

POPULATION PRESSURE AND DEFORESTATION IN INDIA

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INTRODUCTION

The growing global concern for conservation of the world's natural resources has resulted in the formulation of long-term perspective plans for conserving forests. These forests facilitate the conservation of ecological balances, biodiversity, enhance the quality of environment by checking soil erosion, water retention and conservation, regulate water cycle, act as a carbon sink which balances the carbon dioxide and oxygen in the atmosphere and facilitate in reduction of the greenhouse gases effect, etc. Population pressure, poverty and weak institutional framework have often been viewed as

the predominant underlying causes of forest depletion and degradation in developing countries. Excessive population and livestock pressure and the requirements of forest products for essential development generate a pressure on forest resources like fuelwood, fodder, timber, lumber, paper, etc. which in turn triggers a deforestation process. Overexploitation of the forest's resources as compared to its incremental and regenerative capacities escalates the forest depletion and degradation process.

Excessive deforestation has not only local but also global environmental degradation ramifications. It can also affect sustainable socio-economic developmental processes in the developing countries as forests have been generating a lot of employment opportunities in the primary, secondary, and tertiary sectors and have been a source of subsistence to the poorest of the poor in the agricultural economies. Furthermore, inhuman face of deforestation is characterised by the increasing stress on the poorer sections of the society and women, as they have been primarily involved in gathering fuelwood, fodder and water in the traditional village economies.

The enormity of forest stock scarcity in India can be judged from India's position in the world in terms of population and forest resources. India possesses around 16 percent of the world's population and 15 percent of world's livestock, with only 2.4 percent of the world's land area and 1.7 percent of the world's forest stock. Obviously, land and forest resources are not commensurate with the proportionate burden of population and livestock on India's soil. This report purports to highlight linkages between increasing population pressure and shrinking forest resources in the Indian context.

The predominant causes for dwindling forest wealth have been identified as over-exploitation, overgrazing, illegal encroachments, unsustainable practices, forest fires, and an indiscriminate siting of development projects in the forest areas (GoI, 1999). Withdrawal of forest products, including fuelwood, timber, etc. are much beyond the carrying regenerative capacity of our forests. The current annual withdrawal of fuelwood from forests is estimated at 235 million cubic meters against a sustainable capacity of about 48 million cubic meters. The annual demand for industrial wood is about 28 million cubic meters against the production capacity of 12 million cubic meters. Area affected by forest fire range from 33% in West Bengal to 99% in Manipur. However, population pressure is always the underlying cause of overexploitation of the natural resources including forest stock. Possibly, poverty, corruption, weak institutions, and wasteful consumption patterns also combine with the population pressure facilitating depletion and degradation of forest stock having enormous environmental degradation ramifications.

POPULATION PRESSURE

The burgeoning population of India has grown from 361 million in 1951 to 846 million in 1991 (see Table 1) and crossed the one billion mark on 11th May, 2000 and would grow further to 1.7 billion by 2050 as per the UN's long -range projections for India.

India's population has thus grown 2.3 times during a span of just 40 years from 1951 to 1991. Perusal of the table reveals that there has been an acceleration in the process of population growth till the 1970s and a slight deceleration in the process during the 1980s. Though the process of population growth has witnessed a slight deceleration during 1980s, but the process of metropolitization accelerated during the period.

While the total population of India has grown 2.3 times during 1951 to 1991 the process of redistribution has been such that million+ cities population has grown around six times, i.e. from 12 million in 1951 to 71 million in 1991. It may be of interest to mention that the number of million plus population cities have grown from just 5 in 1951 to 12 in 1981 to 23 in 1991. The number is expected to swell faster over the coming years and possibly may cross 50 by the next census of 2001

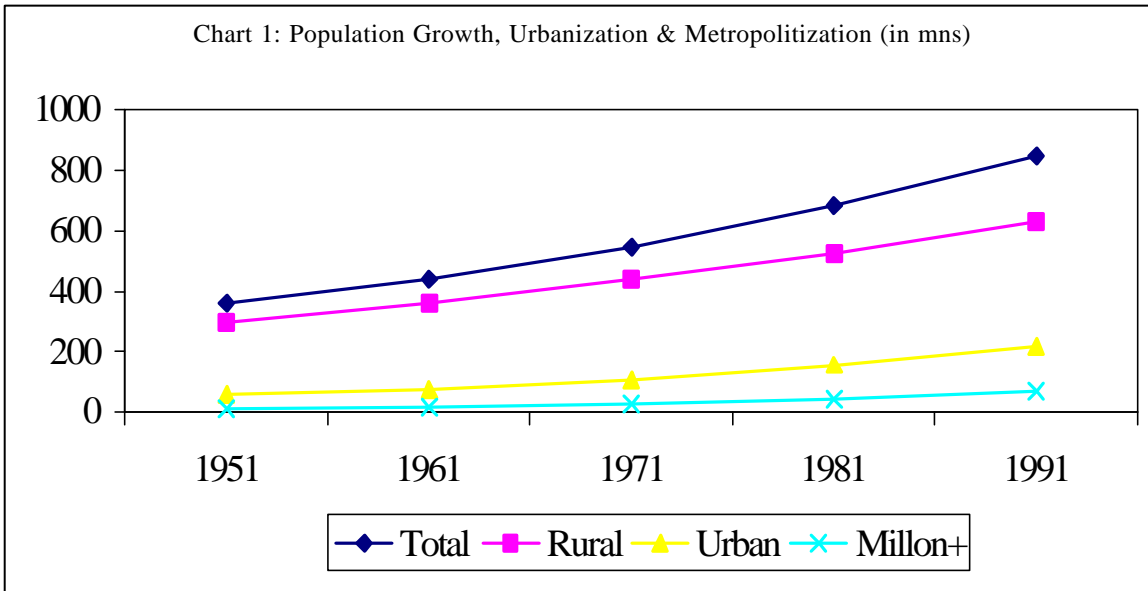
TABLE 1: POPULATION SIZE, GROWTH & DISTRIBUTION PATTERNS In INDIA: 1951-91

	Population In Millions		Decadal Growth * Rate and Population During				Ratio of 1991 to 1951 Popn. 1951=100
	1951	1991	1951-61	1961-71	1971-81	1981-91	
Total	361	846	21.5	24.8	24.7	23.9	234
Rural	299	629	20.5	21.9	19.3	20.0	210
Urban	62	218	26.4	38.2	46.1	36.5	349
Class I Towns	28	139	44.9	53.5	54.4	46.9	504
Million+ Cities	12	71	54.1	53.7	51.3	67.8	601

Note: *Areal population growth is sum of natural increase migration, and reclassification during the intercensal period.

Source: Censuses of India, 1951 to 1991.

Population-driven pressure on croplands, pasturelands, and forestlands coupled with abject rural poverty triggered rural outmigration to urban and industrial centres for wage employment. The pace of urbanisation has always been faster than the pace of population growth in India. Furthermore, the process of metropolitization has always been more accelerated than that of urbanisation and had further escalated since the 1980s (see Chart 1). The process is expected to gather further momentum over the coming years.



Agglomeration of the population in the metros and megapolises primarily because of distress outmigration from rural areas and the has generated a growing demand for timber, lumber and paper which in turn has resulted into depletion and degradation of forest land in India.

LIVESTOCK POPULATION PRESSURE

Demand for livestock products like milk, eggs, meat, etc. is expected to grow along with an increase in income. Due to development and the accelerated process of urbanization and metropolization, people in urban areas and with higher incomes generally substitute pulses with more of fruits, vegetables, and livestock products (Bansal, 1999). Indirect evidences of reduction of the area under cultivation for pulses may also be interpreted as the declining importance of pulses and an increase in per capita availability of livestock products reflects the growing demand for the protected food (UNFPA 1999). Obviously, the consequences of this process are the increasing livestock pressure on land and forests because of increase in demand for fodder and grazing.

India's livestock population has increased from 228 million in 1951 to 336 million in 1992 and is projected to cross 500 million by the end of 2000. Conversion of the livestock population to standard cattle units (SCUs), using cattle equivalents for different categories of livestock (Mishra 1990), reveals that standard cattle units have also grown from 228 million in 1951 to around 336 million in 1992 (see Table 2).

TABLE 2: INDIA'S LIVESTOCK POPULATION: 1951 TO 1992 (Millions)

	1951	1961	1972	1982	1992
Cattle	155.3	175.5	178.3	192.5	204.5
Buffaloes	43.3	51.2	57.4	69.8	83.5
Sheep	38.4	40.0	40.0	48.8	50.8
Goats	47.1	60.9	67.5	95.3	115.3
Horse & Ponies	1.5	1.3	0.9	0.9	0.8
Pigs	4.4	5.2	6.9	10.1	12.8
Camels	0.6	0.9	1.1	1.1	1.1
Others	1.3	1.2	1.1	1.3	1.3
Total	292.0	336.2	353.3	419.6	470.1
Standard Units	228.0	259.7	270.5	304.5	336.0

Note: "Others" include predominantly donkeys and mules.

