



# Forestry Department

Food and Agriculture Organization of the United Nations

## GLOBAL FOREST RESOURCES ASSESSMENT UPDATE 2005

– FRA 2005 –

### PILOT STUDY FOR COUNTRY REPORTING: INDIA

Rome, 2003



## The Forest Resources Assessment Programme

Forests are crucial for the well being of humanity. They provide foundations for life on earth through ecological functions, by regulating the climate and water resources and by serving as habitats for plants and animals. Forests also furnish a wide range of essential goods such as wood, food, fodder and medicines, in addition to opportunities for recreation, spiritual renewal and other services.

Today, forests are under pressure from increasing demands of land-based products and services, which frequently leads to the conversion or degradation of forests into unsustainable forms of land use. When forests are lost or severely degraded, their capacity to function as regulators of the environment is also lost, increasing flood and erosion hazards, reducing soil fertility and contributing to the loss of plant and animal life. As a result, the sustainable provision of goods and services from forests is jeopardized.

FAO, at the request of the member nations and the world community, regularly monitors the world's forests through the Forest Resources Assessment Programme. The Global Forest Resources Assessment 2000 (FRA 2000) reviewed the forest situation by the end of the millennium. FRA 2000 included country-level information based on existing forest inventory data, regional investigations of land-cover change processes and a number of global studies focusing on the interaction between people and forests. The FRA 2000 Main report is published in print and is available on the World Wide Web.

The Global Forest Resources Assessment update 2005 (FRA 2005) has been requested by the FAO Committee on Forestry in 2003. The FRA 2005 will use common thematic areas of the Criteria for Sustainable Forest Management as a reporting framework. FRA 2005 will also focus on the specific conditions and issues in each country.

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## Summary

(This is a draft version of the working paper. The summary will be provided in the final version)

## Abbreviations

AG	Advisory Group to FRA
C&I	Criteria and Indicators (for Sustainable Forest Management)
COFO	Committee on Forestry, the main statutory body of the FAO Forestry Department, meeting every second year in Rome
CSO	Central Statistical Organization
FAO	Food and Agriculture Organization of the United Nations
FRA	The FAO-led Global Forest Resources Assessment
FRA 2000	Global Forest Resources Assessment 2000, see <a href="http://www.fao.org/forestry/fra2000report">www.fao.org/forestry/fra2000report</a>
FRA 2005	Global Forest Resources Assessment update 2005, see <a href="http://www.fao.org/forestry/fra2005">www.fao.org/forestry/fra2005</a>
FSI	Forest Survey of India
GOI	Government of India
ICFRE	Indian Council of Forestry Research and Education
MOEF	Ministry of Environment and Forests
NFAP	National Forestry Action Plan
NC	National Correspondent to FRA
NSS	National Sample Survey Organization
SFM	Sustainable Forest Management
WII	Wildlife Institute of India

# 1. Introduction

This section introduces the purposes of the document, provides background of global Forest Resource Assessments, presents objectives of country report and finally the process of development of information at national level.

## 1.1 Purpose of this document

This working paper presents country report of India as a part of input to global Forest Resource Assessment (FRA) process of FAO especially to FRA 2005, an update to FRA 2000 (FAO, 2001). It contains complete information on all the sixteen global reporting tables, six thematic areas and brief information on the “Review of sustainability of forests in India” (option E) following “Guidelines for Country Reporting” (FRA Working Paper No. 73a).

## 1.2 Background to FRA 2005

Global forest resources assessments have been carried out by FAO since 1948 that is practically since FAO was created. The mandate for such assessments stems both from the basic statutes of FAO (FAO 2003a), and to guidance given by member countries, most significantly at sessions of the Committee on Forestry “COFO” ([www.fao.org/forestry/cofo](http://www.fao.org/forestry/cofo)).

The Kotka IV expert consultation in July 2002 ([www.fao.org/forestry/kotka4](http://www.fao.org/forestry/kotka4)) defined the scope and approach of future FRAs and recommended that they should be structured along the framework of “Criteria” common to the nine regional processes on Criteria and Indicators (C&I) for Sustainable Forest Management (SFM). This recommendation has been reinforced by the international conference on C&I for SFM in February 2003 ([www.fao.org/forestry/crit-ind](http://www.fao.org/forestry/crit-ind)) and COFO in March 2003. This development represents a strong move to establish linkages between politically defined C&I and technically specified FRA. This helps to define the objective of the global FRA more clearly to make it possible to review sustainability of forests at the global level.

## 1.3 Objectives of country reporting in FRA 2005

The objective for the country reporting in FRA 2005 are three fold. First is to produce by 2005 a comprehensive update and refinement of FRA 2000, structured around the core set of global variables and the six common thematic areas (criteria) for sustainable forest management focussing on the trend information. The second is to involve national institutions, experts and other stakeholders in the collection, analyses and validation of national information to secure national ownership of results. The third is to report all information transparently and with complete documentation and analyses of the source data.

Accordingly this country report (working paper) has following two distinct elements and associated reporting steps. It follows the format of a working paper as suggested by FAO in its “Guidelines for Country Reporting”(FRA Working Paper).

**Table 2: Two Steps in Country Reporting**

<b>Reporting step</b>	<b>Contents</b>
1. National data for Global tables	National Reporting Tables containing national data, transformation of national data to global data tables, preferably electronic, containing source references, source data, and reclassifications leading into estimates for the country for each global table.
2. Country report by Thematic Areas	Short report following a predefined outline that builds on the defined Thematic Areas (Criteria) of SFM. The report shall contain additional information relevant in the country for each Theme.

## 1.4 National Information Development Process

At the national level, the statistics wing in the Ministry of “Statistics and Programme Implementation” is the apex body for official statistical system of the country. For this purpose, it acts as a national nodal agency through one of its organization “Central Statistical Organization (CSO)”. CSO also deals with development of concepts, definitions, methodology of data collection, processing and dissemination. It is also responsible for development of national accounts. The Ministry also conducts large scale all-India sample surveys for collecting new field information through its another organization “National Sample Survey Organization (NSSO)” to create the database needed for studying the impact of specific problems for the benefit of different population groups. In addition to this there are specialized technical agencies work under respective ministries to provide specific technical information like Indian Space and Research Organization (ISRO) to provide remotely sensed information and Forest Survey of India to make use of both remotely sensed and ground inventory information to generate new information on the state of forests.

Forest Survey of India (FSI) has been conducting such national assessments of forest resources, since its inception in 1965 as Pre-Investment Survey of Forest Resources. FSI initially used aerial photographs and ground inventory to assess forest resources but soon (early eighties) moved to remotely sensed satellite data. Since 1986, FSI is assessing forest cover on a two-year cycle and is releasing the findings to the public through its premium publication “State of Forest Report” (SFR). Its first assessment was published as SFR 1987 and the latest as SFR 2001. Every successive assessment has made improvement in methodology, resolution and techniques of interpretation. For example, the resolution of data in the first assessment was 80m x 80m, scale of interpretation was 1:1 million and the interpretation was totally manual while the latest assessment resolution was 23.5m x 23.5m, scale of interpretation was 1: 50,000 respectively and the assessment was totally digital. In addition to cover FSI also conducts special studies to provide information on growing stock of forests, tree cover of “Tress Outside Forests” and carbon stocks. FSI works as a lead, and nodal institution in India for forest resource assessment programme of FAO, facilitates collection of information on other variables and conducting special studies when required. It organizes two national level workshops of major stakeholders



and used group convergence method<sup>1</sup> to provide updated and extended information for FRA 2005.

The Indian Council of Forestry Research and Education (ICFRE), an autonomous body under the Ministry of Environment and Forests, Government of India, is the apex national body on forestry research and education. In addition, it is mandated to compile and publish national forest statistics in its prime publication “Forestry Statistics”. Such last publication was “Forestry Statistics 2001”. The scope of this publication includes area of forests, diversion of forest land, plantation, production, revenue and other management related information.

Similarly, Wildlife Institute of India (WII), an autonomous body under the Ministry of Environment and Forests, Government of India, is the apex body on wildlife in India. It maintains National Wildlife database that deals with all the protected areas and biodiversity of wild life. The Directorate of Project Tiger, under Ministry of Environment and Forests conducts once in three or four years a national census of tigers population.

Land use statistics are primarily compiled from the village land records maintained at the local level by a government official. The information is recorded under nine categories: (1) Forests, (2) Area under Non-Agricultural use, (3) Barren and uncultured land, (4) Permanent Pastures and other Grazing Land, (5) Miscellaneous Tree Crops (6) Culturable Waste Land, (7) Fallow Land other than Current Fallows, (8) Current Fallows, and (9) Net Area Sown. The ICFRE provides the compiled national information in its “Forestry Statistics”. Land use statistics are also collected through nationwide land use/cover mapping by National Remote Sensing Agency (NRSA) a unit of ISRO according to its 22 fold classification.

Botanical Survey of India and Zoological Survey of India are two scientific organizations under the Ministry of Environment and Forests which are responsible for generation of data of floral and faunal diversity respectively in the country. These organization take exploratory tours in different priority areas, hot spot, fragile echo systems in different parts of country. During these scientific studies they collect specimen of different species ( floral /faunal) and preserve some of them in the museums /Botanical Gardens or zoos etc. The documentation by these organizations is used for presenting data in the Compendium of Environment Statistics of CSO

This working paper has mainly used five sources (CSO, NSSO, FSI, ICFRE and WII) to present the information contained in this reporting on the sixteen tables and six thematic areas.

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<sup>1</sup> **Govil, K.** 2002. Process of FRA 2005: Review of Sustainability. A paper presented to Advisory Group to Forest Resource Assessment, FAO, at Nairobi, Kenya, October 2002.

## 2. National Reporting Tables

The national data for sixteen global tables has been provided through following sixteen National Reporting Tables (Annex 2) contained in the working papers n. 73a and b.

**Table 3 National Reporting Tables**

No.	Title of the Table	Unit of data	Global Variables (Number of Variables)
1	Extent of Forests	000 ha	Forests, Other Wooded Land, Other land with Trees, Other Land, Inland Water. (5)
2	Ownership	000 ha	Public, Private , Other or unspecified (3)
3	Designation	000 ha	Production Forests, Protective forests, Conservation Forests, Social Services Forests, Multiple Objective Forests, Protective other Wood Lands, Conservation Other Wooded Lands, Social Services Other Wooded lands, Multiple Objective Other Wooded Lands. (9)
4	Characteristics	000 ha	Primary Forests, Modified Forests, Semi-natural Forests, Productive Forest Plantation, Protective Forest Plantation, Primary "Other Wooded Land, Modified "Other Wooded Land", Semi-natural "Other Wooded Land", Protective "Other Wooded Land" Plantation. (9)
5	Forest Growing Stock	million Cubic M	Growing Stock, Commercial Growing Stock .(2)
6	Forest Biomass	million Metric T (Oven Dry )	Woody Biomass, Above Ground Tree Biomass, Below Ground Tree Biomass. (3)
7	Forest Carbon	million Metric T	Carbon in Woody Biomass, Carbon in Above Ground Tree Biomass, Carbon in Below Ground Tree Biomass, Soil Carbon (4)
8	Disturbances to Health and Vitality of Forests	000 ha	Forest Fires, Forest Insects, Forest Diseases. (3)
9	Forest Tree Species	Number	Inventoried Forest Tree Species, Endangered Forest Tree Species (2)
10	Forest Composition	million Cub M	Growing stock of each of the ten most frequent species and combined growing stock of the rest. (11)
11	Wood Removal	000 Cubic M	Industrial Round Wood, Wood Fuel. (2)
12	Value of Primary Wood Supply	National Currency	Value of Industrial Round Wood, Value of Wood Fuel. (2)
13	NWFP Removal	Metric T	NWFP removal under each of the 18 groups of NWFP (1)
14	Value of NWFP	National Currency	Value of NWFP supply under 18 groups of NWFP (1)
15	Sites for Social Functions	Number in 000	Sites for Social Function, Visitors. (2)
16	Employment through Primary Activities	Million Person Years	Employment through Industrial Round Wood Supply, Wood Fuel Supply, NWFP Collection, Silvicultural Activities, Other Primary Activities (5)

## T1. Extent of Forests and Other Wooded Lands

The information on “extent of forests” is necessary for assessment of state and change in forest resources (including goods and services provided by forests) on a global basis. It helps to develop trends of expansion or deforestation of forests and review the sustainability of forests. It facilitates establishing links between national and global classification of extent of forests.

### A. Global Classification and Definitions (FRA 2005)

<b>Forest</b>	Land under forestry or no land use, spanning more than 0.5 hectares; with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds <i>in situ</i> .
<b>Other Wooded Land</b>	Land under forestry or no land use, spanning more than 0.5 hectares; with trees higher than 5 meters and a canopy cover of 5-10 percent, or trees able to reach these thresholds <i>in situ</i> ; or with a combined cover of shrubs, bushes and trees above 10 percent.
<b>Other Land with Tree Cover</b>	The lands primarily not under forests having more than 0.5 hectares with a canopy cover of more than 10 percent of trees able to reach a height of 5 m at maturity. It includes trees outside forests.
<b>Other Land</b>	Land not classified as “forest”, “other wooded land” or “other land with tree cover”.
<b>Inland Water bodies</b>	Inland water bodies generally include major rivers and lakes.

Source: FAO. 2004. Terms and Definition FRA-2005. FRA Working paper 73. Rome

### B. National Data Sources

Forest Survey of India (FSI) is an Government of India organization under the Ministry of Environment & Forests. Since 1965, it is regularly conducting assessment of forest resources at an interval of about 2 years and publishing the information in the “State of Forest Report” (SFR). Following SFRs form the basis of information for this global table.

<b>Information Year</b>	<b>Source</b>
<b>1990</b>	SFR, 1993. State of Forest Resources 1993. Forest Survey of India, Ministry of Environment and Forests, Government of India.
<b>1992</b>	SFR, 1995. State of Forest Resources 1995. Forest Survey of India, Ministry of Environment and Forests, Government of India.
<b>1994</b>	SFR, 1997. State of Forest Resources 1997. Forest Survey of India, Ministry of Environment and Forests, Government of India.
<b>1997</b>	SFR, 1999. State of Forest Resources 1999. Forest Survey of India, Ministry of Environment and Forests, Government of India.
<b>2000</b>	SFR, 2001. State of Forest Resources, 2001. Forest Survey of India, Ministry of Environment and Forests, Government of India.

The first SFR was published as SFR 1987 using 1981-83 remotely sensed images and the latest published report is SFR 2001, which used satellite images for the year 2000. Each successive assessment used better quality of data with higher resolution and scale and with more intensive ground verification and by using superior techniques of interpretation. While in the first

assessment, resolution of data used was 80m x 80m and scale of interpretation was 1:1 million the same in the last assessment is 23.5m x 23.5m and 1:50,000, respectively.

### C. National Classification and Definitions

The following table provides the classification and sub-classification and their definitions in use at Forest Survey of India, Ministry of Environment and Forest, India.

<b>Forest Cover</b>	All lands, more than one hectare in area, with a tree canopy density of more than 10percent. Such lands may not be statutorily notified as forest area.
<b>Dense Forest</b>	All lands, with a forest cover with canopy density of 40 percent and above.
<b>Open Forest</b>	All lands, with forest cover with canopy density of 10 to 40 percent.
<b>Mangrove Cover</b>	(Forests) Area covered under mangrove vegetation as interpreted digitally from remote sensing data. It is also classified into dense cover (canopy density more than 40 percent) and open cover (canopy density from 10 to 40 percent).
<b>Mangrove</b>	Salt tolerant forest ecosystem found mainly in tropical and sub-tropical coastal and/or inter-tidal regions.
<b>Scrub</b>	All lands, generally in and around forest areas, having bushes and or poor tree growth chiefly small or stunted trees with canopy density less than 10 percent.
<b>Trees Outside Forests</b>	Tree wealth existing outside recorded Forest Areas
<b>Tree Cover</b>	Notional land area, covered by crown of trees, that is small (less than 1 hectare) to be delineated by digital interpretation of remote sensing data of forest cover.
<b>Non Forest Land</b>	Lands without any forest cover.

(Source: SFR 2001)

### D. National Data

The following table presents the national data on forest cover in India. This information has been respective State of Forest Report (SFR) developed by FSI as mentioned in the note below the table.

Categories	Land Cover in "000" ha				
	1990	1992	1994	1997	2000
<b>Forests</b>	63938.600	63887.900	63339.700	63729.300	67553.800
<b>Non Forest</b>					
<b>(i) Scrub</b>	5894.300	6052.000	5270.000	5189.600	4731.800
<b>(ii) Other Non Forest</b>	258893.400	258786.400	260116.600	259807.400	256440.700
<b>Total (Country Area)</b>	328726.300	328726.300	328726.300	328726.300	328726.300

Note: 1. Other non forest area includes 31407 (000 ha) of Inland water bodies and 8147 (000 ha) of Tree cover in blocks of less than 1 hectare as mentioned in SFR 2001

FSI, includes area of TOF (Trees out side recorded forests) (10.485 million ha) occurring in blocks of more than 1 hectare and canopy cover more than 10 percent under "forest" cover. It does not provide data on the land use on which TOF exists.

Similarly, FSI assess that TOF (Trees outside recorded forest areas", occurring in blocks of less than 1 hectare, cover about 8.147 million ha. and calls it "tree cover". The area is notional (statistical) in nature because it has been computed based on notional density of trees per hectare to provide a canopy cover of more than 70 percent. The FSI does not include this in its land

cover estimates. In reality, this area at places may be more than 0.5 ha and at other places below 0.5 ha. It is assumed that at least 10 percent of this notional area consist of blocks greater than 0.5 hectares i.e. can be classified as “Other land with trees” of FRA 2005.

FSI does not provide area of “Inland Water bodies” and includes it with the Non-Forest Area. The figures of total area of the country by FSI and UN Statistical Division perfectly match (see section “E”), hence, the area figures of 31.407 million ha. of “Inland Water bodies” with UN division will be used as national data. This figure is same 1990 and 2000, therefore same figure is being assumed for 2005.

### E. Calibration

The land area figures for the whole country match (see below) with the land area figure with UN Statistical Division at New York USA. Hence no need to calibrate the national data.

Agency	Total Land Area of the country in “000”ha				
	1990	1992	1994	1997	2000
FSI, India	328726.300	328726.300	328726.300	328726.300	328726.300
UN Statistical Division	328726.300	328726.300	328726.300	328726.300	328726.300

### F. Estimation and Forecasting

The FSI provides information for 1990 and 2000 therefore there is no need for estimating figures for 1990 and 2000. The figures for 2005 were forecasted using regression estimates.

Category of Land cover	Forecasted Land cover in 2005 (“000”ha)
Forests	67700.518
Scrub	4110.390

### G. Reclassification into FRA 2005 Classes

**Table: Reclassification (Percentage allocation) into FRA 2005 classes (excluding Inland water)**

National Land use	Percentage of a National class belonging to a FRA Class			
	Forests	Other Wooded Land	Other Land with Tree Cover	Other Land
Forests	100			
Non Forest				
(i) Scrub		100		
(ii) Tree Cover			10	90
(iii) Other Non Forest				100

## H. National Information for FRA 2005 Global Tables

**Table: Input to Global Reporting Table T1**

FRA 2005 Classes	Extent in "000"ha		
	1990	2000	2005
Forests	63938.600	67553.800	67700.518
Other Wooded Lands (Scrub)	5894.300	4731.000	4110.390
Other land with Trees	81.472	81.472	81.472
Other land	227404.628	224952.728	225426.620
Inland water	31407.000	31407.000	31407.000
Total Area	328726.000	328726.000	328726.000

## T2. Ownership of Forests and Other Wooded Lands

The information on “ownership” is important for policy, institutional and management purposes. It basically defines the boundaries and location of the authority and control over forest and tree resources.

### A. Global Classification and Definitions (FRA 2005)

<b>Public Ownership</b>	The ownership of State (national, state and regional governments) or government-owned institutions or corporations or other public bodies including cities, municipalities, villages and communes.
<b>Private Ownership</b>	The right of “ownership” of “Forests” and “Other Wooded Lands” with individuals, families, private co-operatives, corporations, industries, religious and educational institutions, pension or investment funds, and other private institutions.
<b>Other or Unspecified Ownership</b>	The “Other” or “Unspecified ownership” is one that is not classified either as “public ownership” or as “private ownership”.

Source: FAO. 2004. Terms and Definition FRA-2005. FRA Working paper 73. Rome

### B. National Data Sources

Forest Survey of India (FSI) is an Government of India organization under the Ministry of Environment & Forests. Since 1965, it is regularly conducting assessment of forest resources and publishes the information in the “State of Forest Report” (SFR).

The SFR also contains information on legal status of forests. It classifies it into three categories (a) Reserved forests , (b) Protected forests and (c) Other or Un-classed forests. The first two categories of forests are “owned by government”. The status of third category is not clear and varies state by state and it includes forest owned by private individual or bodies. The SFR 1993 that contain information for 1990 does not provide this information. Hence SFR 1991 that provides information for 1989 have been used instead and these figures have taken as for 1990 since there is very less variation each year.

Following SFRs form the basis of information for this global table.

<b>Information Year</b>	<b>Source</b>
1990	SFR, 1991. State of Forest Resources 1991. Forest Survey of India, Ministry of Environment and Forests, Government of India.
2000	SFR, 2001. State of Forest Resources, 2001. Forest Survey of India, Ministry of Environment and Forests, Government of India.

The Forestry Statistics compiled and published by Indian Council of Forestry Research and Education (ICFRE) Dehradun, provides information on ownership by each State of India. It presents information by individual States and Union Territories in India . However it does not

provide national totals because there is no information for some states. The figures for “private ownership” of forests, although incomplete have been taken from Forestry Statistics. The area of un-classed forest, less the area under private ownership, has been classified as belonging to “unspecified ownership”.

The period of the annual reporting in Forestry Statistics series is from April 1<sup>st</sup> to March 31<sup>st</sup> of next year. It covers first nine months of the starting year and next 3 months of ending year, therefore information has been dealt as belonging to the starting year. For example, the period 1<sup>st</sup> April 96 to 31<sup>st</sup> March 1997 is nationally denoted as 1996-97 and contains 9 months of 1996 and only 3 months of 1997 therefore the information has been treated as for 1996. Following publication have been used for archiving National Data.

For 1988 to 1993: Forestry Statistics, India, 1988-95. 1997. Indian Council of Forestry Research and Education, Dehradun, Uttaranchal, India.

For 1996 & 1997: Forestry Statistics, India, 2000. 2002. Indian Council of Forestry Research and Education, Dehradun, Uttaranchal, India.

### C. National Classification and Definitions

Broadly speaking, reserved, protected and unclassed are the three major legal classes of forest in India. A legal notification in a government gazette under Indian Forest Act creates or defines the boundaries of “reserved and “protected” forests in India. These forest by definition are owned by government of “Public” at large. The rest of forests areas recorded in government land records as forests are called un-classed forests. The status of their ownership and control varies among various States in India.

<b>Terms</b>	<b>Definition</b>
Reserved Forest	Any forest land or waste land or any other land, not being land for the time being comprised in any holding or in any village abadi, which is the property of Government or over which the Government has proprietary rights, or to the whole or any part of the forest produce of which the Government is entitled, and which is notified in government gazette as “reserve forest” under relevant section of Indian forest Act.  Explanation: In such forest, most of the activities are prohibited unless allowed.
Protected Forests	Any forest land or waste-land or any other land, which is not included in a reserved forest, but which is the property of Government, or over which the Government has proprietary rights, or to the whole or any part of the forest- produce of which the Government is entitled, and which is notified in government gazette as "protected forest" under relevant sections of Indian Forest Act.  Explanation: In such forest, most of the activities are allowed unless prohibited.
Unclassed Forests	Any forest land or waste land or any other land “recorded” in land records as “forest” but not notified in government gazette as “reserved” or “protected” forests under Indian Forest Act.



## D. National Data

The SFRs, published by FSI, help to develop following table that presents the national data on “forest” under “reserved” and “protected” legal categories of forest. It classifies the rest of “recorded forests” as un-classed forests. Further information is available for 189 and 2000 but not 1989. Since there are every minor differences in information in consecutive SFRs, the information for 1989 is being treated as for 1990.

Legal Category of Forest Land	Recorded Forest land in "000"ha.	
	(1989)	(2000)
Reserved Forest Land	41491.617	42331.100
Protected Forest Land	23308.095	21724.500
Un-classed Forest Land	12208.131	12788.100
<b>Total Recorded Forest Land</b>	<b>77007.843</b>	<b>76843.700</b>

The Forestry Statistics, published by ICFRE, provide following information, though incomplete, on private ownership of “recorded forests”. This should represent the minimum area of “Un-classed forests” that are under private ownership.

Category	Recorded Forest under Private Ownership in 000 ha	
	1990	1998
Unclassed Forests	1255.658	1077.932

The Forestry Statistics, published by ICFRE, also provides following information, though incomplete, on public ownership of “forests”. It does not mention whether these forest under the ownership or “Revenue department” and “Corporate/ Communities” are “reserved”, protected or un-classed. In most of the cases, these forest will be un-classed forest however, there will be cases like in Uttaranchal, a state in India, where most of the forest under Revenue department are protected forests.

Public Owners of un-classed Forest	Unclassed Forests in "000"ha.	
	(1990)	(1998)
Forest Department	9003.21	6388.31
Revenue Department	1325.80	3170.51
Corporate /Communities	547.92	785.92
<b>Total</b>	<b>12866.93</b>	<b>12344.74</b>

Adding the above two following picture emerges for un-classed forests although the total is more than the country total of the un-classed. One

Owners of un-classed Forest	Unclassed Forests in "000"ha.	
	(1990)	(1998)
Private Owners	1255.658	1077.932
Public Owners	12866.930	12344.740
<b>Total</b>	<b>14122.588</b>	<b>13422.672</b>

The total area of the un-classed forest is more than what is recorded at national level (see SFR based information, first table in this section). This may be due to double counting of protection areas under ownership of un-classed forest with revenue, and corporate or community.

Therefore, the most conservative approach to classify by ownership is to respect the figures of private forests and consider the rest under public ownership.

### E. Calibration

No calibration is needed as national reports match with UN statistical figures on national areas.

### F. Estimation and Forecasting

Since figures for 1990 for private ownership are available no estimation is needed for 1990. However, figures for 2000 are not available. The latest figures are for 1998. These figures are being assumed for 2000 to be on conservative side.

### G. Reclassification into FRA 2005 Classes

**Table: Reclassification (Percentage allocation) into FRA 2005 classes**

National Classes of Ownership	Percentage of a National class belonging to a FRA Class		
	Public Ownership	Private Ownership	Other or unspecified Ownership
Reserve Forest	100	0	0
Protected Forest	100	0	0
Unclassed Forest for 1990	89.72	10.28	0
Unclassed Forest for 2000	91.57	8.73	0

### H. National Information for FRA 2005 Global Tables

Following table presents ownership of “Forests” reported in Table 1.

