the national poverty line (UNDP, 2008), a Gini index of 36.8 indicates that income distribution is somewhat uneven. Almost half of the children of age less than 5 years are under-nourished or under-weight and 22% (89 million) of the total labor force suffers from chronic unemployment and underemployment (GoI, 2001). Per capita electricity consumption is one-sixth of the world's average and one-twentieth of that in high-income countries (World Bank, 2000).

1.4 Environmental Status

The economic surge provided by 9% growth in GDP has led to increasing demand for services and natural resources. This rapid economic growth and the social and infrastructural development required to achieve the United Nations (UN) Millennium Development Goals suggests that the natural resources, particularly land and water, shall be under heavy pressure in the coming decades. A World Bank study (Brandon and Honmann, 1997) estimated that the major environmental costs for India measured 4.5% of GDP. Water pollution, soil degradation and urban air pollution have the highest share, followed by rangeland degradation, deforestation and tourism. This study, however, does not account for the loss of biodiversity, the loss of soil productivity, and health costs arising out of pollution caused by industrial wastes and use of pesticides.

A little less than half (about 173 million ha) of the country's geographical area is degraded thus affecting the productive resource base of the economy. The major causes of land degradation are deforestation, unsustainable agricultural and water management practices, land use changes for development, and industrialisation. The major process of land degradation is soil erosion (water and wind erosion), contributing to over 71% of the land degradation in the country. Of this soil erosion from water alone contributes to about 61.7%. The land degradation, in turn, results in loss of agricultural productivity; loss of natural resources of flora and fauna, problems of sustenance, and overall decline in the quality of life. Table 3 lists the status of key natural resources and reasons for their qualitative decline.

Table 3: ***Key Natural Resources, Status and Causes***

Key Resource	Status	Causes
Loss of critical habitats/ biodiversity	• 23 species extinct • over 1500 plant species, 79 mammals, 44 birds, 15 reptiles, 3 amphibians and several insects listed as endangered • Conversion of tropical wet evergreen and semi-evergreen forests to littoral and swamp, tropical thorn and tropical dry deciduous forest types.	• Overexploitation of biological resources • Land use changes and developmental activities – roads and mining
Groundwater resources	• Groundwater pockets in industrialized zones contaminated with heavy metals, fluorides, phenols and coliform bacteria	• Excessive extraction of groundwater without commensurate recharge • Leaching of pollutants to the aquifers
Surface water	• 90% of the surface water contaminated • High Biological Oxygen Demand values in rivers and lakes of national importance • Half of the rural households and nearly 20% of the urban households do not yet have access to safe drinking water.	• City sewage and industrial waste discharge into river • Grossly inadequate waste water treatment facility • Lack of national bench marks for consumption of water.
Air	• Annual average concentration of Suspended Particulate Matter (SPM) exceeds the maximum permissible levels in 14 cities. • Delhi listed as the fourth most polluted mega city in the world • Six of the largest cities in the country have annual average concentration of SPM more than three times the average WHO standards. • In 20 cities, the Air Quality Index falls in 'dangerous' category	• Rapid economic development and industrialization • Lack of an efficient and effective public transport system. • Poor urban/land use planning leading to concentration of industries in urban areas
Solid waste	• Increasing generation of solid waste • Increasing generation of toxic and hazardous waste • Only 2-3% of annual fly-ash generated utilized	• Rapid urbanization • Lack of an integrated solid waste management system • Absence of toxic and hazardous waste disposal facilities

(Source: TERI, 1998; JICA, 2002)

1.5 Agricultural Situation

India supports 18% of the world's population and 15% of its livestock on merely 2.2% of the world's geographical area. Of the reported area of 306.05 million ha, nearly 46% area is being utilized for agricultural purposes; 23% is under forests; 8% under buildings, roads and surface water; 6% is barren and uncultivable land covered by snow and desert areas; and 17% under other uncultivated land including fallows. About 60% of the net sown area of 142 million ha is rain-fed. There has been an increase in the gross cultivated area, from 132 million ha to 190 million ha (Table 4) in the past 50 years because of the increase in cropping intensity from 111% to 135%.

Table 4: ***Land Use Date for 1950/51 and 1999/2000***

Category (area in m ha)	**Years**	
	1950/51	**1999/2000**
Geographical area	328.73	328.73
Reporting area	284.32	306.05
Forests	40.48	69.02
Not available for cultivation	44.35	47.52
Area under non-agricultural uses	9.36	22.97
Other uncultivated land excluding fallow land	49.45	28.49
Net cultivated area	118.75	141.23
Gross cultivated area	131.89	189.74
Net irrigated area	20.85	57.24
Gross irrigated area	22.56	76.34

(Source: Directorate of Economics and Statistics, 2003)

Agricultural growth is essential for overall growth of the Indian economy. This growth rate is essential for improving the living standard of agricultural dependent people. The historical growth rate in Indian agriculture post 1950s has been 2.55% per annum. It is estimated that the requirement of food stock to feed India's projected population of 1.4 billion in 2030 will be 114 million tonnes of rice, 83 million tonnes of wheat, 13 million tonnes of maize, 106 million tonnes of fruits, and 193 million tonnes of vegetables (TERI, 2005).

Considering various factors such as population growth rate, diminishing per capita of land and water resources, and increasing land degradation problems, an annual increase of 5-6 million tonnes in the output of food grains will be required (NAPCD, 2001). This is expected to result in tremendous pressure on soil resources considering competitive demand for land for meeting the requirements of industrialisation and urbanisation (MoA, 2000), and raising lucrative cash crops. The National Agricultural Policy aims to achieve more than 4% growth rate. This is a formidable task particularly in context of the historical low rate of growth in Indian agriculture. This growth rate can be achieved through biotechnological breakthroughs, expanding area under irrigation and increasing area under cultivation. Out of these three options, the scope for increasing physical area under cultivation is limited.

Net cultivated area has stagnated at 142 million ha (Table 3). The potential area now available for extension of agriculture comprises marginal and sub-marginal lands and, therefore, further extension of agriculture will be costly, as it would require extensive soil and water conservation works, irrigation, and reclamation (Gundimeda et al., 2005). The physical area under crops is unlikely to increase in future (Persaud and Rosen, 2003; Ravindranath et al., 1995). Intensification of agricultural production and growth in crop yields will play a major role in increasing India's food production in future (Persaud and Rosen, 2003). In India, there is a large scope to increase the crop yield. The productivity of rice in India in 1996 was 2.8 t/ha as against 6.1 t/ha in China and 8.5 t/ha in Australia. Yield gap studies reveal that even in agriculturally advanced states like Punjab, actual yield of paddy can be raised by

87% using existing improved technology. In case of most of the crops, improved technologies are already available to substantially increase the actual yield (Joshi, 1996).

1.6 Livestock Situation

The bovine population has increased substantially by 42% during the last five decades (1951-2003). The sheep population has increased from 39 million in 1951 to 61.5 million in 2003. In the same period, the goat population has increased by 164% from 47 million to 124 million (NDDB, 2003). Across all species, livestock population in India is high but of low productivity. However, livestock rearing is a major instrument for improving rural employment, particularly rural self-employment as it contributes 5-6% to the nation's GDP. In 1991, 65% of the total Indian workforce was dependent on agriculture; 80% of which were involved in livestock production, either as producers or as workers. Women contribute 60% of the livestock rearing and management in rural households (NAPCD, 2001).

2. Forest Information

2.1 Forest Area

Forest Survey of India (FSI) defines 'forest' as 'all lands, more than one hectare in area, with a tree canopy density of more than 10 per cent' for the purpose of mapping forest cover. Using these criteria the forest cover of the country is 67.71 million ha or 20.60% of India's total geographical area (FSI, 2008). The distribution of area under very dense, moderately dense and open forest is given in Table 5. Moderately dense forests cover almost half (10.12%) of the total forests and open forests slightly less at 8.82% of the total land area. Very dense forests cover just about 1.66% of the land surface.

Table 5: ***Forest Cover in India***

Tree Canopy Cover (%)	Area (mha)	% of Geographical Area
Very dense forest (> 70)	5.46	1.66
Medium dense forest (40-70)	33.26	10.12
Open forest (10-40)	28.99	8.82
Total forest cover	67.71	20.60

(Source: SFR, 2005)

In India, information[21] in respect of forest area is also available in terms of 'recorded forest area' which refers to area recorded as forests in government records and reported by the State Forest Departments (SFDs). The recorded forest area in the country are 76.96 million ha and includes 41.90 million ha of Reserve Forests (RF), 21.66 million ha of Protected Forests (PF) and 13.44 million ha of Unclassed Forests (UF) (FSI, 2008). The difference of 9.25 million ha between the recorded and actual forest cover is partly due to the fact that a good part of the recorded forest areas are under permanent snow cover or are deserts without tree growth and partly because some of these recorded forests have been cleared of the tree vegetation by anthropogenic interference.

[21] In this paper, the 'recorded forest area' and 'forest cover ' are reported as indicated in this paragraph

2.2 Forest Distribution

Forests are not distributed evenly in India, but are concentrated in Northeast, the Himalayas and Shiwalik Ranges, the Central highlands, Andaman and Nicobar Islands, strips along Western Ghats, Eastern Ghats and other hilly areas, and in coastal mangroves patches. Madhya Pradesh has the largest land of 7.6 million ha under forest cover constituting 11.22% of the India's forest cover followed by Arunachal Pradesh (10.01%), Chhattisgarh (8.25%), Orissa (7.15%) and Maharashtra (7.10%). The seven states namely Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura in India's northeast together account for one-fourth of the forests and are considered one of the 18 biodiversity hot spots of the world. The total forest cover in the region is 170, 054 km^2, which is 67% of the geographical area of the region, of which 10.32% is very dense; 46.14% moderately dense forests; and 43.42% open forests (FSI, 2008).

The forest cover in the hilly region of the country spread over 124 districts across the country is 38.85% with 55 of these districts having more than two third of the area under forests. Another repository of large extent of forests is the 188 tribal districts that contain 60.11% of the total forest cover of the country. The percentage of average forest cover in these tribal districts is 36.81% (FSI, 2008).

2.3 Forest Tenure

Forests constituted into RFs (41.90 million ha) and PFs (21.66 million ha) are located outside the village boundary with the State governments, represented usually by the state forest department, holding ownership title. RFs and PFs forests are constituted under the Indian Forest Act or under forest laws of the States that prohibit their use by the local population unless specifically authorized. However, the *de-facto* position is different and firewood collection and grazing is common across most of the RF areas. In PFs all activities are permitted unless prohibited. Activities usually not prohibited under PFs include grazing of cattle, and collection of leaves, firewood, fodder and other non-timber forest produce.

However, post-1990 RFs and PFs are increasingly being managed under Joint Forest Management (JFM). The Joint Forest Management (JFM) notification of June 1990, issued by the Government of India pursuant to the National Forest Policy of 1988, emphasises participation of communities living close to forests in the management and development of forests. The JFM guidelines provide a framework for decentralization and devolution of rights and duties to the local forest dependent communities. The JFM committees are entitled to prepare micro-plans for management of the forests, sustainably harvest grass, lop and tops of branches and other NTFPs, and receive a share in income from the sale of timber and other commercially traded NTFPs. About 28% (21.44 million ha) of the total recorded forest area is under the management of 99,868 JFM committees. There is a clear trend towards devolving on the local communities to manage, to sustainably use and the right to earn income from the forest resources falling within the JFM areas (FSI, 2008).

Besides RFs and PFs, there is another category of land notified as 'village forest' within the village boundary which may belong to the forest department, or any other government department but is formally under the management of *village panchayat* (a community of the village). *Van panchayat* forests in Uttaranchal, and *Gramya Jungle* in Orissa, which are formally managed by village communities, are a part of this category. The villagers enjoy rights over timber, fuel wood, fodder and NTFPs in village forests and woodlots subject to the supervision of the *village panchayat*. NSSO (1999) estimates the extent of village forests and woodlots to be 7.9 million ha. Village forests and woodlots form a significant proportion of common property land falling within village boundary in Eastern Himalayas and Bramhaputra Valley, Western Himalayas, and Eastern Plateau and Hills.

In northeast India, indigenous institutions play an important role in forest management. About 9.8 million ha of forestland is under community control in the seven north-eastern states. In states like Nagaland and Meghalaya, over 90% of the forests, categorised as unclassed forests, are under the direct control of traditional village institutions, village communities, tribal clans and private individuals

(Proffenberger, 2006; GoI, 1999). A unique system of governance has evolved in the north-eastern tribal states, where district or regional councils have been given powers to legislate on issues such as forest management, shifting cultivation, and allotment, occupation and use of land with the intention of ensuring community empowerment and strengthening community-based institutions (Proffenberger, 2006).

Table 6: ***Forest Cover in North-east Under Community Control***

State	% of Total Area Under Forest Cover	% of Area Under Forest Cover Under Community Control	Area by Forest Cover Under Community Control (km^2)
Arunachal Pradesh	82	62	42685
Assam	30	33	7817
Manipur	78	68	11821
Meghalaya	70	90	14070
Mizoram	87	33	6052
Nagaland	85	91	12889
Tripura	55	41	2355
		Total	97689

(Source: Proffenberger, 2006)

The protected area (PA) network in India comprises 96 national parks and 510 sanctuaries covering an area of 15.59 million ha constituting 4.8% of the geographical area of the country. Of these, 28 PAs covering 37,761 km^2 have been declared as tiger reserves. Extractive forestry activities are not permitted in core areas of national parks and access of neighbouring communities to such areas are strictly restricted. However, the *facto* position is often different from the *de-jure* and 40% of the PAs are subject to severe livestock grazing, fodder extraction, timber extraction and NTFP collection (Kishwan et al., 2007)

2.4 Ecological Description

Indian forests are highly diverse and contribute about 8% to the world's biodiversity in terms of the total number of species. Out of 18 unique biodiversity 'hot-spots', which are storehouses of nearly 50,000 species or about 20% of the world's flora, two are located in India in the northeastern Himalayas and the Western Ghats. The number of plant species is estimated at more than 45,000, representing nearly 7% of the world's flora. India's faunal diversity represents about 6.4% of the world's fauna, with some 81,000 species (Khoshoo, 1995).

