Forestry Department
Food and Agriculture Organization of the United Nations

GLOBAL FOREST RESOURCES ASSESSMENT

COUNTRY REPORTS

INDIA

FRA2005/001
Rome, 2005

The Forest Resources Assessment Programme

Sustainably managed forests have multiple environmental and socio-economic functions important at the global, national and local scales, and play a vital part in sustainable development. Reliable and up-to-date information on the state of forest resources - not only on area and area change, but also on such variables as growing stock, wood and non-wood products, carbon, protected areas, use of forests for recreation and other services, biological diversity and forests' contribution to national economies - is crucial to support decision-making for policies and programmes in forestry and sustainable development at all levels.

FAO, at the request of its member countries, regularly monitors the world's forests and their management and uses through the Forest Resources Assessment Programme. This country report forms part of the Global Forest Resources Assessment 2005 (FRA 2005), which is the most comprehensive assessment to date. More than 800 people have been involved, including 172 national correspondents and their colleagues, an Advisory Group, international experts, FAO staff, consultants and volunteers. Information has been collated from 229 countries and territories for three points in time: 1990, 2000 and 2005.

The reporting framework for FRA 2005 is based on the thematic elements of sustainable forest management acknowledged in intergovernmental forest-related fora and includes more than 40 variables related to the extent, condition, uses and values of forest resources. More information on the FRA 2005 process and the results - including all the country reports - is available on the FRA 2005 Web site (www.fao.org/forestry/fra2005).

The Global Forest Resources Assessment process is coordinated by the Forestry Department at FAO headquarters in Rome. The contact person for matters related to FRA 2005 is:

Mette Løyche Wilkie
Senior Forestry Officer
FAO Forestry Department
Viale delle Terme di Caracalla
Rome 00100, Italy

E-mail: Mette.LoycheWilkie@fao.org

Readers can also use the following e-mail address: fra@fao.org

Report preparation and contact person

This report has been prepared by:

Name Director, Forest Survey of India
Title: Director, Forest Survey of India
Organization: Forest Survey of India
Address: Kaulagarh Road, 248195 Dehradun, UA, India
Telephone number: 0091-135-756139
Fax number: 0091-135-759104
Email: fsidir@vsnl.com

Contents

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 www.fao.org/forestry/fra2000report
FRA 2005	Global Forest Resources Assessment update 2005, see www.fao.org/forestry/fra2005
FS	Forestry Statistics
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
PS	Pilot Study
SFM	Sustainable Forest Management
SFR	State of Forest Report
WII	Wildlife Institute of India

Introduction

This report provides information on forests and other wooded lands (OWL) in India, following the format, the definitions, and the guidelines of FRA 2005. The report is organised in three distinct sections. The first section provides the information on the process of development of forest related national information in India. The second section presents the country report on 15 National Reporting Tables of FRA 2005. The third and the last section provides additional information on forests and OWL using framework of six thematic areas that are common among the nine regional Criteria and Indicator (C&I) Processes. It also briefly mentions about the review of sustainability of forest resources in India conducted by Forest Survey of India (FSI) using the information contained in earlier tow sections.

National Forest Information Development Process

The statistics wing in the Ministry of "Statistics and Programme Implementation" is the apex body for the official statistical system of the country. For this purpose, its acts as a national nodal agency through one of its organization "Central Statistical Organization (CSO)". The CSO deals with the development of concepts, definitions, methodology of data collection, data processing and data dissemination. It is also responsible for development of national accounts. The Ministry also conducts large scale all-India sample surveys for collecting new socio-economic information through 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. The NSSO has a number of thematic divisions and disseminates information through special reports. The National Surveys are repeated usually 5 years or 10 years. Each round of data collection extend to one year and in every round of sampling about 10,000 sample villages and 5000 urban blocks are sampled covering around 120 to 150 thousand households.

In addition to CSO, there are many national level technical agencies that are working under respective ministries to provide specific technical information such as the Indian Space and Research Organization (ISRO) under Ministry of Space which provides remotely sensed information. Similarly, Forest Survey of India (FSI), Wildlife Institute of India (WII) and Indian Council of Forestry Research and Education (ICFRE) are national level institutions that work under Ministry of Environment and Forests and deal with forest related information. The FSI and WII collect primary ground information and supplement it with secondary information mainly from State Forest Departments to develop their national level data sets on forest related information. The ICFRE develops primary information on forestry basic research. It also compiles forest related national information which is available at FSI, WII and state forestry departments and regularly publishes the compilation as "Forestry Statistics".

Forest Survey of India (FSI) has been conducting 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 has been assessing forest cover on a two year cycle and is releasing the findings to the public through its "State of Forest Report" (SFR). Each successive assessment has made improvements in methodology, resolution and techniques of interpretation, for example the interpretation for the last assessment (SFR 2001) was totally digital and implemented at scale of 1:50,000. In addition to information on forest cover, FSI also conducts special studies to provide information on the growing stock of forests, tree cover ("Trees Outside Forests"), and "Pilot Study for Country Reporting to FRA 2005" (PS). FSI works as the lead, and nodal institution in India for the forest resource assessment programme of FAO, facilitates collection of information on other variables and conducts special studies when required. It has organized two national level workshops involving most of the major stakeholders and has used the group convergence method[1] to provide updated and extended information for FRA 2005.

The Indian Council of Forestry Research and Education (ICFRE), is an autonomous body under the Ministry of Environment and Forests, Government of India and serves as the apex national body on forestry research and education. Its mandate includes compilation and publication of national "Forest Statistics" on annual basis. The "Forestry Statistics" report both publishes and unpublished forest related supplied by national institutions like CSO, FSI, and WII and the State Forest Departments (SFDs) of 29 States and 6 Union Territories of India. The latest publication was "Forestry Statistics 2001". The scope of this publication includes area of forest land, forest cover, diversion of forest land for purposes other than forestry, forest plantation, production from forests, revenue and other management related information. For example, it contains information on "forest cover" as reported by FSI in "SFRs" and area of "forest land" as intimated to ICFRE by SFDs. The "forest land" in the Indian context is the area of land legally notified by the government as "forest" and recorded in the government land revenue records as "forests'. The period of the annual reporting is from April 1st to March 31st of the following year, for example, the period 1st April 2003 to 31st March 2004 and this period is denoted as 2003-04. For this report, such annual information has been treated as for the initial year, for example 2003 for 2003-04.