Sources: Government of India, Livestock Census Reports; Mishra, S.N. and Sharma, R.K., 1990, Livestock Development in India.

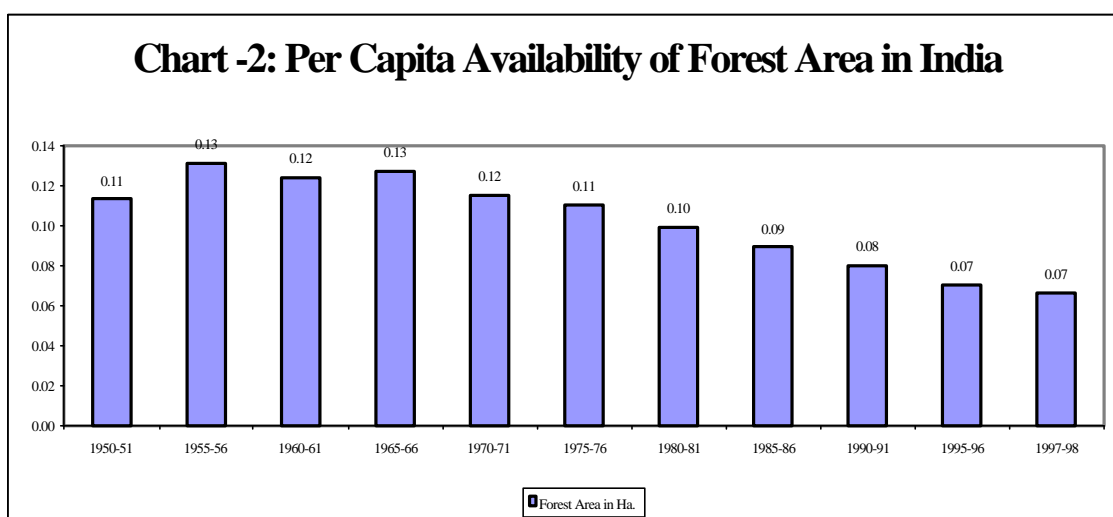
It may be of interest to mention that the proportion of sheep and goats to total livestock population has increased from around 28% in 1951 to more than 35% in 1992. This characterises the extent of deforestation (Gulati and Chopra 1994) in India.

Whether the cattle stock is stalled or being left to graze depicts the increasing burden on foliage over the years. It has often been recognised that illegal grazing and overgrazing in forest tracks has also been primarily responsible for forest degradation in India.

DECLINING PER CAPITA AVAILABILITY OF FOREST AREA IN INDIA: 1951 TO 1997

The recorded forest area in 1950-51 was reported to be 68 million ha and increased to 75 million ha in the early 1980s due to consolidation. The forest area was further reported to be 76.5 million ha in 1997. However, the authenticity of the historical data on the forest area has been doubtful (MoEF 1997). Encroachments lead the list in the diversion of forest area for non-forestry purposes between 1950 and 1980 to the order of 4.5 million hectares, i.e. at an annual rate of 0.15 million hectare. Thereafter marginal declines in forest area have been depicted by an annual decline of 0.016 million hectares (Economic Survey, 1998-99).

Despite an increase in the recorded forest area the accelerated pace of population growth has resulted in declining trend in the per capita availability of forest area since the 1950s. An overall-declining trend is consistently noticeable after 1965-66 (see Chart 2). Overall we find that per capita availability of forestland had oscillated around 1.2 during 1950s and consistently declined from 1965 onwards. The availability declined from 0.127 hectares in mid 1960s to 0.066 hectare in 1997-98, which is extremely poor as compared to the world standards. The availability is expected to decline further with the expected population growth because of inbuilt demographic momentum and higher wanted and unwanted fertility. The growth of population is expected to be faster than the expected improvements in forestland availability as well as forest cover of quality. Despite the governmental initiatives in joint forest management, on the tree growers co-operative movement, etc. over the last 8 to 10 years have not produced any tangible results, and the forest depletion and degradation continues unabated.



Source: Figures used here were worked out by R.N.Pandey, Joint Director, C.S.O., New Delhi, which were based on Land Use Statistics provided by the Ministry of Agriculture.

HISTORICAL PERSPECTIVE OF FOREST COVER DECLINE

Overall the forest cover has been decimated from nearly 40% of India’s geographical area a century ago (Ramachandran 1983) to 22% in 1951 and to 19% in 1997 (MoEF 1997). After independence the forest cover area has further declined from 71.8 million hectare in 1951, and 63.9 million hectares in 1991, to around 63.3 million hectares in 1997, which depicts a consistently declining trend in India’s forest cover till now. Though it has been claimed that forest cover decline has been arrested since 1991, yet the qualitative decline persists as characterised by a decline in the forest’s growing stock during 1989-97.

CURRENT STATUS OF INDIA'S FORESTS

As per the Forest Survey of India assessment in 1997, India's total notified forest area is 76.5 million hectares, which is 23.3% of a total geographical area of 328.7 million hectares. Estimated forest cover, as per the estimate of the Forest Survey of India (MoEF 1999), is only 63.3 million hectares, which is just 19.3% of its geographical area and is way below the stipulated target of 33% by the National Forest Policy document of 1988.

The term ‘crown density’ of forestlands measures the extent of cover of branches and foliage formed by the crowns of trees in a wood. All lands with a forest cover of trees with a canopy density of 40 percent and above are categorised as dense forests (MoEF 1997, p.2). Thus, forestlands with a crown density of 40 percent or more viz. dense forests cover only 36.7 million hectares, or just about 11.2% of India's total geographical area. Open forestland with a crown density of 10 to 40 percent covers 26.1 million hectares or about 7.9 percent of the country's land area. Mangroves with a crown density of less than

Table 3: Forest Area and Forest Cover & Its Composition in 1997 (Sq.Km.)

State	Geographical Area (GA)	Recorded Forest Area	Estimated Forest Cover (FC)	Dense Forest Cover	Open Forest Cover	Man groves	% FC to GA	Per Capita FC (In ha)
Andhra Pr.	275068	63814	43290	23048	19859	383	16	0.07
Assam	78438	30708	23824	15548	8276	0	30	0.11

Bihar	173877	29226	26524	13300	13224	0	15	0.03
Goa	3814	1424	1255	995	255	5	34	0.11
Gujarat	196024	19393	12578	6337	5250	991	6	0.03
Haryana	44212	1673	604	370	234	0	1	0.00
H.P.	55673	35407	12521	9560	2961	0	23	0.24
J.K.	222235	20182	20440	11020	9420	0	9	0.26
Karnataka	191791	38724	32403	24854	7546	3	17	0.07
Kerala	38863	11221	10334	8454	1880	0	27	0.04
M.P.	443446	154497	131195	82745	48450	0	30	0.20
Maharashtra	307690	63842	46143	23622	22397	124	15	0.06
Manipur	22327	15154	17418	4937	12481	0	78	0.95
Meghalaya	22429	9496	15657	4044	11613	0	70	0.88
Mizoram	21081	15935	18775	4348	14427	0	89	2.72
Nagaland	16579	8629	14221	3487	10734	0	86	1.18
Orissa	155707	57184	46941	26101	20629	211	30	0.15
Punjab	50362	2901	1387	511	876	0	3	0.01
Rajasthan	342239	31700	13353	3690	9663	0	4	0.03
Sikkim	7096	2650	3129	2423	706	0	44	0.77
Tamil Nadu	130058	22628	17064	8676	8367	21	13	0.03
Tripura	10486	6292	5546	1819	3727	0	53	0.20
Uttar Pradesh	94411	51663	33994	22958	11036	0	12	0.02
West Bengal	88752	11879	8349	3557	2669	2123	9	0.01
A. & N. Island	8249	7171	7613	6520	127	966	92	2.71
Arunachal Pr.	83743	51540	68602	54155	14447	0	82	7.93
All India	3287263	765209	633397	367260	261310	4827	19	0.07

Notes:

- Recorded Forest Area : All lands statutorily notified as forest though they may not necessarily bear tree cover.
- Forest Cover : All lands with a tree canopy density of more than 10% though they may not be statutorily notified as forest.
- Source : MoEF, 1997; State of Forest Report, Forest Survey of India.