The classification by Champion and Seth (1968) is the most widely used ecological classification for Indian forests. This classification categorises forests into five major groups further divided into 16 forest types based on climate and moisture regimes. Of the area under forest cover the largest extent of 38.2% falls under the category of tropical dry deciduous forests followed by 30.2% under tropical moist deciduous forests. Tropical thorns extend over 6.7% while tropical wet evergreen forests cover 5.8%. Temperate and subtropical forests both cover about 5.6% each and alpine and sub-alpine forests of all descriptions cover about 12.9%. The ecological description and distribution of various forest types in the country is given in *Appendix A.*

2.5 History of Deforestation and Degradation

Before the organization of state forest departments by the British colonial regime in the 19th century, the cultivated and forest lands were in a state of flux and clearing of the forests was as often for military reasons and extending the land under cultivation (Rangarajan, 1994). In the early days of British East India Company rule forests suffered degradation due to large-scale felling for valuable timber and expansion of agriculture. The timber-rich forests in the western coastal tracts were heavily exploited for teak and other timbers required for ship building and for laying rail tracks and manufacture of rail wagons (FRI, 1961). After the excesses of the First World War there was a brief period of serious attempts at sustainable management of forests but soon the Second World War interrupted the process and led to excessive demands for timber and fuel wood all over the country. The discontinuation of supply of coal to the industries and rationing of petrol during the Second World War added further pressure on forests resulting in widespread degradation of forests (TERI, 1998).

After independence in 1947, the government abolished the prevailing *zamindari* (feudal) system, introduced land reforms and large private forestlands were taken over by the government. Before surrendering the forest estate many private forest owners indulged in indiscriminate felling during the transition period between 1946 and 1951 causing large scale degradation (MoEF, 1999). Though the recorded forest area increased from 39.94 million ha in 1947 to 62.70 million ha in 1951 (FRI, 1961), degraded forests formed a sizeable proportion of this increase. In the late 1950s and early 1960s, forestland was also allotted for farming under the 'Grow More Food' programme. Rehabilitation of refugees who came to India after partition also resulted in large-scale deforestation (TERI, 1998).

Diversion of forestland to agricultural, mining, industries and industrial townships and other infrastructural projects has been the main reason for decline in forest cover. An estimated 4.5 million ha of forestland was diverted during the 1950-1980 period for non-forestry purpose (MoEF, 1999) and this trend changed only after the enactment of the Forest (Conservation) Act in 1980.

The quantitative information on overall deforestation rates prior to 1980 is patchy, though a number of estimates for deforestation rates are available. NFAP (1999) reports annual forest loss of upto one million ha from mid 1970s to 1980. TERI (1998) estimates annual forest loss of 144,000 ha till 1980 and from 1975 and 1982 an aggregate loss of 1.4 million ha of forests. The1995 forest assessment by FAO places the area under natural forest cover at 64.96 million ha and under plantations at 17.7 million ha. It estimates annual deforestation rate of 0.6% (0.34 million ha) totalling 3.37 million ha during 1981-1990 period. Another study estimates that the cumulative area afforested in India during the period 1980–2005 at about 34 million ha, at an average annual rate of 1.32 million ha, though reliable information on survival rates or consumption rate of biomass from surviving plantations is lacking (FSI, 2006).

FSI reports an increase of forest cover of 64.08 million ha in 1987 to 67.71 million ha in 2005 and the FAO estimates for the period are only slightly different at 63.93 million ha in 1990 to 67.70 million ha in 2005. However, FSI's forest cover assessments from the year 2001 onwards are not strictly comparable with previous assessments because of change in the technique (digital in place of visual) and scale (1:50,000 in place of 1:250,000) of interpretation. Therefore, difference in forest cover assessed post-2001 from earlier assessments cannot be entirely attributed to actual changes on the ground. The latest FAO and FSI estimates do not differ significantly and indicate an increase in forest cover by 3.6-3.8 million ha over the last two decades. The broad trends of the various assessments, therefore, indicate that the forest cover in India has increased over last two decades and may have stabilized for short term at about 68 million ha. India is one of the few developing countries where the deforestation rate is near zero and forest cover nearly stabilized, unlike most other tropical countries (FAO, 2005; FSI, 2008).

2.6 State of Forest Degradation

Degradation is defined as the reduction in productivity, changes in species composition and reduced biological richness of a forest due to unsustainable harvesting, selective over-exploitation, loss of

natural regeneration, fire, pests and diseases, removal of nutrients and pollution. Change in forest composition, loss of natural regeneration, low growing stock and low productivity are important parameters that indicate the state of forest degradation.

Change in Forest Composition: There has been a steady decrease in high diversity tropical evergreen, semi-evergreen, montane wet temperate and sub-tropical pine forests and increase in relatively low diversity tropical dry deciduous and tropical thorn forests on account of human interference (Bhat et al., 2001). The combined effect of fire and grazing has converted forests into oak shrubs (*Quercus spp.)* in the outer ranges of Himalayas and into grasslands in Nilgiris (TERI, 1998). In disturbed native forests, lantana (*Parthenium hysterophorus* L.) has become the dominant understorey species, disrupting succession and decreasing biodiversity. Lantana has invaded not only natural forests but also PAs and is considered a major threat to native plants and animals (Sahu and Singh, 2008). Lantana invasion and proliferation is resulting in loss of biodiversity and decline in other ecological services in Corbett Tiger Reserve, Kalesar National Park and Pachmarhi Biosphere Reserve (Babu, 2006). *Mikania micrantha*, a perennial fast growing weed, has become a major menace in natural forests, plantations, agricultural systems in northeast and southwest India (Ragubanshi et al., 2005).

Shifting cultivation, fire and over-grazing have resulted in the gradual reduction in the spread of vulnerable species and in making selected tolerant species more abundant. The preponderance of teak (*Tectona grandis*) and sal (*Shorea robusta*) in the deciduous forests and of chir (*Pinus roxburgii*) in the sub-tropical regions of India is attributed to their inherent gregariousness and their resistance to injuries from fire and grazing (TERI, 1998). Concentration of human settlements in the mid-montane regions (about 1000–2000 m elevation) and the spread of fire from *chir* pine forests have reduced the area under *banj* oak (*Quercus leucotrichophora*) in the central Himalayan region (Rana and Singh, 1990). According to many ecologists, a greater part of this area is now dominated by *chir* pine where *banj* oak should have been the climax and dominant species (Champion and Seth, 1968). Bamboo has been wiped out from many parts of central India because of its overexploitation for industrial uses and also because it is extremely sensitive to damage from fire and grazing (TERI, 1998). In tropical forests, biotically disturbed sites have lower regeneration in comparison to relatively undisturbed sites (Champion and Seth, 1968).

Inadequate Natural Regeneration: Adequate natural regeneration is an indicator of well-managed and healthy forests. Loss of natural regeneration represents potential loss of future flow of environmental and economic services and has important implications in the context of rehabilitating degraded forests. Forest fires have also resulted in loss of natural regeneration, particularly of broadleaved species. Natural regeneration is either absent or inadequate in 53% of the country's forests (MoEF, 1999). FSI (1995) conducted regeneration survey in 1995 and estimated that regeneration of important species is absent in 73.56% forests (FSI, 1995). Further, the number of states in which the extent of regeneration was high decreased between 1987 and 1995 indicating progressive degradation of forests (TERI, 1998). Table 7 shows the extent of forest area with inadequate or no regeneration.

Table 7: ***Extent (%) of Forest Area with Inadequate or No Regeneration***

State	% Forest Area with Inadequate/ No Regeneration		State	% Forest Area with Inadequate/ No Regeneration	
	1987	***1995***		***1987***	***1995***
Assam	89.7	84.8	Madhya Pradesh	49.95	75
Arunachal Pradesh	76.8	68.6	Maharastra	-	89
Andaman and Nicobar Islands	31.7	-	Manipur	8.42	90
Bihar	54.01	32.5	Meghalaya	57.6	94
Dadara and Nagar Haveli	-	81	Nagaland	89.4	-
Gujarat	86.13	-	Orissa	85.66	66
Goa	67.93	-	Rajasthan	91.8	90.6
Haryana and Panjab (Shivaliks)	-	90	Sikkim	83.81	47
Himachal Pradesh	69.1	88.8	Tripura	-	69
Jammu and Kashmir	98.97	90.2	Uttar Pradesh	80.55	79.5
Karnataka	98.1	62.6	West Bengal	70.8	15

(Source: TERI, 1998)

Low and Declining Growing Stock in Forests: Table 8 illustrates the growing stock conditions in India's forests in contrast with other parts of the world. The volume of the growing stock in the country is much lower than global and regional values and also much below its potential productivity. The area under open forests is another indicator of extent of degradation. The forest area under open forests (canopy density 10-40%) is 28.99 million ha and has increased from 24.92 million ha in 1995 (FSI, 1995). Forests with canopy density of 40-70% and 10-40% contain 74.1% and 28.2% of the growing stock contained in forests with 70-100% canopy density (FSI, 1995). TERI (1998) estimates that despite an increase in the notified forest area from 62.7 from 1947 to 76.5 million ha in 1995, the growing stock has declined from 5.184 billion m^3 to 4.740 billion m^3 and attributes this to sharp increase in extraction during the industrial expansion after the World War II and also liquidation of tree assets by private land owners to realize quick profits before surrendering surplus lands under land reform acts.

Latest estimates by FSI place the total growing stock of wood in the country at 6.218 billion m^3 comprising of 4.602 billion m^3 inside the forest areas and 1.616 billion m^3 outside the recorded forest areas. The average growing stock per hectare in forest areas is 59.79 m^3 (FSI, 2008). Most of the growing stock in the forest is contributed by *Shorea robusta* (8.04%), *Tectona grandis* (4.33%), *Terminalia crenulata* (2.82%), *Pinus roxburghii* (2.71%), *Anogeissus latifolia* (2.44%), *Abies smithiana* (2.43%), *Quercus semicarpifolia* (2.08%), *Abies pindrow* (1.94%), *Castanopsis* species (1.76%) and

Schima wallichii (1.68%). In contrast, the largest amount of growing stock of wood in areas outside forests is contributed by *Mangifera indica* (11.18%), *Cocos nucifera* (4.94%), *Syzizium cuminii* (4.20%), *Azadirachta indica* (3.91%), *Madhuca latifolia* (3.72%), *Borassus flabelliformis* (3.64%), *Ficus* species (2.72%), *Prosopis cineraria* (2.65%), *Tamarindus indica* (2.57%) and *Acacia arabica* (2.31%) (FSI, 2008).

Table 8: ***Comparative Stocking of Forests***

Country	Region	Volume (m^3/ha)	% Forest Area
India	Asia	43	21.6
Japan	Asia	145	64.0
Nepal	Asia	100	27.3
Congo	Africa	132	64.6
Gabon	Africa	137	84.7
Indonesia	Asia	79	21.6
Austria	Europe	286	47.0
Germany	Europe	268	34.1
USA	N&C America	136	24.7
New Zealand	Oceania	125	29.7
Brazil	South America	131	64.3

(Source: FAO, 2005)

Low Productivity and Loss of Important Forest Functions: The current productivity of Indian forests is 1.37m^3 ha^{-1}, calculated on the basis of net annual increment of 87.62 million m^3 and forest cover of 63.7 million ha (FSI, 1995). This is low when compared to the global average of 2.1 m^3 ha^{-1} yr^{-1} (MoEF, 1999) and very low compared to the maximum potential productivity assessed on the basis of Paterson's index - an index designed to predict the maximum growth potential in terms of volume production over large areas (Johnston et al., 1967) based on evapo-transpiration, annual temperature range, mean annual precipitation, length of growing season and mean monthly temperature of the warmest month. On this basis and accounting for the biotic interference, productivity of forests would range from 1.35 m^3 ha^{-1} yr^{-1} in the arid regions of India to 7.66 m^3 ha^{-1} yr^{-1} in the humid/perhumid regions, with other regions of the country having a productivity of around 3-4 m^3 ha^{-1} yr^{-1} (MoEF, 1999). TERI (1998) estimates that reduced stocking of degraded forests in comparison to achievable potential results in annual loss of Rs 45 billion worth of industrial wood and Rs 12 billion worth of firewood. Forests are unable to meet the needs of the increasing population resulting in unsustainable usage of forests leading to further downward spiral of productivity and loss in important forest functions like watershed protection, soil protection, NTFPs and firewood availability for subsistence use, carbon storage in biomass, and biodiversity.

2.7 Reasons for Degradation

2.7.1 Direct Causes

Direct causes of forest degradation in India are uncontrolled fires, unregulated firewood extraction, grazing, mining, encroachments and shifting cultivation.

Fires

It is estimated that 98% of the forest fires are manmade (Ahmed, 2002). The Forest Survey of India conducted a sample survey in 1995 to estimate forest area annually affected by fire and their assessment reveals that on an average about 53.1% forest area is affected by fire every year. The

figure ranges from as low as 6.8% in Upper Subansiri in Arunachal Pradesh to as high as 97% in Dadra and Nagar Haveli. Of the total inventoried area, on an average, 8.92% is affected by frequent fires and 44.25% by occasional fires (FSI, 1995). Table 9 shows the incidence of fires across different types of forests. Repeated fires have affected relatively hardy species also and their ability to regenerate. The majority of fires are deliberately caused to facilitate collection (Bahuguna and Upadhayay, 2002) of commercially important NTFPs as 'mahua' (*Madhuca indica*) and 'sal' (*Shorea robusta*) seeds. It also results in new flush of grass for grazing and 'tendu' leaves (*Diospyros melanoxylon*) used for rolling local cigarettes. Fire is also used by shifting cultivators as a centuries old practice to clear the forests in northeastern states and in parts of Orissa and Andhra Pradesh.