The "Forestry Statistics" (FS) also contains information on the national land-use which is provided by the CSO. These land-use statistics are primarily compiled at the sub-district (Tehsil) level from the village land records and then compiled at the state level for communication to CSO. The land-use is reported under nine major 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 land-use statistics are also developed at the nation level by the National Remote Sensing Agency (NRSA) a unit of ISRO using its 22 fold classification system. However, the ICFRE is not reporting the NRSA land-use figures in its "FS".

The Wildlife Institute of India (WII), is also an autonomous body under the Ministry of Environment and Forests, Government of India and serves as the apex national body on

[1] **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.

wildlife research, database and management in India. It maintains the National Wildlife database that deals with the protected areas and the biodiversity of wildlife.

The Botanical Survey of India (BSI) and the Zoological Survey of India (ZSI) are two scientific organizations under the Ministry of Environment and Forests that are responsible for the generation of data on floral and faunal diversity respectively in the country. These organizations undertake exploratory tours in different priority areas (hot spots and fragile eco-systems) in different parts of country. During these scientific studies they collect specimens of different species (floral /faunal) and preserve some of them in the museums /Botanical Gardens or zoos etc. The CSO uses this information for developing various country reports and for its publication "Compendium of Environment Statistics".

In addition to the above the many publications of Government of India and International Agencies provide useful information for FRA 2005. The Ministry of Forests and Environment" (MOEF) of the Government of India" (GOI) publishes many report that contain valuable forest related statistics, for example, "Annual Report" (AR) of MOEF, "National Forestry Action Programme" (NFAP) and country submissions to various international agencies. Similarly, many international organizations develop special study reports that provide forest related information. For example, the World Bank developed a study entitled "India: Alleviating Poverty through Employment (APE) that provides very useful information for National Reporting Table 15 on employment. Similarly, the International Forest Fire News (IFNN) provided information on damage to forests from fire for National Reporting Table 8.

The following table indicates the national data sources which have been used to provide the information for each of the 15 National Reporting Tables of FRA 2005.

Table No	Title of Table	Main Data Sources
1	Extent of Forests and Other Wooded Land	SFR
2	Ownership of Forests and Other Wooded Land	FS, SFR
3	Designation of Forests and Other Wooded land	NFAP, Database of WII
4	Characteristics	SFR, FS, PS
5	Growing Stock	SFR
6	Biomass Stock	SFR, PS
7	Carbon Stock	PS
8	Disturbances to Health and Vitality	FS, IFFN, PS, AR
9	Diversity of Tree Species	Red Book of IUCN
10	Growing Stock Composition	SFR, PS
11	Wood Removal	FS, NFAP, PS
12	Value of Wood Removal	FS, NFAP, PS
13	NWFP Removal	FS, NFAP, PS
14	Value of NWFP Removal	FS, NFAP, PS
15	Employment thorough Primary Activities.	APE

(SFR= State of Forest Report, FS= Forestry Statistics, NFAP= National Forestry Action Plan, WII= Wildlife Institute of India, PS= Pilot Study, IFFN= International Forest Fire News, AR= Annual Reports, APE= Alleviation of Poverty through Employment –A World Bank Study)

National Reporting Tables

This section presents country report on 15 National Reporting Tables.

1 T1. Extent of Forests and Other Wooded Lands

Country India

1.1 FRA 2005 Categories and Definitions

Forest	Land 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 in situ. It does not include land that is predominantly under agricultural or urban land use.
Other Wooded Land	Land not classified as "Forest", 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 *in situ*; or with a combined cover of shrubs, bushes and trees above 10 percent. It does not include land that is predominantly under agricultural or urban land use.
Other Land with Tree Cover	Land classified as "Other land", spanning more than 0.5 hectares with a canopy cover of more than 10 percent of trees able to reach a height of 5 meters at maturity.
Other Land	All land that is not classified as "Forest" or "Other Wooded Land".
Inland Water bodies	Inland water bodies generally include major rivers and lakes.

1.2 National Data

1.2.1 Data Sources

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

Source	Variable	Quality	Information Year
FSI, 1993. State of Forest Report 1993. Forest Survey of India, MOEF, GOI, India.	Extent	H	**1990**
FSI, 1995. State of Forest Report1995. Forest Survey of India, MOEF, GOI, India.	Extent	H	**1992**
FSI, 1997. State of Forest Report 1997. Forest Survey of India, MOEF, GOI, India..	Extent	H	**1994**
FSI, 1999. State of Forest Report 1999. Forest Survey of India, MOEF, GOI, India..	Extent	H	**1997**
FSI, 2001. State of Forest Report, 2001. Forest Survey of India, MOEF, GOI, India.	Extent	H	**2000**

(Note MOEF= Ministry of Environment and Forests and GOI= Government of India)

The first SFR was published as SFR 1987 using 1981-83 remotely sensed images. The SFR are generally known by their assessment year and contain forest related information of past two to four years. Therefore, the mid-year of the data period has been taken as the information year. Following table indicate their information and time content.

Assessment Year	Data Period	Sensor	Resolution	Scale of Interpretation
1987	1981-83	Landsat – MSS	80 m	1:1 million
1989	1985-87	Landsat - MSS	30 m	1:250000
1991	1987-89	Landsat - MSS	30 m	1:250000
1993	1989-91	Landsat - MSS	30 m	1:250000
1995	1991-93	IRS-1B LISS II	36.25 m	1:250000
1997	1993-95	IRS-1B LISS II	36.25 m	1:250000
1999	1996-98	IRS-1C/1D LISS III	23.5 m	1:250000
2001	2000	IRS-1C/1D LISS III	23.5 m	1:50000

1.2.2 National Classification and Definitions

The following tables (SFR, 2001) provides the classification and sub-classification and their definitions in use at Forest Survey of India, Ministry of Environment and Forests, India. The "Forest Cover" includes dense forest, open forests and mangrove forests.