10 percent cover only 4.8 thousand sq. km. comprising only 0.1 percent of the country's land area. However, the concentration of mangroves is predominantly in West Bengal, Gujarat and the Andaman and Nicobar Islands. However, the extent of open forestlands, which are primarily degraded forests, depicts the potential available for recuperation and regeneration of forests in India.

Interstate variations in the relatively proportionate geographical area under forests are quite substantial. Table 3 reveals that the proportionate forest cover to geographical area varies from 1% in Haryana to 92% in the Andaman and Nicobar Islands. Most of the smaller states in the north-eastern parts of India over the Himalayan ranges have a major portion of their land under forests such as Mizoram (89%), Nagaland (86%), Arunachal Pradesh (82%), Manipur (78%), Meghalaya (70%), and Tripura (53%). Also we find that the Andaman and Nicobar Islands have around 92% of geographical area under forests. Amongst the larger states Assam, Orissa and Madhya Pradesh have 30% of their geographical area under forests (see Map 1 in Appendices).

REGIONAL VARIATIONS IN PER CAPITA AVAILABILITY OF FOREST COVER IN 1997

Wide disparities exist between different states in the per capita availability of forest cover in 1997 (see Table 3). The availability varies from 7.93 ha per person in Arunachal Pradesh to only 0.01 ha in Punjab and West Bengal. Per capita availability of forest cover in Mizoram and the Andaman and Nicobar Islands is of the order of 2.7 ha per person. There are many forest scarce states with less than a critical minimum of 0.1 hectares per person viz. Andhra Pradesh, Kerala, Karnataka, Tamil Nadu, Gujarat, Maharashtra, Uttar Pradesh, Bihar, etc. Per capita availability of forest cover area for India as a whole is only 0.07 hectare per person in 1997, which is way below the critical level.

Percent distribution of India's total forest cover among the states is quite skewed (see Map 2

in Appendices). Thus Madhya Pradesh tops with 21%, followed by Arunachal Pradesh with only 11%, and thereafter Andhra Pradesh, Orissa, and Maharashtra with each having 7% of India's total forest cover. Thus, these five states have more than 53% of India's total forest cover. For the rest of the India the total forest cover is distributed largely amongst hilly states like Assam, Manipur, Mizoram, Meghalaya, and other states like Bihar, Karnataka, and Uttar Pradesh. There may not be a close association between the percent distribution of forest cover and forest stock as Jammu and Kashmir has only 2.6% of India's forest cover whereas it has 9.9% of the forest stock (see Map 3 in Appendices).

Though forest cover has stopped declining further its quality however is still declining in terms of lowered growing stock and annual incremental rates depicting a lowered volume of the forest's stock and of the productivity of India's forest covered areas. Information on the quality of forests in terms of crown densities started flowing only from 1989 onwards (MoEF 1997). Though further losses in terms of quantitative forestland has been more or less contained, the declines in forest quality in terms of volume of forest's growing stock and incremental rates still continues.

It may be of interest to mention that the changes in terms of increase or decrease in the forest-covered area may not automatically imply increase or decrease in the volume of growing stock or forest's stock characterising forest's quality. Possibly a decline in the overall forest-covered area can coexist with an increase in the stock volume because of compositional changes from open to dense forestlands. Forest losses in terms of quantitative and qualitative aspects can be highlighted for the period 1989 to 1997, since information of changes in forest cover, its composition in terms of crown densities, and volume of forest's stock and annual increments become available for the period.

FOREST COVER CHANGES IN 1997 OVER 1989

India's forest cover has declined from 64.0 million hectare in 1989 to 63.3 million hectares in 1997 depicting a 1% decline during the period (see Table 3 and 4). However, regional disparities in the forest cover decline during the period are quite substantial.

TABLE 4: CHANGES IN THE FOREST COVER: 1989 TO 1997 (AREA IN Sq. KM)

State	Forest Cover Area in 1989	Dense Forest Cover in 1989	Open Forest Cover in 1989	Forest Cover Change	PDIFCC	% Change in Forest Cover
Andhra Pr.	47911	25535	21971	-4621	69	-10
Assam	26058	16688	9370	-2234	33	-9
Bihar	26934	13412	13522	-410	6	-2
Delhi	22	12	10	4	-0	18
Goa	1300	975	322	45	1	-3
Gujarat	11670	5259	5999	908	-13	8
Haryana	563	130	433	41	-1	7
H.P.	13377	7100	6277	-856	13	-6
J.K.	20424	10824	9600	16	-0	0
Karnataka	32100	24749	7351	303	-4	1
Kerala	10149	8312	1837	185	-3	2
M.P.	133191	91448	41743	-1996	30	-1
Maharashtra	44058	26177	17767	2085	-31	5
Manipur	17885	5060	12825	-467	7	-3
Meghalaya	15690	3427	12263	-33	0	-0
Mizoram	18178	3883	14295	597	-9	3
Nagaland	14356	4632	9724	-135	2	-1
Orissa	47137	27561	19384	-196	3	-0
Punjab	1161	97	1064	226	-3	19
Rajasthan	12966	2902	10064	387	-6	3
Sikkim	3124	2410	714	5	-0	0
Tamil Nadu	17715	9759	7909	-651	10	-4
Tripura	5325	1214	4111	221	-3	4
U.P.	33844	22632	11212	150	-2	0
West Bengal	8394	3332	2953	-45	1	-1
Da.N.H.	205	149	56	-1	0	-0
A. & N. Island	7624	6518	133	-11	0	-0
Arun. Pr.	68763	54272	14491	-161	2	-0
Chandigarh	8	0	8	-1	0	-13
All India	640132	378469	257408	-6737	100	-1

Note:

PDIFCC: Percent Distribution of India's Forest Cover Change amongst States.

Interestingly, the percent distribution of India's total forest cover decline amongst the states reveals that the decline is predominantly from three states, viz. Andhra Pradesh accounting for 69% (with 0.46 million ha), Assam for 33% (with 0.22 million ha) and Madhya Pradesh with 30% (with 0.20 million ha). Perusal of Map 4 in Appendices also reveals similar and moderate contributions towards the decline from other states like Himachal Pradesh, Manipur and Bihar, etc.

In some states forest cover has increased during the period, viz. Maharashtra (0.21 million hectares), Gujarat (0.09), Karnataka (0.03), Kerala (0.02), Mizoram (0.06), Punjab (0.02), Rajasthan (0.04), etc. Thus, regional concentrations of India's forest cover decline (0.67 million ha) have been in the three states, viz. Andhra Pradesh, Assam, and Madhya Pradesh. The proportionate contributions of the total forest cover loss during 1989 to 1997 by the three states are 69%, 33%, and 30%, respectively. Whereas Gujarat and Maharashtra have depicted improvements in the forest cover during the period and have rather contributed towards India's forest cover increase to the tune of 13% and 31%, respectively.

FOREST STOCK CHANGES IN 1997 OVER 1989

The forest's growing stock reflecting the quality of forest cover in terms of crown densities was made available by the Forest Survey of India for the first time in 1989. The detailed methodology for the growing stock assessment for the entire country was assessed using information available from the vegetation thematic maps and the ground forest inventory done by the Forest Survey of India (MoEF 1995, pp.14-16). Thus, the growing stock and forested area under various density classes for various states/UTs had been worked out.

The forest's growing stock statewide per hectare under various density classes was applied to forestlands under alternate density classes for 1989 and 1997 to reflect the qualitative changes of forestlands in different states over the period. It would be interesting to note that in 1997 we find only 36.7 million hectares of forested land, i.e. only 11.2 percent of the country's total land area comprise dense forests or forests with a crown density of more than 40%. The remaining forest cover was either open forest with crown density between 10 to 40 % or mangroves with a crown density of less than 10%.

The volume of growing stock per hectare in dense forestlands (vgsdf) and open forestlands (vgsof) have been estimated from the 1995 FSI report. The overall volume of growing stock per ha for India's dense forestland turns out to be around 98.9 cubic meters (see Table 5). Interestingly we find that the volume of growing stock in dense forest areas in the hilly ranges is much higher than the plain areas. The hilly states like Assam (155.0 Cum/ha), Himachal Pradesh (247.8 Cum/ha), Jammu & Kashmir (299.9 Cum/ha), Manipur (111.8 Cum/ha), Meghalaya (154.4 Cum/ha), Nagaland (122.2 Cum/ha), Sikkim (146.3 Cum/ha), etc. depict much higher growing stock per ha as compared to states in the plains of India such as Bihar (49.8 Cum/ha), Haryana (38.4 Cum/ha), Punjab (11.5 Cum/ha), Rajasthan (17.0 Cum/ha), West Bengal (63.2 Cum/ha), etc. Similar patterns of inter-state disparities in hilly and plain areas in volumes of growing stock in open forests are also discernible. The overall volume of growing stock in the open forests of India is only 36.8 Cum/ha as compared to 98.9 Cum/ha in the dense forests of India.