Table 9: ***Percentage of Forest Area Affected Annually by Forest Fires***

Type	Area Affected by Frequent Fires (%)	Area Affected by Occasional Fires (%)
Coniferous forests	8	40
Moist deciduous forests	15	60
Dry deciduous forests	5	35
Wet/Semi evergreen	9	40
North Eastern Region	50	45

(Source: Bahuguna and Upadhaya, 2002)

Firewood Extraction

In 1996, wood energy consumption in India was 3,210 PJ, or 17.4% of the country's total energy consumption (Ravindranath et al., 2000). Fuel wood is used as a source of energy in 71.7% of all households in rural and 32.7% in urban areas (MoEF, 1999). Reliable information, on the income level at which households switch to other more expensive forms of energy, is not available (Lele et al., 1994). Since most wood used for fuel does not pass through the market the data on fuelwood extraction in India is inadequate and unreliable (TERI, 1998; Lele, 1994). Studies by the National Council of Applied Economic Research, Operations Research Group, FSI (1996), Mukherji (1994), Joshi and Sinha (1995), Lete et al. (1985), and Ravindranath and Hall (1995) have dealt with various aspects of fuel wood consumption, such as estimates on fuel wood consumption and rural-urban shares. FSI (1996) estimates total annual household fuel consumption for 1996 to be 162 million tons against sustainable supply of 17 million tonnes from forests and 98 million tonnes from non-forest areas, and concludes that the net deficit of 86 million tons of firewood is unsustainably removed from the forests. Tracing the origin of fuel wood, this study concluded that 51% of the fuel wood is derived from the forest areas and 49% from the non-forest areas of the country. A report prepared for the National Action Program for Combating Desertification (MoEF, 2001) also records that consumption of wood is 4 to 5 times higher than what can be sustainably removed from the forests and conclude that this contributes to the overall deterioration of the quality, stocking condition and productivity of forests ultimately leading to deforestation and degradation.

Shifting Cultivation

Shifting cultivation or *jhum* is a long-standing practice of raising food crops with "slash and burn" technique and ingrained in tradition and culture of most of the tribes inhabiting northeast India and in parts of Andhra Pradesh, Bihar, Madhya Pradesh and Orissa. At least 100 different indigenous tribes and over 600,000 families in the seven states of northeast India depend on *jhum* for subsistence. The area affected by shifting cultivation in northeast is assessed to be 3.8 million ha (Kishwan, 2007). Traditionally shifting cultivation was practiced with long fallow period ranging from 10 to 30 years. However with increase in population and progressive reduction of land, the fallow period has been reduced to about 2-3 years (Ahmed, 1997). This in turn does not permit the natural processes of recuperation to repair the disturbed ecosystem resulting in erosion and decline in soil fertility.

Encroachment

Reliable data on encroachments on forestlands are not available (Ahmed, 1997). In 1987 the Forest Survey of India estimated that over 700,000 hectares of forestlands were under encroachments (FSI, 1990). A 1999 report of the Ministry of Environment & Forests report states that about 1.5 million ha of forest area to be under illegal occupation for agriculture and other uses (MoEF, 1999). Encroachments on forestlands for cultivation and habilitation have been a regular phenomenon since independence. Though such encroachment rarely exceeds 1 or 2 ha at any given spot, the cumulative impact of such practices has resulted in the fragmentation of forests (TERI, 1998). The illegal encroacher cannot avail of technological and financial extension services for farmers and improve their productivity and he has to depend upon surreptiously extending the land under encroachment to increase his agricultural production thus further accelerating forest degradation. At several places the encroachments started as shifting cultivation and subsequently changed to permanent settlement and cultivation resulting in extensive fragmentation of forests (Ahmed, 1997).

Grazing

Several estimates are available in the literature regarding the availability (supply) and requirements (nutritional demand) of feed and fodder for livestock and the actual deficits. India's livestock population of 467 million grazes on 11 million ha of pastures. This implies that an average of 42 animals graze on a hectare of land compared to a threshold level of 5 animals. In the absence of adequate grazing land, nearly a third of the fodder requirement is met from forest resources in the form of grazing and cut fodder for stall-feeding. It is estimated that during 1993, the country faced a deficit of 570 million tonnes green fodder and 276 million dry fodders. In 1995 combined availability of green fodder from permanent pastures, other grazing lands, agricultural lands and forests was estimated at 434 million tonnes, whereas the minimum requirement was estimated to be 882 million tonnes. The big gap has resulted in unlimited and unrestricted grazing on forestlands (MoEF, 1999). An estimated 100 million cow units graze in forests annually whereas the sustainable level is only 31 million (TERI, 2001). Additionally graziers collect an estimated 175–200 million tons of green fodder annually (MoEF, 1999).

Grazing has been reported in 67% of the national parks and 83% of the wildlife sanctuaries surveyed (Singh, 2001). FSI (1995) survey reports incidence of grazing in 77.62% of the inventoried forests. Severe compaction from hooves of the animals have made the soil impervious and rendered it less fertile because of destruction of organic matter (TERI, 1998). Overgrazing and over extraction of green fodder are resulting in forest degradation through loss of vegetation and physical deterioration in the form of compaction and reduced infiltration, and increase in soil erodibility. Studies estimate that overgrazing results in annual erosion 6000 million tons of top soil and in changing plant association that is suitable only for sheep and goats (MoEF, 2001).

Mining

FSI and the Indian Bureau of Mines, Nagpur undertook a study in 1998 to analyze the extent of leased area for mining under forest cover. The study focused on the mining areas of five important metal minerals - bauxite, copper, iron, chromite and manganese - which caused most of the environmental degradation. A total of 353 mining leases of these minerals covered an area of 90,795 ha. It was found that 53,217 ha of the leased area were under forest cover out of which 71% was under dense forest cover. Madhya Pradesh, Orissa and Bihar accounted for 45%, 36% and 19% of the forest cover respectively. Figures about other mines are not available. Considering the area under working and abandoned coalmines, the total area under mining is greater than 1.3 million ha (TERI, 1998). Since 1980, more than 160,000 ha have been diverted for mining and in just last three years, about 300 mining projects involving a diversion of over 20,000 ha of forestlands have been accorded sanction by the central government (Bhullar, 2008).

2.7.2 Underlying Causes

Population Pressure

In heavily populated countries like India population is a major source of both poverty and environmental degradation. Development programs, howsoever innovative, are not likely to yield desired results. The stress on all common resources increases rapidly with increasing population and sustainability becomes nearly unachievable. In India, between 1950 and 1980 the number of people dependent on one hectare of Common Property Resources (CPRs) increased from 4.9 to 13.7 resulting in decline of both the range and the quantity of products from the CPRs. The extent of CPRs also has decreased sharply on account of their privatization through allocation by local and provincial governments further adding to the stress. The total area of CPRs in the country has declined from 100 million ha in 1947 to only 72.80 million ha in 1997 (TERI, 1998). Impoverishment of the natural woody cover of trees and shrubs occurs because per capita forest land in the country is one of the lowest in the world at only 0.08 ha against the requirement of 0.47 ha to meet basic needs, creating excessive pressure on forest lands (UNEP, 2001). Shrinking CPRs are leading to higher levels of resource extraction causing rapid deterioration of the forests across the country.

Poverty

Poverty is said to be both cause and effect of environmental degradation though the link between poverty and environment is an extremely complex phenomenon. The poor, who rely on natural resources more than the rich, deplete natural resources faster for their survival if the exploitation is beyond the carrying capacity. This becomes a vicious cycle with the environment degraded by over exploitation itself becoming the cause for accelerating the process of human impoverishment. In India, NTFPs provide gainful employment during the lean periods and supplements incomes from agriculture and wage labour (Tewari and Cambell, 1997). Nearly 400 million people living in and around forests in India depend on NTFPs for their sustenance and supplemental income and NTFPs provide up to 50% income to about 30% of the rural people (MoEF, 1999). Shortage of fodder, firewood, raw material for handicrafts, small timber requirements and other NTFPs greatly affect the survival needs of the poor and the increase in population results in more number of poor people being forced to share from the shrinking resources. Acceleration in poverty alleviation and a sharp reduction in the population growth rate are needed to break this link between poverty and the environment.

Improper Policy Interventions

A number of policy interventions may have also contributed significantly to the degradation of forests. In order to promote rapid industrialization after independence, vast stretches of bamboo and other forests were leased to paper and pulp mills without creating any long term stakes for the industry to invest in the leased lands for the future. Excessive harvesting by the industry and lack of proper monitoring by the forest departments led to the degradation of large extent of forest resources (TERI, 1998). This practice of leasing forestlands to industries was reversed after the 1988 forest policy came into effect but enormous damage had already been caused.

Prior to the enactment of the Forest (Conservation) Act in 1980 it was the unwritten policy of the state governments across the country to meet the land requirements of all developmental projects from the forest lands in order to reduce the costs instead of acquiring lands through purchase. In addition, the practice of regularly regularizing the encroachment of forest lands provided perverse incentive to encroachers of forest lands. An average of 150,000 ha (MoEF, 1999) of forest lands were lost annually due to this reason which has, fortunately, been brought down to a mere 8,000 ha per year after the enactment of the Forest (Conservation) Act.

Large scale privatization of CPRs, in pursuance of the policy of most state governments for land distribution to the landless, has resulted in a sharp reduction of this common land resource. This also increased pressure on the forests as the demand for grazing and other land related services that were being fulfilled by the CPRs got transferred to the forests as the only other non-privatized lands available accelerating degradation.

Insecure Land Tenure

Many of the lands classified 'forests' or 'wastelands' in official records and formal laws were, and continue to be, under communal property use recognized by local custom. These include shifting cultivators, hunter-gatherer pre-agricultural tribal communities, forest-based settled cultivators and nomadic pastoralists, tenant cultivators of the former Zamindars (big landlords) as well as other communities with diverse livelihood systems (Sarin, 2005). Non-recognition of *de facto* land tenure and other property rights creates suspicion in the minds of the communities and prevents their genuine participation in restoration and protection of degraded forests and generates perverse incentives to fell forests as the communities fear they may not reap the benefits of their labour if the forest department reverses its policy of sharing usufructs prior to the harvests (Proffenberger and Singh, 1998)

Market Failures

Marketing in the technical sense has not been developed for forest products in India. In fact, the situation in the forestry sector in India is one of 'market failure', in which economic efficiency has not been achieved through following a market mechanism (MoEF, 1999). The forest departments sell a wide range of forest products, tariffs and royalties, rents, taxes, levies, fees (grazing, transport permit) and other charges but the prices capture neither the environmental benefits of forests nor the resulting damage to forests (MoEF, 1999). The charges and levies are also not objectively linked to cover the monitoring or implementation cost incurred by the SFDs. In some states like Orissa, the price of NTFPs is administratively fixed by Revenue Department officials at rates higher than the market price only to avoid criticism from the press leading to the buyers withdrawing themselves from the market and hurting the primary gatherers who are mostly tribal and poor forest dependent people (Saxena, 2003).

Poor Inter-sectoral Policy Co-ordination

Forestry interfaces with many other sectors – land records, agriculture, water and soil conservation, animal husbandry, rural development, energy, industry, irrigation tribal welfare and tourism. Current policies are fragmented across several government agencies with differing policy mandates (UNEP, 2001). The weakness of the existing system lies in the inadequate enforcement capabilities of environmental institutions, both at the centre and state levels (UNEP, 2001). Although the 1988 forest policy takes into consideration the dependence of people on forests, the impact that other sectors have upon forests and forestry activities is not recognized; policy is not supported by legislation and appropriate strategies and the task to implement policy recommendations is left to the state governments. Policies for agriculture, settlements, energy, animal husbandry, rural development and other sectors do not recognize their impacts on forests (TERI, 1998). There is no collaborative strategy between forestry and animal husbandry sectors for the management of grazing and fodder production. Tribal welfare departments are poorly linked to forest departments and the plans are not developed in co-ordination (MoEF, 1999).

3. Forest Degradation Control Mechanisms to Date

3.1 Linkage to National and Provincial Forest and Land Use Policies

Forests in India have been protected and administered by the ruling kings for at least two millennia. Generally the motivation was control over these assets not claimed by any individual or community the grant of which could form rewards for loyalty to the king. But, in the case of well established large kingdoms like the Mauryas and Ashoka, larger public good and religious piety to protect wild animals was the primary objective of states' intervention in the management of forests. The focus of this work, however, is on the period beginning with the Industrial Age, a period which coincides with the British colonial rule in India.

By the end of the nineteenth century British India consisted of nine provinces spread over 1.4 million km^2 and a human population of 228 million which was administered either by a Governor or a Lieutenant-Governor. In addition it exercised sovereignty over 675 princely states of various sizes and ranks and the entire administration was under the control of the Central Government of British India under the Viceroy. Central legislative functions fell within the mandate of this central government.

The Indian Forest Act of 1865 was the first centralized forest legislation in India. The primary focus of this Act was the protection of trees, prevention of fire, and prohibition of cultivation and grazing in forest areas in British India. It was revised in 1878 (Act VII of 1878) to provide for the constitution of 'Reserved' and 'Protected' forests thus bringing into India's forestry the concept of landscape management, and was extended to most provinces of British India.

In order to provide intensive forest management, the forests of the country were divided into divisions and forest boundaries were surveyed and mapped. Working plans were prepared to regulate the output of these forests and work them according to scientific principles. A country-wide Forest Service was constituted in 1869. Considerable progress in forestry was made between 1871-1900 when vast areas under forests were surveyed and demarcated. In 1894 the first formal Forest Policy was enacted with the following central features:

(1) The central defining objective of State forests was public benefit at large and the rights and privileges of the people in the neighborhood were regulated with that motive.
(2) Forests were categorized as hill forests/protection forests, economically important/production forests, minor forests, and pasturelands.
(3) Forests situated on hill slopes were to be conserved to protect the cultivated plains situated downstream.
(4) Lands suitable for agriculture within the forests were to be made available for cultivation, provided such conversions did not harm forests and were permanent in nature.
(5) Local populations were to be allowed grazing rights in low-yielding forests.