Forest Area	Geographic areas recorded as forests in government records. It is also referred to as "recorded forest area".
Forest Cover	All lands, more than one hectare in area, with a tree canopy density of more than 10 percent. (Such lands may not be statutorily notified as forest area).
Dense Forest	All lands, with a forest cover with canopy density of 40 percent and above.
Open Forest	All lands, with forest cover with canopy density of 10 to 40 percent.
Mangrove Cover	(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).
Mangrove forests	Salt tolerant forest ecosystem found mainly in tropical and sub-tropical coastal and/or inter-tidal regions. Note: SFR classifies them into closed and open forests.
Non Forest Land	Lands without any forest cover. It excludes closed forest, open forests, mangrove and scrub in legally designated forest lands.
Recorded Forest Area	Same as "forest area"; i.e., geographic areas recorded as forests in government records.
Scrub	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.
Tree Cover	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. It excludes closed forest, open forests, mangrove and scrub.
Trees Outside Forests	Tree wealth existing outside recorded Forest Areas

1.2.3 Original National Data

The following table presents the national data on forest cover in India compiled from biennial "State of Forest Report (SFR)"of FSI as updated and revised in the last report (SFR 2001).

FSI, includes 10.485 million hectares area under trees, out side the legal boundaries of the "recorded forest", that occur in blocks of more than 1 hectare with canopy cover of more than 10 percent under the national category of "forest cover" and classifies it into "dense forests" and "open forests". It does not provide data on the land use on which these blocks of trees/forests exists.

Category	Sub-Category	Extent in "000" ha							
		1982	1986	1988	1990	1992	1994	1997	2000
Forest Cover	Closed	36072	37768	38512	38514	38532	36726	37736	41233
	Open	27605	25687	25000	24999	24903	26131	25506	25873
	Mangrove	405	426	424	426	453	483	487	448
	Sub-Total	**64082**	**63881**	**63936**	**63939**	**63888**	**63340**	**63729**	**67554**
Non Forest	Scrub	7680	6612	5964	5894	6052	5270	5190	4732
	Other NF[1]	256964	258233	258826	258893	258786	260116	259807	256440
	Sub-Total	**264644**	**264845**	**264790**	**264787**	**264838**	**265386**	**264997**	**261172**
Country Total Area	TOTAL	**328726**	**328726**	**328726**	**328726**	**328726**	**328726**	**328726**	**328726**

(Note: 1. NF= Non Forest. It includes 31407 (000 ha) of Inland water bodies and 814.7 (000 ha) of Tree cover in blocks of less than 1 hectare as mentioned in SFR 2001).

The SFR 2001 also reports the "Tree Cover" that is outside of the legal boundaries of the "Recorded forest area" but occurs in blocks of less than 1 hectare in area. This "Tree cover" spans a notional area of about 8.147 million hectares. It is notional (statistical) in nature because it is a computed by dividing number of trees under "Tree Cover" by a notional density (number of trees required to provide a canopy cover of more than 70 percent over one hectare area). Being notional in nature, FSI does not include this area of "Tree Cover" in its land use statistics.

The "total area" of the country reported in SFRs matches completely with the total area figure in FAOSTAT and at the UN Statistical Division. The difference between the "Land Area" and the "Total Area" for a year in the FAOSTAT leads to the following figures of the area of "Inland water bodies".

Categories	Extent in "000"ha.							
	1982	1986	1988	1990	1992	1994	1997	2000
Total Country Area	**328726**	**328726**	**328726**	**328726**	**328726**	**328726**	**328726**	**328726**
Land Area	297319	297319	297319	297319	297319	297319	297319	297319
Inland Water bodies	**31407**	**31407**	**31407**	**31407**	**31407**	**31407**	**31407**	**31407**

1.3 Analysis and Processing of National Data

1.3.1 Calibration

The land area figures for the whole country match with the land area figure with UN Statistical Division at New York USA. therefore, there is no need to calibrate the national data.

1.3.2 Estimation and Forecasting

The national data is available for 1990 and 2000. Regression technique was used to generate following forecast for extent of "Forest Cover" and "Scrub" in 2005 by using data sets from 1990 to 2000. and therefore only forecasting is needed to generate figures for 2005.

National Category	Forecasted for 2005 for Extent in "000"ha
Forest Cover	67701
Scrub	4110

1.4 Reclassification into FRA 2005 Classes

The national definitions provide the basis for the following re-classification of the national categories into the FRA categories. To report the area of "Tree Cover" outside "Recorded forests", it has been assumed that at least ten percent of the notional area reported for 2000 in SFR 2001 represents the "physical" or "real" blocks of trees that have an area more than 0.5 ha and therefore, has been classified into FRA category "Other land – of which with trees". Since no figures are available for the "Tree Cover" in 1990, the figure for the year 2000 has been assumed for 1990 as well as 2005.

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

National Categories	National Classes	Percentage of a National class belonging to a FRA Class or category			
		Forests	Other Wooded Land	Other Land with Tree Cover	Other Land
Forest Cover		100			
Non Forest					
	(i) Scrub		100		
	(ii) Tree Cover			10	90
	(iii) Other Non Forest[1]				100

(Note:1.. Area of Other Non-Forest includes area of "Inland water bodies")

FSI does not separately provide the area of "Inland Water bodies" but includes it in the Non-Forest Area. The figures of the total area of India reported by FSI and the UN Statistical Division and FAOSTAT match, therefore, the area of "Inland Water bodies" (31.407 million ha.) as reported by UN Statistical division is being used as national data as well as FRA data. The area figure for Inland water bodies in the UN Statistical database is the same for 1990 and 2000, therefore, the same area figure is being assumed for 2005.

1.5 Data for National Reporting Table T1

Table: Input to Global Reporting Table T1

FRA 2005 Classes	Extent in "000"ha		
	1990	**2000**	**2005**
Forests	63 939	67 554	67 701
Other Wooded Lands (Scrub)	5 894	4 732	4 110
Other land	227 486	225 033	225 508
...of which tree cover	815	815	815
Inland water	31 407	31 407	31 407
Total Area	**328 726**	**328 726**	**328 726**

2 T2. Ownership of Forests and Other Wooded Lands

Country India

2.1 FRA 2005 Categories and Definitions

Category	Definition
Private ownership	Land owned by individuals, families, private co-operatives, corporations, industries, religious and educational institutions, pension or investment funds, and other private institutions.
Public ownership	Land owned by the State (national, state and regional governments) or government-owned institutions or corporations or other public bodies including cities, municipalities, villages and communes.
Other ownership	Land that is not classified either as "Public ownership" or as "Private ownership".