Using these state level estimates of the volumes of growing stocks per hectare in dense and open forestlands in 1989 and 1997 and estimating the total volume of growing stock for all the states in the two periods provides clues to the state level changes in the volume of the forest stock during the period. The elicited volumes of growing stock for all the states (having more than 1% of India's forest cover) for the two periods are provided in Table 5.

TABLE 5: DEPLETION OF FOREST STOCK: 1997 OVER 1989

State	DFGS	OFGS	VGS89	VGS97	PDIFSC	PCVGS
Andhra Pr.	84.4	36.0	294611	266018	60	-10
Assam	155.0	66.2	320693	295781	53	-8
Bihar	49.8	23.2	98163	96914	3	-1
Delhi	11.5	4.6	18	23	0	25
Goa	122.9	16.0	12498	12637	0	1
Gujarat	67.6	37.0	57747	62263	-10	8
Haryana	38.4	9.0	889	1631	-2	84
H.P.	247.8	59.1	213035	254396	-87	19
J.K.	299.9	137.4	456516	459921	-7	1
Karnataka	100.7	29.6	270981	272616	-3	1
Kerala	97.5	87.7	97152	98914	-4	2
M.P.	62.0	26.4	677179	640927	77	-5
Maharashtra	67.6	28.5	227592	223516	9	-2
Manipur	111.8	29.3	94148	91765	5	-3
Meghalaya	154.4	42.6	105153	111911	-14	6
Mizoram	69.6	25.2	63049	66618	-8	6
Nagaland	122.2	48.1	103375	94242	19	-9
Orissa	67.7	31.2	247066	241066	13	-2
Punjab	11.5	4.6	601	991	-1	65
Rajasthan	17.0	7.1	12079	13134	-2	9
Sikkim	146.3	58.7	39449	39593	0	0
Tamil Nadu	52.3	24.5	70417	65875	10	-6
Tripura	34.2	24.8	14347	15464	-2	8
Uttar Pradesh	131.0	34.3	334936	338603	-8	1
West Bengal	63.2	5.9	22801	24055	-3	6
Da. & N. H.	51.3	11.5	829	867	0	5
A. & N. Island	120.6	43.6	79187	79185	0	0
Arunachal Pr.	128.9	50.9	773325	771593	4	0
Chandigarh	11.5	4.6	4	7		
All India	98.9	38.6	4687842	4640525	100	-1

Notes:

DFGS : Dense Forest Growing Stock (Cubic meter per hectare)

OFGS : Open Forest Growing Stock (Cubic meter per hectare)

VGS89 : Volume of Growing Stock in 1989 (in 000s cubic meter)

VGS97 : Volume of Growing Stock in 1997 (in 000s cubic meter)

PCVGS : Percent Change in Volume of Growing Stock in each state.

PDIFSC: Percent Distribution of India's Forest Stock Change amongst states.

Source : Forest Survey of India (FSI), 1995, 1997 & 1999.

Again we find that the total forest stock for India decimated by only 1% from 1989 to 1997 but the regional disparities in the declines are quite substantial. An overall qualitative decline in India's forestland characterised by depletion in the forest stock from 4688 million cubic meters (mcm) in 1989 to 4640 mcm in 1997 is apparent (see Table 5). However, inter-state differentials in the declines/increases in the forest stock over the period are quite substantial (see Map 5, Appendices). Surprisingly, Madhya Pradesh, which has around 21% of India's forestland, depicts a 5% decline in volume during the period. Andhra Pradesh, which has around 7% of India's forestland, depicts a decline of about 10% in the volume. Assam having 4% of India's forestlands depicts a decline of about 8% in the volume. Arunachal Pradesh having 11% of India's forest cover depicts no decline in the forest's stock during the period.

FOREST COVER AND FOREST STOCK CHANGES DURING 1989 TO 1997

Changes in the forest cover and its composition over 1989 to 1997 have been elicited for all the states

and union territories of India during the period 1989 to 1997. Similarly changes in the forest stock for all the states and union territories have also been worked out utilising the compositional changes in the forest cover and their composition, viz. proportionate changes in dense and open forests (see Table 5), for different areal units. The percent changes in forest cover and forest stock during the period for all the states and union territories are provided in Table 6.

Table 6: CHANGES IN FOREST COVER, 1989-97 (PERCENTAGES)

State	Change in Dense Forest Cover	Change in Open Forest Cover	Change in Total Forest Cover	Change in Forest Stock
Andhra Pradesh	-10	-10	-10	-10
Assam	-7	-12	-9	-8
Bihar	-1	-2	-2	-1
Goa	2	-21	-3	1
Gujarat	20	-13	8	8
Haryana	185	-46	7	84
Himachal Pradesh	35	-53	-6	19
Jammu and Kashmir	2	-2	0	1
Karnataka	0	3	1	1
Kerala	2	2	2	2
Madhya Pradesh	-10	16	-1	-5
Maharashtra	-10	26	5	-2
Manipur	-2	-3	-3	-3
Meghalaya	18	-5	-0	6
Mizoram	12	1	3	6
Nagaland	-25	10	-1	-9
Orissa	-5	6	-0	-2
Punjab	527	-18	19	65
Rajasthan	27	-4	3	9
Sikkim	0	-1	0	0
Tamil Nadu	-11	6	-4	-6
Tripura	50	-9	4	8
Uttar Pradesh	1	-2	0	1
West Bengal	7	-10	-1	6
Arunachal Pradesh	-0	-0	-0	0
India	-3	1	-1	-1

Data in Table 6 reveals that India's forest cover as well as forest stock had declined by only 1 percentage point, respectively. However, substantial regional disparities in the forest cover and forest stock changes are evident from the table.

It may be of interest to mention that Himachal Pradesh, which has witnessed a decline of 6% forest cover during the period, has witnessed an increase of about 19% in the volume of growing stock. Thus, Himachal Pradesh depicts an interesting illustration where forest cover has depleted but the volume of forest stock has improved. This is basically because the dense forest cover has increased from 7100 sq. kms in 1989 to 9560 sq. kms in 1997, whereas open forest cover has declined from 6277 to 2961 sq. kms over the period. Thus, the qualitative improvement in the forestland of Himachal Pradesh has overcompensated the quantitative decline during the period. On the other hand Maharashtra depicts an improvement in forest cover but deterioration in terms of the volume of growing stock. Again this is because of compositional changes in the forest cover characterised as dense or open forests.