The centralization of forest governance, however, led to disaffection among many communities dependent upon forests and it was soon clear that in such a vast country forests can not be managed in a centralized top down manner. At the same time there was also an increased awareness that forests serve the legitimate interests of people far removed from its neighborhood and that they too have a stake in their proper management. This led to a unique legislative experiment in India in the form of the reformulated Indian Forest Act of 1927 in which an overarching central law allowed the incorporation of local concerns. This Indian Forest Act provided enabling provisions to make rules and regulations; which made it distinct from the other Acts of that time. It is this distinct provision that enabled this central Act to continue after independence when the forest was made a subject for the provincial governments to legislate on.

In addition, a number of provinces also enacted their own forest laws, like the Madras Forest Act and the Assam Forest Regulation Act which, while having much in common with the Central Act, provided flexibility for local opinions, conditions and cultural ethos. However, it would not be correct to conclude from this that the restrictive framework now in evidence in many states in India has been the result of a centralized process of law making. Various orders passed by state governments since 1927 (e.g. Forest Produce Transit Regulations, Sawmill and Forest Depot Regulations) have actually contributed to a more restrictive legal framework for the forestry sector and more directly impinged community rights and responsibilities.

After independence, and partition, and the incorporation of the former princely states in Independent India in 1947, a new phase in the administration of forests in India began. The old forest policy was revised and replaced by another policy in 1952 which envisaged evolving a system of land use that would enable optimal production without degradation. This policy recognized the productive, protective and recreational values of forests and classified forests in protected forest, national forest, village forest, and tree lands. It identified vital national needs including a system of balanced and complementary land use, need to check denudation of mountainous regions, erosion of river banks and invasion of sea-sands on coastal tracts and the need to ensure supply of fodder and small wood.

The policy called for maintaining a minimum of one-third of the geographical area of India under forests.

A major shift in focus in India's forestry originated from the recommendations of the National Commission on Agriculture (NCA) in 1976. Two major recommendations of the Commission regarding forests were as follows:

> *'Institutional changes should be brought about in the management for production forestry, and man-made forests should be raised on an extensive scale with the aid of institutional financing. The existing system of harvesting of major and minor forest produce through the intermediary contractors must be replaced by taking it up either directly by the Social Forestry Department or by a network of forest labour cooperative societies, or by a combination of both.'*

For production and social forestry, recommendations of the NCA included identification of 48 million ha of forestland being dedicated as production forest, promulgation of grazing rules, increasing of the grazing fee, prohibiting grazing in regeneration areas, planting of fodder trees, overcoming the problem of shifting cultivation and allotment of homestead lands to tribal communities. The NCA also recommended that development of minor forest produce should be the responsibility of the Forest Department. For protection of forests and wildlife management, the NCA was of the view that there should be sufficient buffer around the boundaries of National Parks and that the Wildlife Division in the Government of India be headed by an officer of the rank of Additional Inspector General of Forests. On forest protection and law, the Commission suggested soliciting support of voluntary associations and local government, undertaking large-scale social forestry programs, creating depots to supply timber to villagers and enacting an All India Forest Act by Parliament.

The NCA's recommendations led to the creation of a separate and full-fledged Department of Forests within the Ministry of Agriculture of the Government of India. This also signaled the birth of the social forestry program in the country and nationalization of forest harvesting, thus eliminating the forest leasing system in vogue for years. Based on the recommendation of the NCA, as well as other progressive ideas that emerged in the period from within and from international covenants, the following important steps were taken between 1971 and 1996:

1. Creation of State Forest Corporations for harvesting forest produce, thereby eliminating contractors and middlemen.
2. Establishment of the Indian Institute of Forest Management to produce qualified managers with the skills to manage forest resources as a business concern.
3. Initiating social forestry on village common lands and private farms.
4. Formulating a new National Forest Policy in 1988.
5. Making forestry a subject of concurrent jurisdiction, whereby both the Centre and States have the powers to legislate on forests (through the 42nd Amendment of the Indian Constitution in 1976).
6. Creating a separate central Ministry of Environment and Forests in 1984.
7. Amendments to the Wild Life Protection Act of 1972 and streamlining the implementation of provisions of the Convention on International Trade in Endangered Species and the Ramsar Convention on Wetlands in India.
8. Ensuring people's participation through adoption of Joint Forest Management as a tool for managing forest resources.

The Forest Policy of 1988, formulated on the basis of the recommendations of the National Commission on Agriculture, had the following basic objectives:

i. Maintenance of environmental stability through preservation and, where necessary, restoration of the ecological balance that has been disturbed by serious depletion of the forests of the country.

ii. Conserving the natural heritage of the country by preserving the remaining natural forests with the vast variety of flora and fauna.

iii. 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 and for the retardation of siltation of reservoirs.

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

v. Increasing the sustainability of the forest/tree cover in the country through massive afforestation and social forestry programmes, especially on denuded, degraded and unproductive lands.

vi. Meeting the requirements of fuel wood, fodder, minor forest produce and small timber of the rural and tribal populations.

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

viii. Encouraging efficient utilization of forest produce and maximizing substitution of wood.

The primary objective of the Forest Policy of 1988 was environmental stability and direct economic benefits were subordinated to this principal aim. This policy also advocated a shift to an integrated approach to the management of forests so that the pressing needs of forest-dwellers could be met. The policy continued with the national goal of the previous policy of bringing a minimum of one-third of the total land area under forest or tree cover.

In pursuance of the objective of preventing exploitation by middlemen the State Governments have also enacted several legislations to control trade in forest products and protect the primary collectors from exploitative trade and patron-client relationships. The most common regulations relate to *tendu* (*Diospyros melanoxylon*) leaves often with separate sets of legislations also covering other NTFPs. An increasing number of NTFP species are being taken out from regulated lists, so that their transport and trade can come under the control of the Panchayati Raj Institutions (PRIs) and local communities can more directly benefit from them.

3.2 Case Studies

Box 1: Greening of Himalayas by Eco-Task Force, Jammu

An innovative model for eco-restoration of degraded forests that has evolved lately in India involves building on the synergies between diverse organizations, such as forest departments with their technical competence and the Army with its unutilized energy and resources during peace times. One of the successes of this approach is in a severely degraded area of 4,735 ha in Rui Watershed of Basantar River in Jammu and Kashmir State. The project area comprised of 9 villages with a human and cattle population of 3,960 and 4,136, respectively.

The primary economic activity was rain-fed agriculture and animal rearing with a heavy dependence on forests combined with over-exploitation of the dominant forest species of *Acacia modesta* for meeting the needs of the calico and printing industry of the area. Over a period of 8 years the Army planted 2.224 million saplings of native species and 0,204 million grass slips over an area of 3,929 ha along with a large number of locally suitable soil and moisture conservation measures, both vegetative and engineering structures. Multiple tangible gains followed that served to strengthen the active co-operation and participation of the stakeholders in forest protection and their restoration and a progressive shift towards high yielding breeds like Jersey cows from the previous goats with increasing economic prosperity. This approach of utilizing the resources of the army during peace time to restore degraded forests is now an institutionalized mechanism across a number of states in India *(Source: The Citizen's Fifth Report, CSE, New Delhi).*

Box 2: Sukhomajri – from Destitution to a Land of Plenty

Sukhomajri is a small village in the Shivalik foothills in Panchkula District of Haryana,that faced severe ecological problems, sparsely vegetated hills and sub-optimal agricultural productivity leading to poverty. In 1970 it was a village of 455 people with 15% literacy and 83 households comprising of traditional graziers of very small land-holdings, on which they practiced rain-fed agriculture and supported a cattle population of 411 animals. With agricultural production of as low as 0.275 tonne/ha in 1977, a large number of people from the village were forced to work outside in factories and business establishments. Its ecological transformation began in 1976 with the construction of two small earthen dams for soil and moisture conservation and the resolve of all stakeholders to voluntarily stop free grazing in order to regenerate the hills. A very crucial role in this entire exercise was played by a village level institution called Hill Resource Management Society consisting of one adult member from each household.

These activities resulted in averting the loss of topsoil, substantial increase in production of grasses and improvement of tree cover. The tree density increased from 13-tree/ha in 1976 to 1,272 per ha in 1992. Similarly, agricultural production increased 22% to 25% while the grass harvest increased from 40 kg/ha in 1972 to 3,000 kg/ha in 1992. As the watershed regenerated, villagers shifted from rearing goats to buffaloes and the number of goats decreased from 246 to 10 between 1975 and 1986 while buffaloes increased from 79 to 291. Enhanced availability of fodder resulted in increased milk yield, which went up from 2.23 liter per animal per day in 1977 to 3.01 litres in 1986. In 1986, the villagers together earned of Rs 0.35 million from milk sales and Rs 0.15 million from the sale of khair and bhabbar grass taking the average household income from Rs. 10,000 in 1979 to Rs. 15,000 in 1984. The cumulative effect of rehabilitation of degraded forests and increased vegetal cover has led to disappearance of hunger and destitution from the area. This example proves the effectiveness of participatory principles in realizing the wealth-creation potential of land *(Source: The Citizen's Fifth Report, CSE, New Delhi).*

Box 3: Indo-German Changar Eco-Development Project (IGCEDP)

IGCEDP (1994-2006) had the basic aim of reversing the degradation of mixed deciduous and coniferous forests and of other lands in parts of Changar area of Kangra District in Himachal Pradesh. The project covered an area of 428 km^2 spread over 578 villages with a total population of 130,000 people. The state government created a flexible public private partnership institution, Himachal Pradesh Eco-Development Society (HPEDS), Palampur, for the purpose of implementing this project with the main objective of bringing about behavioral changes among citizens in the use of natural resources. This society assisted the villages in developing their own micro-plans as a part of the Integrated Resource Management Planning (IRMP), helped government departments to integrate the delivery of their programs, and mediated between the two.

IGCEDP adopted a socio-technical approach on watershed restoration. The newly created village development committees included weaker sections of society and comprised women membership of at least 40% to address social and gender issues. In the early stages the HPEDS undertook and financed plantations and other works at a micro-watershed level, but later changed this direct supply-oriented approach to one that required villages to articulate their own demand for assistance by developing and deciding on their own resource management plans. The hallmark of the project was the demand-oriented approach.

The project has been successful in attaining the quantifiable indicators it had set. The project's success can be attributed to the implementation of village-level planning approach called Integrated Resource Management Planning (IRMP). The result was the evolution of IRMPs into a methodology for villagers to make village cluster level micro-plans. The forest plantations created in the strategic places at the head of watersheds were being maintained and guarded by village groups against incursions from unauthorized persons. The project and the work of the Eco-Development Society have received recognition in several ways. IGCEDP approach is replicable and being emulated by projects supported by other donors such as the UK's Department for International Development and the World Bank. The project has been held up as an example in a joint publication of the Union government and the United Nations Development Programme (Final Evaluation 2006, Indo-German Changar Eco-Development Project, India Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH, Germany).

Box 4: Greening of the Thar Desert in Rajathan

Spread over 20 million ha in the western boarder state of Rajasthan, the Thar Desert typifies vast expanse of sands, almost no precipitation, very high temperatures, lack of vegetation and little forest area. This work of planting trees in this most inhospitable of lands first began as a measure to protect the 1,040 km long Indira Gandhi Canal and its tributaries built in 1961 from shifting sand dunes. The initial successes soon triggered a major afforestation programme along the entire length of the canal and transformed the landscape to a large green tract at the center of this desert.

Shelterbelt plantations, comprising species like *Dalbergia sisoo* (Shisham), *Eucalyptus terreticornis*, and E. *camaldulensis,* have reduced wind erosion by 50% and pan evaporation by 5-14%, increased biodiversity and enhanced production of biomass. With improved availability of biomass, livestock recorded 53.11% increase against 35.65% at national average. The productivity of individual animals has also increased significantly and this has resulted in overall development of the area: higher economic returns, improved standards of living, better nutritional status and higher employment opportunities. Annual revenues of Rs. 500 million are being generated by harvesting the forest plantations raised on desert lands that supported no vegetation earlier. Afforestation of more than 1,000 km^2 of treeless desert area under most hostile and extreme conditions is a significant achievement and, thus, constitutes a major success story in the annals of reforestation and greening programme of the country *(Sources: Third Party's Evaluator's Opinion on Indira Gandhi Canal Region Afforestation Project by Subarta K. Mandal, July 2003; Prospects of Indira Gandhi Canal Project published by ICAR, New Delhi,1991; Indira Gandhi Canal Project by Rakesh Hooj; www.jbic.go.jp/english).*

Box 5: Forest Restoration by Jungle Bachao Groups in Gujurat

Baluji-Na-Muvanda in Panchamahal district of Gujarat is a village of 140 households that depend on forests for subsistence needs. Till the early 1970s, thick tropical dry deciduous teak forests covered its surrounds but when a road was built in its vicinity to facilitate construction of a dam across the Panam River its forests disappeared quickly due to illegal felling of trees by migrant labour and others.

Distressed by the degraded state of the forest, Nanabhai, a former *'Patel',* a traditional village authority, persuaded the villagers of the need for protecting and regulating the harvesting of forests by appointing *chowkidars* (village guards) the payment of which was shared by the villagers through contributions in the form of grains and small sums of money. Forest usage was regulated and only deadwood collection was allowed and firewood cutting was permitted for only two days in a year. Under this system called 'chutti', members who paid their dues were allowed in the forest, but not allowed to carry implements. In exceptional cases, the village committee sanctioned genuine requests for timber extraction for agricultural instruments and house construction.

This protection resulted in improved health of the forests, increased regeneration and enhancement in biological diversity. The area under protection management supports 31 tree species and 17 scrub species compared to only 9 tree species in the neighboring unprotected forests. About 60% of the regeneration resulted from seedlings while the remaining 40% came from coppice indicating that simple low-cost protection measures as regulation of grazing and extraction can help in restoring degraded forests.