2.2 National Data

2.2.1 National Data Sources

The "State of Forest Report" (SFR) contains information on forest area under the three legal categories of forests (Reserved forests, Protected forests and Other or Un-classed forests) in India. The first two categories of forests are owned by the government. However, the status of ownership for the third category is not clear. It varies from state to state and includes forest owned by public and by private individuals or bodies. The SFR 1993 containing information for the year 1990 does not provide information on ownership. Therefore, the figures of the ownership of forests for 1988, contained in the SFR 1991, has been used for 1990 since on average there is insignificant variation in the ownership during one or two years.

Source	Variable	Quality	Information Year
FSI, 1991. State of Forest Report 1991. Forest Survey of India, Ministry of Environment and Forests, Government of India.	Forests Un-classed forests	**H**	**1988**
FSI, 1995. State of Forest Report 2001. Forest Survey of India, Ministry of Environment and Forests, Government of India.	Forests Un-classed forests	**H**	**1992**
FSI, 1997. State of Forest Report 2001. Forest Survey of India, Ministry of Environment and Forests, Government of India.	Forests Un-classed forests	**H**	**1994**
FSI, 1999. State of Forest Report 2001. Forest Survey of India, Ministry of Environment and Forests, Government of India.	Forests Un-classed forests	**H**	**1997**
FSI, 2001. State of Forest Report 2001. Forest Survey of India, Ministry of Environment and Forests, Government of India.	Forests Un-classed forests	**H**	**2000**

Forestry Statistics (FS) publication of Indian Council of Forestry Research and Education (ICFRE) provides some information on ownership and its following editions have been used for this purpose.

Forestry Statistics, India (1988 to 1994). 1997. Indian Council of Forestry Research and Education, Dehradun, Uttaranchal, India	Area under private Ownership	**M**	**1990**
Forestry Statistics, India (1996). 2000. Indian Council of Forestry Research and Education, Dehradun, Uttaranchal, India	Area under private Ownership	**M**	**1996**
Forestry Statistics, India (1997). 2002. Indian Council of Forestry Research and Education, Dehradun, Uttaranchal, India	Area under private Ownership	**M**	**1997**

The "Forestry Statistics (FS)", complied and published by Indian Council of Forestry Research and Education (ICFRE) Dehradun has been used to provide information on "private ownership" of forests for this table. The annual reporting period in "Forestry Statistics" of ICFRE is from April 1st to March 31st of following year, for example, 1st April 1990 to 31st March 1991, nationally denoted as 1990-91. Further, that for FRA 2005 reporting, the information for this period has been treated as for the year 1990.

2.2.2 National Classification and Definitions

Broadly speaking, "reserved", "protected" and "un-classed" are the three major legal categories of forests in India. A legal notification by government under the "Indian Forest Act" defines the boundary of a "reserved" or "protected" forest. These forests areas by definition are owned by government or the "public" at large. The rest of the forests areas recorded as forest in the government land records but not notified as "reserved" or "protected" forest are called un-classed forests. The ownership of "un-classed" forests varies among the States and Union Territories (UTs) of India.

Terms	Definition
Reserved Forest[1]	Any forest land or waste land or any other land, 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 sections of the Indian forest Act.
Protected Forests[1]	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 the Indian Forest Act.
Un-Classed Forests[2]	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 the Indian Forest Act.
Recorded Forests[2]	Geographic areas recorded (land use) as forests in government records. Explanation: The "Recorded Forests" areas may and may not have "Forests" and or OWL". These areas may be owned by government or by private person of companies etc.

(Source: 1.Indian Forest Act, 1927 (as amended up-to-date) Government of India, New Delhi, India. 2. FSI, 2001)

2.2.3 Original National Data

Public and private are the two categories of ownership of forests and OWL in India. The "reserved" and "protected" forests are by definition owned by the government. However, the "un-classed forests" may be either private or public. In other words, leaving apart the private forests area in "un-classed" category of forests, the rest of the forests are "publicly" owned.

Following table presents information on the area of the "un-classed forests" drawn from SFRs. The SFR 1993, that contains the information on forests for the year 1990, does not provide information on the ownership of forests.

Legal Type of Forests	Area in 000 ha				
	1988	1992	1994	1997	2000
Un-classed	12208	12539	12539	12539	12788

(Source: FSI, 1991, FSI 1995, FSI SFR 1997, FSI 1999, and FSI 2001)

The "Forestry Statistics (FS)" provides information on ownership of forests by each State and Union Territory (UT) of India. However, some of the States and UTs of India have not regularly updated their information with ICFRE, hence, this set of information is incapable of providing national (complete total) figures. The following figures for "private ownership" of forests in "FS", although incomplete, indicate the minimum area of "un-classed" forests that is under "private" ownership in that year.

Type of Forests	Private Ownership in 000 ha										
	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Un-Classed	1260	1277	1256	1256	1252	1195	1197	1188	1151	1151	1078

(Source: Forestry Statistics 1997 and Forestry Statistics 2000)

2.3 Analysis and Processing of National Data

2.3.1 Calibration

This step is not considered necessary since country area figures match with figures of UN statistical division.

2.3.2 Estimation and Forecasting

(A) Private Ownership

The information on area of the private "un-classed forests" is not available for the year 2000, therefore, it has been estimated through regression technique by using past information in the "Forestry Statistics".

Legal Type of Forests	Privately owned - Area in 000 ha	
	1990	2000 (Estimate)
Un-classed Forests	1256	1066

(B) Public Ownership

The remaining "un-classed" forests in addition to the "reserved" and the "protected" forests ca be treated as "publicly" owned forests.

Categories	Forest Area in 000 ha	
	1990	2000
Total Forest (National Reporting Table 1)	63939	67554
Privately Owned Forests	1256	1066
Publicly Owned Forests (Total – Private)	62683	66488

The following figures of the ownership of OWL has been estimated assuming that the above percentage between private and public ownership of the "forests" is also applicable to the areas under the OWL.

Categories	OWL Area in 000 ha.	
	1990	2000
Privately Owned OWL	116	75
Publicly Owned OWL	5778	4656
Total OWL (National Reporting Table 1)	5894	4731

2.4 Reclassification into FRA 2005 Classes

Table: Reclassification (Percentage allocation) into FRA 2005 classes

National Classes	Percentage of a National class belonging to a FRA Class		
	Public Ownership	Private Ownership	Other Ownership
Privately owned Un-classed		100	
Public owned Forests	100		
Privately Owned OWL		100	
Publicly Owned OWL	100		

2.5 Data for National Reporting Table T2

Following table presents ownership of "Forests" and "OWL" reported in Table 1.