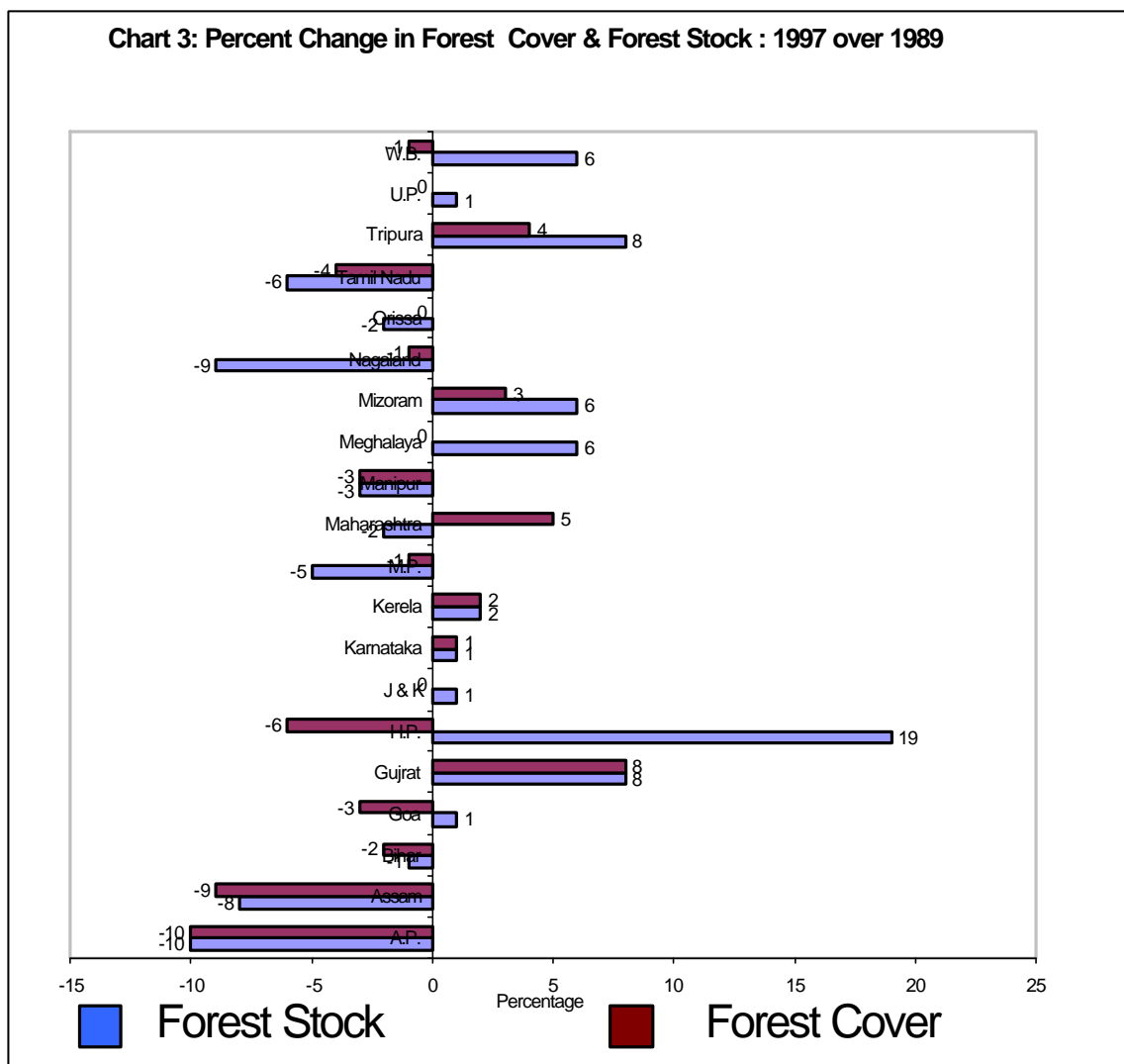


Chart 3 presents state specific percentage changes in 1997 over 1989 in the forest cover and the forest stock. Though, India's forest cover and forest stock have changed only by 1% during 1989 to 1997, the interstate variations in the changes are however quite substantial. Interestingly we find that Assam and Andhra Pradesh have witnessed a massive depletion (decline in forest cover) and degradation (depletion of forest stock) of forests during the period. However, Madhya Pradesh, which has the largest proportion of India's forest cover, has witnessed a massive decline in the forest stock characterising forest degradation.

Overall we find that Madhya Pradesh, with 21% of India's forest cover, has witnessed a 1% decline in the forest cover and a 5% decline in the forest stock or volume of growing stock. Similarly Andhra Pradesh witnessed a 10% decline in the forest cover as well as the forest stock. Assam has witnessed a decline of around 9% in forest cover and a decline of around 8% in the forest stock. Thus, the three states of Madhya Pradesh, Andhra Pradesh and Assam have witnessed a severe depletion and degradation of forests during the period.

It may be relevant to mention that there is lot of scope for forest regeneration and recuperation if perspective planning is formulated for the upgradation of open forests in various states as these constitute a substantial proportion of the states forest cover. Just a similar upgradation of the forest cover from open to dense forest category through afforestation strategies can bring about

substantial improvements in the forest stock.

DECLINING PER CAPITA AVAILABILITY OF FUELWOOD & INDUSTRIAL-WOOD

The primary uses of forests reported in most of the survey-based studies are for fuelwood, fodder, timber, and grazing (Chopra and Kadekodi 1997, p.171)). The rising demand for fuelwood on account of a burgeoning population and the increasing demand for timber and paper because of urbanization and the metropolization process in India has also been responsible for an accelerated forest degradation in the recent past. Use of firewood and cooking fuel is generally expected to go down along with an increase in income and a relatively higher use of other cleaner cooking fuels like kerosene, gas, and electricity. However, due to the dynamics of the price rise during last 15 years, a sharp increase in the price of commercial fuels (kerosene, coal, and charcoal), has forced even the urban poor of India to use fuelwood for cooking food (World Resources 1994, p.93).

Illegal grazing by around 100 million livestock in the tracts of forestland also results in forest degradation in India (World Resources 1994-95). Livestock population has grown from 292 million in 1951 to 470 million in 1992 and is expected to cross the 500 million mark by the end of 2000 (Bansal 1999).

Firewood is still the most prevalent primary source of energy for cooking used by 78% of the rural and around 30% of urban households (NSSO 1997). The proportions of households using firewood as the primary source of cooking fuel had rather gone up in rural areas from 64% in 1974 to 72% in 1991 and gone down from 47% to 33% during the same period in urban areas. TERI's estimates for firewood's annual consumption turns out to be around 325 million cubic meters which is much above the carrying capacity of forests (TERY 2000, p.264).

However, excessive and illegal grazing by about 25% of India's 400 million livestock on tracts of forestland has led to an excessive loss of foliage as compared to the amount that gets regenerated and this also leads to forest degradation (Simon 1986). The carrying capacity of India's forest cover for purposes of grazing or feeding is only for 31 million livestock, which falls much below the actual grazing on the tracts of forestland.

TABLE 6: AVAILABILITY OF FUELWOOD AND INDUSTRIAL WOOD: PER THOUSAND POPULATION: 1980-81 TO 1994-95

Year	In Million	In Million Cubic Meters		Cubic Meter Per Thousand Popn.	
	EPOP	PFW	PIW	AFWPTP	AIWPTP
1980	670.8	275.2	818.7	41.0	122.0
1984	730.1	276.3	651.9	37.8	89.3
1985	745.8	277.0	652.8	37.1	87.5
1986	761.7	277.6	590.0	36.4	77.5
1987	778.0	278.5	521.0	35.8	70.0
1988	794.6	279.9	450.1	35.2	56.7
1989	811.7	280.0	465.4	34.5	57.3
1990	829.1	280.1	413.4	33.8	49.9
1991	846.9	280.4	389.1	33.1	45.9
1992	864.6	280.6	320.7	32.5	37.1
1993	882.8	281.0	329.1	31.8	36.1
1994	901.2	281.4	322.3	31.2	35.8

Notes:

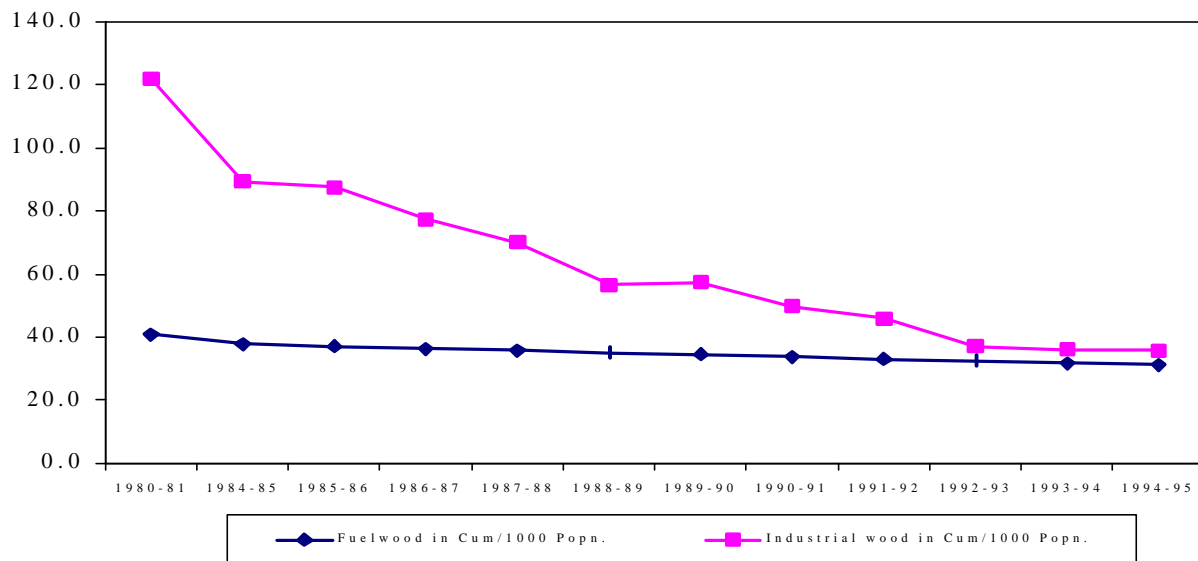
- EPOP : Estimated Population
- PFW : Production of Fuelwood
- PIW : Production of Industrial wood
- AFWPTP : Availability of Fuelwood per 1000 population

AIWPTP : Availability of Industrial wood per 1000 population

Production estimates for fuelwood and industrial wood from the forest during the period 1980-81 to 1994-95 have been elicited using production figures for 1991-92 from FSI's forest products and the value of output from forestry and logging at constant prices from TERI, 2000. The elicited production figures for fuelwood and industrial wood have been presented in Table 6. Population estimates have been interpolated for the intervening years based on census figures for 1981 and 1991 and projection figures by the Registrar General's projections upto 2016.