The motivation to restore the forests by enhanced forest protection and management originated in the village itself and it was the vision and initiative of Nanabhai and the willingness of the villagers to forgo short term benefits for long term rewards that made it possible (*Source: Singh, G., Rathore D.S., Solanki, D.S., Sisiodia, N.D., 2000 Forest Protection by "Jungle Bachao Groups' in Panchmahals District Gujurat. In: Ravindranath et al. (eds.) Joint Forest Management and Community Forestry in India – An ecological and institutional assessment. Oxford & IBH Publishing Company, New Delhi).*

Box 6: Eco-restoration of Jhabua Forests in Madhya Pradesh

Jhabua, dominated by Bhil tribals, in the western Madhya Pradesh, recorded rapid increase in human population from 0.79 million in 1981 to 1.13 million in 1991 and the resultant stress on the already degraded forests brought the percentage of dense forests to a mere 4.9% by 1993. This meant sharp reduction in the value of this resource for tribals dependent on this resource for their livelihood and consequential large-scale seasonal migration of population for wage labour outside the region.

In 1994, Rajiv Gandhi Mission for Watershed Development was launched and restoration of degraded forest was initiated over 1240 km^2 project area spread over 218 watersheds in this tribal belt. The project has improved local ecology and simultaneously enhanced collective and individual financial security of villagers. Of Jhabua's total forest area, 60% is now managed by 344 JFM committees comprising 72,656 active members, who guard and the forests and other community assets. More than 2 million saplings of *Bambusa vulgaris*, *Phyllanthus emblica*, *Acacia catechu*, *Azadricta indica*, *Shorea robusta,* etc. were planted in the area. This reduced the degraded area by about 66%. The villagers generated and saved Rs 4.2 million in "Village Fund" for use by the villages for undertaking collective activities besides another Rs.4.8 million for maintenance of water harvesting structures. Women's Thrift and Credit Groups also generated another Rs. 24.40 million to help women with soft loans. Low cost indigenous technology use and people's participation have contributed significantly to the success of the project (*Source: The Citizen's Fifth Report, Centre for Science and Environment, New Delhi, 1999; Making Water Everybody's Business, CSE, New Delhi, March 2001).*

Box 7: The Solitary Green Guard of Ralegaon Siddhi

In 1975, Ralegaon Siddhi, a small drought prone village situated in Ahmednagar district of Maharashtra with a small population of 1,508, presented an extremely dismal picture. The village land was dry, barren and devoid of tree growth. This low productivity land was burdened with an excessive cattle population. The village society itself was facing social problems such as alcoholism, illiteracy, infighting, out-migration and debt. It was under these conditions that Mr. Baburao Anna Hazare, who had just returned to his native village after seeking retirement from the Indian Army, resolved to act to cause fundamental changes in the manner in which people were leading their lives.

Mr. Hazare motivated inhabitants of the area to impose a complete ban on felling trees in the village and on brewing of countryside liquor and smoking. Emphasis was laid on education, removal of untouchability and organization of collective marriages. These steps resulted in progressive reduction of social problems and utilization of resources and energies toward improvement in the environment and economy. Mr. Hazare was able to channelize the energies of the youth in implementing soil and moisture conservation measures to enhance storage and percolation of rainwater. A modest beginning was made on an area of 122.71 ha of wasteland, 50.78 ha of degraded pastures, 2,200 ha of degraded forest and 3.95 ha of panchayat land (village common land) for their reforestation. An improvement in the local economy and environment soon followed. Moisture conservation significantly enhanced the regenerative capacity of degraded areas and increased production of grass, fodder, food and other NTFPs (*Sources: A Successful Case of Participatory Management of Ralegaon Sidhi Village in District Ahmadnagar, Maharashtra (India) by B. Mishra, FAO Composite Document Repository) 2003, The Citizen's Fifth Report, Centre for Science and Environment, New Delhi,1999; www.ralegaonsidhi.com; www.wikipedia.org/wki/RalegaonSidhi).*

Box 8: The Arabari Experience

The lands in the districts of Midnapur, Bankura, Purulia, Burdwan and Birbhum in southwest Bengal are characterised by red loamy and lateritic soil with sub-soil canker pan. The climate is hot and dry with average rainfall of around 1,300 mm. Earlier the sal (*Shorea robusta*) forests in Midnapur district were under private ownership and subjected to repeated coppicing. When acquired in 1954-55, the forests were already in an advanced stage of degradation. The forests occur in disjointed and isolated patches of varying sizes and as islands amongst the cultivated field surrounded by habitations. The fragmentation combined with population pressure resulted in continued degradation of forests over the years.

Policing efforts to eliminate the biotic pressure lead to increased conflicts between the forest dependent people and the forest department personnel and led to alienation of people. Faced with an impossible situation, a pilot project was undertaken in the Arabari area in 1971-72 with an objective of involving people, living around the fringe of the forests, in protecting the forest resources through improvement of their socio-economic conditions. 1,270 ha of degraded Sal forests including 185 ha of refractory areas unfit for tree farming was taken up for restoration. Through a series of meetings and contact programmes, cooperation of 618 families was secured for rehabilitation of degraded forests. The villagers were assured forestry based employment and entitlement to collect the fuel wood and other usufructs from forests if they cooperated in protecting the forests. They were also guaranteed 25% share in the final harvest of the forest produce generated from restored forests.

From 1971 to 1985, various forestry based activities like afforestation and enrichment plantations with fast growing species over 290 ha, cashew plantations over 65 ha and sisal plantation over 12 ha were taken up. Periodic operations like coppicing, multiple shoot cutting and the like were also carried out. By 1986, the entire pilot project area was restocked with nearly 700 ha of sal coppice forests and another 300 ha of plantation crops with total expenditure of Rs. 1.64 million. In 1987, the West Bengal Forest Development Corporation harvested 97 ha of restored sal forests. A total of 0.22 million man days were generated along with a final harvest benefit amounting to Rs. 6,000 per ha to each family.

Box 9: Participatory Management of the Village Commons in Jammu & Kashmir

Decline of traditional agro-silvo-pastoral management systems and persistent over-exploitation resulted in large-scale degradation of village commons in Chinota Hills, Akhnoor District, Jammu. By early 1980s, the area supported just thorny and unpalatable shrubs. In 1988, the J&K SFD initiated a socio-ecological experiment with people of 15 villages living in and around Chinota hills to develop an alternative forest management system leading to the evolution of participatory management based on mutual respect for common interests.

Appropriate village institutions were formed so that participatory management could be institutionalized. The emphasis was on economic incentives to sustain people's continued participation. In anticipation of multiple benefits, the community members voluntarily agreed to halt free grazing of cattle on common lands to allow regeneration. Approximately 350 ha of degraded land were taken up for forest restoration.

This voluntary protection effort enhanced vegetal cover, increased biomass production of grass and fodder, and allowed natural regeneration and growth of existing plants. Grass production registered an increase of about 3 tonnes/ha. Fodder became available over a longer period and reduced the need to purchase fodder during the dry season (*Source: Co-Managing the Commons - The J&K Experience, SPWD, New Delhi).*

Box 10: NGO-mediated Joint Forest Management in Udaipur

The year 2000 saw an important initiative by an Indian NGO, Foundation for Ecological Security (FES), and the Forest Department to regenerate tropical dry forests and grasslands in Udaipur district of the north-western state of Rajasthan. The framework of the project was the Joint Forest Management (JFM) Programme which forest regeneration and protection is undertaken jointly by government and people. The cash and in-kind benefits from forest recovery are shared between the government and local village committees. The primary concern of FES was the linking of ecosystem recovery with the tribal people's livelihoods, particularly those of the most marginalized groups.

A successful instance of a project is the area managed by Chitrawas Village Forest Protection and Management Committee which covers 14 habitations of three adjacent villages having a beneficiary population of 1500 people in 350 tribal households. This Committee is currently managing 291 ha of forest land and 167 hectares of pastures. The households also, together own 133 ha of mostly unirrigated agricultural lands. When FES began its intervention, tribal livelihoods were based on a mix of subsistence agriculture and livestock dairying, both of which were operating at sub-optimal levels, due to recession of the water table, drying up of streams and lakes and severe degradation of forests and erstwhile pastures. At that time, degraded forests, on three legal categories of land- forest land, revenue wasteland and village-owned pastures-were still important sources of biomass for the locals. The FES' initial assessment suggested that the forest commons provided critical support to tribals during the period of drought and stress. Even in the degraded state, the share of income from biomass of the degraded commons was 20-25%, which was envisioned to be increased substantially through restoration efforts.

Through a detailed tripartite agreement made between FES, village committees and Forest Department, several ecosystem restoration activities are being undertaken from 2000 onwards. Such activities include live and stonewall fencing of forests and pastures, bunding, check-dam construction to stall erosion and planting of native tree species and bamboos. Restoration of forest cover upstream of village water sources was expected to help rejuvenate the water and nutrient cycles, thereby enabling the community to get increased income from their agricultural patches as well. The forest protection duties lie primarily with the villagers who take turns on a voluntary basis. Fodder-grass harvesting and fuelwood extraction is closely monitored and controlled, with equitable distribution of benefits among

After a few years of management, the protected areas of forests and pastures show visible improvements in ecological indicators such as grass diversity and productivity, animal species diversity, water table depth, soil moisture, canopy cover and tree basal areas. There has been a distinct increment in tree species diversity too, due to strict protection and controlled harvest. Ecosystem recovery is paralleled by strengthening of village institutions as was manifested in united action on various fronts by the villagers *(Source: Dr Ghazala Shahabuddin, Scholar-in-Residence, American University, Bethesda MD 20817, USA).*

Analysis of Case Studies

One common strand among these case studies is that success in reversing degradation of land could be achieved only with full community participation in planning, execution and benefit-sharing. In some cases the initiative was of government while in other leadership emerged from local communities but in all the participation of the community was widespread. Besides the participation of the community other important points that emerge from an analysis of these case studies could be summarized as follows:

Effective and Acceptable Leadership: All the cases indicate that the initiative was taken either by a local leadership that had the vision for the community and acceptability among them or a well organized government program led by a competent officer in the beginning.

Access to Resources: In all cases there were sufficient common resources available in the vicinity of the community in the shape of either government or community forests or common lands which were large enough to indicate the possibility of changing the lives of the locals in future if sufficient efforts were made in the present.

Freedom to Decide and Act: The local leadership could do what it did because the laws and policies enabled them, acquiesced in their actions or at least did not oppose their initiatives strongly enough.

Merging with Locally Held Knowledge and Beliefs: The community participation was obtained by recalling the relative prosperity and good life of the past when the forest resources were in good shape. Recourse to the local dominant religious beliefs was also invariably made by the local leadership.

Long Term Assurances of Returns: An assurance of long term control over the resources created was important to sustain the interest of the communities in these common ventures beyond the initial enthusiasm. This either came from the government on their own or, more often, through the insistence of the communities.

Results Far More than Simply Forest Regeneration: A common feature of these success stories have been that the outcomes have invariably transcended the initial objectives of making productive use of forest and the land resources. In almost all cases there has been significantly improved social capital in terms of enhanced gender and caste equity, literacy and health besides strengthening of village institutions. And the economic regeneration has also been significant with better access to financing for micro enterprises at reasonable rates of interest.

These early initiatives yielded notable successes, and formed examples on the basis of which larger institutional programmes like JFM and other large scale watershed projects were later developed. From 1990s onwards, the approach of major restoration initiatives shifted from being purely technical

to socio-technical which has since been increasingly adopted by international donors such as the UK's Department for International Development and the World Bank.

The community initiatives can be successful if formal legal framework is aligned to, and is supportive of, informal community institutions. Absence of effective legal support and lack of recognition of economic assets created through community activities could worsen existing vulnerabilities and may undo the local initiatives. Community initiated restoration initiatives are unlikely to succeed if the community institutions are in conflict with other institutions that surround them. There is thus a need of creating broader enabling frameworks for the governance of commons.

The biggest challenge that lies before local community-based forest management institutions is of mobilizing the community in the first place and in finding common ground on a continuous basis for action among diverse local stakeholders. The success of the restoration initiative at Ralegaon Siddhi can be attributed to the ability of inspirational leaders to channelize the community efforts towards achieving common good, enhancing social capital and community capacity by encouraging the villagers to solve their social problems themselves. The leader, Anna Hazare, understood the prevalent social system and realized that community capacity building and restoration of degraded watershed were interlinked. The case studies indicate that appointing or co-opting local inspirational leaders and motivators in formal institutional restoration programmes, who can encourage the local community in pursuing collective goals, can increase the probability of successful forest restoration outcomes.

3.4 National-level Degradation Control Measures

The Government initiated a major drive towards rehabilitation of degraded forests soon after the promulgation of the National Forest Policy in 1952. By 1961, these efforts brought a total of 35 million ha of forest area under working plans (47.14% of the total forest area). By 1961, 0.49 million ha was planted under various schemes and 10.40 million ha was regenerated by bringing 0.57 million ha of coniferous forests and 9.83 million ha of broad-leaved forests under natural regeneration. The Third Plan (1961-66) laid greater emphasis on artificial plantations of fast-growing species of economically valuable species and on introduction of exotic tree species, particularly eucalyptus, poplars and wattle in a large scale. However, it was during the Fourth Plan (1969-74) that the term afforestation was introduced for the first time and plantation works continued at a modest pace well into the Fifth Plan period (1974-79).

In 1985 the Government of India recognized that continuing deforestation had brought India close to a major ecological and socio-economic crisis and created the National Wasteland Development Board (NWDB) to tackle this problem. This Board started functioning during the Seventh Five Year Plan (1985-90) and laid great emphasis on regeneration of wastelands through participatory restoration activities. The Board covered 8.45 million ha and was upgraded to the status of Technology Mission in October 1989 and assigned a target of 17 million ha during the Eighth Plan (1990-95).

With the exponential increase in human population from 361 million to 838 million and livestock population from 307 million to 470 million from 1956 to 1992, natural forests began facing significant pressures to meet the bona-fide needs of fuel wood, fodder, timber, fiber and other products. The period from 1970 to 1980 witnessed acute shortage of fuel wood and fodder in rural areas resulting in over- exploitation of natural forests while the strict policing regimen of forests by SFDs further alienated the local communities. Due to large-scale diversion of forest land, and their over-exploitation, the area under forests declined from 64.2 million ha in 1983-85 to 63.34 million ha in 1993-95 with the sharpest decrease between 1991-93 and 1993-95. The achievement of afforestation for the various plan periods is given in Table 10.