Table: Input for Global Reporting Table 2

FRA 2005 Categories	Area (1000 hectares)			
	Forest		Other wooded land	
	1990	2000	1990	2000
Private ownership	1 256	1 066	116	75
Public ownership	62 683	66 488	5 778	4 656
Other ownership	0	0	0	0
Total	**63 939**	**67 554**	**5 894**	**4 731**

3 T3. Designation of Forests and Other Wooded Lands

Country India

3.1 FRA 2005 Categories and Definitions

Category	Definition
Primary function	A designated function is considered to be primary when it is significantly more important than other functions. This includes areas that are legally or voluntarily set aside for specific purposes.
Total area with function	Total area where a specific function has been designated, regardless whether it is primary or not.
Production function	Forest / Other wooded land designated for production and extraction of forest goods, including both wood and non-wood forest products.
Protection of soil and water function	Forest / Other wooded land designated for protection of soil and water.
Conservation of biodiversity function	Forest / Other wooded land designated for conservation of biological diversity.
Social services function	Forest / Other wooded land designated for the provision of social services.
Multiple purpose function	Forest / Other wooded land designated to any combination of: production of goods, protection of soil and water, conservation of biodiversity and provision of social services and where none of these alone can be considered as being significantly more important than the others.
No or unknown function	Forest / Other wooded land for which a specific function has not been designated or where designated function is unknown.

3.2 National Data

3.2.1. National Data Sources

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

- Protection Forests (for biological stability)
- Production 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 from the database maintained by the Wild Life Institute of India, WCMC (UNEP), and Annual Reports of Ministry of Environment and Forests, Government of India. The details of these data sources are following.

Sources	Variables	Quality	Year
Forestry Statistics, India 1988 to 1994, 1997. Indian Council of Forestry Research and Education, Dehradun, Uttaranchal, India	Production	M	1990
NFAP, 1999. National Forestry Action Plan, 1999. Ministry of Environment and Forests, Government of India, India	Designation	M	1993
National Wildlife Database. Wild Life Institute of India, India. www.wii.gov.in/nwdc/pastatistics.htm	Protected Areas	H	1990 -2000
UNEP 1993. UN List of National Parks and Protected Areas: India. 1993. WCMC Protected Areas Data Unit..	Protected Areas	H	2000
Government of India. 2003. Annual Report 2002-2203, Ministry Of Environment and Forests, Government of India, New Delhi, India.	Designation	M	2000

3.2.2 National Classification and Definitions

The NFAP (1999) classifies, describes and defines forests based on designation.

Term	Definition
Protection forests	Forest managed for biological stabilities and defined as "An area wholly or partly covered with woody growth, managed primarily for its beneficial effects on water, climate or soil rather than for forest products or services, and involving fragile lands, critical soil, catchment areas, steep slopes, and land at high altitudes. Controlled sustainable extraction of non-wood forest products are often allowed in protection forests"
Production forests	Forests managed for meeting timber requirements of the country and defined as "Forest designated for the sustained production of timber and other forest products, often with protection and/or nature conservation as recognised secondary objectives, chosen because of their potential ot provide a yield of high quality timber(or other products) in perpetuity. This category may also include degraded areas appropriate for reforestation. In general usage that term covers natural forests, forest plantations, woodlots, agroforestry plots, homestead forest etc.
Social Forests	Forests managed for meeting daily needs of local communities.
Protected Area	Forests managed as Protected Area (National Parks and Sanctuaries etc.) also termed as "Conservation area" in NFAP and defined as "Land such as national parks, reserves, protected areas, or other categories gazetted under the appropriate legislation."

(Source: NFAP, 1999)

3.2.3 Original National Data

In India the national forest statistics is not maintained by the designation of forests. However, NFAP, 1999 has provided following broad information on designation of forests for 1993. The NFAP does not provide similar information for scrub areas (other wooded lands) etc. A better estimate of "Protected Areas" is available from the database of the Wild Life Institute of India (WII).

National Classification of Forests	Area in million hectares			
	1993 (NFAP)	**1994 (FS, 94)**	**2000 (FS, 2000)**	**2004 (WII)**
Protection forests (for biological stabilities)	10			
Production forests (for timber Requirements of the country)	15			
Social Forests (for meeting daily needs of local communities)	25			
Protected Area (National Parks and Sanctuaries etc,)	14	14	15.4	15.6
Total Forest	**64**			
Scrub (Other Wooded Lands)		5.9		

(Source : Protected Areas – FS & WII data base and Production forests – NFAP, 1999).

3.3 Analysis and Processing of National Data

3.3.1 Calibration

The calibration is not necessary as the total area of the forests matches with Table 1.

3.3.2 Estimation and Forecasting

Social Forests

The figures for area of social forests for the year 1990, 2000 and 2005 have been derived by apportioning the increases/decreases in the total area of forests for the year 2000 and 2005 in comparison to the area of forest reported for 1993 in NFAP to the area of Social Forests.

	NFAP	**Area in 000 ha**		
Item	**1993**	**1990**	**2000**	**2004**
Total Area of Forests	64000	63900	67600	67700
Social Forest	**25000**	**24900**	**28600**	**28700**

Protected Area Network

The following table provides area of "PAs" with following assumptions.

(a) Area of 1990 same as reported in Forest Statistics for 1994.
(b) Area of 2000 same as reported for 2000 by database of WII and FS
(c) Area for 2005 same as reported for 2004 by database of WII

Item	**Area of PA in 000 ha**		
	1990	**2000**	**2005**
Total Area of Protected Area Network	14000	15400	15600

The above area of PA spans both the "forest" areas as well as scrub (OWL) lands. The ration between "forests" area and "scrub" (OWL) reported in National Reporting Table T1 has been used to apportion area between "forests" and "scrub"(OWL) categories.

Item	Area of PA in 000 ha		
	1990	**2000**	**2005**
Ratio of Scrub to Forests	0.09	0.07	0.06
Proportionate Area of PA in Scrub (OWL)	**1260**	**1078**	**936**
Proportionate Area of PA in Forests	**12740**	**14322**	**14664**
Total PA	14000	15400	15600

Protective Forests

The area of "protective forest" for 1990 have been assumed for 2000 and 2005.