Production of fuelwood has increased from 275 million cubic meters (Cum) in 1980-81 to around 281 million cubic meters in 1994-94. Their fuelwood production has been consistently increasing. However, despite an increase in total production we find that the per capita availability of fuelwood (PCAFW) has been consistently declining (see Chart 4).

**Chart 4: Trends in Availability of Fuelwood and Industrial wood
(Cubic meters per 1,000 population)**



Industrial wood production depicts a consistently declining trend throughout the period (see Chart 4). Production of industrial wood has declined from 819 million cubic meters in 1980-81 to 322 million cubic meters in 1994-95. Furthermore, the per capita availability of industrial wood from forests has consistently declined from 0.122 cubic meters in 1980-81 to just 0.036 cubic meters in 1994-94. Obviously the decline in per capita availability of industrial wood is steeper than the production decline because of the increasing population although the period.

WOMEN AND FORESTS LINKAGES

In many developing countries, women and children are primarily involved in subsistence agriculture, care for the children, the elderly, grazing of animals, gathering of wood, fodder and food from forests, in cooking, cleaning, and sewing and in taking care of the household's immediate environment. Women are the primary resource and environment managers in the household. Thus, much of women's labour is performed in the noncash economy. Women in India remain universally responsible for the bulk of the household work, even when employed outside the home. Furthermore, women's dependence on forests for gathering food, fodder and food has always been much greater (Anil and Sunita 1985)

Thus, depletion and degradation of forests resulting in fuelwood and fodder scarcity or lesser accessibility to forests primarily affects women and girl children, who are generally withdrawn from schools and kept home to help their mothers/women in their household's work (Barbara 1991). Much of the fuelwood and fodder is still gathered and not purchased, especially by the poorer households in the rural India. The search of fuelwood and fodder consumes a lot of women's time and energy and endangers their health. When local wood supplies get scarce, women and girl children have to undertake longer journeys with heavier loads of fuelwood and fodder and obviously risk spinal column damage and uterine prolapse. Several survey-based studies have revealed that rural women in several parts of India spend sometimes more than 4-5 hours in searching for fuelwood. The scarcity of fuelwood because depletion and degradation of forests certainly lengthens the already long hours of the average women's household work (10-12 hours) in most parts of the rural India (Bina 1997).

Firewood is still the most prevalent primary source of energy for cooking used by 78% of the rural and 30% of urban households (TERI 2000, p.266). The dependence of households on firewood and dungcake depicted a marginal decline in both rural and urban areas over the decade 1983-93 (with the exception of firewood in rural areas, which has remained constant). However, the dynamics of the price hike in relatively cleaner cooking fuels, viz. kerosene, coal, and charcoal has

forced even the urban poor of India to use fuelwood for cooking food (WRI 1994, p.93). Thus the shift from cleaner cooking fuels to fuelwood and dungcakes would further endanger the health of women and girl children because of greater indoor pollution and their primary involvement in the cooking. Smoke from wood and other biomass fuels used for households cooking could be responsible for about 50 percent of the total human exposure to particulate (Kirk Smith 1992). Cooking and household chores are primarily done by women and thus fuelwood, animal dung and crop wastes, which are certainly inefficient fuels compared to kerosene, gas and electricity, endangers the respiratory health of women and deprive the livestock of fodder and the soil of natural fertilizer.

POVERTY AND FORESTS LINKAGES

Poverty, rapid population growth, economic stagnation, unemployment, and environmental degradation are found to coexist and thus seem to be reinforcing each other. Poverty also contributes to environmental degradation in most of the agriculture-based developing countries as for example farmers living in poverty may let the immediate need to produce food outweigh the long-term benefits of conserving land. Overexploitation of natural resources like land, forests, and water, etc. have often been held responsible for the environmental degradation (PRB 1999).

Macro-level poverty ratios (see Table 7) reveal that though India's poverty reduction efforts through the anti-poverty and employment generation programmes along with overall economic growth planning efforts seem to have helped in reducing the overall incidence of the poverty ratio from 55% in 1973-74 to 36% percent in 1993-94, yet the number of persons below the poverty line have remained more or less the same, i.e. around 320 million. The total number of persons below the poverty line remained same basically because of an accelerated pace of population growth during the period.

TABLE 7: NUMBER AND PERCENTAGE OF POPULATION BELOW POVERTY LINE IN INDIA: 1973-93.

Year	Rural Sector		Urban Sector		Combined All India	
	Number (In Mn)	Poverty Ratio (In %)	Number (In Mn)	Poverty Ratio	Number (In Mn)	Poverty Ratio
1973-74	261	56.4	60	49.0	321	54.9
1977-78	264	53.1	65	45.2	329	51.3
1983-84	252	45.7	71	40.8	323	44.5
1987-88	232	39.1	75	38.2	307	38.9
1993-94	244	37.3	76	32.4	320	36.0

Source: Economic Survey, 1998-99.

However, despite the direct poverty alleviation and employment-generation programmes initiated in India in the early seventies, viz. Integrated Rural Development Programme (IRDP), National Rural Employment Programme (NREP), Rural Landless Employment Guarantee Programme (RLEGP), Jawahar Rozgar Yojana (JRY), etc.; we have not been able to alleviate poverty, unemployment or underemployment by providing supplemental wage employment through generating income-augmentation assets. In India 320 million persons are still below the poverty line which means that the basic minimum needs of such a large population has not been met.

However, India's performance in poverty alleviation is considered to be weak as compared with some of the East Asian countries, viz. China, Indonesia, and Philippines (GoI 1999). Faster overall economic growth led to a faster reduction in poverty ratios in the selected Asian countries, viz. China, Indonesia, etc. as compared to India. Nevertheless, the combined effects of an excessive population growth, the lack of developmental efforts, degradation of natural resources, etc. seems to have resulted in the persistence of the poverty burden in India.

Poverty is presumed to be a function of income and other crucial factors like health, education, nutrition, and access to basic needs and services. Thus, accessibility to basic human needs like food, clothing, housing, safe drinking water, basic health services, etc. are important ingredients of human consumption and are considered to have serious environmental and health implications. Also it is often true that availability does not imply accessibility in poorer countries because of iniquitous income distribution.

While consumption differences between income groups are not wide especially for essential items such as food and clothing, they are however substantial for other commodities and for the resources required in producing them. Poverty alleviation through the generation of employment opportunities in agricultural areas would help in the regeneration of natural resources like forests.

Poorer people, who cannot meet their subsistence needs through purchase, are forced to use common property resources such as forests and pasturelands for fuelwood, fodder and food. Population growth in poverty conditions further increases the pressure on natural resources, in some cases to the point of its destruction. Even distress rural outmigration has been primarily because of push factors operative at the place of origin, for example, land degradation, water scarcity, deforestation, etc. and also because of the shrinkage of common property resources, which have a natural tendency to be overexploited.

A survey-based study of the tribal districts in Rajasthan revealed that the distress outmigration from the rural tracts got stalled by regeneration of forests and pasturelands, improvement in irrigational potential, and bringing more land under common property regime (Chopra and Gulati 1998). Furthermore, proper delineation of common property rights in commons like forests, land and water, as a consequence of the existence of non-governmental organizations, did reduce distress outmigration from the arid and semi-arid regions of India. The study also discerned that increased interest in commons like forests and water leads to decline in short as well as long distance outmigration. Furthermore, the poorer rural households depended more biofuels like wood, crop residue, and animal dung as they could not afford to buy the cleaner commercial fuels, viz. kerosene, liquefied petroleum gas, electricity. Thus, women in the poorer households risk the health effects of such cooking, which include respiratory disease, anaemia, and cancer.

CONCLUSIONS

Burgeoning figures for population and cattlestock along with forest depletion and degradation in India seem to have spiral linkages hampering short and long-run sustainable developmental prospects for its peoples. Population control as well as forest upgradation are serious issues confronting Indian planners and policy implementers in the recent past.