Table 10: ***Areas Afforested During Successive Five-Year Plan Periods***

Plan Period	Area Afforested (million ha)	Expenditure (million Rs)	Percent of Outlay of Total Plan
First (1951-56)	0.052	12.8	0.39
Second (1956-61)	0.311	68.6	0.46
Third (1961-66)	0.583	211.3	0.53
(1966-69)	0.453	230.2	0.63
Fourth (1969-74)	0.714	443.4	0.54
Fifth (1974-79)	1.221	1072.8	0.31
(1979-80)	0.222	371.0	0.54
Sixth (1980-85)	4.650	9260.1	0.71
Seventh (1985-90)	8.865	25398.80	1.01
(1990-91)	0.750	NA	NA
(1991-92)	1.15	NA	NA
Eighth Plan (1992-97)	7.953	12000.0	1.13
Ninth Plan (1997-2002)	1.48	29657.20	0.34
Tenth Plan (2002-2007)	1.21	5112.37	

(Source: Kishwan et al., 2007)

Social Forestry and Farm Forestry: On the recommendations of the NCA in 1976 during the Sixth Plan (1980-85), Social Forestry and Farm Forestry Projects were launched in as many as 14 States of the Indian Union from 1982-84 to 1999. The Social Forestry Project brought a significant attitudinal change in the mind of the Indian public to undertaking degradation control measures and large-scale plantations in non-conventional areas. An area of 2.64 million ha was brought under plantations under this project at a cost of Rs. 18.4 billion. However, the SF afforestation schemes carried out on public lands were characterized by lack of a viable long-term institutional framework conducive to the objective of increased biomass for the poor, social equity and resource sustainability.

Massive investments in the SF programmes converted private agricultural lands, barren public revenue lands to productive assets. SF schemes in reality took a resource away from the local poor, since they no longer had access to the areas now policed by the forest guards. The experience of SF made it abundantly clear that it would be impossible to prevent the degradation of forests unless real and immediate benefits equitably accrue to the local communities who depended most on forests for their livelihood needs. Consequently, a revised approach that required decentralized and participatory management involving active participation between the forest department and local villagers was advocated.

National Afforestation and Eco-development Board: In order to promote afforestation and restoration of forests on a massive scale in the country, the National Afforestation and Eco-development Board was set up in August 1992. This Board focused on rehabilitation of degraded forest areas and lands adjoining the forest areas, National Parks, Wildlife Sanctuaries and the ecologically fragile areas in the western Himalayas, Aravallis and Western Ghats. Subsequently, to decentralize the planning of afforestation and involve local communities, Forest Development Agencies (FDA) was formed in 2001, comprising village community members and technically supported by forest officials. As of 2008, 743 FDAs have been operationalized in the country. Since the launch of FDAs, they have been instrumental in rehabilitation of 1.231 million ha of forest area at a cost of Rs. 19.2 billion.

Private Sector Plantations and Farm Forestry: The National Forest Policy of 1988 altered the government strategy towards supplying raw materials to wood-based industries such as paper, providing for growing raw materials through industry-farmer collaborations. For meeting raw material

requirements, the industry promoted partnership initiatives expanding agro-forestry and farm forestry on private lands with credit facilities to farmers being provided by National Bank for Agricultural and Rural Development. The potential of this scheme is being constrained by the generally small landholdings (<1.5 ha) of farmers who opt for farm forestry and by the Land Ceiling Act that limits the area under private control.

Removal of Subsidies: High subsidies to the industry in the past have led to indiscriminate exploitation of natural forests and lack of restoration strategies. For instance, leasing forestlands to paper and pulp industry without creating stakes in their future productivity, led to indifference towards sustainable extraction practices, to a large extent. Since the late 1970s, subsidy to the industry has been gradually reduced.

Establishment of Protected Areas: As of 2003, 35,780 km^2 is under National Parks and 117,300 km^2 under Wildlife Sanctuaries. Tiger Reserves refer to larger areas comprising different categories of PAs, Reserved Forests and Protected Forests but do not have separate legal status. Protected Areas are primarily managed by the governments at the state level but substantial funding is received from the central government. The legal framework for establishment and management of PAs is the Wildlife Protection Act established in 1972.

The considerable importance of the PA network in India lies in the fact that these PAs could be considered as best-case scenarios for forest and biodiversity conservation and represent relatively intact forest remnants in India, compared to other management categories such as community-managed forests, social forestry or commercial tree plantations. This is because the primary management objective in these areas is the conservation of biodiversity rather than utilitarian values. Compared to the various categories of used forests, PAs usually harbor a greater variety of flora and fauna in their natural habitats and could well be the last remaining source habitats for much of India's genetic diversity. However, existing research and anecdotal evidence reveals that, there is considerable forest degradation even inside PAs due to heavy local dependence for biomass and forest products, grazing, fragmentation due to dams, roads and settlements and disturbance due to tourism and pollution. However, inappropriate management practices related to the control of invasive species and the use of fire for habitat management are as often responsible for species loss as over-exploitation of biological resources. This is particularly true for Wildlife Sanctuaries where there is lower protection, less restrictive rules and lower financial allocation in comparison to National Parks. PA degradation takes the form of reduced species richness of flora and fauna, loss of viability of animal populations, loss of endemics, or less commonly, outright deforestation in portions of PAs.

Creation of Community Reserves: Community or people-based informal conservation on a small-scale has always been prevalent in India. In many cases, this takes the form of localized protection of endangered animal species such as the golden langur in Chakrashila Sanctuary in Assam, or the spotted-billed pelican in the village of Kokkrebellur in Karnataka. In some other cases, local people are simply protecting forest patches for religious or utilitarian reasons and other times, reacting to perceived declines in their natural resources base.

An amendment to the Wildlife Protection Act (1972) in 2002 allows the establishment of people-managed wildlife areas named Community Reserves (CR) where there is evidence of local interest in conservation, adjacent to existing National Parks and Wildlife Sanctuaries. Several CRs have been declared since then for instance India's first Marine Conservation Reserve in Lakshadweep initiated by the Bombay Natural History Society in 2005, centred on the commercial importance of the valuable giant clam. Another instance is of a wildlife sanctuary that has been created for the rare pheasant, the Blyth's tragopan by the village of Khonoma in Nagaland.

Community Reserves can play an important role in supporting conservation in the larger PAs through acting as buffers and corridors and diverting extraction pressure from them. While Community Reserves are a promising legislation that can revolutionize the participation of local people in conservation, their efficacy is likely to depend on the process of establishment of a Reserve, particularly in the extent of involvement of local stakeholders. For instance, in the Lakshadweep instance, the collaborators went through a consultative process where more than 400 public meetings

were held before the Reserve was formally notified. If the government simply takes over existing community reserves under the Wildlife Protection Act, without a sensitive framing of rules, these reserves, along with their conservation value, might be destroyed. Such existing community initiatives have to be nurtured, through a system of local incentives and encouragement before they are commonly institutionalized under the Community Reserve network.

Joint Forest Management (JFM): JFM involves institutional arrangements in which local people jointly protect and manage forests with government agencies on a benefit-sharing basis. Forest management and protection activities are decided beforehand through a consultative process and recorded in micro-plans. Today more than a hundred thousand JFM Committees in 27 states are protecting about 22 million ha of degraded forests. This program has been a major recipient of bilateral and multilateral financial assistance in the past two decades.

Voluntary Participation: Successful examples of voluntary involvement in eco-restoration are also available from different parts of the country. The National Tree Growers' Cooperative Federation is an example, made possible by organizing village-level Tree Growers' Cooperative Societies in states of Andhra Pradesh, Gujarat, Karnataka, Orissa, Rajasthan and Uttar Pradesh. Research expertise and financial and extension facilities are made available to them. There are today numerous examples of village-initiated and NGO-initiated restoration of forests and soils that were originally started with the aim of reviving people's livelihoods. Aravari, Bastar, Jhabua, and Ralegaon Siddhi are some instances of this approach. Though these initiatives typically impact just a few villages at a time, the results appear to be more durable in the long-run due to more effective empowerment at the local level, local initiation and support and have been found to improve the quality of people's lives in a significant way.

3.5. International Support for Degradation Control

To fulfill the policy objective of increasing forest cover to 33% of country's area by 2020, an annual programme of afforestation and regeneration of 3 million ha is required. This would require an estimated annual budget of Rs. 52,850 million against the average annual availability of Rs. 8,186.2 million for the forestry and wildlife sectors, Rs. 6013.80 million under Environment and another Rs. 16,150 million of related programmes under different ministries for the current year; which adds up to just about half of the required amount.

The Earth Summit had recommended that about 80% of the cost involved in sustainable development should be found from within the country. In the long run, available resources for afforestation would be determined by the country's resource mobilization capability, which in turn is determined by national income and the willingness of the society to invest in forestry related activities. Private investments would come if private profits could be made from these ventures. In such a situation, external assistance plays an important role by acting as a catalyst, providing the much needed initiative, breaking inertia, improving management capabilities and encouraging technology acquisition.

The first forestry project to be undertaken with external assistance was the World Bank-aided Uttar Pradesh Social Forestry Project in 1979. So far, 16 such afforestation projects have now been completed in 14 states covering approximately 2.64 million ha. Between 1981-82 and 1991-92, the percentage share of donor assistance in the total forestry plan outlay was around 30%. In some years (e.g. 1990-91), it reached as high as 40% while in other years, it was reduced to 5% (e.g. 1998-99). Financial resources mobilized annually for forestry are currently about Rs 9.9 billion and are allocated through Central and State plan budgets. The important activities in externally-aided projects have been rehabilitation of degraded forests, farm forestry, institutional plantations, agro-forestry and plantations on community land. Most of these externally aided projects have approached the problem of tackling degradation through comprehensive programs that included institutional development, human resource development, biodiversity conservation, Joint Forest Management and development of Management Information Systems and Geographical Information Systems. This approach enabled capacity building of the forest departments and NGOs, setting up of grassroot community organizations, coordination between the working partners, technology infusion, modernizing

management and policy formulations at the center and state levels besides the actual work of raising trees on forest and non-forest lands.

4. Capacities to Address Degradation Problems

4.1 Research

4.1.1 Present Status and Capacity

Forestry research in India is carried out by institutes under the Indian Council of Forestry Research and Education (ICFRE), State Forest Research Institutes (SFRI), research wings under the SFDs, NGOs, international forestry organizations and private organizations. ICFRE, an autonomous and apex body established in 1986 manages and coordinates forestry research and education in India. Some agroforestry related research is also undertaken by the Indian Council of Agricultural Research (ICAR). The mission of the ICFRE is "to generate, preserve, disseminate and advance knowledge, technologies and solutions for addressing issues arising out of interactions between people and forests and environment on a sustained basis through research, education and extension". ICFRE has eight regional research institutes and three research centers in different bio-geographical regions of the country to cater to the region-specific forestry research needs.

Besides the continuance of its conventional forestry research programs the ICFRE has also under new activities In the field of social forestry at its specialized Center at Allahabad on planting stock improvement program, wasteland reclamation, development of agro-forestry models, reclamation of mined areas through afforestation and studies on *shisham* mortality among others. In the area of eco-restoration and rehabilitation of heavily degraded forests, where technical interventions are required, ICFRE has undertaken systematic research on rehabilitation of problematic soils like quartz dumps and mine spoils, fly ash dumps and sodic soils using suitable tree species and proper soil amendments. The findings of these research activities are expected to help in making significant additions to tree cover in India through utilization of some of the most refractory lands.

Each state has a State Forestry Research Plan (SFRP) and each ICFRE institute also prepares an institute level research plan. On the basis of these research plans, national level priorities are decided, and accordingly research projects are developed. The prioritized projects constitute the dynamic National Forestry Reseach Plan. Seven states namely Kerala, Madhya Pradesh, Uttar Pradesh, Jammu and Kashmir, Karnataka, AP, and Uttaranchal have established their own forest research institutes (SFRIs) to carry out research on state specific forestry and wildlife issues. In other states, a separate wing within the SFDs exists which undertakes state specific research activities.

Some non-governmental organizations have also been active in the field of forestry related research, particularly in its social aspects. The Society for Promotion of Wasteland Development has set up a National Support Group (NSG) on JFM to generate information to assist policy makers. The NSG works through a system of networks, namely the institutional network, equity and gender network, training network, and ecological and economics research network (EERN). The EERN, which is being co-coordinated by the Indian Institute of Science, is a network of research institutions and NGOs and is responsible for research and monitoring through a coordinated multi-locational research programme (Ravindranath et al., 2000).

4.1.2 Constraints and Suggested Approach

Though systematic data collection on forestry resources of India has been undertaken for the last 150 years the data is still inadequate for the requirements of modern forestry management and requires a thorough revision in the nature of data to be collected, process of collection, quality control, data storage, access and retrieval. The Working Group (WG, 2007) constituted by the Planning Commission identifies major critical gaps in the forestry database and its management as:

- Absence of systematic approach to generate, collate and correlate data on natural forest resources.

- Availability of sketchy, non-standard and scattered database that is inadequate for national or regional level policy research and studies.
- Absence of a comprehensive management information system i.e. no warehouse has been conceptualized for the creation of a database on natural resources.

- Lack of institutionalized access to whatever information is available.

- Psychological mindset that impedes data sharing - data are normally thought as something very personal /institutional.

The urgent need to develop a unified forestry database for meaningful policy planning and implementation research cannot be overstated. Lack of adequate funds and non-availability of trained personnel is a major constraint that limits the capacity of forestry research institutions in India. The scope for the ICFRE to generate its own financial resources is limited. This resource constraint could be narrowed if it is made mandatory for the forest departments to make 5% of their budgets available for research activities. The constraint of personnel could be addressed if the universities across the country are co-opted in forestry research. Efforts in this direction are already underway through the research extension programs of the ICFRE but are limited by resource crunch as also lack of innovative proposals from the universities.