Item	Area in 000 ha		
	1990	**2000**	**2005**
Protective Forests	**10000**	**10000**	**10000**

Production forests

The decreases/increases in the area of "PAs" in "Forests", in comparison with the figures for 1993 in NFAP, have been compensated by increases/decreases in the area of the production forests reported for 1993 in NFAP.

Item	Area in 000 ha			
	NFAP	**National Data for Reporting**		
	1993	**1990**	**2000**	**2005**
Area of PA in Forests	14000	12740	14322	14664
Area Production Forests	**15000**	**16260**	**14678**	**14336**
Area of PA in Scrub (OWL) lands		1260	1078	936
Total PA	14000	14000	15400	15600

"Production" Scrub (OWL)

It has been assumed that "scrub" (OWL) have the same ratio between the area of "productive scrub (OWL)" and the area of "scrub" (OWL) as the "forests" have between the area of the "productive forests" and the area of "forests" recognizing that the fuelwood may be the main product from the "scrub" lands unlike the "forests" areas, where the "round wood" may be the main product.

Item	Area in 000 ha		
	1990	**2000**	**2005**
Area of Forests	63939	67554	67701
Area of Production Forests	16260	14678	14336
Ratio of Area "Productive Forests" to "Forests"	0.25	0.22	0.21
Area of Scrub (OWL)	5894	4731	4110
Area of Production Scrub	**1499**	**1028**	**870**

Protection Scrub OWL

It has been assumed that "scrub" (OWL) have the same ratio between the area of "protective scrub (OWL)" and the area of "scrub" (OWL) as the "forests" have between the area of the "protective forests" and the area of "forests" .

Item	Area in 000 ha		
	1990	2000	2005
Ratio of Area of "Protection Forests" to "Forests"	0.16	0.15	0.15
Area of Scrub (OWL)	5894	4731	4110
Area of Protection Scrub	**922**	**700**	**607**

Social Scrub Land

It has been assumed that the area of scrub lands after deducting area of Production Scrub, Protection Scrub and Protected Area network represents the social scrub land.

National Classes	Area in "000" ha		
	1990	2000	2005
Production + Protection + PA Scrub Lands	3681	2806	2413
Social Scrub Lands	**2219**	**1894**	**1687**
Total Area Scrub ("Other Wooded lands")	5900	4700	4100

Integrated National Data

Above tables lead to following integrated national data set.

National Classes	Area in "000" ha		
	1990	2000	2005
Production Forest	16260	14678	14336
Protective Forest	10000	10000	10000
Protection Area Network	12740	14322	14664
Social Forest	24939	28554	28701
Total Area of Forests	**63939**	**67554**	**67701**
Production Scrub Lands	1499	1028	870
Protection Scrub Lands	922	700	607
Protective Area Network	1260	1078	936
Social Scrub Lands	2213	1926	1697
Total Area Scrub ("**Other Wooded lands"**)	**5894**	**4732**	**4110**

(Note: Area under Social Forest adjusted to match the area in Table 1)

3.4 Reclassification into FRA 2005 Classes

A. For Area under Primary Function

National Class	Percentage of a National Class to a FRA Classes of Primary Function					
	Production For./OWL	Protection For./OWL	Conservation of Biodiversity	Social Service	Multiple Function	Unknown Function.
	%	%	%	%	%	%
Production Forest./Scrub	100					
Protection Forest/Scrub		100				
Social Forest/Scrub					100	
PA Network			100			

B. For Area under Total Area with Function

National Class	Percentage of a National Class to FRA Classes of Total Function					
	Production For. / OWL	Protection For./ OWL	Conservation of Biodiversity	Social Service	Multiple Function	Unknown Function.
	%	%	%	%	%	%
Production Forest./Scrub	100	100		100		
Protection Forest/Scrub		100	100	100		
Social Forest/Scrub	100	100	100	100		
PA Network		100	100	100		

3.5 Data for National Reporting Table T3

Table: Input for Global Reporting Table 3

FRA 2005 Categories / Designated function	Area (1000 hectares)					
	Primary function			Total area with function		
	1990	2000	2005	1990	2000	2005
Forest						
Production	16 260	14 678	14 336	41 160	43 278	43 036
Protection of soil and water	10 000	10 000	10 000	63 939	67 554	67 701
Conservation of biodiversity	12 740	14 322	14 664	47 640	52 922	53 364
Social services	in cons.	in cons.	in cons.	63 939	67 554	67 701
Multiple purpose	24 939	28 554	28 701	not appl.	not appl.	not appl.
No or unknown function				not appl.	not appl.	not appl.
Total - Forest	63 939	67 554	67 701	**not appl.**	**not appl.**	**not appl.**
Other wooded land						
Production	1 499	1 028	870	3 718	2 922	2 557
Protection of soil and water	922	700	607	5 894	4 732	4 110
Conservation of biodiversity	1 260	1 078	9 36	4 401	3 672	3 230
Social services	in cons.	in cons.	in cons.	5 894	4 732	4 110
Multiple purpose	2 213	1 926	1 697	not appl.	not appl.	not appl.
No or unknown function				not appl.	not appl.	not appl.
Total – Other wooded land	5894	4 732	4 110	**not appl.**	**not appl.**	**not appl.**

4 T4. Characteristics of Forests and Other Wooded Lands

Country India

4.1 FRA 2005 Categories and Definitions

Category	Definition
Primary	Forest / Other wooded land of native species, where there are no clearly visible indications of human activities and the ecological processes are not significantly disturbed.
Modified Natural	Forest / Other wooded land of naturally regenerated native species where there are clearly visible indications of human activities.
Semi-Natural	Forest / Other wooded land of native species, established through planting, seeding or assisted natural regeneration.
Productive plantation	Forest / Other wooded land of introduced species, and in some cases native species, established through planting or seeding mainly for production of wood or non wood goods.
Protective plantation	Forest / Other wooded land of native or introduced species, established through planting or seeding mainly for provision of services.

4.2 National Data

4.2.1 Data Sources

Following forms the basis of information for this national reporting table.