**Table: Input for Global Reporting Table 2**

Type of Ownership	Extent of “Forests” in 000 ha	
	1990	2000
1. Under Public Ownership	62683.600	66475.800
2. Under Private Ownership	1255.000	1078.000
3. Under Other or Unspecified Ownership	0	0
Total	63938.600	67553.800

Note: The figure of private ownership for 1998 has been assumed for 2000

### T3. Designation of Forests and Other Wooded Lands

The information on “designation” or current management objective is essential for development of efficient planning, design and assessment of cross-sectoral impacts, and implementation of forest policy. The “designation” defines boundaries for planned interference in context of the conditions in which “Forests” and “Other Wooded land” reside.

#### A. Global Classification and Definitions (FRA 2005)

<b>Production Forest</b>	Forest actually designated for production of forest goods i.e. where the extraction of forest products, usually wood and fibre, are the predominant management objective. It includes both wood and non wood forest products.
<b>Protective Forest</b>	Forests where service of protection to soil and water is the predominant management objective.
<b>Conservation Forest</b>	The “Forests” with predominant management objective of “conservation of biodiversity”.
<b>Social Services Forest</b>	The “forests” where provision of social services (recreation, spiritual, and cultural) is the predominant management objective.
<b>Multiple Objective Forest</b>	The “forests” where a combination of production of goods, protection of soil and water, conservation of biodiversity and provision of social services is the predominant management objective.
<b>Protective“Other Wooded Lands”</b>	The “Other Wooded Land” with predominant management objective of providing service of protection to soil and water.
<b>Conservation“Other Wooded lands</b>	The “Other Wooded Lands” with predominant management objective of “conservation of biodiversity”.
<b>Social Service“Other Wooded lands”</b>	The “Other Wooded Land” with predominant management objective of providing social services (recreation, spiritual, and cultural).
<b>Multiple Objective“Other Wooded lands”</b>	The “Other Wooded Land” where a combination of production of goods, protection of soil and water, conservation of biodiversity and provision of social services is the predominant management objective.

Source: FAO. 2004. Terms and Definition FRA-2005. FRA Working paper 73. Rome

#### B. National Data Sources

The National Forestry Action Plan of India classifies the forests of country into following four functional categories. This does not classify “Other Wooded Lands”.

- Production Forests (for biological stabilities)
- Protection Forests (for meeting timber requirements)
- Social Forests (for meeting daily needs of the community)
- Protected Area Network (National Parks and Sanctuaries)

Information on areas on protected forests is mainly provided by database maintained by Wild Life Institute of India, UN agencies (UNEP-WCMC) and Annual Reports of Ministry of Environment and Forests, Government of India. Following are the details of these data sources:

- **NFAP, 1999.** National Forestry Action Plan, 1999. Ministry of Environment and Forests, Government of India, New Delhi, India
- **National Wildlife Database.** Wild Life Institute of India, Dehradun, India.
- **UNEP 1993.** United Nations List of National Parks and Protected Areas: India. 1993. WCMC Protected Areas Data Unit..
- **Government of India. 2003.** Annual Report 2002-2203, Ministry Of Environment and Forests, Government of India, New Delhi, India.

### C. National Classification and Definitions

The NFAP provides description of the classification based on designation of Forests.

Term	Definition
<b>Protection forests</b>	Forest managed for biological stabilities.
<b>Production forests</b>	Forests managed for meeting timber Requirements of the country.
<b>Social Forests</b>	Forests managed for meeting daily needs of local communities.
<b>Protected Area</b>	Forests managed as Protected Area (National Parks and Sanctuaries etc.).

### D. National Data

National statistics are not maintained by designation of Forests. However, NFAP, 1999 attempts to provide following broad information on designation of forest. It provides figures rounded to nearest million hectares (column 2) for 1993 which for this table are being assumed for 1990. The NFAP does not provide any such classification for scrub areas (other wooded lands) etc. Following tables also attempts to provide more realistic picture in case of Protected Areas through column (3).

National Classification of Forests	Area in million ha (1990)	
	NFAP	Detail figures
Protection forests (for biological stabilities)	10	10.0
Production forests (for timber Requirements of the country)	15	15.3
Social Forests (for meeting daily needs of local communities)	25	25.0
Protected Area (National Parks and Sanctuaries etc.)	14	13.6
<b>Total Forest</b>	<b>64</b>	<b>63.9</b>
Scrub (Other Wooded Lands)		5.9

**E. Calibration** Not necessary as total matches with that in Global Table 1.

### F. Estimation and Forecasting

Estimation and forecasting is difficult as national statistics is not maintained by designation. However, information is for extent of forests under Protected Areas for the year 2000. The

following table therefore uses only this as new information for 2000 and maintains all other figures as in national reporting table 1.

### G. Reclassification into FRA 2005 Classes

**Table: Reclassification (Percentage allocation) into FRA 2005 classes**

National Classes	Percentage of a National Class into a FRA class								
	Prod F	Prot F	Cons F	Soc F	Mult F	Prot O	Cons O	Soc O	Mult O
	%	%	%	%	%	%	%	%	%
Protection forests		100							
Production forests	100								
Social Forests					100				
Protected Area Forests			100						
Scrub (Other Wooded land)									100

Note: 1.F = Forests, O = Other Wooded lands, Prod = Production, Prot = Protective, Cons = Conservation Forests  
Soc = Social Services, and Mult = Multiple Objective

### H. National Information for FRA 2005 Global Tables

**Table: Input for Global Reporting Table 3**

FRA 2005 Classes	Area in "000" ha		
	1990	2000	2005
Production Forest	15.3	13.6	13.6
Protective Forest	10.0	10.0	10
Conservation Forest	13.6	15.4	15.4
Social Services Forest	Included in Conservation Forest		
Multiple Objective Forest	25.0	28.6	28.7
<b>Total Forests for country</b>	<b>63.9</b>	<b>67.6</b>	<b>67.7</b>
Protective "Other Wooded lands"			
Conservation "Other Wooded Lands			
Social Services "Other Wooded lands"			
Multiple Objective "Other Wooded lands	5.9	4.7	4.1
<b>Total for country (Scrub in Other Wooded Land)</b>	<b>5.9</b>	<b>4.7</b>	<b>4.1</b>

Note: All increase in 2000 apportioned to Multiple Objective Forests. Increase in PA compensated by decrease in Production forests. Increase in 2005 apportioned to Multiple objective Forests

## T4. Characteristics of Forests and Other Wooded Lands

The information on “forest characteristics ” is essential for development of appropriate efficient silvicultural and management practices to ensure and promote sustainability of forest resources. These practices will define the future structure and composition of forest resources and their ability to provide goods and services.

### A. Global Classification and Definitions (FRA 2005)

<b>Primary Forests</b>	Forests of native species, where ecological processes are undisturbed by human activities. Forest management plan may or may not exist.
<b>Modified Natural Forests</b>	Forests of native species or naturally regenerating introduced species, where ecological processes have been disturbed by human activities and it includes forests established through natural and or assisted natural regeneration. Forest management plan may or may not exist
<b>Semi-Natural Forests</b>	The “Forests” of native species or naturally regenerating introduced species established through natural or assisted natural regeneration. The forests are under intensive forest management.
<b>Productive Forest Plantation</b>	The “Forests” of “introduced species”, established through planting or seeding mainly for production of wood or non wood goods.
<b>Protective Forest Plantation</b>	The “Forests” of introduced species, established through planting or seeding mainly for provision of forest services, e.g. soil and water conservation, pest control, and conservation of (habitat) biological diversity.
<b>Primary “Other Wooded Land”</b>	The “Other Wooded land” of native species, where ecological processes are undisturbed by human activities. Forest management plan may or may not exist.
<b>Modified “Other Wooded Land”</b>	The “Other Wooded land” of native species or naturally regenerating introduced species, where ecological processes have been disturbed by human activities and it includes “Other Wooded Land” established through natural and or assisted natural regeneration.
<b>Semi-Natural “Other Wooded Land”</b>	The “Other Wooded Land” of native species or naturally regenerating introduced species established through natural or assisted natural regeneration. Such “Other wooded lands” are under intensive management although a formal management plan may or may not exist.
<b>Protective “Other Wooded Land” Plantation</b>	The “Other Wooded Land” of “introduced species”, established through planting or seeding mainly to provide service of protection to soil and water resources.

Source: FAO. 2004. Terms and Definition FRA-2005. FRA Working paper 73. Rome

## B. National Data Sources

Following form the basis of information for this global table.

- **SFR, 1993.** State of Forest Resources 1993. Forest Survey of India, Ministry of Environment and Forests, Government of India.
- **SFR, 1995.** State of Forest Resources 1995. Forest Survey of India, Ministry of Environment and Forests, Government of India.
- **SFR, 1997.** State of Forest Resources 1997. Forest Survey of India, Ministry of Environment and Forests, Government of India.
- **SFR, 1999.** State of Forest Resources 1999. Forest Survey of India, Ministry of Environment and Forests, Government of India.
- **SFR, 2001.** State of Forest Resources, 2001. Forest Survey of India, Ministry of Environment and Forests, Government of India.
- **Forestry Statistics 1996.** 1998. Indian Council of Forestry Research and Education, Dehradun, Uttaranchal, India.
- **Forestry Statistics 2000.** 2002. Indian Council of Forestry Research and Education, Dehradun, Uttaranchal, India.
- **India Input Tables for FRA 2000.** 1999. Forest Survey of India, Ministry of Environment and Forests, Government of India.

## C. National Classification and Definitions

No standard national definitions

## D. National Data

National information is not available in FRA 2005 classes. Therefore information has been derived by using following assumptions. Further, the national information provides combined area of “forest” and “other wooded land”. Therefore, information by each class is divided between the two taking care that there is no class like “productive OWL plantations”.

- (1) **Primary** : No information is available
- (2) **Semi – Natural**: This information has been derived by computing area of the forest “land” (“Forests” plus other wooded land”) that is not under any management plans (15% of the total) plus the area of forests under protected areas.
- (3) **Modified**: This information has been derived by computing area of the forest land less area of PAs and Plantations (Introduced species) that is under management (85 percent of the total)
- (4) **Productive Plantation (introduced species)**: First area of total plantation have been computed and then based on percentage area of introduced species (rounded to 15

percent) from the input tables of FRA 2000, the area of plantation of introduced species has been derived. The breakdown between productive and protective is explained below.

- (5) **Protective Plantation (introduced species)** : Area of plantation under national category “others” (other than for industrial round wood and fuelwood etc.) has been taken as that of protective plantation and rest treated as productive. The ratio between protective and productive plantation areas for 1997 was calculated and applied to figures after 1997 for break down. The level plantation activity in 1997 was assumed to continue in future to arrive at figures for 100 and 2005. Further, all forest plantations on public lands are assumed to be on forest land (legal definition) that includes “forests” and “other wooded land” (FRA 2005 definition).

### E. Calibration

The total area of “Forests” under various national classes of characteristics defined matches with total in National Reporting Table 1 hence no calibration is needed.

### F. Estimation and Forecasting

The national data estimating for 1990, 2000 and 2005 in global table 1 has been classified into global classes using assumption mentioned in section D above.

### G. Reclassification into FRA 2005 Classes

Assuming that plantation other for industrial round wood and fuelwood are for “protective” purposes.

**Table: Reclassification (Percentage allocation) into FRA 2005 classes**

National Classes	Percentage of a National Class into a FRA class								
	Pri F	Mod F	Semi F	Prod PI F	Prot PI F	Pri OWL	Mod OWL	Semi OWL	Prot PI OWL
	%	%	%	%	%	%	%	%	%
Forest not under management plans			100					100	
Forest (Less PA) with Management Plans		100					100		
Protected Areas			100					100	
Industrial and Fuelwood Plantation				100					
Other Plantations					100				100

Note: F = Forests, OWL = Other Wooded lands, PI = Plantation, Pri = Primary, Mod = Modified, Semi = Semi-Natural, and Prod = Production and Prot = Protective



## H. National Information for FRA 2005 Global Tables

FRA 2005 Classes	Area in 000 ha		
	1990	2000	2005
Primary Forest	NA	NA	NA
Modified Forest	19861.5	21912.4	21972.6
Semi- Natural Forest	42053.3	42696.1	42321.7
Productive Forest Plantation	708.3	1007.7	1160.2
Protective Forest Plantation	1315.5	1937.6	2246.1
Primary "Other Wooded Land"	NA	NA	NA
Modified "Other Wooded Land"	1851.5	1557.8	1357.3
Semi- Natural "Other Wooded Land"	3920.2	3035.4	2614.3
Protective "Other Wooded Land" Plantation	122.6	137.8	138.8
Total	69832.9	72284.8	71810.9

## T5. Forest Growing Stock

The information on “growing stock” is essential to understand dynamics of forest stands, their productive capacity and to manage their use within limits of sustainability defined by their dynamics of growth.

### A. Global Classification and Definitions (FRA 2005)

<b>Growing Stock</b>	Volume of all living trees more than X cm in diameter at breast height (or above buttress if these are higher) measured over bark from ground or stump height to a top stem diameter of Y cm, excluding or including branches to a minimum diameter of Z cm. Excludes: smaller branches, twigs, foliage, flowers, seeds, stump and roots.
<b>Commercial Growing Stock</b>	The part of the growing stock of species, considered as actually or potentially commercial under current market conditions, measured above a minimum say “X cm” diameter at breast height. Includes: all potentially commercial (merchantable) species for domestic or international markets.

Source: FAO, 2004. Terms and Definition FRA-2005. FRA Working paper 73. Rome

### B. National Data Sources

Forest Survey of India (FSI) is an Government of India organization under the Ministry of Environment & Forests. Since early 1980s, it is regularly conducting assessment of forest resources at an interval of about 2 years using remotely sensed data and publishes the information in the “State of Forest Report” (SFR). Field inventory, which is an essential component of forest survey has been in operation in Forest Survey of India since 1965. However, calculation of growing stock from forest cover data for the country was only attempted for 1984 and 1994, which were taken from the State of Forest Report 1989 and 1997 respectively. Though the growing stock calculation was carried out for various international communications but this data has not yet been published.

<b>Information Year</b>	<b>Source</b>
1984	SFR, 1989. State of Forest Report 1989. Forest Survey of India, Ministry of Environment and Forests, Government of India.
1994	SFR, 1997. State of Forest Report 1997. Forest Survey of India, Ministry of Environment and Forests, Government of India.
2000	SFR, 2001. State of Forest Report, 2001. Forest Survey of India, Ministry of Environment and Forests, Government of India.

### C. National Classification and Definitions

The following table provides the definition of growing stock as used by Forest Survey of India, Ministry of Environment and Forest, India.

<b>Growing Stock</b>	The sum-total of all trees, by number or volume or biomass, growing within a particular area of interest. Explanation: Volume of all living trees more than 10 cm in diameter at breast height (or above buttress if these are higher) measured over bark from ground or stump height to a top stem diameter of 10 cm, excluding or including branches to a minimum diameter of 5 cm. Excludes: smaller branches, twigs, foliage, flowers, seeds, stump and roots
<b>Commercial Growing Stock</b>	The part of the growing stock of species, considered as actually or potentially commercial under current market conditions, measured above a minimum of 10 cm diameter at breast height. Includes: all potentially commercial (merchantable) species for domestic markets. Explanation: This definition is based on the definition given by FAO as in India there is no separate definition for commercial growing stock available.

#### D. National Data

Categories	Growing Stock in million cu.m.	
	1984	1994
Forests	4328.5	4340.0

#### E. Calibration

Not considered necessary

#### F. Estimation and Forecasting

The growing stock for 1990 based on forest cover assessment for the period 1984 and 1994 as mentioned above is as following. The figures for the year 2000 and 2005 have been forecasted using regression estimates.

Categories	Growing Stock in million cu.m.		
	1990	2000	2005
Forests	4335.4	4629.1	4639.1

#### G. Reclassification into FRA 2005 Classes

**Table: Reclassification (Percentage allocation) into FRA 2005 classes**

National Classification	Percentage of a National Class belonging to a FRA Class	
	Growing Stock	Commercial Growing Stock
Growing stock	100	Only 40 percent of the total growing stock is considered to be Commercial.

## H. National Information for FRA 2005 Global Tables

**Table: Input for FRA 2005**

8. National Information for FRA 2005 Global Tables			
Growing Stock in Forests	Volume in "million" cubic meters		
	1990	2000	2005
Growing Stock	4335.4	4629.1	4639.1
Commercial Growing Stock	1734.16	1851.64	1855.64

Note: Commercial growing stock assumed 40 percent of "Growing Stock"

**Appendix 1 to National Reporting Table 5**

Item	Unit	Information	
		1984	1994
1. How much of growing stock is of broadleaved trees	million m <sup>3</sup>	3398.3	3355.3
2. How much of growing stock is of coniferous trees	million m <sup>3</sup>	749.1	795.8
3. How much growing stock is of mixed (coniferous + broadleaved)	million m <sup>3</sup>	181.0	189.0
4.. Area over which all Growing Stock has been measured	"000" ha	63880	63340
5. Minimum diameter at breast height of trees in Growing Stock	cm	10	10
6. Minimum diameter at the top end of stem of trees in Growing Stock	cm	10	10
7. Minimum diameter of the branches in Growing Stock	cm	5	5
8. Average height of the stumps (can be zero if cut at ground level)	cm	10	10
9. Have above thresholds (points 5 to 8) changed since 1990	Yes/No	No	No
7. If yes, then attach a separate note giving details of the change	Attachment	-	-

## T6. Biomass Stock of Forests

The information on “biomass stocks” is essential to assess the total and the annual capacity of “forests” and Other Wooded Land” to sequester carbon. The annual growth (capacity) defines their sustenance limits of use and management needs and opportunities.

### A. Global Classification and Definitions (FRA 2005)

<b>Above Ground Tree Biomass</b>	The mass, expressed as oven-dry weight (including or excluding bark), of the woody parts (stem, bark, branches and twigs) of all living trees excluding stump and roots.
<b>Below Ground Tree Biomass</b>	The mass, expressed as oven-dry weight of below ground woody parts (includes all roots greater than 2 mm in diameter) of all living trees.
<b>Woody Biomass Stock</b>	The mass expressed as oven-dry weight (including bark) of the woody parts (stem, bark, branches and twigs) of all trees, alive and dead, shrubs and bushes, including stumps, roots, deadwood and litter.

Source: FAO. 2004. Terms and Definition FRA-2005. FRA Working paper 73. Rome

### B. National Data Sources

Forest Survey of India (FSI) and Forest Research Institute (FRI) have jointly worked out the above ground growing stock, biomass and carbon stock in India’s forests using forest cover information of two assessment years – 1989 and 1997. These years respectively refer to the data or information year 1984 and 1994.. The biomass was calculated using specific gravity of dominant species in the particular strata Though the biomass calculation was carried out for various international communications but this data has not yet been published.

<b>Information Year</b>	<b>Source</b>
1984	SFR, 1989. State of Forest Report 1989. Forest Survey of India, Ministry of Environment and Forests, Government of India.
1994	SFR, 1997. State of Forest Report 1997. Forest Survey of India, Ministry of Environment and Forests, Government of India.
2000	SFR, 2001. State of Forest Report, 2001. Forest Survey of India, Ministry of Environment and Forests, Government of India.

### C. National Classification and Definitions

No standard national definitions

### D. National Data

The following table presents the national data on above ground tree biomass in India. This basic information is derived from the State of Forest Report (SFR) of FSI.

Categories	Above Ground Tree Biomass in million ton	
	1984	1994
Forests	2398.5	2395.4

### E. Calibration

It is not required in this case.

### F. Estimation and Forecasting

Forest Survey of India has calculated the above ground tree biomass based on forest cover assessment for the period 1984 and 1994 as mentioned above. Moreover, FSI has also estimated the growing stock for the country for the year 1990 based on the 1984 and 1994 figures. The figures for the year 2000 and 2005 are forecasted using regression estimates.

Categories	Above Ground Tree Biomass in million ton		
	1990	2000	2005
Forests	2396.6	2554.7	2560.3

### G. Reclassification into FRA 2005 Classes

**Table: Reclassification (Percentage allocation) into FRA 2005 classes**

National Classification	Percentage of a National Class to a FRA Class		
	Woody	Above Ground	Below Ground
Above Ground Tree Biomass	-	100%	-

### H. Information for FRA 2005 Global Tables

**Table: Input to Global Reporting Tables**

Biomass Stock in Forests	Biomass "million" metric tones (Oven Dry Weight)		
	1990	2000	2005
Woody Biomass	-	-	-
Above Ground Tree Biomass	2396.6	2554.7	2560.3
Below Ground Tree Biomass	-	-	-

### Appendix T6 to National Reporting Table 6

Item	Unit	Information	
		1984	1994
1. Area over which Biomass has been measured	"000"ha	63880	63340
2. Average height of the stumps	cm	10 cm	10 cm
3. Minimum diameter (X) for "dead wood biomass" measurements		NA	NA
4. Stump biomass is in Above/Below Ground Tree Biomass	Above/Below	Below	Below
5. Whether biomass includes or excludes bark	Includes/Excludes	Includes	Includes
5. Have above threshold changed since 1990	Yes/No	No	No
6. If yes, then attach a separate note giving details of the change	Yes/No	NA	NA

Notes: Countries should provide details on their biomass expansion factors if any as an attachment to this Appendix

## T7. Forest Carbon

The information on “Carbon stock” indicate the contribution of “Forest” and Other Wooded Land” to carbon cycle and is required in international process related to mitigation of climate change like UNFCCC.

### A. Global Classification and Definitions (FRA 2005)

<b>Carbon in Woody Biomass</b>	The carbon content in the “Woody Biomass”.
<b>Carbon in Above Ground Tree Biomass</b>	The carbon content in the “Above Ground Tree Biomass”.
<b>Carbon in Below Ground Tree Biomass</b>	The carbon content in the “Below Ground Tree Biomass”.
<b>Soil Carbon</b>	The carbon content in the soil (mineral and organic) material at the depth or layer (X cm) of the soil with bulk density (Y Mg m-3) in “Forest and “Other Wooded Land”.

Source: FAO. 2004. Terms and Definition FRA-2005. FRA Working paper 73. Rome

### B. National Data Sources

Forest Survey of India (FSI) and Forest Research Institute (FRI) have jointly worked out the above ground growing stock, biomass and carbon stock in India’s forests using forest cover information of two assessment years – 1989 and 1997. These years respectively refer to the data or information year 1984 and 1994. The biomass was calculated using specific gravity of dominant species in the particular strata while carbon contents were assessed using ash method. This assessment of carbon was carried out for various international communications but this data has not yet been published.

### C. National Classification and Definitions

No standard national definitions

### D. National Data

The following table presents the national data on Carbon Stocks in forest in India in 1984 and 1994.

Year	Forest cover (000 ha)	Growing stock (million m <sup>3</sup> )	Biomass (million tons)	Carbon (million tons)
1984	63878	4328.45	2398.46	1085.17
1994	63336	4340.03	2395.37	1083.79

### E. Calibration

Not Considered Necessary

## F. Estimation and Forecasting

The biomass estimates and forecast for 1990, 2000 and 2005 developed in global table 6 were used to develop carbon stock estimate and forecast for 1990, 2000 and 2005. The average of ratio of biomass to carbon for 1984 and 1994 was used to convert biomass into estimate and forecasts for carbon stocks.

Categories	Carbon Stock (Above ground) in million ton		
	1990	2000	2005
Forests	1084.337	1155.87	1158.403

## G. Reclassification into FRA 2005 Classes

**Table: Reclassification (Percentage allocation) into FRA 2005 classes**

National Classification	Percentage of a National Class belonging to a FRA Class		
	Woody	Above Ground	Below Ground
Carbon Stock in forests		100	

## H. Information for FRA 2005 Global Tables

**Table: Input to Global Reporting Tables**

Carbon Stock in Forests	Carbon Stock (above ground) in "million" metric tones		
	1990	2000	2005
Carbon Stock (Above ground)	1084.337	1155.87	1158.403



## T8. Disturbances affecting Health and Vitality of Forests and Other Wooded Lands

The understanding of the “disturbances” (mainly fire, insects and diseases) is essential to develop appropriate management regimes to contain them and their impact on health and vitality of “Forest” and “Other Wooded lands”.

### A. Global Classification and Definitions (FRA 2005)

<b>Forest Fire</b>	An unplanned fire in the “Forest” and or “Other Wooded Land”, whether it broke out inside or outside the “Forest” or the “Other Wooded Land”.
<b>Forest Insect</b>	A forest insect is an animal belonging to the class Hexapoda with its habitat in “Forest” and “Other Wooded Land”.
<b>Forest Disease</b>	A condition caused by living organisms or environmental changes that impairs the normal functions of tree or Forest.

Source: FAO. 2004. Terms and Definition FRA-2005. FRA Working paper 73. Rome

### B. National Data Sources

#### (1) Area affected by Fire

Forestry Statistics compiled and published by Indian Council of Forestry Research and Education (ICFRE) Dehradun is the main source of basic information. It present information by individual States and Union Territories in India . The period of the annual reporting is from April 1<sup>st</sup> to March 31<sup>st</sup> of next year. It covers first nine months of the starting year and next 3 months of ending year, therefore information has been dealt as belonging to the starting year. For example, the period 1<sup>st</sup> April 96 to 31<sup>st</sup> March 1997 is nationally denoted as 1996-97 and contains 9 months of 1996 and only 3 months of 1997 therefore the information has been treated as for 1996. The following publications have been used for archiving National Data:

- For 1988 to 1993: **Forestry Statistics, India, 1988-95**. 1997. Indian Council of Forestry Research and Education, Dehradun, Uttaranchal, India.
- For 1994 & 1995: **Forestry Statistics, India, 1996**. 1998. Indian Council of Forestry Research and Education, Dehradun, Uttaranchal, India.
- For 1996 & 1997: **Forestry Statistics, India, 2000**. 2002. Indian Council of Forestry Research and Education, Dehradun, Uttaranchal, India.
- In addition to this report submitted by Government of India to Global Fire Monitoring Center and IFFN and published in IFFN No. 26, January, 2002 indicates the annual level of fires to be around 3.7 million hectares. This figure has been used as an estimate of forest fire during 2000.

- **Bahuguna, V. K.** 2002. “*Fire Situation in India*” in IFFN No. 26, 2002. Report submitted by Ministry of Environment and Forests, Government of India to Global Fire Monitoring Centre and International Forest Fire News . ([www.fire.uni-freiburg.de/iffn/country/in/in\\_5.htm](http://www.fire.uni-freiburg.de/iffn/country/in/in_5.htm)).

## (2) Area affected by Insects and diseases

More than 21 major insect pests affect forest resources but no statistics is available on area affected by insects. Figures are available mostly at local level or in some national report of paper presented at conferences. Following sources of information available on the internet have been used to provide some information on the subject.

- **Sharma et al.** 2000. 2000. Dalbergia Sissoo in India. In Proceedings of the Sub-Regional Seminar “Die-Back of Sissoo (Dalbergia Sissoo).
- **Annual Report 2000-2001.** 2001. Annual Report 2000-2001, Ministry Of Environment and Forests, Government of India. (Mentions about Sal borer problem).

## C. National Classification and Definitions

The Forest Survey of India defines forest fire as under. The definition is totally compatible with FRA 2005 definition.

<b>Forest Fire</b>	Any fire on forest land which is not used as a tool in forest production or management in accordance with an approved plan.
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There is no definition for area affected by insects or diseases.