While India has done reasonably well in research on silviculture and community based forestry much needs to be done in fields like environmental ethics, political ecology, environmental history and ecological economics. Biological control over exotic weeds like *eupatorium, Mikenia, Strobilanthes, lantana, mimosa* and *parthenium*, which are a serious threat to the regeneration of natural forests, is an urgent requirement (NFCR, 2006). Other important areas are productivity enhancement of private and community landholdings, rationalizing barriers to the marketing and utilization of minor and major forest produce, appropriate management models of JFM. Identification of species indicates the presence or absence of key ecological functions that affect productivity, diversity and sustainability of forest communities (WG, 2007). Institutions specializing in specific sectors on similar subjects in areas like soil sciences, microbiology, eco-friendly technologies, natural disaster management, floods, coastal cyclones and landslides, coastal resources, mountain ecosystems, and freshwater resources and wetlands need to develop strong and effective linkages for coordinated, integrated and multi-disciplinary research at low costs. All large forestry projects should have an inbuilt component of research to ensure improvement in project implementation and in mobilization of scarce financial resources for forestry research.

4.2 Education and Training

4.2.1 Present Status and Capacity

In India, different types and levels of forestry education and training systems under university and non-university systems, covering specialists, professionals, technical and vocational requirements have evolved over the years. The information contained in Box 11 below provides an overview of forestry education and training facilities in India.

4.2.2 Constraints

Forestry, like professions, requires new technological, legal and management tools to keep pace with the changes that are occurring all around us thus necessitating regular training of the forestry professionals. With the shift towards sustainable development and participatory mode of forest management, forestry has been undergoing fundamental changes in recent times. Emphasis on conservation practices and collaborative management involving the local stakeholder communities and

individuals is required. Lack of financial resources and adequately trained teaching personnel and effective teaching aids and material is a key bottleneck in achieving this objective. The course content is focused excessively on technical aspects of forestry and other social science subjects like rural sociology, traditional ecological knowledge, rural economy and political ecology are not adequately covered. The financial and infrastructural resources available to support forestry training are generally insufficient.

Box 11: Forestry Education and Training Facilities

- ***Indira Gandhi National Forest Academy, Dehradun***: Establish in 1938 as Indian Forest College; provides induction and mid-career training to Indian Forest Service officers.
- ***State Forest Service Colleges*****:** Three colleges located at Burnihat, Coimbatore and Dedradun provide training to State Forest Service officers.
- ***Indian Institute of Forest Management, Bhopal:*** Established in 1982; offers post-graduate diploma and M. Phil. course in forest management; provides in-service trainings to mid-career forestry professionals.
- ***Wildlife Institute of India, Dehradun:*** Established in 1986, offers post-graduate diploma course in wildlife and PA management; provides in-service trainings to mid-career forestry professionals.
- ***State agricultural universities:*** Five ICFRE recognized universities offer graduate, post-graduate and PhD in forestry.
- ***Forest Survey of India, Dehradun***: Established in 1970s; provides training in remote sensing, forest inventory management and preparation of thematic and vegetation maps and digital data processing.
- ***Rangers Training College***: Six colleges provide two-year training course to forest rangers.
- ***Foresters Training and Forest Guards Schools***: Run by the SFDs; provide 6 months to 1 year training programmes to fresh recruits/promoted personnel.
- ***Forest Extension workers training programmes:*** Imparts trainings to forestry extension workers as per programme specific requirements.
- ***Other trainings***: Special workshops and training programmes by international forestry organizations, private organizations, NGOs, central and state governments on specific topics.

Institutional Capacity: Establishing sustainable forests and forestry in a country requires institutions that can provide enabling environment so that actions are based on rules, processes and practices that can be sustained through time and the local communities see these rules and their implementation as fair and legitimate. India has been fortunate in having a number of sound institutions but for it to reach its true potential lots of work needs to be done in this field. A network of local, regional and central institutions must develop afresh, those already in existence need to be strengthened and emboldened to act without fear and all must seek to upgrade their quality of output at all events. This requires resources but, more importantly, a vigilant civil society and high emphasis on information generation and sharing.

4.3 NGO Activities

India has a long tradition of social service, social reform and voluntary work. Over the years a large number of NGOs have emerged in India to work on issues related to socio-economic problems, livelihood and social discrimination. These groups work on behalf of the poor, the landless, the tribals, the labourers and other social groups who face marginalization and discrimination under the existing social structure. Many are grassroots organizations that work at the micro-level with limited resources but often achieve significant results at the village or watershed level. Still others have a more scientific focus with greater attention to environmental research that can inform national and local policy-making on environment.

In the forestry sector a number of non-government organizations of all sizes and capabilities have been actively working for the past many decades particularly in the field of extension, implementation, policy advocacy and environmental public interest litigation. Many of the achievements of the past two decades in the field of biodiversity conservation, wildlife management, social forestry and sustainable development can be attributed to the active role that the NGOs have played. These NGOs have also been able to use the country's judiciary to bear on the executive to enhance the quality of delivery in these areas. The NGOs have also played an important facilitation role that includes research, training, policy analysis, documentation and the organization of seminars and workshops. More than a thousand NGOs have been active in the JFM programme in the states of Andhra Pradesh, Manipur, Tamil Nadu, Tripura, Uttar Pradesh and Uttaranchal alone (Saigal et al., 2005). The level of NGO participation, however, varies considerably from state to state – from very limited participation in states such as Himachal Pradesh and West Bengal to very active participation in Andhra Pradesh where over 250 NGOs are involved in the JFM programme (Saigal et al., 2005).

NGOs have a major role to play in educating the public and creating a broad public demand for government-wide responsiveness towards environmental conservation. Forestry and watershed management have attracted the maximum attention and interest of voluntary agencies to built environmentally sound principles, processes, procedures and practices related with forests and environment while keeping a special focus on social and economic equity. In situations of partnerships between forest managers and NGOs, there are significant gains in the area of forest conservation. In the Eighth Five Year Plan, the importance of NGOs was enhanced due to their participation in rural appraisal for drawing up development plans at a very low cost and involving the rural community. Today, India has a vigorous NGO sector. Though there has been no complete census of NGOs, it is estimated that about 25,000 to 30,000 of different sizes are active in India.

Yet there are a number of constraints that limit the effectiveness of NGOs in India such as reduced access to technical expertise and knowledge, limited area of reach and small scale of funding. A problem with environmental NGOs in India, as with NGOs anywhere else in the developing world, has also been their increasing dependency on governmental funds or international bilateral and multinational donors leading to a lack of flexibility on the part of NGOs to pick up their missions/objectives and maintain impartiality. Accountability and misuse and inappropriate use of funds are also significant issues as are the lack of institutional infrastructure and trained personnel to carry out the tasks. Nevertheless, the experiences in India indicate that the NGO community has a very important role to play in capacity building, education, awareness raising and training community

representatives to take up the leadership role in forest restoration initiatives under the JFM programme.

4.4 Extension

The objective and purpose of meaningful extension is to extend, reach out and spread knowledge, technology or benefit to the designated target groups irrespective of their spatial distribution, position or reach. Forestry extension in India gained importance with the introduction of social forestry in 1980s. Most SFDs had initially created separate wings under their social forestry directorates to perform the extension role. A major extension programme under the National Forestry Extension Programme (NFEP) has also been initiated through specially created Directorate of Extension under ICFRE. The NFEP disseminates information on forest protection, land and water conservation, eco-restoration, JFM, agro-forestry, rationalization of shifting cultivation, and greening campaigns to the target groups. Forestry Extension in India is usually promoted through publications, a network of *Van Vigyan Kendras* (forest information and extension centres) and adoption of villages to showcase the latest innovations and technologies.

The general opinion, however, remains that the research results are not being transferred into field applications (WG, 2007). One of the root causes of such a situation is that research in most of the research institutions is conducted in isolation without consulting or involving the potential stakeholders. The WG (2007) recommends that it is essential to dovetail forestry extension activities with the general activities of the SFDS to make up for the shortage of the trained extension personnel. This requires structured capacity building of the extension staff to enable them to disseminate information about adaptable forestry technologies. The NFCR (2006) also recommends that an in-built system of dissemination of research results to the SFDs and other stakeholders needs to be developed through refresher courses, seminars, workshops, electronic and print media. It further recommends that effective linkages should be established amongst research institutes and the beneficiaries of research to enable multi-stakeholder learning.

The extension activities for successful implementation of community based forest restoration initiatives require not only the transfer of plantation technology from the laboratory to the field but also transfer of knowledge about the JFM institution itself. A number of states such as Andhra Pradesh and Karnataka have involved local NGOs in creating awareness in local communities about JFM policies, procedures and other opportunities that it offers. Outsourcing extension, particularly activities pertaining to raising awareness about the JFM programme, can be a viable mechanism to overcome shortage of skilled extension personnel and simultaneously develop capacity in this specialized field. This will also reduce the burden on the frontline staff enabling them to focus more on technical aspects of forestry.

5. Innovative Approaches to Address Forest Degradation

5.1 Ecosystem Services, Carbon Sequestration and REDD

A promising market based mechanism for capturing another ecosystem service provided by forests - forest carbon storage - is through earning carbon credits. The National Environment Policy Draft circulated by the MoEF in 2004 envisages an environment policy that promotes carbon trading and trade in other environmental services. The move towards carbon forestry also dovetails with the existing National Forestry Action Programme (NFAP) to bring 31 million ha of degraded forests and other lands under industrial tree and cash crop plantation by 2020 through collaboration with the private sector, state governments and local communities. A Planning Commission (PC, 2003) document estimates that Indian plantations could sequester 5 million tonnes of carbon resulting in a possible flow of about USD 125 million during the Kyoto Protocol's first commitment period. The Government of Himachal Pradesh, India has submitted a Project Idea Note for Bio-Carbon Conservation Sub-Project as an additional component of the World Bank aided Mid-Himalayan Watershed Project. The intervention proposed under the Bio-Carbon Conservation Sub-Project makes villagers a strategic seller of carbon credits under the Kyoto Protocol. Reforestation has been identified

as the principal carbon sequestration activity involving 600 villages. Indicative value of US$ 5 per tonnes of Certified Emission Reductions is proposed subject to negotiations and financial due diligence. The state of Uttranchal is also taking up carbon conservation sub-projects as an additional component of the World Bank aided Participatory Watershed Management Projects (Singh, 2008).

With the Bali Action Plan categorically placing reduced emissions from degradation and deforestation (REDD) activities on the agenda of future climate change negotiations, there is now a strong possibility that policy approaches and incentives relating to enhancement of carbon stocks in low biomass forests will be successfully negotiated and accepted as a legitimate greenhouse gas mitigation option in the upcoming post-2012 climate change regime. Using the institutional mechanisms provided by community-based forest management (CBFM), 833.8 Tg carbon can be sequestered by enhancement of forest carbon stocks in low biomass Indian forests (Singh, 2008). Bhadwal and Singh (2002) estimate that Indian plantations between 2000 and 2050 could sequester as much as staggering 7 billion tonnes worth of carbon credits. A study (Haripriya, 2001) projects carbon mitigation estimate of 153 Tg yr^{-1} till the year 2030. The higher estimate is because of the consideration of carbon storage in pools other than the above ground biomass and the assumption that the entire area of feasible land is used for forestry. Another study by Ravindranath et al. (2001) proposes that sustainable forestry scenario may enhance additional carbon stocks by 237 Tg (19.75 Tg C yr^{-1} over a 12-year period) from 2000 to 2012 and in addition to meeting all the incremental biomass demands of the nation, commercial forestry would lead to an additional carbon stock of 78 Tg (6.5 Tg C yr^{-1}) during 2000-2012 under the commercial forestry scenario. The findings reported here indicate that even if moderate efforts towards rehabilitating degraded forests are carried out, the potential of additional carbon storage is enormous.

Channeling carbon investment funds into CBFM projects can make both development and conservation economically viable and attractive for the local communities to maintain biodiversity and integrity of nature. The strategy of dovetailing carbon sequestration subprojects with larger national development programmes can result in improved participation and additional financial income to the small stakeholders. However, before actual funding under the Clean Development Mechanism and other international Carbon investment funds is available, policy approaches and positive incentives on issues relating to REDD need to be negotiated and agreed upon by the participating nations to the UNFCCC.

5.2 Landscape Approach

Important landscape level initiatives that are being undertaken in India, apart from the Project Tiger and Project Elephant, are the Asian Rhino and Elephant Action Strategy Wild Lands Programme and the Terai Arc Restoration Initiative. Under the Asian Rhino and Elephant Action Strategy (AREAS) of WWF India four priority landscapes – Nilgiris-Eastern Ghats (elephants) in Karnataka; North Banks (elephants) and Kaziranga-Karbi Anglong (rhino and elephants) in Assam; and Western Terai (rhinos) in Uttar Pradesh have been identified for conservation. Another innovative landscape level approach that involves pro-active management of high conservation value private lands is being attempted under the Wild Lands Programme. Under this programme the thrust is on identifying, prioritizing, securing and managing private owned lands that are of critical importance to the threatened wild species and, thereby, creating buffers for the PAs.

The Terai Arc Restoration Initiative, supported by World Bank/WWF Alliance for Forest Conservation and Sustainable Use, is one of the largest landscape level interventions in South Asia that covers approximately 5 million ha of land from Nepal's Bagmati River in the east to India's Yamuna River in the west. The Terai Arc ecoregion initiative is highly innovative and ambitious where almost all the CBD principles of Ecosystem Approach are being implemented across a single continuous landscape. The initiative aims to restore and reconnect eleven national parks in Nepal and India to create one continuous landscape that allows wildlife to flourish and simultaneously benefit the local people by integrating biodiversity and livelihoods and addressing these challenges in an integrated manner.

5.3 Prospects for Future and the Likely Countries Approach

The PA network presently covers about 20.42% of the forest area of the country. The National Wildlife Action Plan (2002-2016) aims to double this area and focuses on landscape level initiatives. The plan emphasizes on landscape level planning and seeks to develop buffer areas and corridors to link protected areas. The Planning Commission has been requested for financial allocations for developing areas falling within the radius of 5 km of the boundary of national parks and sanctuaries as special development areas so that a human-park interface can be effectively managed. The Wildlife Conservation Strategy, 2002 also focuses on protecting the interests of the rural poor and tribes living around protected areas. It recommends that lands falling within 10 km of the boundaries of the national parks and sanctuaries should be notified as eco-fragile zones under the Environmental (Protection) Act.