Source	Variable	Quality	Year
FSI, 1993. State of Forest Report 1993. Forest Survey of India, Ministry of Environment and Forests, Government of India.	Extent, Manage.	H, M	1990
FSI, 1995. State of Forest Report 1995. Forest Survey of India, Ministry of Environment and Forests, Government of India.	Extent, Manage.	H, M	1992
FSI, 1997. State of Forest Report 1997. Forest Survey of India, Ministry of Environment and Forests, Government of India	Extent, Manage.	H, M	1994
FSI, 1999. State of Forest Report 1999. Forest Survey of India, Ministry of Environment and Forests, Government of India.	Extent, Manage.	H, M	1997
FSI, 2001. State of Forest Report, 2001. Forest Survey of India, Ministry of Environment and Forests, Government of India.	Extent, Manage.	H, M	2000
Forestry Statistics 1996. 1998. Indian Council of Forestry Research and Education, Dehradun, Uttaranchal, India.	Extent, Manage.	H, M	1996
Forestry Statistics 2000. 2002. Indian Council of Forestry Research and Education, Dehradun, Uttaranchal, India	Extent, Manage.	H, M	2000
India Input Tables for FRA 2000. 1999. Forest Survey of India, Ministry of Environment and Forests, Government of India.	Extent, Manage.	H, M	1999

(Manage. = Management)

4.2.2. National Classification and Definitions

There is no national class that match a FRA 2005 class, therefore, help of other associated information has been taken to derive information for this table. The following are some of the related definitions.

Category	Definition
Forest under management	Forest managed under a "working plan" or a "management plan".
Working Plan	A working plan (or scheme) is essentially a plan detailing the existing forest wealth (land, flora, fauna & water resources) describing the climatic and biotic factors and prescribing management practices to conserve, preserve and efficiently utilize this forest resource. (http://upgov.up.nic.in/upforest/WorkingPlan/workingplan2.htm)
Management Plan	A plan document for managing Protected Areas (National Park or Wildlife sanctuary) with specific objectives to conserve wildlife and biodiversity. (http://www.mp.nic.in/forest/forestmanagement.html#)

4.2.3 Original National Data

This section presents the original national data in the context of following assumptions.

(a) The "modified" include areas "not under management" and the areas under PAs.
(b) The "semi-natural" include areas "under management" and exclude "PA" & Plantations.
(c) The "public" plantations are on the "Forest" and "Scrub" lands.
(d) The "private" plantations are on the "Other land".
(e) The "Other purpose" "public" plantations are for protection of "soil and water". Their distribution on "forest" and "scrub" follows the ratio of area of "forest" and "scrub".
(f) The "public" "Other plantations" are on "Scrub" (OWL) lands.

Area of Forests under management

Item	Total Forests	Under management	Not under Management
Area in 000 ha	63340	46159	17181
Percentage	100	73	27

(Note: Area under management includes plantations and Protected areas. Reference year 1994, Source "Country Input Table to FRA 2000)

Ratio between area of Forests and Scrub lands

FRA 2005 Classes	Extent in "000"ha		
	1990	2000	2005
Scrub (Other Wooded Lands)	5894	4731	4110
Forests	63939	67554	67701
Ratio	0.09	0.07	0.06

Area under Protected Area Network

National Category	Area in "000"ha		
	1990	2000	2005
Area of PA in Scrub (OWL)	1260	1078	936
Area of PA in Forests	12740	14322	14664
Total PA	14000	15400	15600

(Source - National Reporting Table 3)

Area under plantations till 1997

Purpose of Plantation	Area of plantation till 1997 in 000 ha		
	Public	Private	Total
Industrial round-wood	4460	5000	9460
Rubber/Coconut/Oil palm	12	2337	2349
Fuelwood	1266	4546	5812
Other purpose	12185		12185
Other plantation	167	405	572
Total Area Plantation	**18090**	**12288**	**30378**

(Reference year 1997, Source "Country Input Table to FRA 2000)

Area of Productive and Protective Plantations till 1997

Purpose of Plantation	Area of plantation till 1997 in 000 ha		
	Public	Private	Total
Productive Plantation	5905	12288	18193
Protective Plantation	12185	0	12185
Total Area Plantation	**18090**	**12288**	**30378**

(Note: The "Productive" plantations include plantations for "round wood", "fuelwood", "rubber, coconut, and palm oil" The "rotective plantations" include "plantations for "other purpose"; Source "Country Input Table to FRA 2000)

Area of "public" forest plantations raised during 1991 and 1997

Year	Area of Plantation in "000"ha.
1991-92	683
1992-93	736
1993-94	621
1994-95	563
1995-96	558
1996-97	620
Total 1991-97 (Ha)	3780

(Source: Forestry Statistics 1996, Forestry Statistics, 2000)

Area under Introduced and Indigenous Species in Industrial Wood Plantations

Species	Area 000 ha	Percentage of Exotic and Indigenous		
		Exotic	Indigenous	Total
Teak	1337		14.1	14.13
Eucalyptus spp.	1361	14.4	0.0	14.39
Gmelina arborea	148		1.6	1.57
Shorea robusta	250		2.7	2.65
Dalbergia sissoo	267		2.8	2.82
Cedrus deodara	125		1.3	1.32
Pinus roxburghii	444		4.7	4.69
Bombax ceiba	39		0.4	0.41
Acacia nilotica	157		1.7	1.66
Acacia mearnsii	38		0.4	0.40
Pinus patula	3		0.0	0.03
Populus	48	0.5	0.0	0.50
Others	5243		55.4	55.42
Total	**9460**	**14.9**	**85.1**	**100.00**

(Reference year 1997, Source "Country Input Table to FRA 2000)

4.3 Analysis and Processing of National Data

4.3.1 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.

4.3.2 Estimation and Forecasting

A. Forest Area under management

The following figures assume that the relative percentages of the "area under management (73%)" and the "area not under management (27%)" in the year 1994 are also applicable for the reference years 1990, 2000 and 2005.

National Classes	Extent in "000"ha		
	1990	2000	2005
Forests under management	46675	49315	49422
Forests not under management	17264	18239	18279
Scrub (OWL) under management	4303	3454	3000
Scrub (OWL) not under management	1591	1277	1110
TOTAL	**69833**	**72285**	**71811**

(Reference year 1994, Source "Country Input Table to FRA 2000)

B. Area of Forest Plantation of Introduced Species

The following table estimates area of productive and protective public (on forest land) plantations (both native and introduced species) with the assumption that the relative

percentages of the productive (32.6%) and the protective (67.4%) plantations in cumulative area of plantation raised till 1997, are also applicable to the plantation data for the period 1991-1997 and for the years 2000 and 2005. It may be mentioned that figures are totals of annual plantation activity in different States and UTs in India and for those who have reported their information to ICFRE. Therefore, it may be an underestimate at the same time the area under annual plantation activity may include replanting of old harvested plantations and therefore overestimate area under plantations at any point in time.