## D. National Data

### (1) Area Affected by Forest Fires

The national reporting on “forest fire” is not done on the basis of crown cover classification into “forest” and “Other wooded land” rather it is done for the legal classification i.e. “forest land”).

Year	Forest Land/Area Affected by forest fires in million hectares					
	1985	1987	1995	1996	1997	2000
Forest Area Affected	0.986	1.034	1.450	0.100	0.072	3.700

Note:

1. The above figures present reported information and may and may not capture all the forest fires in the country.
2. Figures for 1985, 1987, 1996 and 1997 come from Forestry Statistics, ICFRE, figure for 1995 come from FSI and figure for 2000 come from IFFN 26, 2002.

### (2) Area Affected by Insects and Diseases

The national paper presented on the “Dalbergia Sissoo in India” mentions that Dalbergia sissoo is diseased over an area of 8400 square kilometres of Gangetic plains in north of Bihar (one of the States of India) alone. With very conservative estimate of one percent of this figure spanning

forest land leads to an estimate of about 8,400 hectares of area affected by one disease and that too in part of one of the states of India.

Similarly, the “Annual Reports” of Ministry of Environment and Forests, Government India indicate mortality of millions of trees of Shorea robusta due to a stem borer insect (Hoplocerambyx spinicornis). This alone will cover more than 1000 ha of forest land. Since no area figure is reported hence most conservative estimate of 1000 ha of Shorea forest affected by this insect has been made for the year 2000.

### E. Calibration

This step is not considered necessary

### F. Estimation and Forecasting

The figure for area affected by fire during 1990 has been derived through regression estimate using data of 1985, 1987 and 1995. The figure for 1990 comes to 1.205 million hectares.

### G. Reclassification into FRA 2005 Classes

Reclassification of national data on forest fire is not necessary as the national and FRA 2005 definitions match with each other.

### H. National Information for FRA 2005 Global Tables

**Table: Input for Global Reporting Table**

Disturbances	Average Annual Area Affected "000"hectares			
	Forests		Other Wooded lands	
	1990	2000	1990	2000
Forest Fires	1205.000	3700.000	Added in Forests	Added in Forests
Forest Insects	NA	1.000	Added in Forests	Added in Forests
Forest Diseases	NA	8.400	Added in Forests	Added in Forests

Note:

1. The figure for fire in 1990 is based on past levels of fire damage and for figure for 2000 is from IFFN No 26, 2002
2. Figure for insect affected areas indicates reported part of the mortality of millions of trees of Shorea robusta in Madhya Pradesh from Sal borer.
3. The figures indicates part of reported mortality of Dalbergia sisso trees in Bihar State of India mentioned in a presentation in a sub-regional seminar organised by FAO at Kathmandu, April 2000. Assuming one percent of the affected area falls in forest.

## T9. Forest Tree Species

The information on forest tree species provides much needed information on tree species distribution for addressing many critical issues relating to conservation of biodiversity in Forests. It helps to meet some of the national and international reporting requirements of biodiversity.

### A. Global Classification and Definitions (FRA 2005)

<b>Inventoried Forest Tree Species</b>	A “forest tree” species in “Forest” or “Other Wooded Land”, which is measured and recorded separately in a forest inventory.
<b>Endangered Forest Tree Species</b>	A tree species facing a high risk of extinction in “Forest” and “Other Wooded Land” in the near future and included in IUCN list of endangered species.

Source: FAO. 2004. Terms and Definition FRA-2005. FRA Working paper 73. Rome

### B. National Data Sources

Indian flora accounts for 10.78% of the global total. According to the Red List (IUCN, 2000) 113 plant species are endangered and out of this 98 are tree (short or tall) species. There is no regular inventory of these species and therefore it is difficult to develop trend information.

The source for this information is the following:

- IUCN. 2002. Red List of Threatened Species. Gland, Switzerland: The World Conservation Union.

Forest Survey of India conducts national forestry inventories and cover about 1200 tree species and 40 bamboo and canes species.

### C. National Classification and Definitions

There are no standard national definitions or classifications.

### D. National Data

Forest Tree Species	Total Number (type) of species	
	1990	2000
Inventoried Forest Tree Species	1240	1240
Endangered Forest Tree Species	98	98

### E. Calibration

Considered not necessary

## F. Estimation and Forecasting

Necessary data and basis missing for any estimation and forecasting.

## G. Reclassification into FRA 2005 Classes

This step is not considered necessary as national forest inventories includes only “tree species”.

## H. National Information for FRA 2005 Global Tables

**Table: Input to Global Reporting Table 9**

Forest Tree Species	Total Number (type) of species	
	1990	2000
Inventoried Forest Tree Species	1240	1240
Endangered Forest Tree Species	98	98

Note:

1. The above total of 1240 includes 1200 tree species and 40 bamboo and canes species
2. Same data for both years as separate information is not available.

Following is the list of endangered tree species in India

Name	
1	<i>Actinodaphne bourneae</i>
2	<i>Actinodaphne salicina</i>
3	<i>Adinandra griffithii</i>
4	<i>Anacolosa densiflora</i>
5	<i>Aporosa bourdillonii</i>
6	<i>Ardisia amplexicaulis</i>
7	<i>Ardisia blatteri</i>
8	<i>Ardisia sonchifolia</i>
9	<i>Atuna indica</i>
10	<i>Atuna travancorica</i>
11	<i>Bentinckia nicobarica</i>
12	<i>Byrsophyllum tetrandrum</i>
13	<i>Canthium ficiforme</i>
14	<i>Canthium pergracilis</i>
15	<i>Capparis pachyphylla</i>
16	<i>Chionanthus linocieroides</i>
17	<i>Cinnamomum chemungianum</i>
18	<i>Cinnamomum filipedicellatum</i>
19	<i>Cleistanthus travancorensis</i>
20	<i>Cryptocarya anamallayana</i>
21	<i>Cynometra bourdillonii</i>
22	<i>Cynometra travancorica</i>
23	<i>Dimorphocalyx beddomei</i>
24	<i>Dipterocarpus alatus</i>
25	<i>Dipterocarpus costatus</i>
26	<i>Dipterocarpus indicus</i>
27	<i>Drypetes andamanica</i>
28	<i>Drypetes porteri</i>
29	<i>Drypetes travancoria</i>
30	<i>Dysoxylum beddomei</i>
31	<i>Elaeocarpus blascoi</i>
32	<i>Eugenia discifera</i>
33	<i>Eugenia floccosa</i>
34	<i>Eugenia indica</i>
35	<i>Euodia lunuankenda</i>
36	<i>Euonymus assamicus</i>
37	<i>Euonymus paniculatus</i>
38	<i>Ficus andamanica</i>
39	<i>Garcinia imberti</i>
40	<i>Garcinia kingii</i>
41	<i>Glochidion pauciflorum</i>
42	<i>Glochidion sisparensense</i>
43	<i>Glochidion tomentosum</i>
44	<i>Goniothalamus rhynchantherus</i>
45	<i>Homalium jainii</i>
46	<i>Hopea glabra</i>
47	<i>Hopea parviflora</i>
48	<i>Hopea ponga</i>
49	<i>Hopea racophloea</i>
50	<i>Hopea utilis</i>

<b>Name</b>	
51	<i>Hopea wightiana</i>
52	<i>Humboldtia bourdillonii</i>
53	<i>Ilex venulosa</i>
54	<i>Isonandra stocksii</i>
55	<i>Isonandra villosa</i>
56	<i>Ixora lawsoni</i>
57	<i>Ixora saulierei</i>
58	<i>Julostylis polyandra</i>
59	<i>Kingiodendron pinnatum</i>
60	<i>Lagerstroemia minuticarpa</i>
61	<i>Litsea beddomei</i>
62	<i>Litsea leiantha</i>
63	<i>Litsea nigrescens</i>
64	<i>Litsea travancorica</i>
65	<i>Madhuca bourdillonii</i>
66	<i>Madhuca diplostemon</i>
67	<i>Mangifera andamanica</i>
68	<i>Mangifera nicobarica</i>
69	<i>Melicope indica</i>
70	<i>Memecylon flavescens</i>
61	<i>Litsea beddomei</i>
62	<i>Litsea leiantha</i>
63	<i>Litsea nigrescens</i>
64	<i>Litsea travancorica</i>
65	<i>Madhuca bourdillonii</i>
66	<i>Madhuca diplostemon</i>
67	<i>Mangifera andamanica</i>
68	<i>Mangifera nicobarica</i>
69	<i>Melicope indica</i>
70	<i>Memecylon flavescens</i>
68	<i>Mangifera nicobarica</i>
69	<i>Melicope indica</i>
70	<i>Memecylon flavescens</i>
71	<i>Memecylon subramanii</i>
72	<i>Microtropis densiflora</i>
73	<i>Myristica magnifica</i>
74	<i>Orophea thomsoni</i>
75	<i>Palaquium ravii</i>
76	<i>Pittosporum eriocarpum</i>
77	<i>Polyalthia rufescens</i>
78	<i>Polyalthia shendurunii</i>
79	<i>Popowia beddomeana</i>
80	<i>Psychotria beddomei</i>
81	<i>Psychotria macrocarpa</i>
82	<i>Pterocarpus santalinus</i>
83	<i>Rapanea striata</i>
84	<i>Sageraea grandiflora</i>
85	<i>Shorea roxburghii</i>
86	<i>Sophora wightii</i>
87	<i>Symplocos anamallayana</i>
88	<i>Symplocos barberi</i>
89	<i>Symplocos nairii</i>
90	<i>Symplocos oligandra</i>
91	<i>Syzygium beddomei</i>
92	<i>Syzygium bourdillonii</i>
93	<i>Syzygium chavaran</i>
94	<i>Syzygium microphyllum</i>
95	<i>Syzygium myhendrae</i>
96	<i>Syzygium parameswaranii</i>
97	<i>Syzygium stocksii</i>
98	<i>Xylosma latifolium</i>
80	<i>Psychotria beddomei</i>
81	<i>Psychotria macrocarpa</i>
82	<i>Pterocarpus santalinus</i>
83	<i>Rapanea striata</i>
84	<i>Sageraea grandiflora</i>
85	<i>Shorea roxburghii</i>
86	<i>Sophora wightii</i>
87	<i>Symplocos anamallayana</i>
88	<i>Symplocos barberi</i>
89	<i>Symplocos nairii</i>
90	<i>Symplocos oligandra</i>
91	<i>Syzygium beddomei</i>
92	<i>Syzygium bourdillonii</i>
93	<i>Syzygium chavaran</i>
94	<i>Syzygium microphyllum</i>
95	<i>Syzygium myhendrae</i>
96	<i>Syzygium parameswaranii</i>
97	<i>Syzygium stocksii</i>
98	<i>Xylosma latifolium</i>

Source: IUCN 2002. 2002 IUCN Red List of Threatened Species

## T10. Forest Composition

The information on “Forest Composition ” is required for understanding dynamics of composition of forests that addresses some critical issues relating to conservation of biodiversity. It also helps in developing efficient management plan for their sustenance in addition to satisfying needs of national and international reporting relating to biodiversity.

### A. Global Classification and Definitions (FRA 2005)

<b>Forest Composition</b>	The composition of “growing stock” in “Forest” and “Other Wooded land” by each “inventoried forest tree species”.
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Source: FAO, 2004. Terms and Definition FRA-2005. FRA Working paper 73. Rome

### B. National Data Sources

FSI and FRI have jointly estimated the above ground growing stock, biomass and carbon stock in India’s forests using forest cover information of two assessment years – 1984 and 1994 for each inventory strata. Some of the strata represent pure formation or dominant species while other represent mixed combination. These results have not been published.

- **SFR**, 1989. State of Forest Report 1989. Forest Survey of India, Ministry of Environment and Forests, Government of India.
- **SFR**, 1997. State of Forest Report 1997. Forest Survey of India, Ministry of Environment and Forests, Government of India.

### C. National Classification and Definitions

No national standard definition and classification

### D. National Data

Both 1984 and 1994 assessment of the growing stock indicate same relative percentage of the species or species group (strata). Following presents the relative ranking of these species. First being the specie that has maximum share in the national growing stock.

1. Sal
2. Teak
3. Fir
4. Chir Pine
5. Blue Pine
6. Deodar
7. Spruce
8. Khasi Pine
9. Khair
10. Salai
11. Rest of Species

## E. Calibration

Not considered necessary.

## F. Estimation and Forecasting

It is assumed that the relative share of the species or species group will continue to remain in 2000 and 2005 as it remained same in 1984 and 1994.

## G. Reclassification into FRA 2005 Classes

**Table: Reclassification (Percentage allocation) into FRA 2005 classes**

Year	Percentage of Growing Stock in Order of most frequent species (FRA 2005 Classes)										
	Most	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>	5 <sup>th</sup>	6 <sup>th</sup>	7 <sup>th</sup>	8 <sup>th</sup>	9 <sup>th</sup>	10 <sup>th</sup>	Rest
	Sal	Teak	Fir	Chir-Pine	Blue-Pine	Deodar	Spruce	Khasi-Pine	Khair	Salai	Rest
1990	12.75	6.86	3.41	2.27	1.67	0.57	0.27	0.14	0.06	0.09	71.91
2000	11.85	6.59	3.50	2.20	1.70	0.70	0.32	0.14	0.06	0.09	72.85

## H. National Information for FRA 2005 Global Tables

**Table: Input to Global Reporting Table 10**

Ten (name) Most Frequent Tree Species and Rest	Growing Stock in Forests in million cubic meters	
	1990	2000
Sal	552.6	548.4
Teak	297.3	305.2
Fir	147.8	162.2
Chir-Pine	98.5	102.0
Blue-Pine	72.4	78.6
Deodar	24.9	32.4
Spruce	11.7	14.6
Khasi pine	6.1	6.7
Khair	2.6	2.8
Salai	3.7	4.1
Rest	3117.8	3372.2
<b>Total</b>	<b>4335.4</b>	<b>4629.1</b>



## T11. Wood Removal

The table provides information on actual removal of “Round Wood” from “Forests”, “Other Wooded Lands” and “Other Land with Trees” (including Trees Outside Forests). It indicates the economic and social potential and utility of forest tree species in national economy and dependent local communities. It helps to monitor sustained use of tree resources by comparing actual removal with sustainable potential.

### A. Global Classification and Definitions (FRA 2005)

<b>Industrial Round Wood Removal</b>	The “round wood” removed (volume in round wood under-bark) from “Forest” or “Other Wooded Land” for production of goods and services other than source of “wood fuel” (“fuelwood”).
<b>Wood Fuel (Fuelwood ) Removal</b>	The “Wood Fuel” removed from “Forest” or “Other Wooded Land” (volume in round wood under-bark) both for industrial and domestic purposes.

Source: FAO. 2004. Terms and Definition FRA-2005. FRA Working paper 73. Rome

### B. National Data Sources

Forestry Statistics compiled and published by Indian Council of Forestry Research and Education (ICFRE) Dehradun provides basic information. It present information by individual States and Union Territories in India . However it does not provide national totals because it maintains reporting units of the States and does not covert into same units. For example, some States report production of wooden poles by number and some other by cubic meters.

The period of the annual reporting is from April 1<sup>st</sup> to March 31<sup>st</sup> of next year. It covers first nine months of the starting year and next 3 months of ending year, therefore information has been dealt as belonging to the starting year. For example, the period 1<sup>st</sup> April 96 to 31<sup>st</sup> March 1997 is nationally denoted as 1996-97 and contains 9 months of 1996 and only 3 months of 1997 therefore the information has been treated as for 1996. Following publication have been used for archiving National Data.

- For 1988 to 1993: **Forestry Statistics, India, 1988-95.** 1997. Indian Council of Forestry Research and Education, Dehradun, Uttaranchal, India.
- For 1994 & 1995: **Forestry Statistics, India, 1996.** 1998. Indian Council of Forestry Research and Education, Dehradun, Uttaranchal, India.
- For 1996 & 1997: **Forestry Statistics, India, 2000.** 2002. Indian Council of Forestry Research and Education, Dehradun, Uttaranchal, India.

### C. National Classification and Definitions

The units of the published wood removal figures were first converted to cubic meters by using following factors. Then quantity of wood, poles, pulp wood and match wood was totalled to derive figures of industrial round wood removal. The figures of fuelwood, if in tonnes, were converted to round wood cubic meters using the first of the two following conversion factors.

$$\begin{aligned} 1 \text{ metric ton of wood} &= 1.37931 \text{ cubic meters round} \\ 1 \text{ wooden pole} &= 0.05 \text{ cubic meters} \end{aligned}$$

### D. National Data

Product	Unit	1990	1994	1995	1996	1997	1998	1999	2000
Industrial Timber	Mill Cub M	4.534	3.394	3.708	2.746	2.801	2.274	2.187	1.927
Wood Fuel	Mill Cub M	3.293	3.025	3.452	2.609	2.575	3.174	3.686	2.968

### E. Calibration

This step was not considered necessary.

### F. Estimation and Forecasting

For estimating wood removal in year 2000, the information for full past five year period (1998 to 2002) is not available, therefore, the annual average supply for 2000 has been estimated as an average of last 2 years (1996 and 1997) of wood removal for which information is available.

The information for 2005 has been forecasted on the basis of simple linear regression using actual wood removal information from 1994 to 1997 and estimated removal during 2000.

### G. Reclassification into FRA 2005 Classes

The national data did not need any reclassification as fuelwood (wood fuel) is reported separately than wood (Timber, Wood Poles, Matchwood and Pulpwood).

### H. National Information for FRA 2005 Global Tables

National information is not available separately for “Wood Removal” from “forest” and “Other Wooded Lands”. Since, most of the reported production comes from “forest” and hence it has been shown against “forests”. No information is available on “wood removals” from “Other Land with Trees”.

**Table: Input to Global Reporting Tables**

Round Wood Removal	Volume in "million" cubic meters as round wood under bark					
	Forests			Other Land with Trees (Trees Outside Forest)		
	1990	2000	2005	1990	2000	2005
Industrial Round Wood	4.534	1.927	1.088	NA	NA	NA
Wood Fuel (Fuelwood )	3.293	2.968	1.676	NA	NA	NA
Total for Country	7.827	4.895	2.764	NA	NA	NA

Note:

1. Forecast of Industrial Round Wood for 2005 is based on linear regression using recent data (1998 to 2000)
2. Estimated of Fuelwood for 2000 and 2005 based on average ratio (fuelwood to timber during 1995 to 1999)
3. Following conversion factors have been used 1metric ton Wood Fuel = 1.37931 cubic meter round wood: from FAO Forestry Statistics Series 171 (Pub. 2001); 1 normal wooden pole (mainly hard wood species) = 0.05 cubic meters

## T12. Value of Wood Removal

The value of “ Wood Removal” indicates the “economic health” of the “Forest”, “Other Wooded Land” and “Other Lands with Trees” which is basically a function of output and demands of forest products, prices, surplus, employment and other variables. This table deals with the market value (product of price and quantity) of “wood removal”.

### A. Global Classification and Definitions (FRA 2005)

<b>Value of Wood Removal</b>	The market value of total annual removal of primary “round wood” (“industrial round wood”, and “wood fuel” or “fuelwood”).
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Source: FAO. 2004. Terms and Definition FRA-2005. FRA Working paper 73. Rome

### B. National Data Sources

Forestry Statistics compiled and published by Indian Council of Forestry Research and Education (ICFRE) Dehradun provides basic information. It present information by individual States and Union Territories in India . The period of the annual reporting is from April 1<sup>st</sup> to March 31<sup>st</sup> of next year. It covers first nine months of the starting year and next 3 months of ending year, therefore information has been dealt as belonging to the starting year. For example, the period 1<sup>st</sup> April 96 to 31<sup>st</sup> March 1997 is nationally denoted as 1996-97 and contains 9 months of 1996 and only 3 months of 1997 therefore the information has been treated as for 1996. Following publication have been used for archiving National Data.

- For 1988 to 1993: **Forestry Statistics, India, 1988-95.** 1997. Indian Council of Forestry Research and Education, Dehradun, Uttaranchal, India.
- For 1994 & 1995: **Forestry Statistics, India, 1996.** 1998. Indian Council of Forestry Research and Education, Dehradun, Uttaranchal, India.
- For 1996 & 1997: **Forestry Statistics, India, 2000.** 2002. Indian Council of Forestry Research and Education, Dehradun, Uttaranchal, India.

### C. National Classification and Definitions

The national statistics uses the terms “revenue” and not market value. It does not include taxes, if any, imposed by central or state governments.

<b>Value of Wood Removal</b>	The revenue earned from removal of wood produced in forests.
Revenue	The revenue arising in the course of ordinary activities of the enterprise from , A. Sale of goods B. Rendering of services C. The use by others of enterprise resources yielding interest, royalties and dividends. <u>Explanations:</u> Following are excluded . a. Realised or Unrealised gains from the appreciation in the value of fixed assets. b. Unrealised holding gains resulting from the change in value of current assets. c. Unrealised holding gains resulting from the natural increases in forest resources. d. Realised or Unrealised gains from changes in foreign exchange rates and adjustments.

Note: The definition of revenue is from Institute of Chartered Accountant of India at [http://www.icai/resource/as9\\_intro.html](http://www.icai/resource/as9_intro.html)

### D. National Data

The Forestry Statistics published by ICFRE has many gaps or missing information for few of the States of India. Such gaps have been treated as zero for arriving at national totals. Due to the missing information the revenue reported in following table “under estimates” the contribution “round wood” to the forest revenue. However it is felt that such gaps will not alter the trend, which is more important than the total themselves. Further, the break down of total revenue by “industrial round wood” and “wood fuel” from 1997 to 2000 is not available. Therefore past average of their ratio in total revenue has been used to split the total revenue of this period between the two.

Product	Revenue (Rs. In Millions)							
	1990	1994	1995	1996	1997	1998	1999	2000
Industrial Round Wood	5613	8913	9261	10992	11104	15561	14087	13438
Wood Fuel	315	373	382	279	302	598	541	516

### E. Calibration

This step is not considered necessary.

### F. Estimation and Forecasting

The figures for 2005 were estimated based on regression relationship developed with the help of recent information (years 1997 to 2000).

### G. Reclassification into FRA 2005 Classes

Reclassification was not needed because information on revenue from wood was available.

## H. National Information for FRA 2005 Global Tables

**Table: Input to Global Reporting Table**

Round Wood Removal	Value of Round Wood Removal in Million Rupees					
	Forests and Other Wooded land			Other Land with Trees		
	1990	2000	2005	1990	2000	2005
Industrial Wood Removal	5613	13438	9076	NA	NA	NA
Wood Fuel Removal	315	516	349	NA	NA	NA
Total (Round Wood Removal)	5928	13954	9425	NA	NA	NA

Notes to table

1. The figures for 2005 are based on regression estimate using data from 1997 to 2000.
2. Separate information for OWL is not available.
3. No information is available for Other land with trees including TOF

## T13. Non Wood Forest Products (NWFP) Removal

The information on “Non Wood Forest Products (NWFP) Removal” demonstrates the potential of forests in providing NWFP and indicates the priority NWFPs deserve in development of management strategies to conserve resources and to sustain and promote livelihoods of local and indigenous people dependent on them.

### A. Global Classification and Definitions (FRA 2005)

<b>Non Wood Forest Products Removal</b>	Annual removal of a Non Wood Forest Product (NWFP) from “Forest” and “Other Wooded Land”.
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Source: FAO, 2004. Terms and Definition FRA-2005. FRA Working paper 73. Rome

### B. National Data Sources

Forestry Statistics compiled and published by Indian Council of Forestry Research and Education (ICFRE) Dehradun provides basic information on removal of NWFP. It present information by individual States and Union Territories in India . However it does not provide national totals because it maintains reporting units of the States and does not covert into one units like metric tonne. For example, production of tendu leaves is reported in “standard bags” and bamboo in “running meters” and grass and fodder in “kilograms”. This global reporting table needs information in one unit “metric tonnes”. Further, period of the annual reporting is from April 1<sup>st</sup> to March 31<sup>st</sup> of next year. It covers first nine months of the starting year and next 3 months of ending year, therefore information has been dealt as belonging to the starting year. For example, the period 1<sup>st</sup> April 96 to 31<sup>st</sup> March 1997 is nationally denoted as 1996-97 and contains 9 months of 1996 and only 3 months of 1997 therefore the information has been treated as for 1996. Following publication have been used for archiving National Data.

- **Forestry Statistics, India, 1988-95.** 1997. Indian Council of Forestry Research and Education, Dehradun, Uttaranchal, India.
- **Forestry Statistics, India, 1996.** 1998. Indian Council of Forestry Research and Education, Dehradun, Uttaranchal, India.
- **Forestry Statistics, India, 2000.** 2002. Indian Council of Forestry Research and Education, Dehradun, Uttaranchal, India.
- **Forestry Statistics, India, 2001.** 2003. Indian Council of Forestry Research and Education, Dehradun, Uttaranchal, India.

### C. National Classification and Definitions

There are no standard national definitions for NWFP. The data units were converted to metric tonnes by using conversion factors, for example, the following.

Weight of Standard bag of Bidi Leaves: 40 Kg

Canes: Kaps = 1 billet, One bundle = 50 billet, One billet = 3.65 metre, One meter = 0.5342 Kg

Resin: One blaze ( Lip & Cup Method) = 1 Kg & (Rill Method)= 3 Kg

Grass & Fodder: One bundle= 35 Kg

Bamboo: 2400 Running meter = 1 Metric Tonne

#### D. National Data

Year	Removal of NWFP ( in 000 metric tonnes)										
	Sal Seed	Bidi leave	Cane	Resin	Gum	Lac	Drug & Spice	Grass & Fodder	Tanning Material	Others	Bamboo
1987	21.29	505.53	1.61	98.32	13.82	9.11	12.05	304.49	20.22	318.44	642.38
1988	23.81	531.5	6.26	105.6	4.09	69	11.49	332.47	234	229.7	829.76
1989	54.58	556.04	42.6	117.6	1.39	1.06	18.66	119.98	22.4	68.58	1934.59
1990	N A.	N A.	N A.	N A.	N A.	5.77	26.53	102.19	20.27	N A.	660.12
1991	N A.	N A.	N A.	N A.	N A.	6.01	62.81	161.79	20.42	N A.	754.64
1992	N A.	N A.	N A.	N A.	N A.	8.28	23.33	421.62	8.39	N A.	721.34
1993	N A.	N A.	N A.	N A.	N A.	7.28	18.16	113.34	11.52	N A.	455.4
1994	18.53	542.76	65.14	88.23	21.1	9.07	21.57	74.91	10.46	10039	822.63
1995	27.62	322.16	345.4	169.2	3.04	0.1	59.78	64.06	8.35	7782.1	632.54
1996	87.51	112.25	5.02	26.02	3.56	0.08	41.21	62.98	19.06	111.91	1186.05
1997	12.58	744.35	2.1	18.34	1	0.75	62.7	418.53	4.93	197.94	3629.79
1998	57.78	384.94	18.69	14.35	2.14	0.02	N A.	213.85	N A.	69.94	1119.67
1999	78.74	400.81	2.02	0.96	2.42	0.31	N A.	45.78	N A.	165.95	1261.86

#### E. Calibration

Not considered necessary

#### F. Estimation and Forecasting

The national data shows large variation including cyclic variation in annual production figures, For Sal and Bidi first three year averages were developed and then these averages were regressed to estimate and forecast figures for 2000 and 2005. For Bamboo, the data for 1996, 1998 and 1999 was used to estimate 2000 and 2005 production figures. In case of Cane, Resin, Gum, Lac, Drug, Grass and Fodder, and Others, the variation does not allow use of regression estimate, therefore in these cases, the last data on annual production was assumed for 2000 and 2005.