Despite legislative and regulatory measures provided in the Water Act, 1974; the Forest (Conservation) Act, 1980, the Environment (Protection) Act, 1986, etc. and several governmental initiatives like Tree Growers Co-operative Societies, Joint Forest Management, Chakriya Vikas Pranali, etc. initiated in the late 1980s and early 1990s; the process of forest degradation could yet not be arrested. The depletion of forest cover and the degradation of forest stock are still persisting even after provision of governmental as well as non-governmental afforestation schemes. Officially, various factors with varying intensities like overgrazing, illegal encroachments, unsustainable practices, forest fires, and indiscriminate siting of development projects in the forest areas have already been notified but other unofficial factors like weak institutions, corruption, connivance of foresters and timber merchants, illegal encroachments, illegal grazing, naxalite activities, wasteful expenditures, etc., have also been identified as responsible for severe forest degradation in some regions of the country.

The promulgation of the National Forest Protection Act of 1986, envisaging the people's involvement, in partnership with other stakeholders was an attempt in the development and protection of forests. The Act was also intended to facilitate forest conservation and upgradation, which would

help towards reduction of greenhouse gases having local and global atmospheric pollution ramifications. Nevertheless, the process of forest's depletion and degradation continued. Despite governmental initiatives like the tree grower's co-operatives and joint forest management towards forest upgradation the desirable results could not be achieved. Possibly, people's effective involvement towards forest management necessitates delineation of common property and usufruct rights for sharing forest products like fuelwood, fodder and small timber, which helps not only in afforestation but also in the fulfilment of the social objectives of employment generation and the economic betterment of local poor and tribal communities as also to save women from the drudgery of long distance collection and in the management of such resources for daily household rigours.

Despite well conceived, formulated and implemented forest management policies it is obvious that increasing population pressure will either neutralise the afforestation efforts or exacerbate the forest depletion and degradation process. Growing population pressure in India had steepened the declining trend of per capita availability of forest cover, forest stock, fuelwood, industrial wood, etc. With India's population projected to reach 1.7 billion by 2050, the long-term deleterious effects on forest stock are certainly grave and in turn would aggravate forest products scarcity. Effective and integrated population control and forest management strategies are essential to subvert the spiral of population pressure and forest degradation.

Women's sensitisation and involvement in forest management and conservation can bring better results towards forest upgradation as women are primarily responsible for collection and processing of fuelwood in rural and forest areas. Furthermore, greater participation from local communities and nongovernmental organizations can certainly help in faster regeneration of forest resources. Such efforts also require a strong commitment by resource management officials.

Poverty reduction would certainly facilitate forest conservation and upgradation, as poverty reduces incentives for long-term resource management and natural resources. Poorer people generally, to meet present income needs, tend to favour rapid resource extraction and short-term production strategies such as overexploitation of forest resources and overgrazing pasturelands. Forest and natural resources degradation, in turn, lessens the labour productivity of the poor and the productivity of the natural resources they manage. Furthermore, poverty also interacts with population parameters, especially fertility, and hinders the transition to slower population growth.

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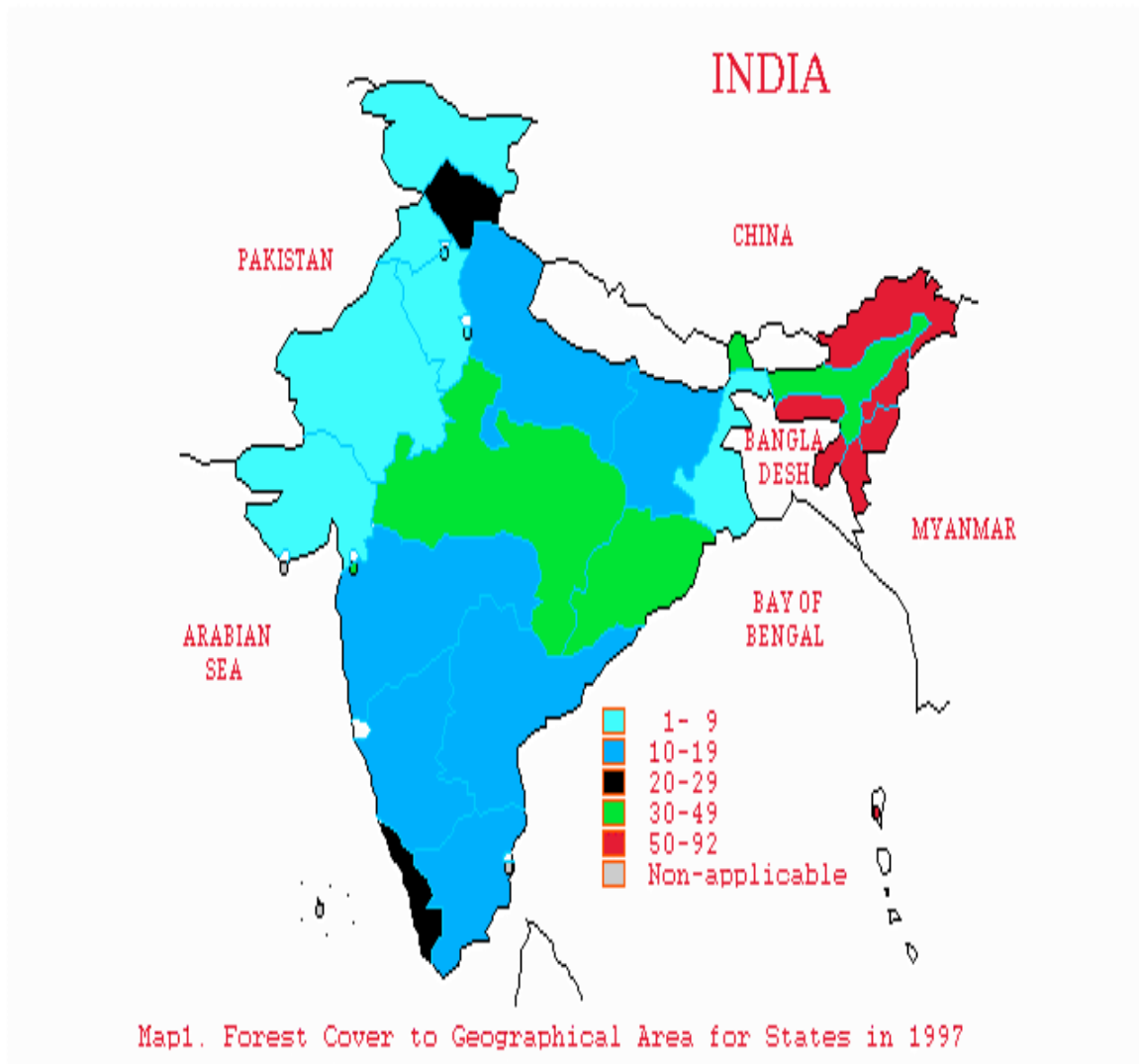
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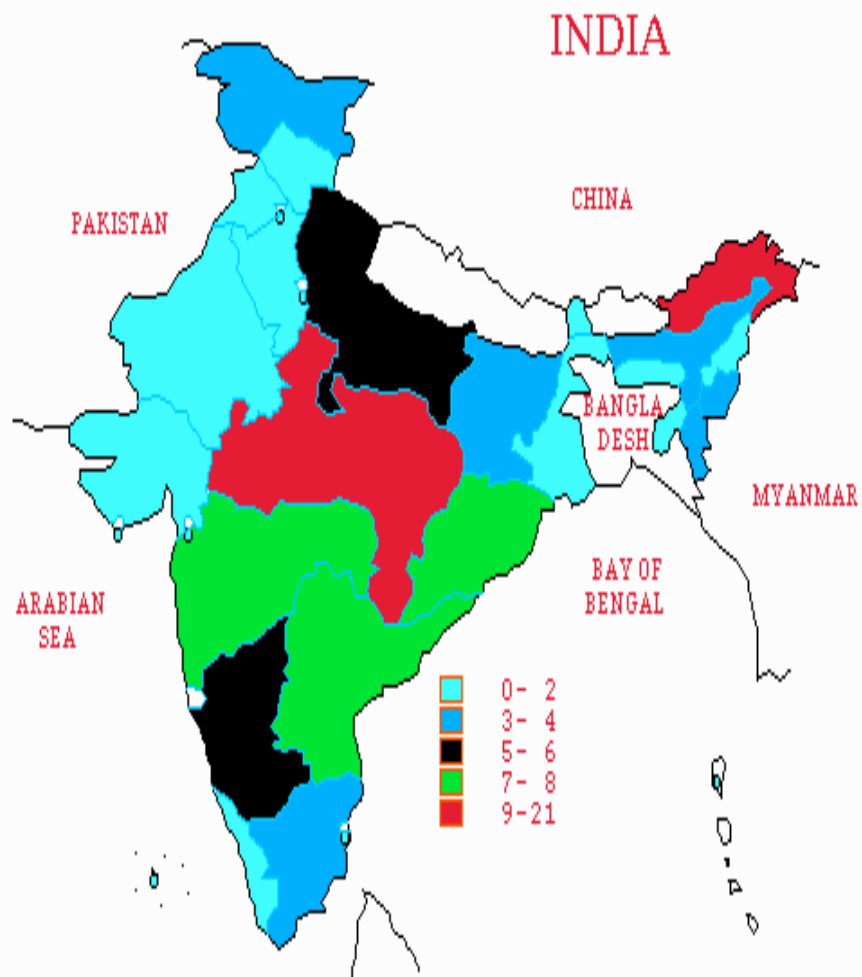
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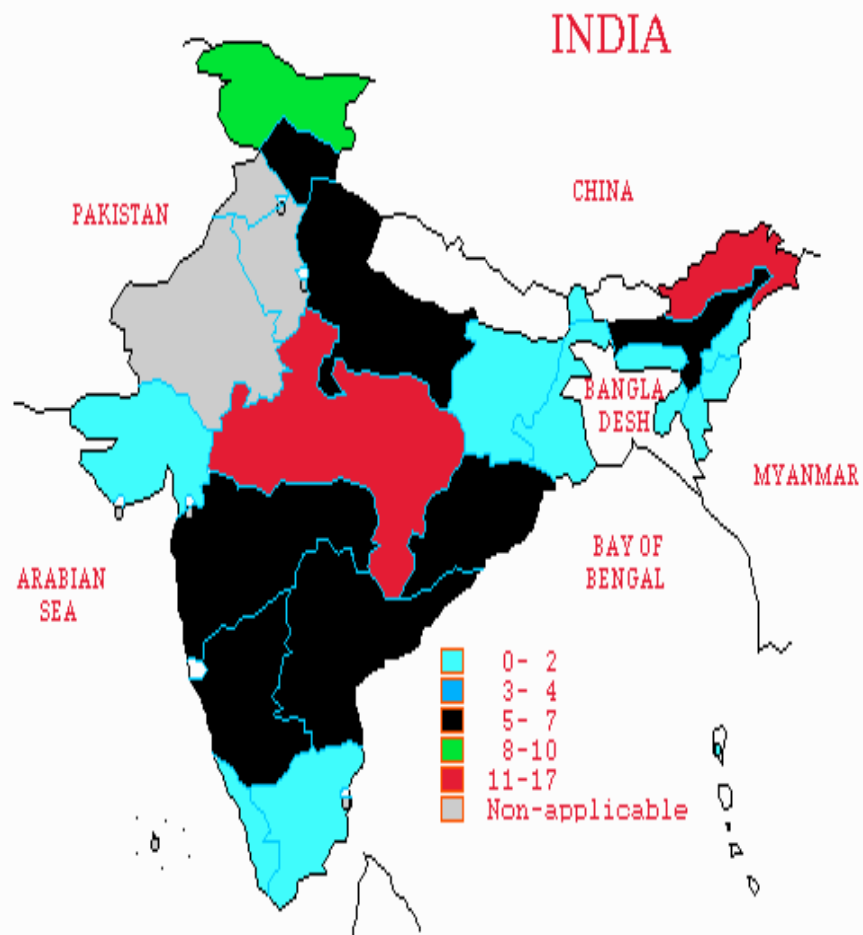
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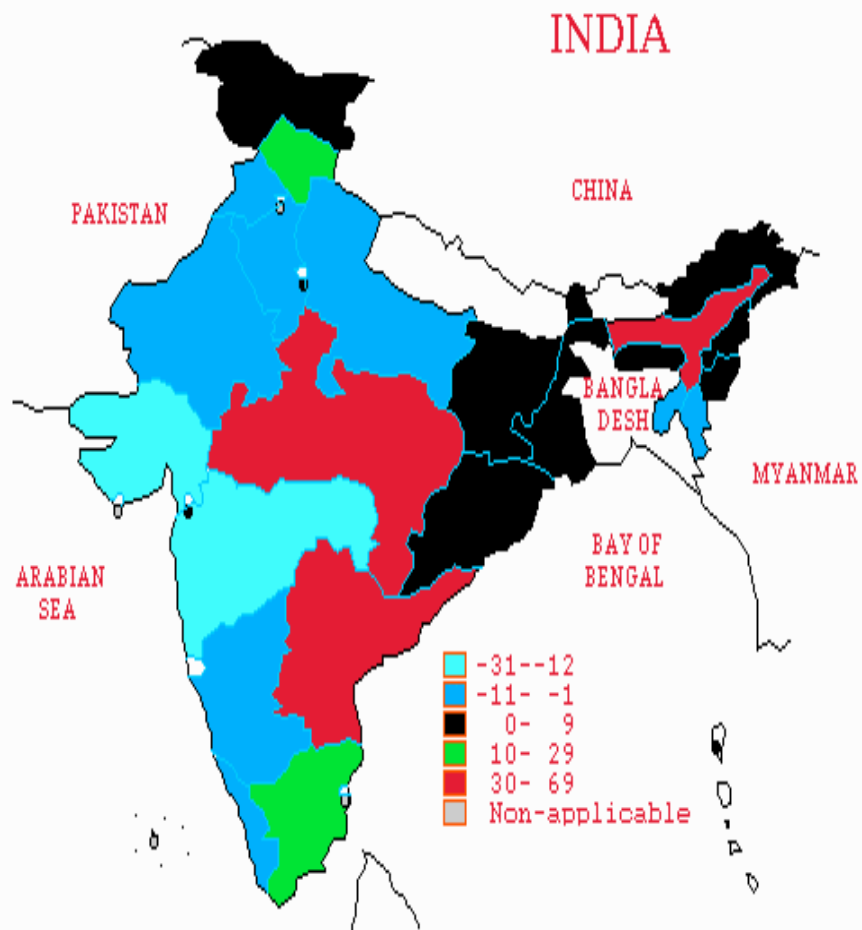