Project Tiger, launched in 1973, initially adopted traditional conservation approaches but this is now changing to incorporate an ecosystem approach to manage forests and wildlife. The emphasis is now on managing the landscape by linking the tiger habitats to improve the viability of tiger populations. The thrust is on identifying on priority basis, clusters of PAs and non-PAs areas, which seem contiguous through potential corridors and linkages. A minimum core area of 300 km^2 with a sizeable buffer is recommended for each of the 28 tiger reserves (2005). The ecosystem approach adopted by Project Tiger in 2001 seeks to superimpose land use features, settlements, and livestock distribution to assess biotic pressures on the landscape and evolve mechanisms and processes to ensure planning and strategy continuum across Wildlife Management Plans, Forest Working Plans and District and *Panchayat* Plans. This approach emphasizes formulation of land/water use plans at local, state and national levels based on regional perspective that identifies critical conservation areas within and across stated levels where human activities should be compatible with conservation values (NBASP, 2004). The revised Project Tiger based on the ecosystem approach is the national-level institutional approach that the country is most likely to adopt for managing other high value conservation areas. Project Elephant, which is another major national programme to conserve elephants and being implemented in 12 states of India and 14 elephant reserves, is also based on the similar ecosystem management approach.

Another innovative initiative that seems to be a promising approach for conservation and restoration of degraded landscapes is the creation of community and conservation reserves. A step was taken in this direction by creating two special categories of protected areas - community reserves and conservation reserves by amending the Wildlife (Protection) Act, 1972 in 2003. Section 36C of the Wildlife Act provides that the state government may, where the community or an individual has volunteered to conserve wild life and its habitat, declare any private or community land not comprised within a National Park, sanctuary or a conservation reserve, as a community reserve, for protecting fauna, flora and traditional or cultural conservation values and practices. The objective behind creating community reserves is to provide enabling legal environment so that people are able to conserve community owned or private land that have high conservation value or have high traditional cultural or religious values and practices.

Conservation reserves, another promising likely country approach, provides that the state government may, after consulting the local communities, declare any area owned by the government, particularly the areas adjacent to National Parks and sanctuaries and those areas which link one protected area with another, as a conservation reserve for protecting landscapes, seascapes, flora and fauna and their habitat. The management of conservation reserves rests with a committee, comprising five representatives nominated by the village panchayat (village council) or where such panchayat does not exist, the members of the gram sabha (village assembly) and one representative of the SFD or wildlife department under whose jurisdiction the community reserve is located. Conservation reserves provide a legally enabling environment for creating buffer areas and corridors for wildlife management and simultaneously involving local communities in active planning and conservation. In 2005, Tiruvidaimarudur Conservation Reserve became the first Conservation Reserve to be established in the country.

However, the most dominant institutional approach to manage degraded forest land outside the PA network that is likely to be strengthened in coming decades is that of Joint Forest Management. Appropriately designed JFM policies can sustain and strengthen community livelihoods and simultaneously avoid deforestation, restore forest cover and density, provide carbon mitigation and other ecosystem services and create rural assets and livelihoods. JFM is being ambitiously funded by the central government under the National Afforestation Plan and international funding institutions and as such the area under CBFM is likely to increase rapidly. The JFM approach is likely to be strengthened institutionally and seems to provide promising prospects for the future to rehabilitate and manage degraded forests in India.

5.4 Payment for Environmental Services

Markets for a number of environmental services provided by the forests – water, timber, fire-wood, charcoal, NTFPs, fodder, grasses, and recreation and tourism in National Parks and Sanctuaries already exists in India since decades. Other environmental services of forests like watershed protection and carbon storage are the emerging markets for payment of ecosystem services (PES) in India.

One of the most basic economic instruments for PES in India is the payment of Net Present Value (NPV) of forgone ecosystem services resulting from forestland diversion for non-forestry purposes. The provisions of the Forest (Conservation) Act, 1980 (FCA) stipulate prior central government approval before any forest land is sought to be diverted for non-forestry purpose. Prior to the enactment of the FCA, forestlands were *defacto* zero cost land resource and were increasingly being diverted for settlements and development projects by the state governments. The FCA provides for the mandatory compensatory afforestation on equivalent non-forestry land or double the area on degraded forest land if non-forestry land is unavailable. In addition the user agency is also required to pay NPV to compensate for the consequential loss of environmental services to the society resulting from diversion of forestland for non-forestry purposes, the amount of which ranges between Rs 0.58 million to Rs 0.92 million per hectare depending on the canopy density of the diverted forestland. In the case of hydroelectric projects the project authorities are also required to pay for catchment area treatment.

A study by Sengupta et al. (2003) explores the potential and appropriateness of using market-based mechanisms for improving watershed protection services and livelihoods in India at small, intermediate and large scales and reports several successful examples of small initiatives which more or less replicate market-based mechanisms for watershed protection services. In *Sukhomajri* and *Nada* in Haryana and *Pani Panchayats* in Maharashtra, the allocation of equal water rights to all villagers, irrespective of whether or not they own land, in return for their participation in watershed protection activities on common lands, have enabled the landless and the land poor to sell their water rights to larger landowning farmers who need the surplus water. This market-based mechanism has significantly increased equity and improved livelihoods at the village level. But, the study notes, that the examples where such trading of water rights have taken place are more of exceptions rather than the rule, and more research is needed to find out why such market-based mechanisms have not occurred at a larger scale in other parts of India. The study also explores the prospects of upstream JFM communities receiving payments for sustainable use and protection of upper forest catchments from hydroelectric power project authorities or from Irrigation and Public Health Department for supplying piped water to downstream water users. The study concludes that more theoretical analysis is required so that an enabling framework for creating and functioning for watershed protection services markets could be developed.

The share of the forestry sector in the plan outlays of India is around 1% which translates into an annual allocation of about Rs. 15,000 million. As against this the recorded and unrecorded removal of the forest produce from forests is valued at over Rs. 300,000 million which is 20 times the total outlay (NFAP, 1999). The restoration of degraded forests in India on a sustainable basis thus requires huge funding. The government through its command and control methods alone cannot manage the forest successfully and this calls for looking at strengthening alternate options, particularly economic instruments like PES. The introduction of suitable economic instruments for PES for forests can

strengthen forest conservation and sustainable development in India by raising the necessary capital to rehabilitate degraded forests on one hand and by providing financial incentives to communities in return for their participation in managing degraded forests.

6. Recommendations

India is one of the few developing countries that has consistently taken a large number of steps in the six decades of its independent history to protect its natural resources and restore its forest vegetation and has strived, with commendable resolve though inadequate results, to bring one third of its land area under forest cover. Its large and increasing population, burgeoning demand for forest products, the grinding poverty of a significant section of its population, limited financial resources and pressure on land for its multifarious developmental needs have made the progress slower than what it would have hoped for. Now, with the giant strides it has made on the path of development in the past decade or so, its improved access to financial resources, enhancement in its technological and management capacities, and the new opportunities that are opening up for the forestry sector in view of its importance to climate change mitigation it is now poised to take major progress in reaching its objectives. On this fast pace journey the approach suggested below may be of help, based as it is on the lessons of the past.

Recommendations for the future are:

- **Accord priority to community based programmes**: Policy changes and legislations have been able to bring down deforestation and the forest cover has stabilized at about 64 million. Forests continue to be subjected to increasing local extraction pressures with growing demands. As such, strategy of involving communities should be given priority given that the landscapes requiring conservation and restoration are human dominated ecosystems.

- **Increase in forestry sector funding:** The effort for restoring degraded forests in India requires huge funding. The present share of the forestry sector in the outlay is around 1%. This needs to be augmented and backed by strong institutional support.

- **Integrate climate change mitigation and payment for other ecological services at the core of forest development and management**: The wide acceptance of forests as one of the most important climate change mitigation tool and the availability of carbon markets provide new opportunities for capturing true economic value of the forests. Similar market mechanisms also need to be evolved for other important ecological services that the forests provide. Only then bringing, and maintaining a third of the land under forests would be economically feasible for a country of limited resources like India.

- **Make forest conservation based economic activities locally important**: Economic activities like eco-tourism provide a service that would be increasingly in demand as the country prospers and has the potential of creating a large number of dispersed employment opportunities across the country. The fact that the presence of good forests enriches ecotourism experience would help make forest conservation an economically desirable activity.

- **Recognize pre-existing rights:** Customary tenures are often poorly recorded in official records which prevent genuine participation of individuals and communities in restoration and protection of degraded forests. These rights need to be recognized and simultaneously balanced by adequate legal and institutional measures so that the sustainability of ecosystem services is not compromised.

- **Broaden forest research beyond the traditional:** Forestry research needs to reorient its focus from traditional silviculture to the current needs in the areas of community based forestry, environmental ethics, political ecology, environmental history and ecological economics, urban forestry, mitigation of and adaptation to climate change etc. There is a need to develop

institutions for integrative and multi-disciplinary research to overcome the current disciplinary fragmentation of the forest science community located in forestry institutes and universities.

- **Reduce gaps in forestry database:** The existing forestry database is fragmented, patchy and inadequate. The urgent need to develop a unified forestry database for meaningful policy planning and implementation research is required for meaningful national and regional level policy research and implementation.

- **Increase forestry infrastructure and existing managerial capacity**: The weakness of the existing system lies in the inadequate policy enforcement capabilities of environmental institutions, both in terms of the inadequate manpower and the quality of services they are capable of delivering. This needs to be improved by upgrading their physical infrastructure and managerial capacity. Some of these services can also be obtained through outsourcing from academic centers and private sector. This will compensate for lack of adequate institutional capacities while building academic and private economic interest in creating and protecting forests.

- **Develop institutions for multi-scale governance:** Forests serve not only needs of the communities on their periphery but also those far beyond. There has been success in building village level institutions but to ensure the delivery of sustained social benefits to larger distant communities requires the adoption of multi-scale institutions for governance. Excessive focus on centralized governance or solely on local community based governance may be counterproductive in the long run. In this context, local community-based forest restoration should be nested within larger ecosystem and landscape management programmes.

- **Inter-sectoral policy coordination:** In India, excessive firewood harvesting and grazing are major causes leading to forest degradation. Collaborative mechanism between forestry and other sectors especially animal husbandry sector for management of grazing and fodder production, and energy sector for management of rural energy requirements need to be set-up at local, state and national level.

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List of Acronyms and Abbreviations

CAT	Catchment Area Treatment
CBD	Convention on Biological Diversity
CBFM	Community-based Forest Management
CPR	Common Property Resources
CR	Community Reserves
EERN	Ecological and Economics Research Network
FAO	Food and Agricultural Organization
FCA	Forest (Conservation) Act, 1980
FDA	Forest Development Agency
FES	Foundation for Ecological Security
FSI	Forest Survey of India
FY	Fiscal Year
GDP	Gross Domestic Product
HDI	Human Development Index
HPEDS	Himachal Pradesh Eco-Development Society
ICAR	Indian Council of Agricultural Research
ICFRE	Indian Council of Forestry Research and Education
IGCEDP	Indo-German Changar Eco-Development Project
IRMP	Integrated Resource Management Planning
JFM	Joint Forest Management
MoA	Ministry of Agriculture
MoEF	Ministry of Environment and Forests
NAPCD	National Action Programme to Combat Desertification
NBASP	National Biodiversity Action Plan
NCA	National Commission on Agriculture
NFAP	National Forestry Action Plan
NFCR	National Forestry Commission Report
NFEP	National Forestry Extension Programme
NGO	Non-Governmental Organization
NPV	Net Present Value
NSSO	National Sample Survey Organization,
NTFP	Non Timber Forest Products
NWDB	National Wasteland Development Board
PA	Protected Area
PC	Planning Commission
PES	Payment of Ecosystem Services
PF	Protected Forest
PIL	Public Interest Litigation
PPP	Purchasing Power Parity

PRI	Panachayati Raj Institutions
REDD	Reduced Emissions from Deforestation and Degradation
RF	Reserve Forest
Rs	Rupees
SFD	State Forest Department
SFR	State of Forest Report
SFRI	State Forest Research Institute
SFRP	State Forestry Research Plan
SPM	Suspended Particulate Matter
TERI	The Energy and Resources Institute
UF	Unclassed Forest
UN	United Nations
UNFCCC	United Nations Framework on Climate Change Convention
USD	United States Dollar
WHO	World Health Organization

Appendix A: ***Ecological Description and Distribution of Forest Types***

Forest Type	Distribution	% of Forest Areas
Tropical Forests		
Tropical wet evergreen	Northeast and South India, A&N Islands	5.8
Tropical semi evergreen	South and East India	2.5
Tropical moist deciduous	Central and East India	30.3
Tropical littoral and swamp	Along the east and west coast	0.9
Tropical dry deciduous	West and Central India	38.2
Tropical thorn	West and Central India	6.7
Tropical dry evergreen	Central and South India	0.1
Subtropical Forests		
Subtropical broadleaved hill forests	South India	0.4
Subtropical	Sub-himalayan tract	5.0
Subtropical	Northeast and South India	0.2
Temperate Forests		
Montane wet temperate	Himalayas and Nilgiris (in Western Ghats)	2.0
Himalayan moist temperate	Temperate areas of Himalayas	3.4
Himalayan dry temperate	Dry Temperate areas of Himalayas	0.2
Sub-alpine and alpine Forests		
Sub-alpine	Himalayas	
Moist alpine shrub	Himalayas	4.3
Dry alpine shrub	Himalayas	

(Source: MoEF, 1999)

Bluepine (*Pinus wallichiana*) Forests of Jammu & Kashmir State, India

Mangrove Forests (showing *Rhizophora*) of Coastal India

Intrinsic Dependence of Locals on Forests for Fuelwood

Harvesting of Fodder Grass by the Local Communities to Sustain Cattle Population