## G. Reclassification into FRA 2005 Classes

**Table: Reclassification (Percentage allocation) into FRA 2005 classes**

National Class	Percentage a National class that falls in a FRA class of NWFP									
	1	2	3	4	5	6	7	8	9	10
Sal Seed	100									
Bidi leave										100
Cane							100			
Resin									100	
Gum									100	
Lac										100
Drug& Spice			100							
Grass & Fodder		100								
Tanning Material						100				
Bamboo							100			
Others										100

### Notes

Following are the names of NWFP (FRA class) against the ID No. of each of the above column.

ID No	Name of Product	ID No	Name of Product
1	Food	6	Dying and Tanning & Construction material
2	Fodder	7	Utensils, Handicrafts
3	. Medicine	8	Ornamental
4	4. Medicinal Plants	9	Exudates
5	5. Perfumes	10	Others

## H. National Information for FRA 2005 Global Tables

**Table: Input to Global Reporting Table**

FRA Class	NWFP Removal in 000 MT		
	1990	2000	2005
1	36.50	52.87	61.06
2	102.19	45.78	45.78
3	26.53	62.70	62.70
4	NA	NA	NA
5	NA	NA	NA
6	20.27	4.93	4.93
7	111.18	167.97	167.97
8	NA	NA	NA
9	118.99	3.38	3.38
10	665.89	1128.95	1313.54
<b>Total</b>	1081.55	1466.58	1659.36

### Notes

1. For Sal and Bidi: Three year averages (due to yearly fluctuations) were regressed for 2000 and 2005 estimates
2. For Cane, Resin, Gum, Lac, Drug, Grass and Fodder, and Others: Last reported data was taken for 2000 and 2005

## T14. Value of Non Wood Forest Product Removal

The value of Non Wood Forest Products (NWFP) derived from the “Forest” is an important component of the economic health of forest resources and support to local communities. This information helps in allocation of resources and in priority setting at national level planning (social, economic, sectoral and regional planning).

### A. Global Classification and Definitions (FRA 2005)

<b>Value of NWFP Removal</b>	The market value of total annual removal of all primary Non Wood Forest Products (NWFP).
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Source: FAO, 2004. Terms and Definition FRA-2005. FRA Working paper 73. Rome

### B. National Data Sources

ICFRE provides basic information on forest revenue by individual States and Union Territories in India. The period of the annual reporting is from April 1<sup>st</sup> to March 31<sup>st</sup> of next year. It covers first nine months of the starting year and next 3 months of ending year, therefore information has been dealt as belonging to the starting year. For example, the period 1<sup>st</sup> April 96 to 31<sup>st</sup> March 1997 is nationally denoted as 1996-97 and contains 9 months of 1996 and only 3 months of 1997 therefore the information has been treated as for 1996. Following publication have been for procuring data.

- **Forestry Statistics, India, 1996.** 1998. Indian Council of Forestry Research and Education, Dehradun, Uttaranchal, India.
- **Forestry Statistics, India, 2000.** 2002. Indian Council of Forestry Research and Education, Dehradun, Uttaranchal, India.

### C. National Classification and Definitions

The national statistics uses the terms “revenue” and not market value. It does not include taxes, if any, imposed by central or state governments.

<b>Value of Wood Removal</b>	The revenue earned from removal of wood produced in forests.
Revenue	The revenue arising in the course of ordinary activities of the enterprise from: A. Sale of goods B. Rendering of services C. The use by others of enterprise resources yielding interest, royalties and dividends. <u>Explanations:</u> Following are excluded. a. Realised or Unrealised gains from the appreciation in the value of fixed assets. b. Unrealised holding gains resulting from the change in value of current assets. c. Unrealised holding gains resulting from the natural increases in forest resources. d. Realised or Unrealised gains from changes in foreign exchange rates and adjustments.

Note: The definition of revenue is from Institute of Chartered Accountant of India at [http://www.icai/resource/as9\\_intro.html](http://www.icai/resource/as9_intro.html)

## D. National Data

The Forestry Statistics published by ICFRE has many gaps or missing information for few of the States of India. Such gaps have been treated as zero for arriving at national totals. Due to the missing information the revenue reported in following table “under estimates” the contribution “NWFP” to the forest revenue. However it is felt that such gaps will not alter the trend, which is more important than the total themselves. Further, the information is available for on few of the NWFPs and that from 1994 to 1997. However, information for Tannin is only available for 1994 to 1996, to complete the matrix information for 1996 has been assumed for 1997 as well.

**Table: National Data**

NWFP National Classes	Revenue from NWFP Removals (Rupees in million)			
	1994	1995	1996	1997
Sal Seed	1.7	6.2	39.8	15.0
Bidi	1919.3	4583.7	4845.5	4625.6
Drug and Spices	1.0	0.6	4.9	10.7
Tannins	32.9	23.7	42.1	42.1
Grass and Fodder	33.0	36.0	17.6	49.4
Lac	0.0	0.2	1.6	0.9
Rattan	0.6	0.4	188.2	410.9
Bamboo	905.0	704.3	901.4	992.4
Other	172.5	231.1	246.7	388.7
<b>TOTAL</b>	<b>3066.0</b>	<b>5586.2</b>	<b>6287.7</b>	<b>6535.7</b>

## E. Calibration

Not considered necessary

## F. Estimation and Forecasting

Since past information is not available for 1990 and 2000 therefore support of regression relationship has been taken to estimate revenue from NWFP during 1990 and 2000 as well as to forecast for 2005. To make the result more realistic, outlier has been excluded for example information for 1994 was excluded for Sal, Bidi, Drug and Spices, and others”, 1996 was excluded for Lac, and 1997 was excluded for Rattan 1997. Similarly, information for 1990 has been assumed to be same as that for 1994 for Sal, Bidi, and Rattan. The following table provides results of this exercise.

National Classes	Estimation and Forecasting (Rs. Million)			
	NWFP	1990	2000	2005
Sal Seed		1.7	28.4	50.6
Bidi		1919.3	4768.8	4873.7
Drug and Spices		1.0	19.4	36.2
Tannins		9.8	55.9	55.9
Grass and Fodder		9.4	65.6	65.6
Lac		0.1	1.6	2.9
Rattan		0.6	532.1	532.1
Bamboo		623.2	1082.4	1311.9
Other		172.5	469.9	863.4
TOTAL		2737.5	7024.0	7792.2

### G. Reclassification into FRA 2005 Classes

The following table indicates correspondence between national categories and FRA 2005 classes.

National Class	Percentage a National class that falls in a FRA class of NWFP									
	1	2	3	4	5	6	7	8	9	10
Sal Seed	100									
Bidi leave										100
Cane							100			
Resin									100	
Gum									100	
Lac										100
Drug& Spice			100							
Grass & Fodder		100								
Tanning Material						100				
Bamboo							100			
Others										100

Notes: Following are the names of NWFP (FRA class) against the ID No. of each of the above column.

ID No	Name of Product	ID No	Name of Product
1	Food	6	Dying and Tanning & Construction material
2	Fodder	7	Utensils, Handicrafts
3	. Medicine	8	Ornamental
4	4. Medicinal Plants	9	Exudates
5	5. Perfumes	10	Others

## H. National Information for FRA 2005 Global Tables

Following table provides information on revenue from NWFP organised by global FRA classes.

**Table: Input to Global Reporting Table 14**

FRA Class	Value of NWFP Removal in 000 MT		
	1990	2000	2005
1	1.7	28.4	50.6
2	9.4	65.6	65.6
3	1.0	19.4	36.2
4			
5			
6	9.8	55.9	55.9
7	623.8	1614.5	1844.0
8			
9			
10*	2091.9	5240.3	5740.0
Total	2737.5	7024.0	7792.2

Notes to the table

1. Revenue from Gum (FRA class 9) is not available separately. It may be included in FRA Class 10.
2. It not known whether "taxes are included in the above data sets.
3. Information the point (forest or market etc.) at which information (value) is based is not known

## T15. Sites for Social Functions in Forests and Other Wooded lands

The information on status and trends on allocation (management) and utility of sites in “Forest” and “Other Wooded Land” for addressing social function helps to understand the state and changes in the bondage between the society and the Forest. It also measures the extent to which forest management recognizes and respects social needs.

### A. Global Classification and Definitions (FRA 2005)

<b>Sites for Social Functions</b>	A site or facility designated and or managed for cultural, social (recreation and tourism) and spiritual needs in “Forest” and Other Wooded Land”.
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Source: FAO, 2004. Terms and Definition FRA-2005. FRA Working paper 73. Rome

### B. National Data Sources

The two variables (number of sites and visitors) related to this table directly link societies with forests, help to increase environment understanding and appreciation and enhance options for support for conservation. However, information on these variables is only available for recreation related to protected areas in the forests. The data for this table has been taken mainly from following sources.

Information	Data Sources
Number of sites (Protected Areas)	National Wildlife Database at Wild Life Institute of India, Dehradun, India.
	<b>UNEP 1993.</b> United Nations List of National Parks and Protected Areas: India. 1993. WCMC Protected Areas Data Unit..
	<b>Government of India. 2003.</b> Annual Report 2002-2003, Ministry Of Environment and Forests, Government of India, New Delhi, India.
Number of recreational visitors to forest related sites	<b>Goodwin, H. J., Kent, I.J., Parker, K. T. &amp; Walpole, M. J.</b> 1997. <i>Tourism, Conservation and Sustainable Development: Four Volumes, April 1997</i>
	<b>Sharma, S. et al.</b> 2002. Management Plan of Keoladeo National Park, Forest Department, Govt. of Rajasthan.

### C. National Classification and Definitions

There is no national standard definition or classification for visits to social sites including recreation service sites. Following provides definition of recreation services from World Tourism Organization.

Term	Definition
Recreation Services	Tourism that involves travelling to relatively undisturbed areas with the specified object of studying, admiring and enjoying the scenery and its wild plants and animals, as well as any existing cultural aspects (both of the past and present) found in the area. ( <i>World Tourism Organization</i> ).

## D. National Data

Information on protected areas in India is kept by Wild Life Institute of India in its National Wildlife Database. Following information is available for the period in question.

Information	1990	2000	2002
Total Number of Protected Areas	363	573	589

About 4.19 percent of the foreign visitors plan to go forest related sites in India and an additional 3.7 percent visitors plan to visit landscape within and outside forests. The long term data at two National Parks indicates that number of domestic tourist is roughly more than double the foreign tourist. Assuming on conservative side that number of domestic visitors is 2 times that of foreign visitors, it can be assumed that total number of visitors to forest related sites is more than 12 percent (3 times 4.19 percent) of total foreign tourists. Following table presents this information.

Variables	Number of Visitors to Forest related Sites (in 000)							
	1980	1990	1996	1997	1998	1999	2000	2001
Number of Visitors	150	205	275	285	283	298	318	304

## E. Calibration

Not considered necessary.

## F. Estimation and Forecasting

Estimation is not necessary as national data is available for 1990 and 2000. Number of Protected Areas (National Parks and Sanctuaries) for 2005 has been assumed to be same as in 2002. A regression relationship was used to forecast number of probable visitors in 2005.

Variables	Number of Visitors to Forest related Sites (in 000)		
	1990	2000	2005
Number of Sites (PAs)	0.363	0.573	0.589
Number of Visitors	0.205	0.318	0.376

## G. Reclassification into FRA 2005 Classes

Not needed as information is available on the two variables

## H. National Information for FRA 2005 Global Tables

Table: Input to Global Reporting Tables

Variables	Number of Visitors to Forest related Sites (in 000)		
	1990	2000	2005
Number of Sites (PAs)	0.363	0.573	0.589
Number of Visitors	205	318	376

Note. This includes both sites those that are connected by roads and those that are not connected by roads

## T16. Employment in Forest and Other Wooded lands

The information on employment is useful in identifying trends, especially in the context of public expectations, government policies, industry developments and socio-economic dependence.

### A. Global Classification and Definitions

<b>Primary Employment</b>	The employment provided within the “Forest and “Other Wooded Land” by activities relating to primary (raw) production of goods, provision of services, and other primary activities.
<b>Primary Activities</b>	The forestry activities within the “Forest” and “Other Wooded Land”. FRA 2005 classifies forestry activities into three broad classes; activities relating to “Wood Removal”, “Non Wood Forest Product Removal” and “Other Primary Activities”.
<b>Other Primary Activities</b>	The forestry activities, within the “Forest” and “Other Wooded Land”, other than those related to “Wood Removal” (including “wood fuel” or “fuelwood” removal) and removal of “NWFP”.

Source: FAO. 2004. Terms and Definition FRA-2005. FRA Working paper 73. Rome

### B. National Data Sources

The employment by production and other activities in forest is not reported at the national level. To develop this information three sets of data sources have been used. First is a study by World Bank to provide employment by production and other activities in forests in 1993 to derive employment per unit (cubic meter of 000 ha) of activity. The second is information on level of production from the Reporting Table 11. Third information is on level of plantation activity is from Forestry Statistics.

- **World Bank, 2000.** India: Alleviating Poverty through Employment. The World Bank. 2000.
- **Forestry Statistics, India, 1988-95.** 1997. Indian Council of Forestry Research and Education, Dehradun, Uttaranchal, India.
- **Forestry Statistics, India, 1996. 1998.** Indian Council of Forestry Research and Education, Dehradun, Uttaranchal, India.
- **Forestry Statistics, India, 2000. 2002.** Indian Council of Forestry Research and Education, Dehradun, Uttaranchal, India.



### C. National Classification and Definitions

<b>Principal “Usual Status” or Principal Activity</b>	The activity on which the person spent relatively more time preceding 365 days.
<b>Employed in Principal Activity or Usual Status</b>	A person is “working or employed” if he or she was engaged for a relatively longer time during the past year in one or more work activities (economic activities).
<b>Unemployed in Principal Activity or Usual Status</b>	A person is “seeking or available for work or unemployed” if he or she was not working but was seeking or was available for work for a relatively longer time during the past year.
<b>Out of Labour Force (Primary Activities)</b>	A person is “out of labour force” if he or she was engaged in non-economic activities for a relatively longer time of the reference year.
<b>Principal Status “Worker” or “Employed”</b>	A person categorised as “worker” or “employed” on the basis of principal status is as principal status “worker” or “employed”. Explanation: Unpaid helpers, who assist in operation of an economic activity in household farm or non farm activities are also considered as workers. It does not include persons engaged in collection of firewood as a non-economic activity.
<b>Subsidiary Status “Worker” or “Employed”</b>	A person categorised as non worker (unemployed or “out of labour force”) who pursued some economic activity in a subsidiary capacity. Explanation: Unpaid helpers, who assist in operation of an economic activity in household farm or non farm activities are also considered as workers. It does not include persons engaged in collection of firewood as a non-economic activity.
<b>Total Workers</b>	Sum of Principal Status Workers and Subsidiary Status workers under “Usual Status” Classification.
<b>Economic Activity</b>	It includes (a) all market activities performed for pay or profit that result in production of goods and services for exchange, and (b) selected non market activities like agriculture sector activities that result in production (including gathering of uncultivated crops, forestry, collection of firewood, hunting, fishing etc.) of agriculture produce for consumption; activities relating to the production of fixed assets for personal use (including houses, roads, wells, machinery, tools etc. for household enterprise and construction of private or community facilities free of charge)

### D. National Data

Following table provides information on number of principal and Subsidiary workers in 1993 in selected categories (World Bank, 2000).

<b>Industry</b>	<b>Number in 1993 (in millions)</b>
Logging	0.251
Firewood/fuelwood by exploitation of forest	0.049
Gathering of fodder from forests	0.014
Uncultivated materials in forests	0.300
Hunting, trapping, and game propagation	0.067
Medicinal plants and other Agricultural production	0.193
Plantations	4.703
Planting, replanting and conservation of forests	0.532
Forest services	0.344

Source: Census 91 and N.S.S. 93/94 as explained in the World Bank report.

Note: 1. The total estimated annual employment provided by plantations, that includes plantations of non forest species and on Other land with or without trees, is 94.06 million. It is assumed that only fifty percent is related to forests and Other Wooded lands with both sharing equal amounts. The assumption of equal division is made because there is no basis to have some other division.

2. The total estimated annual employment provided by medicinal plants and other agricultural production is 3.85 million. It includes non forest related production also. . It is assumed that only fifty percent is related to forests and Other Wooded lands with both sharing equal amounts. The assumption of equal division is made because there is no basis to have some other division.

Following table presents actual data (1990, 1993 and 1997) and estimated data (2000 and 2005) on plantations from Forestry Statistics (ICFRE, 2002).

Year	1993	1990	1997	2000	2005
Million ha	0.621	0.618	0.616	0.612	0.61

### E. Calibration

Figure published by the World Bank from the study “India Alleviating Poverty through Employment, World Bank 2000” are taken as standard verified figures and there is no need for any calibration.

### F. Estimation and Forecasting

The interpolation and extrapolations to derive estimates for reference periods are based on the temporal trends of respective groups. The employment from logging follows the trend of wood production (Reporting Table No. 11). The employment from fuelwood, fodder, uncultivated material, hunting and NWFP follows the trend of fuelwood production (Reporting Table 11). The employment from other activities (plantation and planting etc.) follows the trend of forest plantations. For this purpose, first the employment by level of activity (per million cubic meter or per million ha of plantation) was calculated based on the level of activities in 1993. Then these figures were multiplied with level of production or activity in 1990, 2000, 2005 to estimate or forecast employment figures.

Employment Category	Employment in million persons		
	(1990)	(2000)	(2005)
Logging	0.33	0.14	0.08
Firewood/fuelwood by exploitation of forest	0.08	0.07	0.04
Gathering of fodder from forests	0.02	0.02	0.01
Uncultivated materials in forests	0.49	0.44	0.25
Hunting, trapping, and game propagation	0.11	0.10	0.06
Medicinal plants and other Agricultural production	0.31	0.28	0.16
Plantations	4.68	4.63	4.62
Planting, replanting and conservation of forests	0.53	0.52	0.52
Forest services	0.34	0.34	0.34
<b>Total</b>	<b>6.89</b>	<b>6.55</b>	<b>6.08</b>

## G. Reclassification into FRA 2005 Classes

**Table: Reclassification (Percentage allocation) into FRA 2005 classes**

National Class of of employment	Percentage of a National Class belonging to a FRA Class				
	Wood Removal	NWFP Removal	Other Activity	Combinati on	Total
Logging	100	0	0	0	100
Firewood/fuelwood by exploitation of forest	100	0	0	0	100
Gathering of fodder from forests	0	100	0	0	100
Uncultivated materials in forests	0	100	0	0	100
Hunting, trapping, and game propagation	0	100	0	0	100
Medicinal plants and other Agricultural production	0	100	0	0	100
Plantations	0	0	100	0	100
Planting, replanting and conservation of forests	0	0	100	0	100
Forest services	0	0	0	100	100

## H. National Information for FRA 2005 Global Tables

The table presents national information as an input to the Global Reporting Table. The national estimates have been classified and grouped into global categories by using the classification table.

**Table: Input to Global Reporting Tables**

Category of Employment	Primary Activities	Employment in Forests and Other Wooded Land (millions person years)		
		1990	2000	2005
A. Forest Workers	Wood Removal	0.408	0.211	0.119
	NWFP Removal	0.932	0.840	0.474
	Other Primary Activities	5.209	5.159	5.142
	Total	6.549	6.210	5.735
B. Regular Staff	All above Activities	0.344	0.344	0.344
Grand Total		6.893	6.500	6.229

### 3. Report by Thematic Areas

This country report by the six “Criteria” or “Thematic Areas” (after the recommendations of the International Conference on Criteria and Indicator, held in Guatemala in February 2003) is expected to provide comprehensive input for development of effective national policy and strategies to sustain forest resources and to maximize their social, economic and ecological benefits. It provides the umbilical link to review the sustainability of forest resources. This report is organized by the following six of the seven Thematic Areas (Criteria) common across the nine regional processes on Criteria and Indicators (Govil, 2002).

- 1) Extent of forest resources and Contribution to the Global carbon cycle,
- 2) Forest ecosystem health and vitality,
- 3) Biological diversity,
- 4) Productive functions,
- 5) Protective functions
- 6) Social and Economic functions.

#### 3.1 Extent of Forests Resources and Contribution to Global Carbon Cycle

This section is divided in two sub-sections, the first dealing with the extent of forest resources and the second dealing with the contribution of forests to the Global Carbon Cycle.

##### **3.1.1 Extent of Forests Resources**

This subsection provides information on the method and approach chosen to identify and assess the complementary national variables and then the national data and its assessment.

###### **3.1.1.1 Method and Approach**

The for identification and assessment of variables, India through FSI used the “Group Convergence Method” (Govil, 2002). Two workshops were organized one for briefing and explaining and second for implementation of Group Convergence Method to arrive the final list of identified variables. Temporal trends were developed and GCM was used to assess the state and change in these variables with respect to sustainability of forest resources.

###### **3.1.1.2 Relevant Variables**

Following national variables in addition to the global variable “Forest Cover” have been identified as complementary variables that are essential to explain the state of “Extent of Forest Resources” in India and for which some information was available.

- a. Area of Recorded Forest
- b. Proportion of Dense to Open Forest Cover
- c. Area of Forest diverted for Non-Forest Purposes
- d. Extent of Trees Outside Forests (TOF)
- e. Area of Forest under Management Plans

### 3.1.1.3 Source and Source Data

Following table indicates sources of data for the additional variables.

Additional Variable	Information Year	Source
Recorded Forest Area	1990	<b>SFR, 1993</b> State of Forest Resources 1993. Forest Survey of India, Ministry of Environment and Forests, Government of India.
	1992	<b>SFR, 1995.</b> State of Forest Resources 1995. Forest Survey of India, Ministry of Environment and Forests, Government of India.
	1994	<b>SFR, 1997.</b> State of Forest Resources, 1997. Forest Survey of India, Ministry of Environment and Forests, Government of India.
	1997	<b>SFR, 1999.</b> State of Forest Resources, 1999. Forest Survey of India, Ministry of Environment and Forests, Government of India.
	2000	<b>SFR, 2001.</b> State of Forest Resources, 2001. Forest Survey of India, Ministry of Environment and Forests, Government of India.
Diversion of Recorded Forest Area	1990	<b>Forestry Statistics, 2000.</b> Indian Council Of Forestry Research and Education. Dehradun, India
	1998	<b>Forestry Statistics, 2000.</b> Indian Council Of Forestry Research and Education. Dehradun, India
Open and Dense Forest Cover	1990	<b>SFR, 1993</b> State of Forest Resources 1993. Forest Survey of India, Ministry of Environment and Forests, Government of India.
	2000	<b>SFR, 2001.</b> State of Forest Resources, 2001. Forest Survey of India, Ministry of Environment and Forests, Government of India.
Trees Outside Forests	1990	<b>Pilot Study Forest Survey of India, 2003</b>
	2000	<b>Pilot Study Forest Survey of India, 2003</b>
Forest under Management Plans	1987	<b>SFR, 1987,</b> State of Forest Resources 1987. Forest Survey of India, Ministry of Environment and Forests, Government of India.
	2000	Ministry of Environment and Forest, Government of India cited in Pilot study by FSI

### 3.1.1.4 Additional Data: Area of Recorded Forest

This section provides information on each of the identified additional variables. It contains relevant definitions, source and source data, temporal trends and its assessment.

In India, “forest” also has legal identity and is an “area” (with boundary and extent) of land recorded as “forest” in revenue (government) land records or legally notified as “forest” under Indian Forest Act and or any other law (Act) relating to forests. Such lands are referred as “recorded forests” and they may and may not contain any “forest”. Due to this the physical “recorded area of such forests” at the ground level is not always same as “area of identified patches of forest cover”. The identification of smaller patches depends on the resolution of camera with satellites and the scale of mapping. The Indian Forest Acts classifies the “forest areas” into three categories (“Reserved Forest”, “Protected Forest” and “Unclassed Forest”). Currently, the recorded forest area is 768,436 km<sup>2</sup> containing 423,311 km<sup>2</sup> of Reserved Forests, 217,245 km<sup>2</sup> of Protected Forests and the rest is 127,882 km<sup>2</sup> of Unclassed Forest.

### Definition

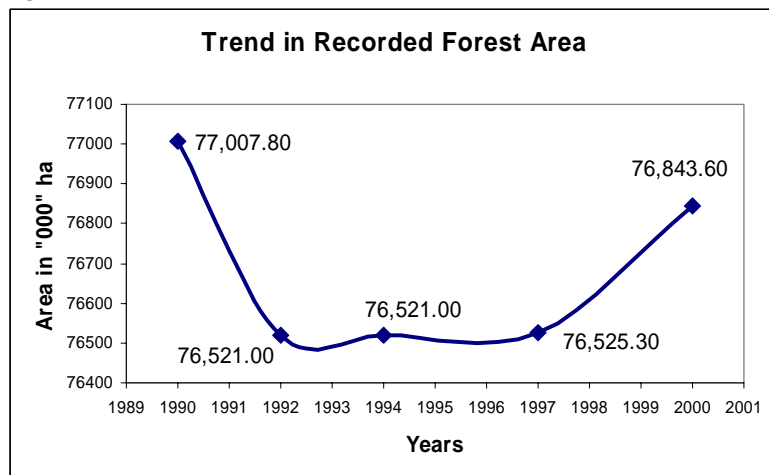
Terms	Definition
Recorded Forests	Any land (including inland water bodies) recorded as “forests” in revenue records (land use and ownership) of government.

**Transformation** Not needed

### Data and Temporal Trend

Following figures present the temporal data on recorded forest area in India.

**Figure 1: Trend in Recorded Forest Area**



### Assessment

The recorded forest area is increasing after a decline in 1992 and is approaching level of 1990. The trend of change is positive and indicates societal support and is a healthy trend.

### 3.1.1.5 Additional Data: Open and Closed Forest Cover

Sustenance and development of a society depends to a large extent on the judicious management of its natural resources - renewable as well as non-renewable. Therefore, it is essential to ensure sustainability of forests resources on a regular basis. Periodic assessment of “forest cover” (National Reporting Table No. 1) i.e. monitoring of forest cover (above 10 percent crown density) is necessary but is not sufficient. It is equally important to see how the composition of forest cover by crown density classes is changing over time. India considers that to initiate efforts in this directions it is necessary to observe over time the ratio of “Dense” (more than 40 percent crown density) to “Open” ( 10 to 40 percent crown density) forest cover and later to increase more categories like adding “close” (40 to 70 percent crown density) and modifying “dense” (more than 70 percent crown density) forest cover etc.