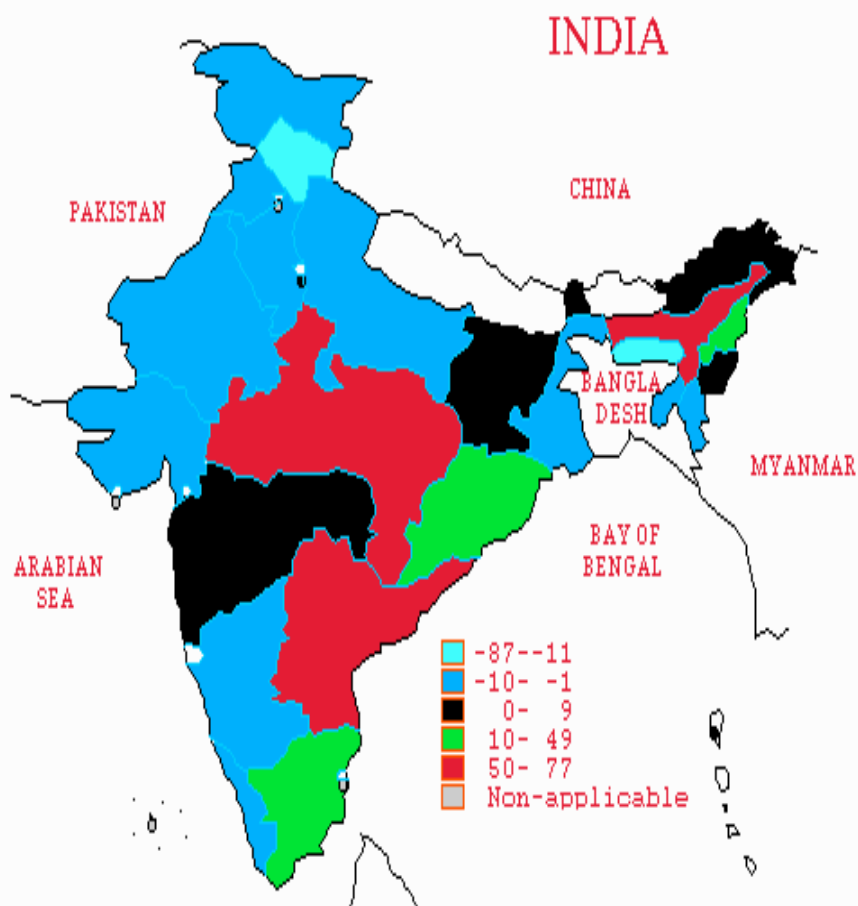
Map 2. Distribution of Forest Cover in 1997 Amongst States



Map 3. Distribution of Forest Stock in 1997 Amongst States



Map 4. Distribution of Total Forest Cover Decline Amongst States :1997 over 89



Map 5. Distribution of Total Forest Stock Decline Amongst States:1997 Over 89