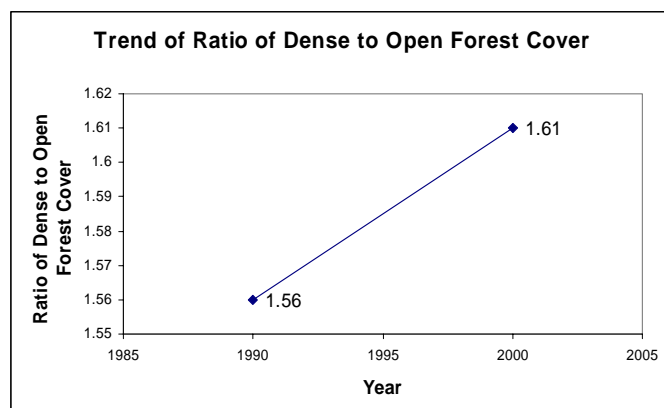
#### Definitions

Terms	Definition
Dense Forest	All lands with a forest cover with canopy density of 40 percent and above.
Open Forest	All lands with a forest cover with a canopy density of 10 to 40 percent.

**Transformation** Not necessary

#### Data and Temporal Trend

Following figure presents data and the temporal trend in relative composition of forest cover.



#### Assessment

The share of dense forest cover is increasing which is a good sign for the sustenance of forest resources.

### 3.1.1.6 Additional Data: Area of Forest diverted for “Non-Forest Purposes”

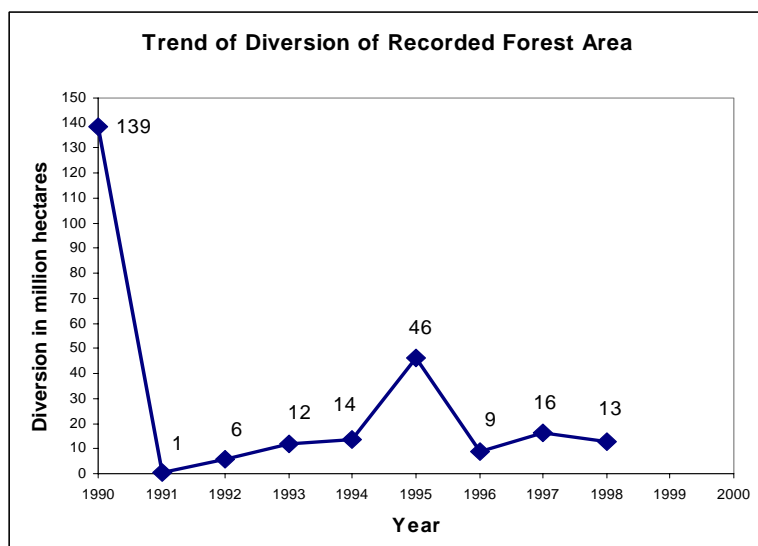
The scarcity of land in India leads to the official diversion of public forest land (recorded forest area) for “non-forest purposes” for taking up development activities (major irrigation dams, mining, and laying of transmission lines etc.) and meeting social objectives (rehabilitation of people) including shifting cultivation. This variable is an essential and important variable as it has direct link with ‘extent of forests’.

Terms	Definition
Diversion of Recorded Forest Area for Non-Forest Purposes	Use of any forest land or any portion thereof any non-forest purpose: Explanation – The "non-forest purpose" means the breaking up or clearing of any forest land or portion thereof for, – the cultivation of tea, coffee, spices, rubber, palms, oil-bearing plants, horticultural crops or medicinal plants; – any purpose other than reforestation; but does not include any work relating or ancillary to conservation, development and management of forests and wildlife, namely, the establishment of check-posts, fire lines, wireless communications and construction of fencing, bridges and culverts, dams, waterholes, trench marks, boundary marks, pipelines or other like purposes. (Source: Forest Conservation Act, 1980)

**Transformation** Not necessary

#### Data and Temporal Trend

Following figure gives an overview of diversion of forest lands during 1990 to 2000. It indicates decline in diversion in recorded forest area.





## Assessment of Variable

The decline trend of diversion is good for forest conservation and is a healthy sign.

### 3.1.1.7 Additional Data: Extent of Trees Outside Forests (TOF)

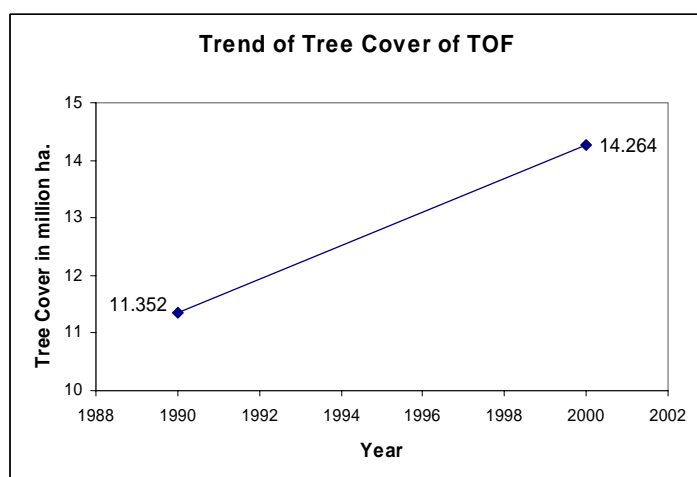
Since late seventies, India is supporting a massive programme to enhance, promote and support development and conservation of the stock of “Trees Outside Forests” (TOF) to supplement satisfaction of demand of forest tree products and to reduce burden on natural forests. The inventory data provides an estimate of species wise and diameter wise average number of trees per hectare a stratum or zone. A relationship between diameter of each tree species and its crown area for each zone has been developed to estimate tree cover (crown cover) of TOF. The word “tree cover” is different then “forest cover” as it is the estimated crown area of TOF with theoretical crown density of 70 percent assuming that all trees are together at one place.

### Definition of Trees Outside of Forests

Terms	Definition
<b>Trees</b>	A woody perennial with a single main stem, having 10 cm or more diameter at breast height (1.37m). If there are several stems then those which has attained 10 cm diameter at breast height (dbh) will be considered as individual trees.
<b>Trees Outside Forests (TOF)</b>	Trees on lands (rural and urban) outside the Recorded Forest Area.
<b>Tree Cover</b>	Estimated notional area of a block with tree cover with crown cover density of seventy percent assuming hypothetically that all Trees Outside of Forests are placed at one location in that block.

### Temporal Trend

FSI has developed a regression based relationship between annual area of plantation and number of planted trees for estimating number of TOF in 1990 and 1980.



## Assessment

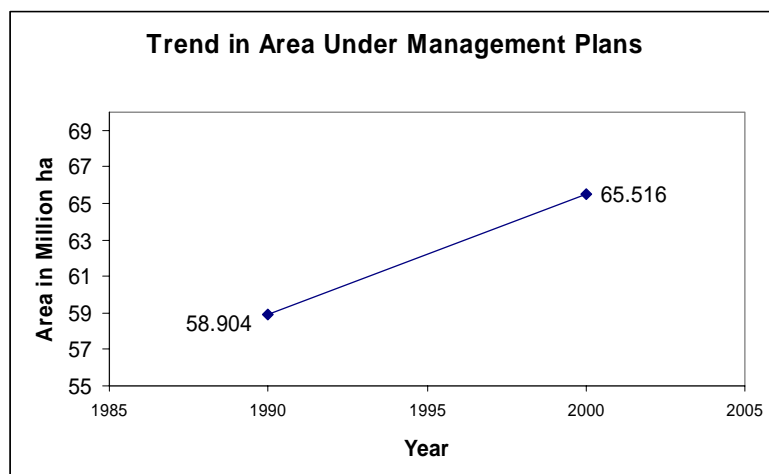
The tree cover is increasing is a healthy trend for the sustenance of forest resources.

### 3.1.1.8 Additional Data: Area of Forest under Management Plans

The working plan (management plan) for scientific working of forests in India dates back to 1870. The forest policy provides implementation guidelines for forestry work. The current national forest policy (1988) explicitly provides that “*No forest should be permitted to be worked without the Government having approved the management plan, which should be in a prescribed format and in keeping with the National Forest Policy.*” The basic aim of all the management plans is to ensure sustainability of forest resources. Therefore the area of forest covered by management plans is an indicator of presence of a system to ensure sustainability of the forest resources. Specifically, these plan document for working in forest area is called "Working Plan" and for conservation of Protected Area is called “Management Plan”. However, in general, the “management plans” stands for both “working plans” and “management plan”.

### Data and Temporal Trend

Most of the recorded forest area has been under working plans for many decades. The remaining areas are being steadily brought under management plans (including working plans). The following figures indicates state of forest area under management plans in 1990 (actual data is for 1987) and 2000 (actual data is for 2002).



## Assessment

The progressively increasing forest area under scientific management plans indicates very positive commitment of the government and public for sustainability of natural resources.

### 3.1.2 Contribution to Global Carbon Cycle

This subsection provides information on the method and approach chosen to identify and assess the complementary national variables and then the national data and its assessment.

#### 3.1.2.1 Method and Approach

The for identification and assessment of variables, India through FSI used the “Group Convergence Method (GCM)” (Govil, 2002). Two workshops were organized one for briefing and explaining and second for implementation of Group Convergence Method to arrive the finalist of identified variables. Temporal trends were developed and GCM was used to assess the state and change in these variables with respect to sustainability of forest resources.

#### 3.1.2.2 Relevant Variables

India has identified “Carbon in Trees outside forests” a national variable that in addition to the three global variables ( “Carbon in above ground biomass”, “Carbon in below ground biomass” and “Carbon in Soil”) is essential to explain the state of “Contribution to Global Carbon Cycle” in India and for which some information was available.

#### 3.1.2.3 Source and Source Data

Following table indicates sources of data for this additional variable.

Additional Variable	Source
Carbon in Trees Outside Forests	Pilot Study to review sustainability of forests in India. FSI, 2003

#### 3.1.2.4 Additional Data

This section provides information on the identified complementary national variable “Carbon in Trees Outside Forest”. It contains relevant definition, data, temporal trend and its assessment. The TOF now constitute a very significant part of ecosystem as well as production. There extent now define the level and nature of stress on forests in other words TOF is now an important factor in the sustainability of forest resources in India.

#### Definition

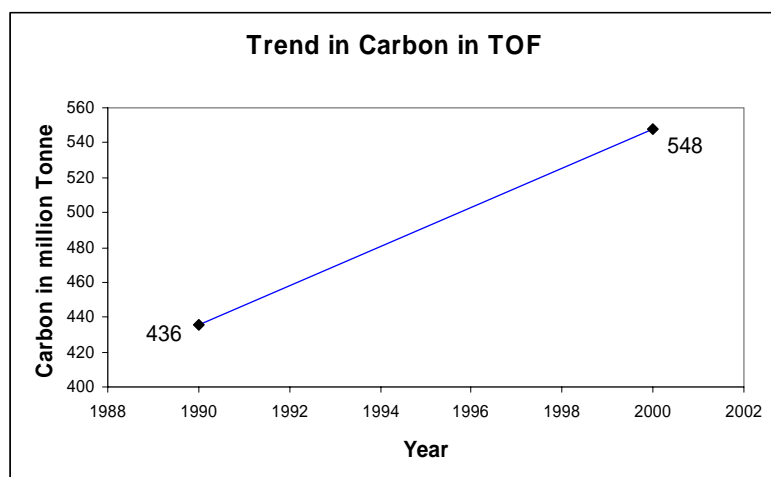
Term	Definition
Trees Outside Forests	Tree wealth existing outside recorded forest areas

**Transformation** Not needed

### **Data and Temporal Changes**

FSI has inventories TOF both in rural and urban areas (as defined by Census of India) to estimate the number of trees and their volume. It has used pre-established relationships between diameter of a tree species and its volume within a zone to estimate volume and biomass (with the help of information on its specific density). FSI has aggregated this data to zones (stratum) using ratio method. While extrapolation, it has excluded the land that does not support vegetation such as wetlands; riverbeds and perennial snow covered mountains.

FSI has used specific factors for species to estimate the carbon content from the biomass estimates and where such information was not available for any species, a default value of “45 % of biomass” has been used. FSI has generated direct primary information for the year 2000 based on its field work from 1997-2002. FSI has developed an estimate of area, number of trees, volume and biomass of TOF in 1990 using average annual plantation rates. Following table and figure indicate this information.



Year	Growing stock (million cum)	Biomass (million tonne)	Carbon (million tonne)
1990	1771	945	436
2000	2225	1187	548

### **Assessment**

The above information indicates that the carbon content of TOF is increasing in India, which is a very good sign. A complementary pilot study by FSI indicates that the estimated rate of increase of carbon content in TOF during 1990 to 2000 period is actually less than during previous decade (1980 to 1990) may be due to lower level of planting activities in previous decade.

## 3.2 Health and Vitality

This section provides information on the method and approach chosen to identify and assess the complementary national variables followed by presentation of the national data and finally a brief assessment.

### 3.2.1 Method and Approach

FSI has used the “Group Convergence Method” (Govil, 2002) for identification and assessment of variables. FSI organized two workshops to identify variables that are necessary to explain condition of forest against this criteria (Theme) using group comprised of experts from various disciplines. It lead to the final list of identified variables and in their valuation based on their temporal trend and related information.

### 3.2.2 Relevant Variables

Following seven national variables in addition to the three global variables (Area affected by fire, Area affected by insects, and Area affected by diseases) have been identified as complementary variables. These variables are essential to explain the state of “Health and Vitality” of forest resources in India. However, information is available only for some of them, for the rest of them either information is partially available or not available at all.

- a. Status of Natural Regeneration
- b. Incidence of Weeds Infestation
- c. Incidence of Grazing in different forest types
- d. Status of Pollutants
- e. Presence of indicator species
- f. Density of forest canopy
- g. Status of forest fragmentation

### 3.2.3 Source and Source Data

Following table indicates sources of data for the additional variables.

Additional Variable	Information Year	Source
Status of Natural Regeneration	1982	SFR1987 State of Forest Resources 1993. Forest Survey of India, Ministry of Environment and Forests, Government of India
	1992	SFR1995, State of Forest Resources 1993. Forest Survey of India, Ministry of Environment and Forests, Government of India
Incidence of Weed Infestation	1990s	Kumar and Rohatgi (1999), The role of invasive weeds in changing floristic diversity, <i>Ann. For.</i> 7(1):147-150. (2)
Incidence of grazing		SFRxxx, State of Forest Resources 1993. Forest Survey of India, Ministry of Environment and Forests, Government of India

(follows from previous page)

Pollutants		No data is available and hence no source data
Density of forest canopy	1982	SFR, 1987 State of Forest Resources 1987. Forest Survey of India, Ministry of Environment and Forests, Government of India.
	1986	SFR, 1989 State of Forest Resources 1989. Forest Survey of India, Ministry of Environment and Forests, Government of India.
	1988	SFR, 1991 State of Forest Resources 1991. Forest Survey of India, Ministry of Environment and Forests, Government of India.
	1990	SFR, 1993 State of Forest Resources 1993. Forest Survey of India, Ministry of Environment and Forests, Government of India.
	1992	SFR, 1995 State of Forest Resources 1995. Forest Survey of India, Ministry of Environment and Forests, Government of India.
	1994	SFR, 1997 State of Forest Resources 1993. Forest Survey of India, Ministry of Environment and Forests, Government of India.
	1997	SFR, 1999. State of Forest Resources 1999. Forest Survey of India, Ministry of Environment and Forests, Government of India.
	2000	SFR, 2000. State of Forest Resources 200. Forest Survey of India, Ministry of Environment and Forests, Government of India.
<b>Presence of Indicator Species</b>		
Forest fragmentation	1990	Independent Pan-Tropical Remote Sensing Survey, 2000. FAO Rome.
	2000	Independent Pan-Tropical Remote Sensing Survey, 2000. FAO Rome.
Recorded Forest Area	1990	SFR, 1993 State of Forest Resources 1993. Forest Survey of India, Ministry of Environment and Forests, Government of India.
	1992	SFR, 1995. State of Forest Resources 1995. Forest Survey of India, Ministry of Environment and Forests, Government of India.
	1994	SFR, 1997. State of Forest Resources, 1997. Forest Survey of India, Ministry of Environment and Forests, Government of India.
	1997	SFR, 1999. State of Forest Resources, 1999. Forest Survey of India, Ministry of Environment and Forests, Government of India.
	2000	SFR, 2001. State of Forest Resources, 2001. Forest Survey of India, Ministry of Environment and Forests, Government of India.

### 3.2.4 Additional Data

This section provides information on each of the identified additional variables. It contains relevant definitions, source and source data, temporal trends and its assessment.

#### 3.2.4.1 Status of Natural Regeneration

Natural regeneration indicates the capacity of ecosystem to sustain the “forests” in perpetuity. The information was collected by FSI while conducting forest inventories. FAI follows a systematic sampling method for its forest inventories where it overlays a 2 ½’x 2 ½’ grid of latitudes and longitudes divides on a 1:50,000 scale topographic sheet to divide it into 36 grid cells and selects two sample points within each such grid for collecting inventory data from a

square plot of 0.1 ha at each of these sample points. The FSI lays a 4 m x 4 m plot at each of two sample points to collect supplementary data on natural regeneration.

**Definition (FAOA)**

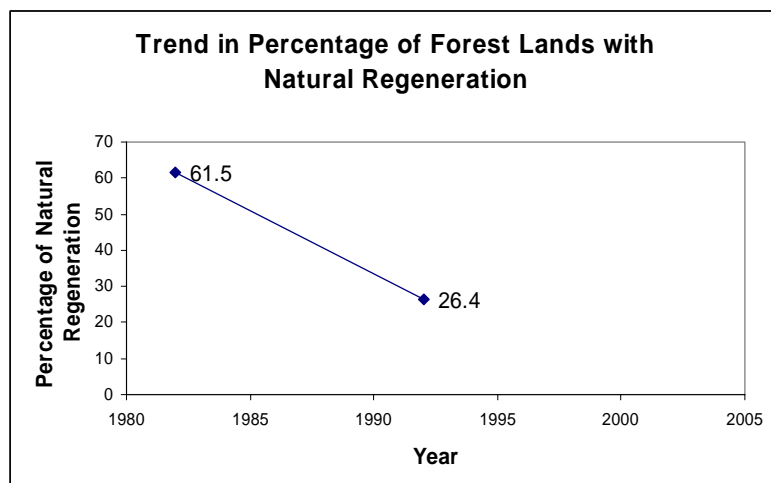
No standard national definition is available

Terms	Definition
Natural Regeneration	Natural succession of forest trees on temporarily unstocked forest lands

**Transformation** There is no need for transformation of the variable.

**Data and Temporal Changes**

The information on assessment of regeneration is only available for only 1982 and 1992.



**Assessment of Variable**

The negative trend indicated during 1982 to 1992 is not good for the sustenance of forest resources in the country.

**3.2.4.2 Incidence of Insect and Pests**

Insect pests are normally present all the time in forest areas and it is only when they cross certain threshold the condition is called “out break”. Majority of insect pests are localized and general feeders but some are quite specific and confine to a particular hosts only. There is lack of systematically recorded data on incidence and damage by forest insects.

**Table: Major Insect Pest Problems in Forests, Plantations and Nurseries**

Insect pest species	Common name	Order/family	Year of Epidemics/ Mortality
<i>Cryptothelia cramerii</i> Westwood	Chir pine defoliator	Lepidoptera : Psychidae	First epidemic reported in 1885 from Tons Valley, Uttranchal. Subsequently recorded from H.P. (1928), Kahhula, Pakistan (1934). Recently reported from Rajouri (J&K) in 1989 – 1990. 5% mortality in 2000 ha. area, with 0.3 million trees in J&K; net loss 22.5 million rupees.
<i>Hoplocerambyx spinicornis</i> Newman	Sal heart wood borer	- do -	Epidemic dates back to 1899 in Singhbhoom, Bihar. Reported from Assam (1906, 1961), H.P. (1948 – 1952), M.P. (1905, 1927 – 28, 1948-52, 1959-63), Uttranchal (1916-24, 1934-37, 1958-60, 1961, 1965), West Bengal (1931-34). Recently a very heavy epidemic occurred in M.P. in 1998, affected some million sal trees.
<i>Hypsipyla robusta</i> Moore	Toon shoot borer	- do -	A serious pest of toon and mahogany, capable of causing 100% mortality in seedlings and young plantations. In India, some of the seriously infested toon plantations were destroyed, causing loss of R.15-30 per acre. Also reported to cause damage in Sri Lanka, Australia, Bangla Desh, Pakistan, Nigeria and West Indies).
<i>Ectropis deodarae</i> Prout	Deodar defoliator	Lepidoptera: Geometridae	Large areas of deodar forests in the outer ranges of north - western and western Himalaya are often defoliated completely by <i>Ectropis deodarae</i> , causing heavy mortality. Recently, an epidemic of deodar defoliator was reported from Lolab Valley, J&K. Mortality has been as high as 30%. Epidemics have occurred at intervals of about 10 year and may last for 2 or 3 years.
<i>Eutectona machaeralis</i> Walker	Teak skeletonizer	Lepidoptera : Pyralidae	Major pests of teak, occurring throughout south Asia and some parts of South-East Asia. Complete defoliation by the pests results in more or less leaflessness during most of the growing period. The damage varies from almost negligible to as much as half of the total annual increment. The studies carried out in the past estimate the loss to about 0.051 millions/ha/year.
<i>Plecoptera reflexa</i> Guenee	Shisham defoliator	Lepidoptera : Noctuidae	Serious epidemic in Changa Manga and Khanewal forest divisions (now in Pakistan) in 1899. Serious epidemics have been recorded from Chichawatni and Khanewal in 1927, 1928, 1932 and in Ambala forest division in 1974 and 1975.
<i>Dioryctria abietella</i> Devis & Schiffer Mudlor	Chilgoza cone borer	Lepidoptera : Pyralidae	The insect causes, damage to cones and seeds of coniferous species, covering major zoogeographical regions of the world (North-West and Western Himalaya, Afghanistan and Europe and North America). Reported 32.7% damage to <i>Pinus taeda</i> in 1973-74, 1.5–5.4% in <i>Abies pindrow</i> in Pakistan in 1980 and almost 100% loss in seeds in fully developed cones of <i>Pinus wallichiana</i> in 1986 in Chakrata, Uttranchal.
<i>Celosterna scabrator</i> Fabr.	Babul shoot & root borer	Coleoptera : Cerambycidae	A most notorious pest of <i>Acacia nilotica</i> reported from Bera (M.P.) in 1890. Incidence of borer attack upto 80% has been reported from the babul planted in unsuitable sites. Reported to be injurious to <i>Acacia catechu</i> , <i>Cassia siamea</i> , <i>Casuarina equisetifolia</i> , <i>Eucalyptus</i> spp., <i>Prosopis juliflora</i> , <i>P.spocigera</i> , <i>Tectona grandis</i> .
<i>Eligma narcissus</i> Rothschild	Ailanthus defoliator	Lepodoptera: Noctuidae	Defoliates seedlings and young plants (upto 5 years old) in plantations of <i>Ailanthus excelsa</i> and <i>A.triphysa</i> in penninsulan India. During heavy infestation, about 20-40% larvae are found in each leaf, causing heavy damage whereas in nurseries complete defoliation (100%) may occur. A widely distributed species in South – East Asia, east of Phillipines in the Oriental region.



(follows from previous)

Insect pest species	Common name	Order/family	Year of Epidemics/ Mortality
<i>Eterusia pulchella</i>	Khasi pine defoliator	Lepidoptera : Zygaeniidae	A large scale epidemic occurred in 1975 in 7500 ha. of Jaintia hills and 2500 ha. in Khasi hills. Affected stands of 5-30 years; heavy mortality (50%). Heavy defoliation occurred again in 1978. Two or more complete defoliations are sufficient to kill the tree.
<i>Apriona cinerea</i> Cheverolet	Poplar stem borer	Coleoptera : Cerambycidae	A serious problem in cultivation of exotic poplars in India. Mostly 1-3 years old plants are more prone to borer attack. Very common in North-West Himalaya and the adjoining plains region.
<i>Atteva fabriciella</i> Swedrus	Ailanthus webworm	Lepidoptera : Yponomeutida	A major pest in young plantations of <i>Ailanthus excelsa</i> and <i>A. grandis</i> is greater part of India and Pakistan. Repeated defoliations result in increment loss, particularly in plantations growing and hostile soil conditions. Also reported from Kalimantan (Borneo).
<i>Eucosoma hysidrvs</i> Meyrick	Spruce bud Worm	Lepidoptera : Eucosmidae	A major primary cause of mortality of <i>Picea</i> spp. in the Himalayas. Trees of all ages are attacked. Heavy and repeated infestation results in weakening of the host.
<i>Calopepla leayana</i> Latreille	Gamha defoliator	Coleoptera : Chrysomelidae	A serious pest of gamhar plantations in Assam, Trefru. Heavy infestation leads to drying up of shoots of young trees and the trees remain leafless for about 4 months of the growing season leading to ultimate death.
<i>Melosoma populi</i> Linn.	Poplar defoliator	Coleoptera : Chrysomelidae	A serious pest of Poplars and Willows in the temperate Himalayas from J&K to Arunachal Pradesh.
<i>Clostera cupreata</i> Butler & <i>C. fulgurita</i> (Walker)	Poplar defoliator	Lepidoptera : Notodontidae	A major problem in poplar plantation in tarai region of Uttar Pradesh since 1966 and in Punjab since 1986. Develop into epidemic form after 3 <sup>rd</sup> year of plantation of Poplars.
<i>Dichomeris eridantis</i> Meyrick	Shisham leaf roller	Lepidoptera : Gelechiidae	A major problem in Shisham plantations.
<i>Lebeda nobilis</i> Walker	Chir pine defoliator	Lepidoptera : Lasiocampidae	Large scale epidemic defoliation in Sankosh Valley chir forest in Bhutan from 1984 to 1986, led to large scale drying of chir. All age classes of pines are attacked.
<i>Lymantria obfuscat</i> Walker	Kashmir Willow defoliator	Lepidoptera : Lymentridae	Most destructive pest of Willows, results in loss of increment: trees may be killed if they are severely defoliated for more than one year.
<i>Malacosoma indica</i> Walker	Forest tent caterpillar	Lepidoptera : Lascocampidae	Widespread defoliation epidemics occur in North-West Himalaya.
<i>Tonica niviferana</i> Walker	Semul shoot borer	Lepidoptera : Oecophoridae	An important pest in Semul nurseries and young plantations. The attacked shoots of the young plants die in due course. The same plant may be attacked again and again. If the attack is repeated consequently for some years, the young plants are killed.
<i>Hylea puera</i> Gram	Teak defoliator	Lepidoptera : Hyleaidae	Pest epidemics reported from time to time.

## Assessment

The frequency and extent of incidence is increasing and it is not a good sign for sustenance of forest resources in India.

### 3.2.4.3 Incidence Weeds Infestation

Invasion of forest lands by alien species or incidence of weeds is the most urgent problem faced by forest resource managers. The forest weeds compete with native and desired forest flora for light, moisture, nutrients and space. They include herbs, shrubs, vines and tree species. Table gives a list of main weeds in forests of India. Survival and growth of selected trees is an important aspect of forest management. Weeds compete with these trees for light, moisture, nutrients and space

**Definition** No national definition is available.

**Transformation** Not necessary

#### Data and Temporal Trend

Not much data is available on this important variable; therefore development of temporal trend is not available.

**Table: Main Weeds in Forests of India**

Species	Distribution
<i>Eupatorium odoratum</i>	Assam, West Bengal, Bihar, Karnataka, Kerala, Goa, Western Ghat region.
<i>Lantana camara</i>	Throughout India, in hilly regions up to 8000 ft. height.
<i>Mallotus philippensis</i>	Uttar Pradesh, Uttaranchal, Bihar, Sub-himalayan tract from Punjab eastward ascending up to 4500 ft. West Bengal, Central India.
<i>Clerodendron viscosum</i>	Uttar Pradesh, Uttaranchal, Bihar, Nagaland up to 4500 ft. height
<i>Moghania chapper</i>	In Sal forests of Uttar Pradesh and Bihar.
<i>Ageratum conyzoides</i>	Uttar Pradesh, Uttaranchal, Bihar,
<i>Desmodium cylindrica</i>	Uttar Pradesh, Uttaranchal, Bihar,
<i>Eriethus munja</i>	Tall grass in plantations throughout India
<i>Sacharum spontaneum</i>	Tall grass in plantations throughout India
<i>Dendrophthoe falcate</i>	Parasites in commercial forests of India
<i>Scurulla parasitica</i>	Parasites in commercial forests of India
<i>Cuscuta reflexa</i>	Parasites in commercial forests of India
<i>Viscum monoicum</i>	Uttar Pradesh, Sikkim, Meghalaya, Western Peninsula
<i>Macrosolen cochinchensis</i>	Parasites in commercial forests of India
<i>Mikania</i>	Throughout India
<i>Parthenium</i>	Throughout India
<i>Carthamus oxycantha</i>	Throughout India
<i>Argemone maxicana</i>	Throughout India

#### Assessment

There is perception among experts that there is an increasing trend of weed infestation in forest areas. Non availability of data makes the situation worse.

### 3.2.4.4 Incidence of Grazing in different Forest Types

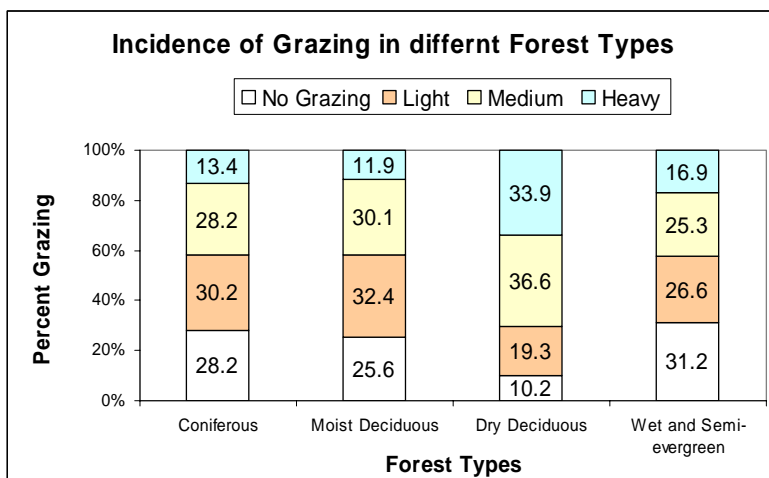
In most of the forests in India, the level and nature of grazing, in general, exceeds the capacity of the forests and thus is one of the most important factor for degradation of forests. One guess estimates that about 100 million cattle graze in forest area against its capacity of about 28 million livestock. This problem gets worse because, neither public not private grazing lands or range lands are scientifically managed in India.

**Definition** No national definition is available

**Transformation** It is not necessary

#### Data and Temporal trends

The FSI also conducts a supplementary assessment of the extent of grazing when it is conducting forest inventory in a forest area. The FSI has already covered about 80% of the forest area of the country under ground inventories. It estimates that about 77.6 per cent of forest area of the country is affected by grazing. Of this 17.9% of forest area is affected by high incidences of grazing, 30.7% by medium and 29% by light grazing incidences. Following figure indicates the extent of grazing in different forest types.



#### Assessment

The forests are under very high incidence of grazing pressure that is more than their capacities. Therefore, it may endanger their long-term sustainability.

### 3.2.4.5 Incidence of Fire

Frequent and unplanned fires adversely affect forest stock as well as flow of its goods and services. About 54.7% of India's forests are fire prone and of this about 9.2% forest areas are affected by frequent forest fires and 45.5% forest areas by occasional fires (FSI, 1997). Further, most of such forest fires are caused by man.

**Definition** There is no national definition for fire

**Transformation** Not necessary

**Data and Temporal Trend**

FSI conducted a study to estimate extent of fire in 1995 through 139 scenes on 1:1 million scale with three lasses (i) fire affected, (ii) smoke and (iii) fire unaffected. An intensive ground verification was done on related 349 toposheets at 1:50,000. The study revealed that during 1995 at national level about 2.31 percent of forest cover was affected by fire.

There is no other study at the national level to indicate the trend.

**Assessment**

No national level assessment is possible due to lack of data.

**3.2.4.6 Incidence of Pollutants**

The pollutants affect development of plant through their impact on photosynthesis and respiration leading to modified distribution and sustenance of species and their foliar diseases. The sustainability of the any forest relating to the impact of pollutants may be judged either looking their absorbing and mitigation potential or looking the damages due to pollutants.

**Definition**

Term	Definition
Pollutant	Any substance, which causes pollution, is called a pollutant. Explanation: A pollutant may include any chemical or geo-chemical substance, biotic component or its product, or physical factor that is released intentionally by man into the environment in such a concentration that may have adverse, harmful or unpleasant effects.

**Transformation** Not needed

**Data and Temporal Trends** No Data is available

**Assessment**

The variable is important but lack of data limits any assessment.

### 3.2.4.7 Presence of Indicator Species

Certain indicator species help to judge the health and vitality of a forest. For example, the presence of palms, orchids, ferns, arboreal mammals, owls, honey bees and butterflies may reflect the stable and healthy forests. It is considered important that India identifies “keystone species” and documents the presence, absence or abundance of such key indicator taxa within the representative forest types.

#### Definition (UNEP)

No standard national definition is available

Term	Definition
Indicator Species	<p>A species whose status provides information on the overall condition of the ecosystem and of other species in that ecosystem.</p> <p>Explanation It flags changes in biotic or abiotic conditions. They reflect the quality and changes in environmental conditions as well as aspects of community composition.</p>

**Transformation:** No data is available hence no question of transformation.

#### Data and Temporal trend

Necessary information is not available. Recently, few Protected Areas have started systematic monitoring of vegetation structures, rare plants and animals in the country but no assessment has been done for various species as indicators of forest health.

#### Assessment

The variable is very useful but lack of data limits its utility.

### 3.2.4.7 Density of Forest Canopy

This variable is very important because it expresses the distribution of canopy defines the composition, rates of growth and regeneration of forest stands as canopy controls distribution of sunlight to plants. Any significant change in the forest canopy may have effect on forest succession, growth and composition.

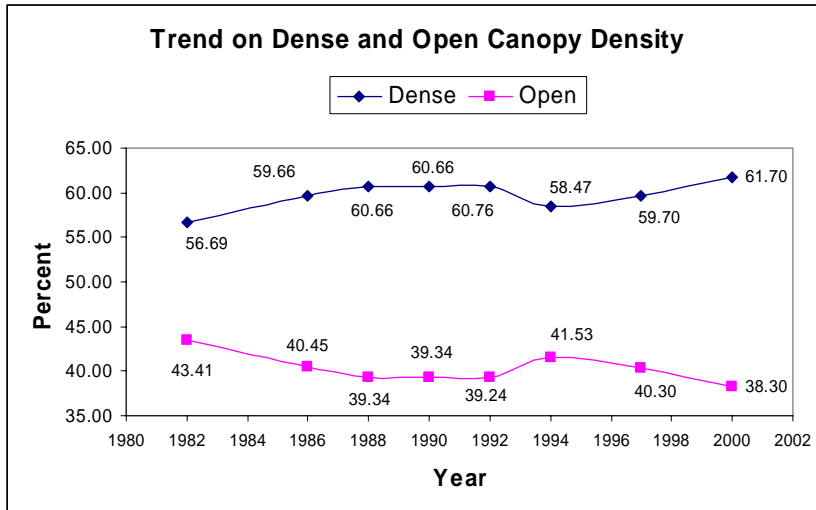
#### Definition

Term	Definition
Canopy Density	Percent area of land covered by canopy of the trees

**Transformation** Not needed

**Data and Temporal Trend**

Following figures present the information on the percent of dense and open canopy forest in India.



**Assessment**

The trend indicates the density of closed forest is increasing. This is a good sign for sustenance of forest resources in India.

**3.2.4.8 Status of Forest Fragmentation**

The forest fragmentation directly affects the local ecological processes processes both in the short as well as in the long-run and may endanger sustainability of resulting smaller patches of forests. The loss of connectivity between too patches may threaten existence of certain floral and faunal species and may also reduce adaptation resiliency of forest system to climate change. It may also lead to forest and land degradation, soil erosion and depletion of water storage and flow. Therefore, the “forest fragmentation” is one of key factors for monitoring of sustainability of forest resources.

**Definition** (CBD’s definition)

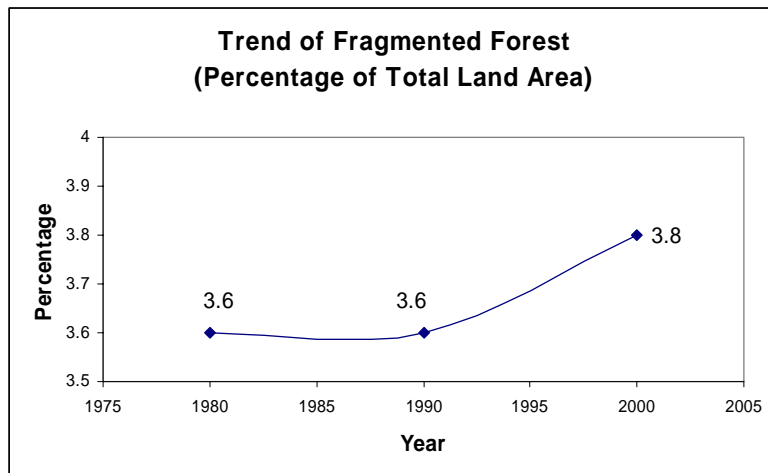
No national standard definition is available

Term	Definition
Forest Fragmentation	Any process that results in the conversion of formerly continuous forest into patches of forest separated by non-forest (lands).

**Transformation** Not considered necessary

### **Data and Temporal trend**

The following presents information on the percentage of fragmented forest in 1980, 1990 and 2000 based on the independent remote sensing implemented by FAO, Rome.



### **Assessment**

The data from independent remote sensing for 1980, 1990 and 2000 on selected sample locations in India indicates that percentage of fragmented forest is increasing since 1990 at a significant rate. This condition of forest is not good for the country.

### 3.3 Biodiversity

This section provides information on the method and approach chosen to identify and assess the complementary national variables followed by the national data and brief assessment.

#### 3.3.1 Method and Approach

India through FSI organised a group comprising of experts from various disciplines to implement the “Group Convergence Method” (Govil, 2002) for identification and assessment of variables. The group identified variables that are necessary to explain condition of forest against this criteria (Theme) but could not assess most of them due to lack of data.

#### 3.3.2 Relevant Variables

India has identified following five national variables that in addition to the four global variables (Conservation forests, Conservation “Other Wooded lands”, Forest Tree Species, Forest Composition) that are essential to describe the biodiversity in its forests.

- a. Area under Protected Areas (PA)
- b. Status of Endemic Species (flora)
- c. Status of Nationally Threatened Species (flora)
- d. Status of Introduced and Invasive Species (flora)
- e. Species Richness and Diversity

#### 3.3.3 Source and Source Data

Following table indicates sources of data for the additional variables.

Additional Variable	Source
Extent of Protected Areas	<b>Gadgil, M. and Meher-Homji, V.M.</b> 1986. Localities of great significance to conservation of India’s biological diversity. Proc. IAS. Suppl. 1986.
	<b>The Wildlife (Protection) Act, 1972, India</b>
	National Wildlife Database.. Wildlife Institute of India (WII), India.
Status of Endemic species	<b>Chowdhary, H.J. &amp; Murti, S.K.</b> 2000. <i>Plant Diversity and Conservation in India – An Overview</i> . B.S.I. Dehradun.
	<b>Nayar, M.P.</b> 1996. <i>Hot-spot of Endemic Plants of India, Nepal and Bhutan</i> . Thiruvananthapuram, Kerala.
Status of Nationally Threatened Species	<b>Nayar, M.P. and A.R.K. Sastry</b> 1987. <i>Red Data Book of Indian Plants Vol. 1 to 5</i> . BSI, Calcutta.
Introduced and Invasive Species	No temporal Data is available
Species Richness and Diversity	No temporal Data is available



### 3.3.4 Additional Data

This section provides information on each of the identified additional variables. It contains relevant definitions, source and source data, temporal trends and its assessment.

#### 3.3.4.1 Area under Protected Areas

The protected areas (PAs) provide ecological baseline information apart from ecological services including serving as gene banks and providing sustenance to life support system. In India primarily there are two major (National Parks and Sanctuaries) legal categories of PAs to provide legal protection to wildlife. The extent (size) of the PA within each forest types indicates social and political commitment of the country for conserving biodiversity and also the extent to which forest resources are better conserved.

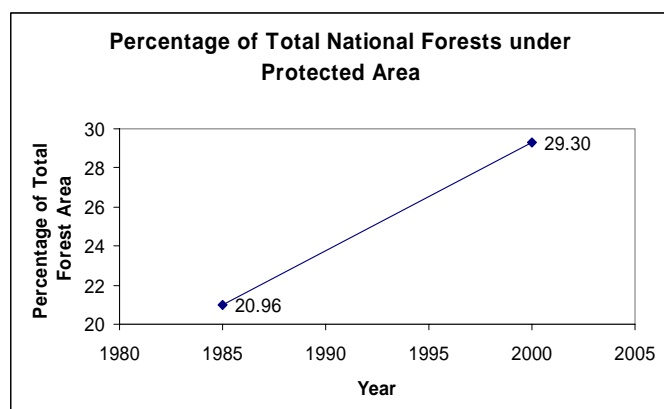
#### Definitions

<b>National Park</b>	An area declared, whether under sec.35. or sec.38 or deemed, under sub-section (3) of sec.66 of Wildlife (Protection) Act, 1972 to be declared, as a National Park
<b>Sanctuary</b>	An area declared, whether under sec. [26(A)5] or sec 38, or deemed, under sub section (3) of Sec.66 of Wildlife (Protection) Act, 1972 to be declared, as a wildlife sanctuary

**Transformation** Not necessary

#### Data and Temporal Trend

A comparison 1985 and 2000 indicates that number and area of PA has increased from 298 (51 National Parks and 247 Sanctuaries) covering 10.055 million ha to 573 (89 National Parks and 484 Sanctuaries) in covering 15.404 million ha in 2000.



## Assessment

Increasing trend number, area and forested area under PA is indicates better sustainability conditions.

### 3.3.4.2 Status of Endemic Species (Flora)

Endemism represents the uniqueness of the flora of a region or local area and leads to understand local patterns of bio-diversity. It basically captures the “natural” spatial distribution of species.

#### Definition (CBD)

<b>Endemic Species</b>	An endemic species is a native species restricted to a particular geographic region owing to factors such as isolation or in response to soil or climatic conditions.
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**Transformation** Not necessary

#### Data and Temporal Trend

India has about 6000 endemic species. The Eastern Himalayas and Western Ghats are included in the list of so far identified 18 "Hotspots" in the world. India has three mega centres (Eastern Himalayas, Western Himalayas, and Western Ghats) and more than 40 sites of high endemism (Nayar, 1996). Few important centres of them are Trans Himalayan Cold desert & Western Himalayan regions, Garhwal-Kumaon Himalayas, Eastern Himalaya, North eastern regions, Aravali hills, Panchmari-Satpura-Bastar region, Chotanagpur plateau, Simlipal-Jeypore hills, Eastern Ghats, Western Ghats, Saurashtra-Kutch region and Andaman and Nicobar Islands. There are about 5725 endemic species out of an estimated 17000 flowering plants. Of this, 3471 are Himalyaan taxa, nearly 2015 are peninsular region & 239 are from Andaman & Nicobar.

There are different estimates of endemics shown by different workers as number of species are added due to more and more explorations and also sometimes decreased due to exclusion of the species from the list of endemics if it is reported from other geographic region.

The trend data on endemic species is not available as normal regular assessments (forest or botanical survey) do not address these species and because no specific survey are done for them to collect temporal data.

## Assessment

The variable is important but due to lack of temporal data no trends are available limiting its utility to monitor the sustainability of forest resources.

### 3.3.4.3 Status of Threatened Species

Regular monitoring of “Threatened species” is very necessary for conservation of biodiversity. In absence of this information no policy or intervention can be designed to ensure sustainability of the biodiversity.

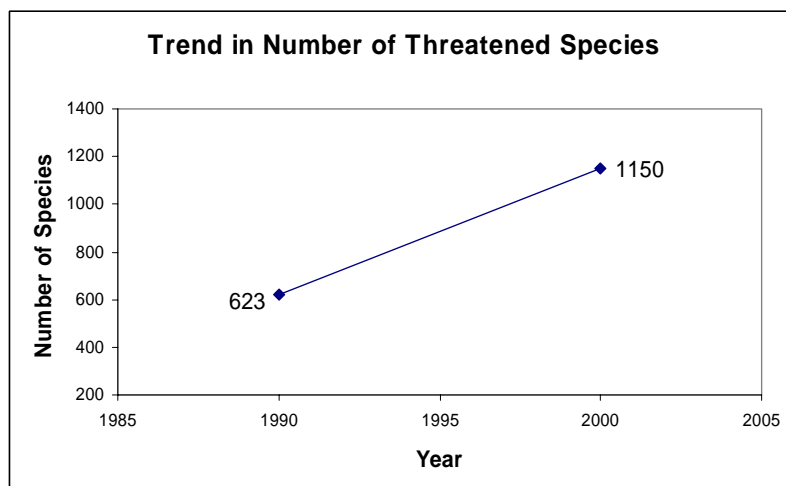
#### Definition (IUCN)

<b>Threatened Species</b>	A taxa classified in any of the three IUCN categories namely Critically Endangered, Endangered, or Vulnerable species.
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**Transformation** Not needed

#### Data and Temporal Trend

Nayar and Sastry (1987, 1988, 1990) indicate that 623 species were under various categories of threat. During the last decade BSI has identified over 1150 rare/threatened species of flowering plants (Vol. IV & Vol. V of Red Data Book) Following figure presents this trend.



#### Assessment

The data indicates addition of 527 (1150-623) species but in absence of complete details it is not clear whether these new species have been surveyed for the first time or they were surveyed in past and were not threatened. Assuming that these were surveyed earlier, it can be said that the increase in number of threatened is indicate conditions adverse for sustainability of forest resources.

### 3.3.4.4 Introduced and Invasive Species (Flora)

Introduced species are introduced with some specific objectives while invasive species invade the area naturally. Monitoring of these species is necessary to understand their positive or negative contribution to the sustainability of forest resources.

#### Definition

Term	Definition
Introduced Species	"Alien species" (synonyms: non-native, non-indigenous, foreign, exotic): a species, subspecies, or lower taxon introduced outside its normal past or present distribution; includes any part, gametes, seeds, eggs, or propagules of such species that might survive and subsequently reproduce. (UNEP/CBD/SBSTTA/6/INF/5 Annex II.)
Invasive Species	Invasive species are organisms (usually transported by humans) which successfully establish themselves in, and then overcome, otherwise intact, pre-existing native ecosystems IUCN/SSC (Species Survival Commission) Invasive Species Specialist Group

#### Transformation

Not required as no temporal data is available on either of the two variables.

#### Data and Temporal Trend

Following table provides some of the available information on the introduced species.

Species	Place of introduction	Country of origin
<i>Acacia auriculiformis</i>	FRI West Bengal, Bihar	Queensland, Australia
<i>Acacia decurrens</i>	Nilgiris (1524m to 2133m)	-do-
<i>Acacia mangium</i>	Dinga, coastal area of south-west Bengal	Australia
<i>Acacia mearnsii</i>	Nilgiris (in 1677 at 2286m) Palni Hills (in 1828 at 2438m)	Australia (S.victoria) and Tasmania
<i>Acacia dealbata</i>	Nilgiris (in 1832 above 1524m)	Tasmania and south Australia.
<i>Acacia pyrenantha</i>	Nilgiris and U.P.	-do-
<i>Acacia tortillas</i>	Jodhour, Rajasthan	Israel
<i>Adenthera microsperma</i>	F.R.I., Dehra Dun	Indonesia, Jawa.
<i>Agathis robusta</i>	F.R.I., Dehra Dun	Queensland, Australia.
<i>Albizia falcate</i>	Assam	Indonesia
<i>Araucaria cunninghamii</i>	F.R.I., Dehra Dun	Queensland, Australia
<i>Bambusa burmenica</i>	F.R.I., Dehra Dun	Burma
<i>Bambusa glaucescens</i>	F.R.I., Dehra Dun	China
<i>Broussonetia papyrifera</i>	Bamanpokri (Bengal), Shahapur (Maharashtra), Dandeli (Karnataka), Begur (Tamilnadu)	China
<i>Castanea sativa</i>	Manali (H.P.). Chakrata (U.P.)	Europe
<i>Casuarina equestifolia</i>	Tamil Nadu (in 1860)	Indonesia
<i>C. Cunninghamiana</i>	West Coast of Saurashtra (in 1950)	Thailand
<i>C. junghiana</i>	Tamilnadu	Thailand
<i>Chlorisia speciosa</i>	New Forest	S. Brazil

(follows from previous page)

Species	Place of introduction	Country of origin
<i>Cinnamomum camphora</i>	New Forest, Saharanpur, Tamil Nadu Karnataka.	China and Japan
<i>Christomaria japonica</i>	Darjeeling (West Bengal)	Japan
<i>Dendrocalamus giganteus</i>	New Forest	Burma
<i>Eucalyptus Alba</i>	New Forest	Indonesia, N. America
<i>E.Camaldulensis</i>	Punjab, U.P.	Australia
<i>E.Citriodora</i>	Londha, Dandeli	Australia
<i>E.deglupta</i>	New Forest	Indonesia
<i>E.globulus</i>	Nilgiris (Tamil Nadu)	Australia
<i>E.grandia</i>	Kerala	Australia
<i>E.maculata</i>	Shahapur (Maharashtra)	Australia
<i>E.paniculata</i>	New Forest	Australia
<i>E. tereticornis</i>	U.P., Assam, Punjab	Australia
<i>Fagus sylvatica</i>	Kulu, Manali (H.P)	Europe
<i>Fraxinus excelsa</i>	Kulu, J& K	Europe
<i>Havea brasiliensis</i>	Kerala, Tamil Nadu	Brazil
<i>Grevillea pteridifolia</i>	Amar Katak (Shahdol), Madhya Pradesh	Australia
<i>Grivellea robusta</i>	New Forest, Mussoorie	-
<i>Leucaena leucocephala</i>	New Forest, Maharashtra, Gujarat, Bihar.	Hawaii, Philippines, El Salvador, Peru.
<i>Ocroma lagopus</i>	Tamil Nadu, Karnataka.	Central America
<i>Parkinsonia aculeate</i>	Rajasthan, U.P., Delhi	Mexico
<i>Pinus carebaea</i>	Assan, New forest, M.P.	Br.Honduras
<i>P. nigra</i>	West Bengal, H.P.	Europe
<i>p.patula</i>	West Bengal, Bihar, H.P.	Mexico
<i>P.taeda</i>	H.P.	U.S.A.
<i>P. deltoids</i>	H.P., U.P., Punjab.	US and European Countries
<i>Prosopis juliflora</i>	Rajasthan, M.P. Maharashtra, Tamil Nadu	Mexico

## Assessment

Due to lack of temporal data no trend assessment was done.

### 3.3.4.5 Species Richness and Diversity

Natural ecosystems with more species richness and diversity are considered more resilient than with less. Hence, these variables have the potential to monitor sustainability of forests.

## Definition

<b>Species Richness</b>	The number of species within a region.
<b>Species Diversity</b>	The number and variety of species found in a given area in a region.

## Transformation

Not required as data is not available.

**Data and Temporal Trend**

National level information on these variables is not available for developing temporal trends.

**Assessment**

No assessment has been attempted as sufficient data is not available.

### 3.4 Productive Functions

This section first presents the method and approach chosen to identify and assess the complementary national variables and then provides national data and its assessment.

#### 3.4.1 Method and Approach

The for identification and assessment of variables, India through FSI used the “Group Convergence Method” (Govil, 2002). Two workshops were organized one for briefing and explaining and second for implementation of Group Convergence Method to arrive at the final list of identified variables. Temporal trends were developed and GCM was used to assess the state and change in these variables with respect to sustainability of forest resources.

#### 3.4.2 Relevant Variables

Following national variables in addition to the two global variables (“Wood Removal” and “NWFP Removal”) have been identified as complementary national variables that are essential to explain the state of “Production Function” in India and for which some information was available.

- a. Per Hectare Growing Stock
- b. Rate of Annual Volume (Growing Stock) Increment
- c. Extent of Planting Stock Improvement

#### 3.4.3 Source Data

Additional Variable	Source
Per Hectare Growing Stock	SFR, 1987 State of Forest Resources 1993. Forest Survey of India, Ministry of Environment and Forests, Government of India.
	SFR, 1993 State of Forest Resources 1993. Forest Survey of India, Ministry of Environment and Forests, Government of India.
	SFR, 1997. State of Forest Resources 1995. Forest Survey of India, Ministry of Environment and Forests, Government of India

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Rate of Annual Volume Increment	SFR, 1991 State of Forest Resources 1993. Forest Survey of India, Ministry of Environment and Forests, Government of India.
	SFR, 1993 State of Forest Resources 1993. Forest Survey of India, Ministry of Environment and Forests, Government of India.
	SFR, 1997 State of Forest Resources 1993. Forest Survey of India, Ministry of Environment and Forests, Government of India.
Area under improved Planting Stock	K. Gurusurthi and K. Subramanain. 1997. Research and Extension strategies for Genetics, Tree Improvement and Propagation in ICFRE, Proceedings of National Workshop on Linkage between Forestry Research and Forestry Practices held at ICFRE, Dehra Dun, May, 1997.
	Seedling Seed Orchard for Breeding Tropical Trees. 2000. Institute of Forest Genetics and Tree Breeding, ICFRE, Coimbatore, India.

### 3.4.4 Additional Data

This section provides information on each of the identified additional variables. It contains relevant definitions, source and source data, temporal trends and its assessment.

#### 3.4.4.1 Per hectare Growing Stock

The per hectare growing stock defines the level of flow of goods and services form forests. It is a direct measure of production function of forests. It becomes a measure of sustainability of the forests when its trend is related with annual growth rate of forests and annual production.

#### Definition

Term	Definition
Per Hectare Growing Stock	The growing stock per unit area (hectare) of forests

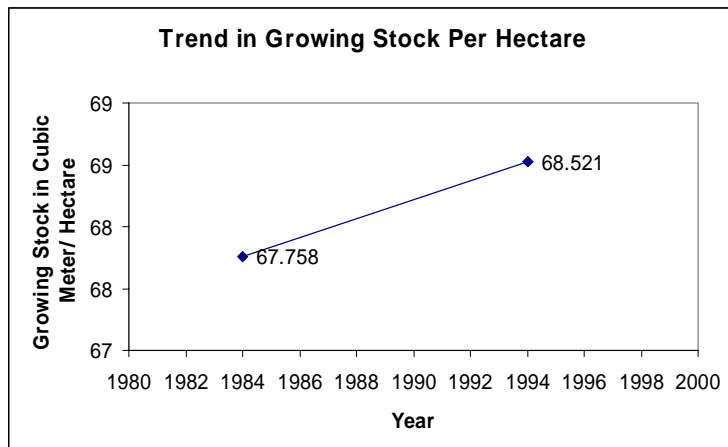
**Transformation:** Not needed

#### Data and Temporal Changes

Following table and figure present the growing stock and growing stock per hectare respectively for the years 1984 and 1994.

Year of Assessment	Forest Cover (million ha)	Growing stock (million m <sup>3</sup> )
1984	63880	4328
1994	63340	4340





### Assessment

The increasing trend in Growing Stock per hectare is a good sign for sustainability of the forest resources.

#### 3.4.4.2 Rate of Annual Volume Increment

The growing stock and its annual increment define the level of potential flows of good and services from a forests. The management and silviculture system have the capacity to manipulate the annual rate of increment of a forest within a given ecological and biological range. It is a very important variable for sustainable forest management and it basically fixes the value of a forest.

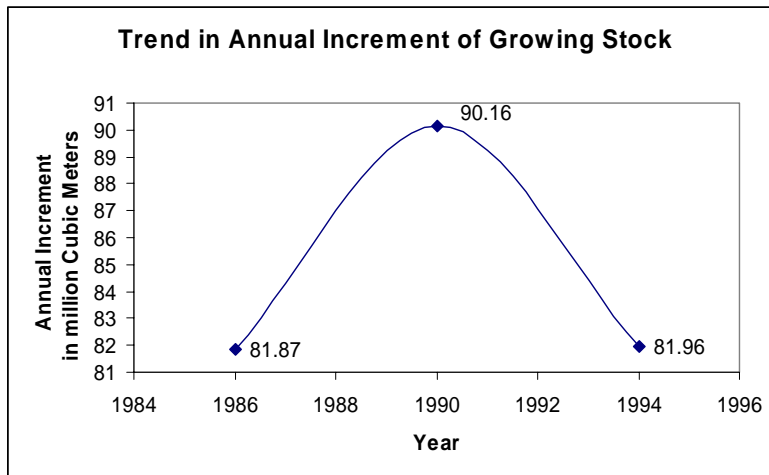
### Definition

**Transformation** Not needed

### Data and Temporal Trends

It is difficult to make estimation of annual increment of forest growing stock at national level in India due to large number of forest types and because statistical measurements from well laid out sample plots and tree increment plots are not available for last two or three decades.

The FSI has opted an alternative approach and used Von Mental's formula (Increment = 2\* growing stock/ rotation) to estimate this variable. The FSI assumes a rotation period for each of its inventory stratum and calculates its increment using Von Mental's formula. Based on this approach, FSI has generated estimates for 1986 ( Assessment year 1989), 1990 (Assessment year 1993) and 1994 (Assessment year 1997).



### Assessment

Rise and then decline in the annual increment is within 10 percent limit, which is less than the range of accuracy of its estimation. Therefore, it is difficult to infer whether the change indicates a “trend” or a “fluctuation”.

### 3.4.4.3 Extent of Planting Stock Improvement

Productivity and production are directly related to each other. India is one of the oldest and a leading country in terms of age and area under forest plantations but unfortunately not in performance in terms of survival and productivity. Therefore, India has taken steps for Tree improvement programs from beginning of 1960s. This programs consists of improving planting stock through establishment of high quality and productive Seed Production Areas (SPA) Seedling Seed Orchards (SSOs) and Clonal Seed Orchards (CSOs), and adopting improved vegetative propagation techniques and mass multiplication approaches.

**Definition** No standard national definition available

**Transformation** Not needed

### Data and Temporal trends

The seeds from Seed Production Areas (SPAs) are of superior quality as the parent trees due to their phenotype superiority. SPAs have been established in different states of India over about 10,727 ha.

The Seedling Seed (SSO) Orchard are developed with seedlings of phenotypically and/or genetically superior trees. About 3,018 hectare of SSOs have been raised and established in different states of India.

The Clone Seed Orchard (CSO) have been established over about 1569 ha. different states of India through grafts, cuttings, air-layered plants, tissue cultured plantlets or other methods of vegetative propagation of planting material from a plus trees or elite trees.

However, year-wise break down of above achievement is not available to develop temporal trend for this variable.

### **Assessment**

The variable is important and lays solid foundation to increase productivity of plantation but enough information is not available for assessment.

### 3.5 Protective Functions

This section provides information first on the method and approach chosen to identify and assess the complementary national variables and then presents the national data and its assessment including the global variable.

#### 3.5.1 Method and Approach

The for identification and assessment of variables, India through FSI used the “Group Convergence Method” (Govil, 2002). Two workshops were organized one for briefing and explaining and second for implementation of Group Convergence Method to arrive the finalist of identified variables. Temporal trends were developed and GCM was used to assess the state and change in these variables with respect to sustainability of forest resources.

#### 3.5.2 Relevant Variables

Following national variables in addition to the two global variables (“Protective Forests” and “Protective Other wooded lands”) have been identified as complementary national variables that are essential to explain the state of “Protective Function” of Forests in India.

- a. Extent of Forests under Watershed “Treatment”
- b. Status of Forest Soil Fertility
- c. Extent of Degraded Forests
- d. Ground Water Table in vicinity of Forest
- e. Extent of Forest in Hilly Region
- f. Extent of Forest in Mangroves

#### 3.5.3 Source Data

Additional Variable	Source
Extent of Forests under Watershed Treatment	Report of the Working Group on Watershed Development, Rainfed Farming and Natural Resources Management for the Tenth Five Year Plan, Government of India, Planning Commission, August 2001.
	Black, P. E. 1996. Watershed hydrology, second edition. Ann Arbor Press, Chelsea, MI.
Status of Forest Soil Fertility	No national level information is available
Extent of Degraded forests	SFR, 1987. State of Forest Resources 1993. Forest Survey of India, Ministry of Environment and Forests, Government of India.
	SFR, 1989. State of Forest Resources 1993. Forest Survey of India, Ministry of Environment and Forests, Government of India.
	SFR, 1991. State of Forest Resources 1993. Forest Survey of India, Ministry of Environment and Forests, Government of India.

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	SFR, 1993. State of Forest Resources 1993. Forest Survey of India, Ministry of Environment and Forests, Government of India.
	SFR, 1995. State of Forest Resources 1995. Forest Survey of India, Ministry of Environment and Forests, Government of India.
	SFR, 1997. State of Forest Resources, 1997. Forest Survey of India, Ministry of Environment and Forests, Government of India.
	SFR, 1999. State of Forest Resources, 1999. Forest Survey of India, Ministry of Environment and Forests, Government of India.
	SFR, 2001. State of Forest Resources, 2001. Forest Survey of India, Ministry of Environment and Forests, Government of India.
Ground Water Table in Vicinity of Forests	Francis Hilary Raj, Mathur, H. N. and Rajagopala, K (1984).Some hydrological investigations on blue gum ( <i>Eucalyptus globulus</i> ) at Osamund (Nilgiri). <i>Proc: National Seminar on Eucalyptus</i> ,Jan-30-31,1984, Kerala Forest Research Institute, Peechi.
	Goel, P.K and Singh H.B (1996). Impact of soil conservation measures on ground water availability. <i>Indian J.Soil Cons.</i> , <b>24</b> (1).
	Khepar, S.D <i>et al.</i> (2001). Impact of soil and water conservation work on ground water regime in Kandi Area of Punjab. <i>Jr.Soil and Water Conservation</i> , <b>45</b> (3&4).
	<u>Mallikarjunappa Gouda, D.S.,Maurya, N. L, Belgami, M.I., Chidanand, P. Mansur and Kubsad,V.S (1992).Impact of water harvesting structures (Nala Band)on ground water recharge.</u> <i>Indian J Soil Cons.</i> , <b>20</b> (3).
Extent of Forest In Hilly Region	<u>SFR, 1995. State of Forest Resources 1995. Forest Survey of India, Ministry of Environment and Forests, Government of India.</u>
	<u>SFR, 1997. State of Forest Resources, 1997. Forest Survey of India, Ministry of Environment and Forests, Government of India.</u>
	<u>SFR, 1999. State of Forest Resources, 1999. Forest Survey of India, Ministry of Environment and Forests, Government of India.</u>
	<u>SFR, 2001. State of Forest Resources, 2001. Forest Survey of India, Ministry of Environment and Forests, Government of India.</u>
Extent of Forest in Mangroves	<u>SFR, 1987. State of Forest Resources 1993. Forest Survey of India, Ministry of Environment and Forests, Government of India.</u>
	<u>SFR, 1989. State of Forest Resources 1993. Forest Survey of India, Ministry of Environment and Forests, Government of India.</u>
	<u>SFR, 1991. State of Forest Resources 1993. Forest Survey of India, Ministry of Environment and Forests, Government of India.</u>
	<u>SFR, 1993. State of Forest Resources 1993. Forest Survey of India, Ministry of Environment and Forests, Government of India.</u>
	<u>SFR, 1995. State of Forest Resources 1995. Forest Survey of India, Ministry of Environment and Forests, Government of India.</u>
	<u>SFR, 1997. State of Forest Resources, 1997. Forest Survey of India, Ministry of Environment and Forests, Government of India.</u>
	<u>SFR, 1999. State of Forest Resources, 1999. Forest Survey of India, Ministry of Environment and Forests, Government of India.</u>
	<u>SFR, 2001. State of Forest Resources, 2001. Forest Survey of India, Ministry of Environment and Forests, Government of India.</u>

### 3.5.4 Additional Data

This section provides information on each of the identified additional variables. It contains relevant definitions, source and source data, temporal trends and its assessment.

#### 3.5.4.1 Extent of Forests under Watershed “Treatment”

Treatment of watershed areas helps to maintain its hydrological regime and includes conservation and development of forest areas. Treatment spans activities like control measures for soil and water erosion and controlled access or disturbances to fragile areas. The “Extent of Forest under such “Treatment” of watersheds is an important variable to monitor protective services of forests.

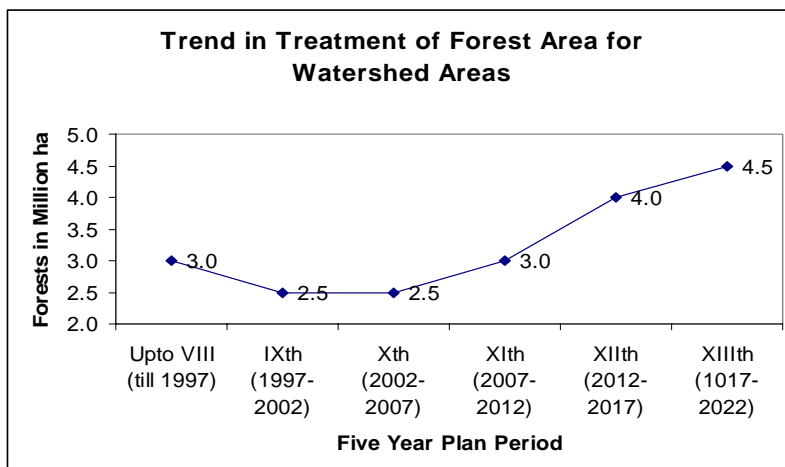
**Definition** (No standard definition available)

Term	Definition
Watershed	A watershed is an area in which the natural hydrological boundaries drain to a common point on a watercourse, usually a confluence of streams or rivers (also known as drainage area or, catchment).
Treatment (Management)	The planned manipulation of one or more factors of the natural or disturbed drainage so as to effect a desired change in or maintain a desired condition of the water resource. (Black, 1996)

**Transformation** Not needed

#### Data and Temporal Trends

Following figure indicates the magnitude of “treatment” in successive “Five Year Plans” including level of the activity proposed for future plans.



## Assessment

The temporal trend indicates increasing commitment of government to address the issue of protection to watershed areas.

### 3.5.4.2 Status of Forest Soil Fertility

Forests protect and contribute to soil fertility. Monitoring of the trend of soil fertility or the productive potential of forest soils is necessary to measure the trend in capacity of the forest to provide necessary protection and conservation to soil resources. In other words it is a direct measure of one of the protective functions of the forests.

**Definition:** (Not standard national definition is available)

Term	Definition
Forest Soil Fertility	The forest productive capacity of a soil.  Explanation: It depends on those factors in the soil that determine its crop production potential. Such factors are the presence of essential plant nutrients in available form and in a suitable balance; the proper micro-biological status of the soil to provide healthy environment for the release of plant nutrients; and freedom from any toxic or injurious agents, conditions or substances in the soil.

**Transformation** Not needed

### Data and Temporal trend

The fertility of forest soil is normally measured through the level of N, P and K as well as Ph of soil and is well documented. Although forest soils in India have been studied in detail but they are mostly one time period studies and do not provide information on temporal trend.

## Assessment

Assessment is not possible due to lack of data. It is suggested that temporal data on this variable be collected to monitor the fertility level at regular intervals of time. It will facilitate in time diagnosis of start of any degradation process, such conditions may be indicated by lower levels of availability of N, P, and K, and or with large changes in Ph. of soil (taking it to very high or very low values).

### 3.5.4.3 Extent of Degraded Forests

Healthy forests are necessary to maintain their protective flows. Over use, misuse, and or unscientific use of forests leads to transformation of "forest" into "degraded" forests. Monitoring of extent of degraded forest is important because increases in area of degraded forest provide direct indication of loss in the protective flows from forests.

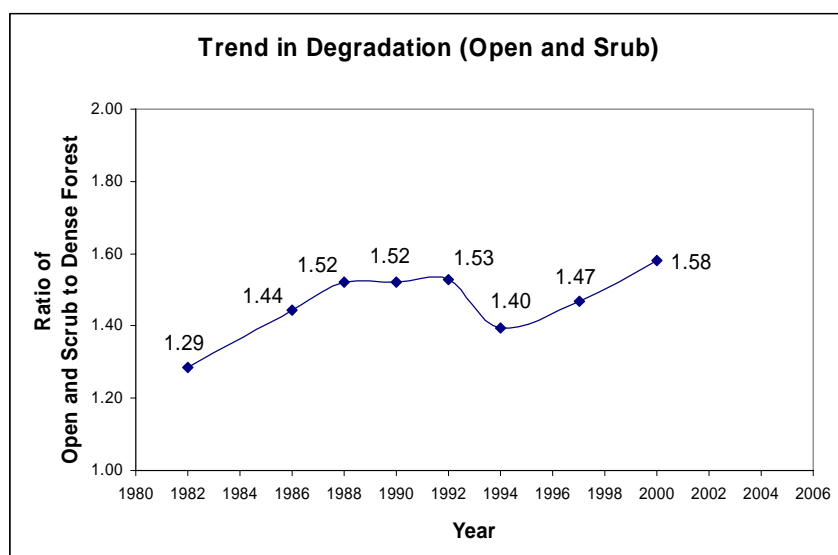
**Definition** (Not standard national definition is available)

Term	Definition
Degraded Forest	Forest with its reduced capacity to provide goods and services.

**Transformation** Not needed

### Data and Temporal Trend

The “Open forests” and “scrub forest” may exist either due to ecological conditions or due to degradation of “dense forests”. To distinguish between the two processes, it may be assumed that changes in “open” and “scrub” forests over small periods of time like two years of biannual survey of FSI may be due to improvement or degradation in “forests” and not due to ecological changes. FSI uses the ratio ( a unit and scale free dimension) of “open and scrub forests” to “dense forest” to develop trends because it is difficult to compare data over time when it comes from different resolutions and scale, as in case of data on forest cover.



### Assessment

The temporal trend indicates an increase trend in degradation of forests which is not a good sign for the forest resources of the country.

#### 3.5.4.4 Ground Water Table in Vicinity of Forests

Forest affect and get affected by the ground water regime. Ground water resources in India are depleting at very fast rate and the condition is like to worsen in future with increase in by 50% over the next 20 yrs. Monitoring of ground water in areas near to forest is therefore very important for ensuring sustainability of forest resource.



**Definition** (No standard national definition is available)

<b>Term</b>	<b>Definition</b>
<b>Ground Water</b>	All subsurface water that fills the pores, voids, fractures, and other spaces between soil particles and in rock strata in the saturated zone of geologic formations. ( <a href="http://ohioline.osu.edu/aex-fact/0460.html">http://ohioline.osu.edu/aex-fact/0460.html</a> )
<b>Water Table</b>	The surface of the body of unconfined ground water where the hydrostatic pressure is equal to atmospheric pressure. The water table is the boundary between the saturated and unsaturated zones and fluctuates according to season and rainfall. ( <a href="http://oaspub.epa.gov/trs/trs_proc_qry.alphabet">http://oaspub.epa.gov/trs/trs_proc_qry.alphabet</a> )
<b>Water level</b>	The water-surface elevation or stage of the free surface of a body of water above or below any datum, or the surface of water standing in a well, usually indicative of the position of the water table or other potentiometric surface. ( <a href="http://ohioline.osu.edu/aex-fact/0460.html">http://ohioline.osu.edu/aex-fact/0460.html</a> )

**Transformation** Not necessary as data is not available

### **Data and Temporal Trend**

Necessary and sufficient information on this variable is not available therefore it is difficult to develop temporal trends.

### **Assessment**

No assessment is possible as national level information on this variable is not available. However, there is a public consensus based on local studies that level of ground water in India has an overall declining temporal trend.

### **3.5.4.5 Extent of Forests in Hills**

The variable helps to understand the existence of protective forest cover to conserve soil and water regimes in hill regions which are fragile landscapes of India. The monitoring of forest cover in hills is important for long term sustainability of hilly landscapes.

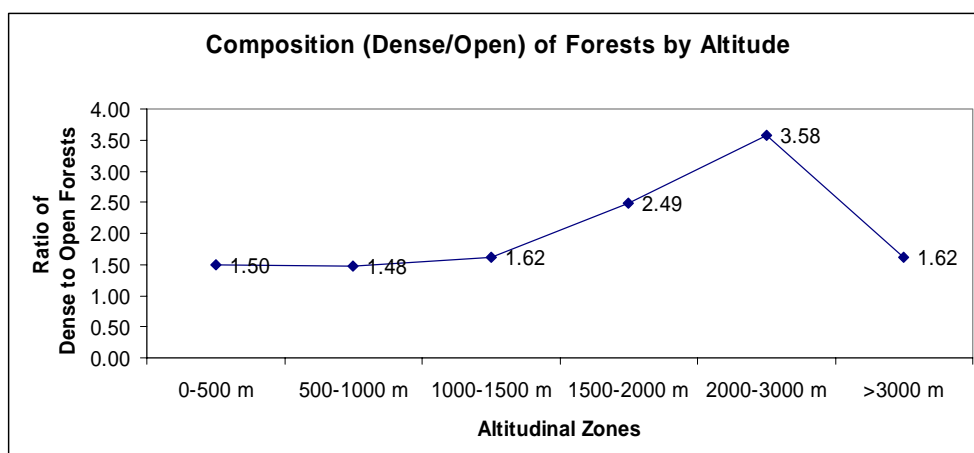
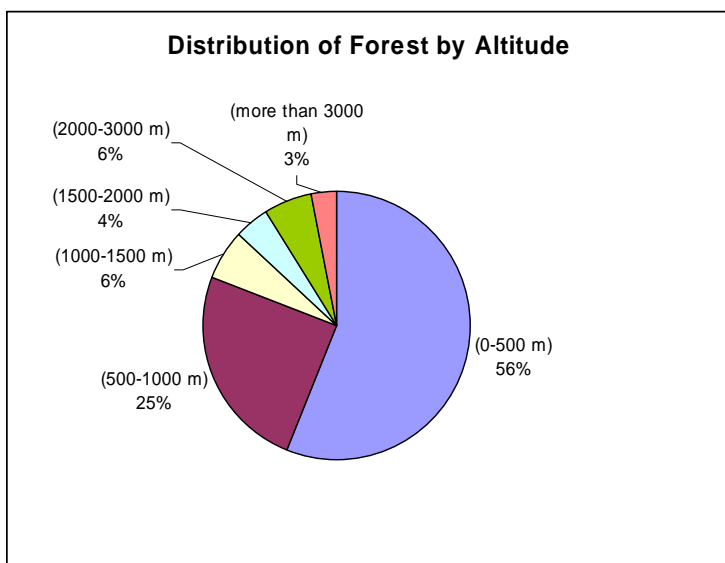
### **Definition**

<b>Term</b>	<b>Definition</b>
Hilly Region	A region above 500 meter altitude

**Transformation** Not needed

### **Data and Temporal Trend**

The Himalayan eco-system is a fragile ecosystem and its fragility increases with altitudes. FSI has digitized 500 M contours and identified the following distribution as well as composition (ratio of dense forest to open) of forests by altitude zones.



## Assessment

The temporal trend in last three assessments relating to data period of 1994, 1997 and 2000 indicates that forest cover in the hilly region of India is roughly constant at 37 percent, which is a good indication for sustainability of the forest resources in the hilly regions of India.

### 3.5.4.6 Extent of Mangroves

Mangrove forests are bio-diverse wetland forest ecosystems with muddy substratum of varying depth for their growth. They protect coastal area by checking soil erosion from tidal action of waves, strong winds and cyclone and also support livelihood of local people.

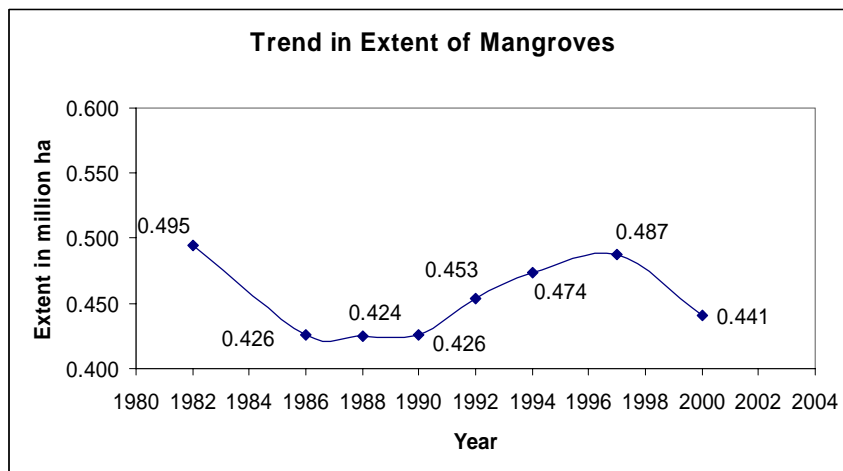
## Definition

Term	Definition
<b>Mangroves</b>	Salt tolerant forest ecosystem found mainly in tropical and sub- tropical coastal and/or inter-tidal regions.
<b>Mangrove Cover</b>	Area covered under mangrove vegetation as interpreted digitally from remote sensing data. It is classified into dense mangrove cover (canopy density over 40 percent) and open mangrove cover (canopy density from 10 to 40 percent).

**Transformation** Not needed

## Data and Temporal Trends

Expect for periodic survey by FSI, there are very few studies on Mangroves in India. Following figure presents the extent of mangroves in India based on biannual surveys by FSI.



## Assessment

One of the many explanations for the above temporal changes is that it is mainly due to change in resolution of satellite imageries and increase in scale of interpretation. It means that its area has increased because small additional patches of mangrove could be identified and its area has decreased because small patches of “non-mangrove” areas were detected within earlier demarcated mangrove areas. Therefore, it may be better to treat these changes as fluctuations and not a trend.

## 3.6 Social Functions

This section provides information first on the method and approach chosen to identify and assess the complementary national variables and then presents the data and its assessment.

### 3.6.1 Method and Approach

The for identification and assessment of variables, India through FSI used the “Group Convergence Method” (Govil, 2002). Temporal trends were developed and GCM was used to assess the state and change in these variables with respect to sustainability of forest resources.

### 3.6.2 Relevant Variables

Following variables in addition to global variables (“Sites for Social Function”) have been identified as complementary national variables to explain the “Social Function” of Forests.

- a. Use of Traditional Knowledge
- b. Quality And Extent Of Privileges
- c. Extent of Cultural/Sacred Forests
- d. Energy From Wood Resources
- e. Extent of Grazing (Cattle Population Dependent On Forest)
- f. Number of Participatory Institutions & Area Under It

### 3.6.3 Source Data

Additional Variable	Source
Use of Traditional Knowledge	The Patents (2 <sup>nd</sup> Amendment) Bill. 1999. Government of India, Ministry of Environment and Forests, Delhi
	The Biological Diversity Bill. 2000. Government of India, Ministry of Environment and Forests, Delhi
	The Protection of Plant Varieties and Farmers' Rights Act. 2001. Government of India, Ministry of Environment and Forests, Delhi
	World Intellectual Property Organization WIPO, 2002
Extent of Cultural and Sacred Forests	Induchoodan, N. C. 1996. <i>Ecological Studies of Sacred Groves of Kerala</i> . Ph. D. Thesis submitted to the Central University of Pondicherry.
	Ramakrishnan P. S. and Saxena K. G. and Chandrashekara U.M. 1998. <i>Conserving the Sacred: For Biodiversity Management</i> , UNESCO Vol., Oxford & IBH Publ, New Delhi.
Energy from Wood Resources	National Forestry Action Programme. 1999. Government of India, Ministry of Environment and Forests, Delhi
Extent of Grazing	SFR, 1995. State of Forest Resources 1995. Forest Survey of India, Ministry of Environment and Forests, Government of India.
Participatory Institutions	<i>Joint Forest Management: A Decade of Partnership</i> , RUPFOR. 2002. Government of India, Ministry of Environment and Forests, New Delhi.

### 3.6.4 Additional Data

This section provides information on each of the identified additional variables. It contains relevant definitions, source and source data, temporal trends and its assessment.

#### 3.6.4.1 Use of Traditional knowledge

The local “Traditional knowledge” (TK) related with biological resource is an inseparable part of resource. India is making a determined effort to use TK for sustainable management of its forest resources and in addition to taking a major initiative of “Joint Forest Management” it has developed three laws in (the Protection of Plant Varieties and Farmers' Rights Act, 2001, the Biological Diversity Bill, 2000, and the Patents Bill, 1999) that also address protection and support to the traditional knowledge on biological resources. It is therefore necessary to monitor use of TK in enhancement of sustainability of forest resources.

**Definition** (There is no standard national definition)

Term	Definition
Traditional knowledge	<p>It is a multifaceted concept that encompasses several components. It refers to “tradition-based” literary, artistic or scientific works; performances; inventions; scientific discoveries; designs; marks, names and symbols; undisclosed information; and all other tradition-based innovations and creations resulting from intellectual activity in the industrial, scientific, literary or artistic fields.</p> <p>Explanation:</p> <ol style="list-style-type: none"><li>1. It is "traditional" only to the extent that its creation and use are part of the cultural traditions of communities.</li><li>2. "Traditional" does not necessarily mean that the knowledge is ancient. "Traditional" knowledge is being created every day, it is evolving as a response of individuals and communities to the challenges posed by their social environment.</li><li>3. The intellectual property, however, is not only about property. It is also about recognition of and respect for the contributions of identifiable, human creators.</li></ol>
Tradition-based	<p>It refers to knowledge systems, creations, innovations and cultural expressions which: have generally been transmitted from generation to generation; are generally regarded as pertaining to a particular people or its territory; and are constantly evolving in response to a changing environment.</p>

**Transformation** Not necessary

#### Data and Temporal Trends

Data is not available for developing trend.

#### Assessment

It is political and contentious variable whose importance is steadily increasing. It has been recognised in India and world over which is a very positive sign.

### 3.6.4.2 Quality and Extent of Rights and Privileges

This variable deals with the privilege (rights, concessions and free grants) given to local people with an social obligation to protect man maintain their sustainability. In many states of India, the forests are not unable to satisfy these privileges. For example, presently, out of about 445 million cattle, sheep and goats in the country about 270 million graze in the forest areas when the grazing capacity of these forests is about 30 millions cattle only.

#### Definition

Term	Definition
Privilege	A right, advantage, or immunity granted to or enjoyed by a person or a class of people, beyond the usual rights or advantages of others.

**Transformation** Not needed

#### Data and Temporal trend

Sufficient information is not available at national level to identify trends and to see the impact of rights and concessions on condition of forests.

#### Assessment

There is a general perception that quantity of rights and concessions exceed resiliency limits of forests at many places in India.\

### 3.6.4.3 Extent of Cultural and Sacred Forests

The cultural and sacred forests are better protected than other forests due to social values attached to them. Their condition improves or decline with over their social values.

**Definition** Not standard national definition

**Transformation** Not needed

#### Data and Temporal Trend

The national data is weak but it indicates presence of such forests all over India with their area varying from less than one hectare to more than 5000 ha.

#### Assessment

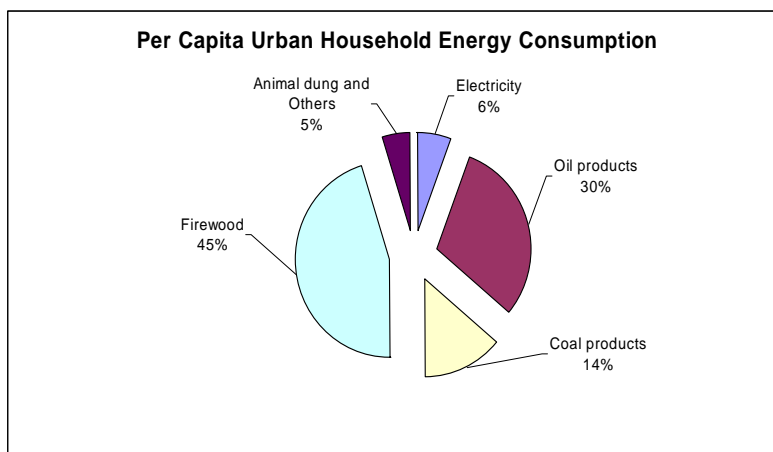
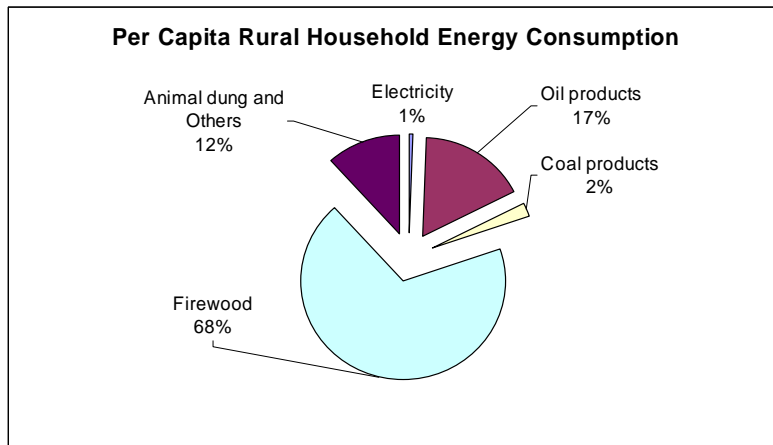
The general impression supported with scattered studies in various parts of India indicate that there is a decline in the number and extent of the cultural and sacred forest. This indicates loss in social value of forests at the local and it is not a good sign for conservation of forests.

### 3.6.4.4 Consumption of Energy From Wood Resources

In India, fuelwood is the main source of household energy both in rural and urban areas and its share in per capita consumption is about 68.5 % and 45.5 % respectively, therefore, consumption of energy from wood resources is an important parameter to define the social functions performed by the forests.

#### Data and Temporal Trend

Most of the estimation on consumption of fuelwood are not compatible and thus containing ability to develop time series data.



The total consumption of fuelwood far exceeds (about 3 times) the sustainable capacity of government forests (44 million tonnes) and private areas (35 million tonnes).





## Assessment

There is no temporal data at the national level due to incompatible survey designs. Most of the time series estimation mimic annual increase of human population at the rate of 2.1%.

### 3.6.4.5 Extent of Grazing (Cattle Population Dependent on Forests)

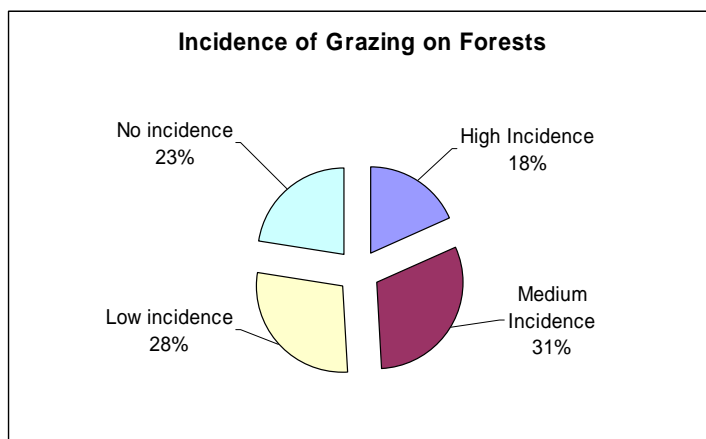
The “forests” in India meet about 30 percent of fodder requirements mostly through provision of grazing facilities in forests. This large extent of grazing, which is much more than the sustainable capacity of the forests, adversely affects forest and the conditions in which forest reside. The cattle, on the other hand, provide social and economic benefits and support mostly to the poor section of the society. The forest therefore serve a very important social function by providing grazing facilities and its review is very important keeping in view its adverse impact on forests.

**Definition** (No standard national definition)

**Transformation** Not needed

### Data and Temporal Trend

A study at FSI (SFR, 1995) analysed the extent of grazing in the inventoried forest areas to assess the incidence of grazing in forests India. It indicates that 77.5 percent of the total forest areas are subject to various levels of grazing. Same areas have not been visited again to provide temporal information. However, temporal statistics indicates that number of cattle is increasing although slowly.



## Assessment

The increase trend of cattle population coupled with extensive area of forest vulnerable to grazing do not provide conditions that promote sustainability of forest resources.

### 3.6.4.6 Participatory institutions

Utility and efficiency of participation between the “state” (state government) and local institutions for promoting sustainable management of forest resources is now well recognized. Monitoring of number of participatory institutions and the extent of forest with them is a good indicator to monitor long-term sustainability of forest resources.

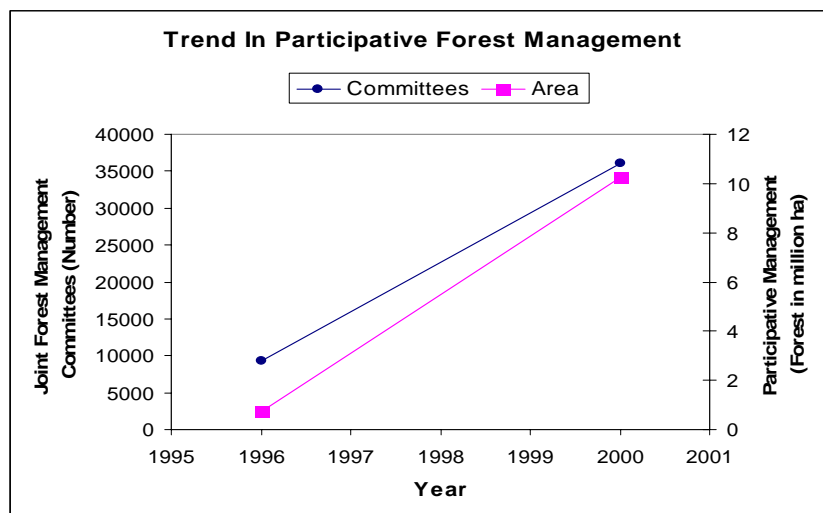
**Definitions** (Not standard national definition)

Term	Definition
Joint Forest Management	It is a forest management strategy under which the government (represented by the Forest Department) and the village community enter into an agreement to jointly protect and manage forestlands adjoining villages and to share responsibilities and benefits.

**Transformation** Not needed

#### Data and Temporal Trends

The government attaches great importance to this change (JFM) in management regime and directly monitors its progress. The following figures indicates past progress in this respect.



#### Assessment

The participative management of forests has increased at very fast rate during last decade and is a good sign for long term sustainability of forest resources.

### 3.7 Economic Functions

This section provides information first on the method and approach chosen to identify and assess the complementary national variables and then presents the national data and its assessment including the global variable.

#### 3.7.1 Method and Approach

The for identification and assessment of variables, India through FSI used the “Group Convergence Method” (Govil, 2002). Two workshops were organized one for briefing and explaining and second for implementation of Group Convergence Method to arrive the finalist of identified variables. Temporal trends were developed and GCM was used to assess the state and change in these variables with respect to sustainability of forest resources.

#### 3.7.2 Relevant Variables

Following national variables in addition to global variables (“Wood Removal”, “NWFP Removal”, “Value of Wood Removal” and “Value of NWFP Removal” and “Employment in Forestry”) have been identified to explain the “Economic Functions” of forests in India.

- a. Financial Investment in Forests
- b. Revenue from Forests
- c. Trade of Wood
- d. Trade of NWFPs
- e. Contribution of Forest Sector to GDP

#### 3.7.3 Source Data

Additional Variable	Source
Financial Investment in Forests	Forestry Statistics, 1996. Indian Council Of Forestry Research and Education. Dehradun, India
	Forestry Statistics, 2000. Indian Council Of Forestry Research and Education. Dehradun, India
	Forestry Statistics, 2001. Indian Council Of Forestry Research and Education. Dehradun, India
Revenue From Forests	Same as above
Trade of Wood	‘Monthly Statistics of Foreign Trade of India,’ Vol (I)-EXPORTS and Vol (II) - IMPORTS published by Directorate General of Commercial Intelligence & Statistics, Calcutta.
Trade of NWFP	Same as above
Contribution of Forest Sector to GDP	National Forest Action Plan. 1999. Ministry of Environment and Forests, Government of India
	Forestry Statistics, 2001. Indian Council Of Forestry Research and Education. Dehradun, India

### 3.7.4 Additional Data

This section provides information on each of the identified additional variables. It contains relevant definitions, source and source data, temporal trends and its assessment.

#### 3.7.4.1 Financial investments in forests

Financial investment in forests demonstrates the commitment of society to develop and sustain forest resources. It also defines the economic activity and support to livelihood that results from this investment. All this makes it an important variable to monitor regularly.

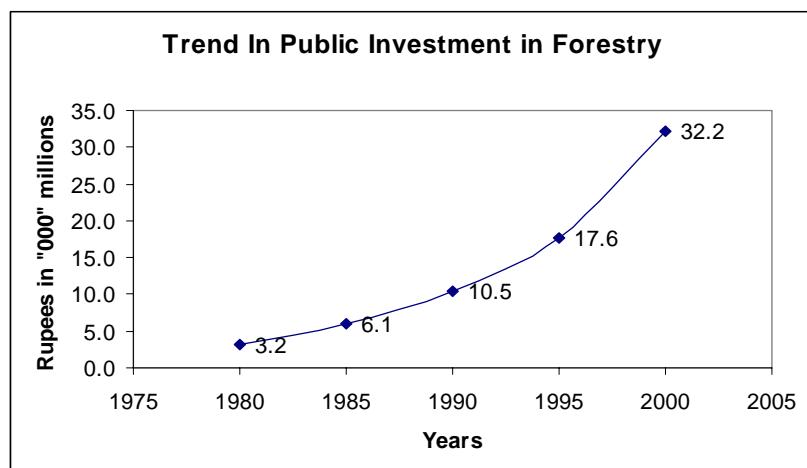
**Definition** (There is no national standard definition)

Term	Definition
Financial Investment In Forests	Use of current financial resources to accumulate forest capital assets and thereby expand productive capacity of forests for the future.

**Transformation** Not needed

#### Data and Temporal Trends

The following figure presents public investment in forestry activities. The investment represents the total of plan and non plan (revenue and capital) expenditure. The figure (32.2 billion rupees) for 1999 has been assumed for the year 2000.



#### Assessment

Increasing exponential trend in investment in forest resources is good for the country and indicate increase in commitment of the government to sustain forest resources in the country.

### 3.7.4.2 Revenue from forests

Revenue from forests an direct indicator of its economic function. More the revenue from the forest, the more is the economic contribution to or service of society by forests. It has a multiplier effect on the economic and social support system in a country.

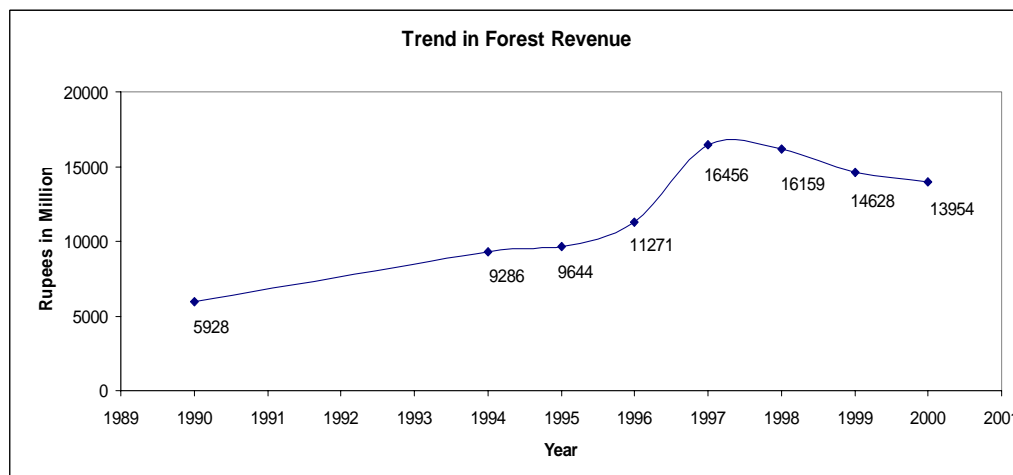
**Definition** (There is no national standard definition)

Term	Definition
Revenue from Forests	The gross inflow of cash, receivables or other consideration arising from the sale of goods, from the rendering of services, and from the use by others yielding interest, royalties and dividends. Revenue is measured by the charges made to users for goods supplied and services rendered to them and by the charges and rewards arising from the use of resources by them.

**Transformation** Not needed

#### Data and Temporal Trend

The revenue from forests indicate increasing trend till 1997 but shows declining trend since then.



#### Assessment

The recent declining trend in forest revenue suggests need of a detailed study to find reasons for this decline, if it indicates that this is due to allocation of more areas for protection or substitution of wood by some other products then this is a positive sign for sustainability otherwise it may not be the case.

### 3.7.4.3 Trade of Wood

The domestic and international trade of wood directly affects the demand and pressure on forest resources. It is very important to monitor this variable to monitor sustainability of forest resources.

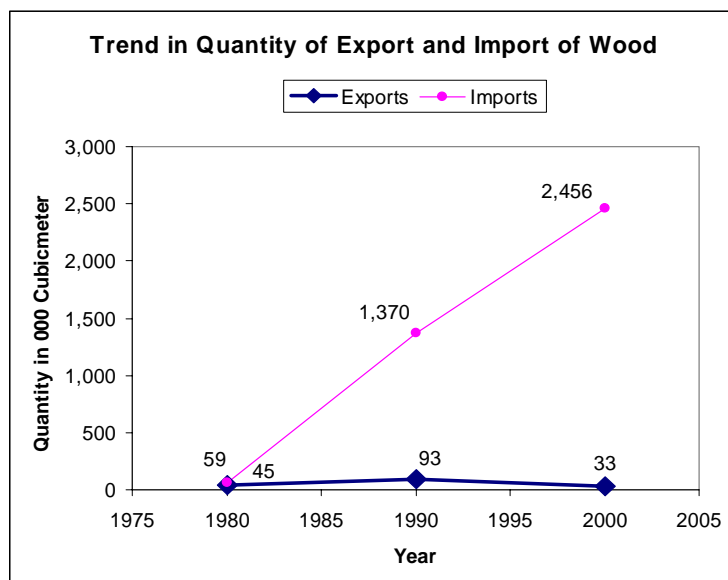
**Definition** (There is no national standard definition)

Term	Definition
Trade	Buying or selling of goods, services, securities or commodities

**Transformation** Not Needed

#### Data and Temporal Variable

The total requirement timber has been estimated at 64 million cu.m in 1996, which will rise to 73 and 82 million cum in 2001 and 2006 respectively. Out of 64 million cu.m demand of timber, nearly twenty percent comes forests as recorded removal and the rest from trees outside forests and other sources. This large gap in unsatisfied requirement has led to unrecorded removals, increase in imports and decrease in exports. The following figure present this situation graphically.



#### Assessment

The situation is unsatisfactory, there is urgent need to increase productivity of forest and plantations (public and private) to address this situation.

### 3.7.4.4 Trade of NWFP

The variable derives importance from the fact that many indigenous and local people depend on NWFP to meet their daily needs and to economic supplement through their trade.

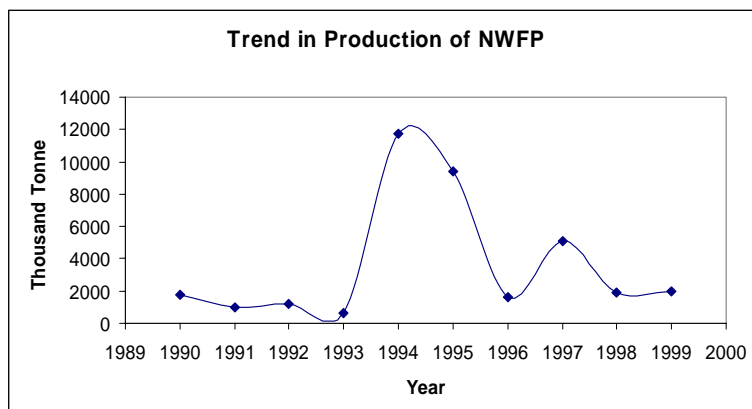
**Definition** (There is no national standard definition)

Term	Definition
Trade	Buying or selling of goods, services, securities or commodities
NWFP	Goods of biological origin, other than wood, as well as services, derived from forests and allied land uses.”

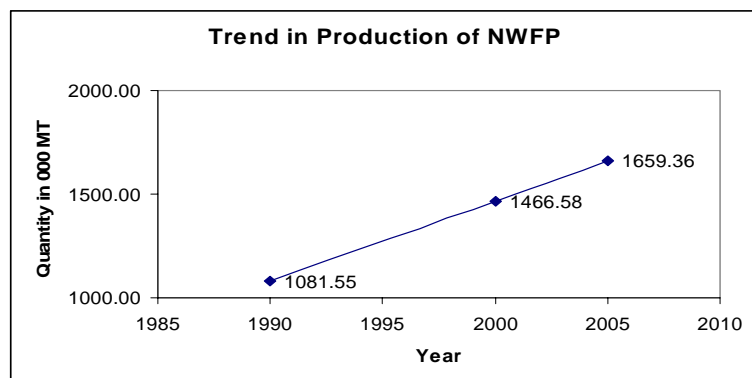
**Transformation** Not needed

#### Data and Temporal Trend

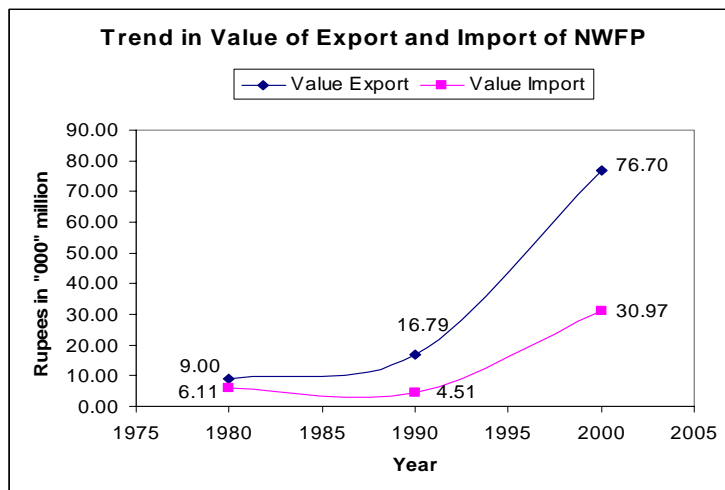
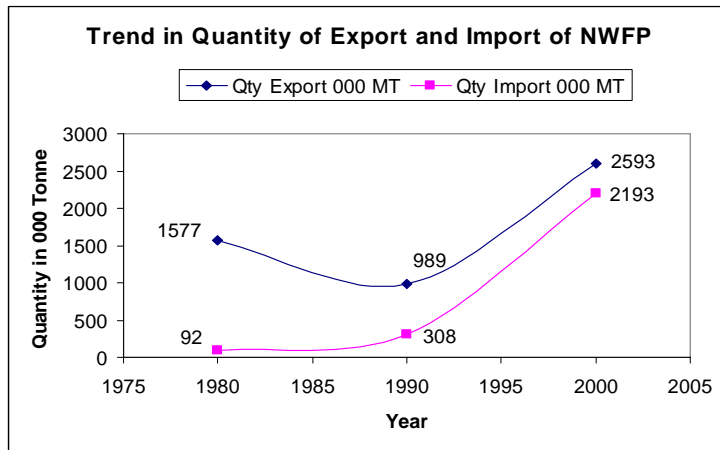
Data on annual production is very weak and indicates very large variation that may be due to seasonal variation and due to missing information.



However, if outliers are excluded then it indicates an increasing trend.



The quality of information on export and import of NWFP is better than on production. Following figures present trends in quantity and value of export and import of NWFP.



### Assessment

The quantity, price and thus value of both imports and exports of NWFP has increased. The increase is more in exports than imports and is therefore a good sign. Benefit of such increase will be still more if these benefits trickle down to the local people. This is very important especially when a large section of people living near to forests derive economic support form these products and when India has a rich resource base of NWFP that includes 3,000 species of plants, 1800 medicinal plants, 250 essential oil yielding plants, 100 tans and dye yielding plants and 120 gums and resin yielding plants.



### 3.7.4.5 Contribution of Forest Sector to Gross Domestic Product (GDP)

It is direct measure of contribution of forestry sector to national economy and can be used to estimate its multiplier effects on other sectors of economy. It provides one of the basis for allocation of resources in Indian national planning system and thus availability of for resources for forest development. Since it measures unduplicated value-added, the GDP is may be considered more useful to measure economic contribution than revenue or even employment.

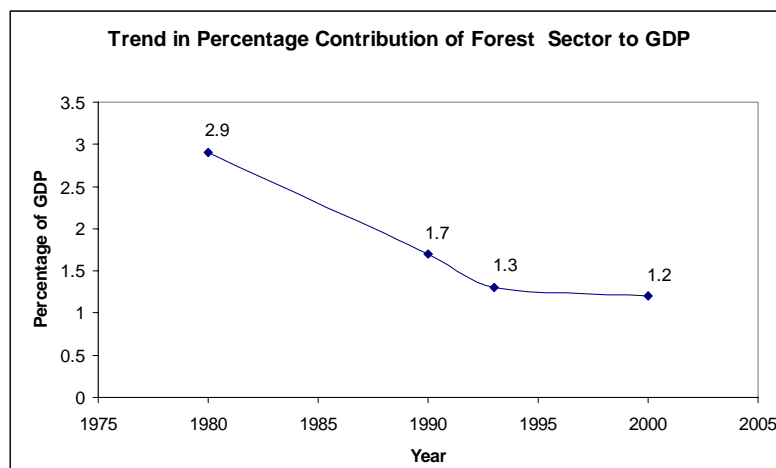
**Definition** (There is no national standard definition)

Terms	Definition
Gross Domestic Product	Gross domestic product (GDP), is the value of all goods and services produced in a year within national borders.

**Transformation** Not Needed

#### Data and Temporal Trend

In India, the contribution of forestry sector in GDP includes value of “round wood” and “NWFP” but does not include contribution of forest-based industries which is included in the “manufacturing sector” and is difficult to isolate. The forestry contribution interestingly, includes additional 10% of the value of the recorded production to account for any unrecorded production. Similarly, for states of India, where data on production and price of “NWFP” is not available, it conservatively estimates the contribution of NWFP as ten times of the royalty amount received by the state.



#### Assessment

The declining trend demands detailed study of the estimates and to identify causes of decline and revise the estimates if necessary.

### 3.8 Review of Sustainability of Forest Resources

FSI has gone further and has carried out a quantitative review<sup>2</sup> of sustainability of forest resources in India using group convergence method (see foot note 2) that led to a sustainability score of 55.8 for forest resources in India indicating a satisfactory state. A value of 50 or below would have meant that the status of sustainability was a cause for concern. Following table present scores by each Criterion or Thematic Area that indicates three thematic areas (Forest health and Vitality, Social Function and Economic Function) need more attention from policy planners to ensure long term sustainability of forest resources in India.

	<b>Criteria</b>	<b>Relative Weight</b>	<b>Score</b>	<b>Weighted Score</b>
1(a)	Extent of forest	14.9	69.2	10.3
1(b)	Contribution to Carbon	10.1	61.0	6.2
2	Forest Health & Vitality	13.3	48.0	6.4
3	Biodiversity Function	12.7	58.3	7.4
4	Production Function	12.3	52.0	6.4
5	Protection Function	12.6	59.7	7.5
6(a)	Social Function	11.9	47.1	5.6
6(b)	Economic Function	12.1	49.3	6.0
	<b>Total</b>	<b>100.0</b>		<b>55.8</b>

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<sup>2</sup> For details see Pilot Study to review Sustainability of Forest Resources – India (FRA, FAO) – implemented by Forest Survey of India.

## **4. Validation of findings**

FSI has validated the content of this working paper and is planning to further update and validate this country information before submitting its final report.

## **5. Conclusion**

FSI by developing this process of reporting has institutionalized this process at the national level and has identified its strength and needs to report to FRA 2005. This working paper sets the baseline for further improvement and refinement for final input from India to FRA 2005. In addition, this working paper has enhanced the transparency of information production process, credibility of national and related global data, and efficiency of recording keeping.