Public Plantation	**Area of plantation in "000" ha.**		
	Productive	**Protective**	**Total**
Area under plantation in 1997	5905	12185	18090
Plantations raised during 1991-97	1232	2548	3780
Area under plantation in 1990	**4665**	**9645**	**14310**

The following table estimates and forecasts the area of public plantations in 2000 and 2005 respectively with the assumption that the annual rate (616, 000 ha- Forestry Statistics 2000) of establishment of plantations in 1997-1998 will continue till 2005.

Type of Public Plantations	**Area of Total Plantations in 000 ha**		
	1990	**2000**	**2005**
Productive plantation	4665	6708	7712
Protective plantation	9645	13845	15921
Total	14310	20553	23633

The following table presents the area of plantation under introduced species with the assumption that the percentage (14.9%) of the area under the introduced species in plantations raised till 1997 also applies to plantations in 1990, 2000 and 2005.

	Area of Introduced Species Plantation in 000 ha		
Type of public plantations	**1990**	**2000**	**2005**
Productive plantations	700	1006	1157
Protective plantations	1447	2077	2388
Total	**2147**	**3083**	**3545**

Finally, following table presents the area of introduced species plantations separately for the "forest" and the "scrub" lands assuming that the ratio of area of plantations on "forest" and "scrub" lands follows the ratio of extent of the "forests" and the "scrub" land. .

Type of Introduced Species Plantation	**Area in 000 ha**		
	1990	**2000**	**2005**
(Ratio of Scrub Land to Forest Land)	(0.09)	(0.07)	(0.06)
Productive Plantation on Forest Land (Area 000 ha)	637	915	1053
Productive Plantation on Scrub Land (Area 000 ha)	63	91	104
Protective Plantations on Forest Land (Area 000 ha)	1317	1890	2173
Protective Plantation on Scrub Land (Area 000 ha)	130	187	215

C. Integrated National Data

The above estimates lead to the following integrated national data set for 1990, 2000 and 2005. The areas of the "Protected Area (PA)" network and the plantations (productive and protective) have been presented separately to match FRA 2005 categories.

National Classes	**Extent in "000"ha**		
	1990	**2000**	**2005**
Forest			
Area of Forest not under management	17264	18239	18279
Area of Forest under PA	12740	14322	14664
Area of Forest under management	31981	32188	31532
Area of Forest under Productive Plantation (introduced spp)	637	915	1053
Area of Forest under Protective Plantation (introduced spp)	1317	1890	2173
SubTotal	63939	67554	67701
Scrub			
Area of Scrub not under management	1591	1277	1110
Area of Scrub under PA	1260	1078	936
Area of Scrub under management	2850	2098	1745
Area of Scrub under Productive Plantation (introduced spp)	63	91	104
Area of Scrub under Protective Plantation (introduced spp)	130	187	215
Subtotal	5894	4731	4110
TOTAL	69833	72285	71811

(Note: The "productive" plantations include plantations for "round wood", "fuelwood", "rubber, coconut, and palm oil" The "protective plantations" include "plantations for "other purpose".

4.4 Reclassification into FRA 2005 Classes

Table: Reclassification (Percentage allocation) into FRA 2005 classes

National Classes	Percentage of a National class that matches a FRA Class				
	Primary	Modified	Semi-Natural	Productive Plantation	Protective Plantation
	%	%	%	%	%
Forest /OWL not under management		100			
Protected Areas		100			
Forest/OWL under management			100		
Production Plantation				100	
Protective Plantation					100

4.5 Data for National Reporting Table T4

FRA 2005 Categories	Area (1000 hectares)					
	Forest			Other wooded land		
	1990	2000	2005	1990	2000	2005
Primary						
Modified natural	30004	32561	32943	2851	2355	2046
Semi-natural	31981	32188	31532	2850	2098	1745
Productive plantation	637	915	1053	63	91	104
Protective plantation	1317	1890	2173	130	187	215
TOTAL	**63939**	**67554**	**67701**	**5894**	**4731**	**4110**

5 T5. Growing Stock

Country India

5.1 FRA 2005 Categories and Definitions

Category	Definition
Growing stock	Volume over bark of all living trees more than X cm in diameter at breast height (or above buttresses if these are higher). Includes the stem from ground level or stump height up to a top diameter of Y cm, and may also include branches to a minimum diameter of W cm.
Commercial growing stock	The part of the growing stock of species that are considered as commercial or potentially commercial under current market conditions, and with a diameter at breast height of Z cm or more.

5.2 National Data

5.2.2 National Data Sources

Forest Survey of India (FSI) is regularly conducting assessment of forest resources at an interval of about 2 years using remotely sensed data and publishing the information in the "State of Forest Report" (SFR) since 1987. However, FSI has estimated and published the growing stock figures only for two years: 1984 based on SFR 1989 and 1994 based on SFR 1995. FSI has recently assessed the growing stock for reporting to various international agencies and processes but it has not published this data.

Source	Variable	Quality	Year
FSI, 1989. State of Forest Report 1989. Forest Survey of India, Ministry of Environment and Forests, Government of India.	Extent, Growing Stock	H	1984
FSI, 1995. State of Forest Report 1995. Forest Survey of India, Ministry of Environment and Forests, Government of India.	Extent, Growing Stock	H	1994
FSI, 2001. State of Forest Report, 2001. Forest Survey of India, Ministry of Environment and Forests, Government of India.	Extent	H	2000
FSI, 2003. India Pilot Study. Forest Survey of India, Ministry of Environment and Forests, Government of India. (Unpublished report).	Extent, Growing Stock	H	2003

5.2.2 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.

Growing Stock	The sum-total of all trees, by number or volume or biomass, growing within a particular area of interest.

(Source: FSI, 2001)

5.2.3 Original National Data

Following table contain national data on growing stock which is stem volume including volume of merchantable branches up to a diameter of 5 cm.

Categories	**Reference Year**	
	1984	**1994**
Growing Stock in million m^3	4329	4340
Extent of Forest in "000"ha	63880	63340

5.3 Analysis and Processing of National Data

5.3.1 Calibration

Not considered necessary

5.3.2 Estimation and Forecasting

The estimates of the per hectare growing stock for 1990 and forecasts for the year 2000 and 2005 have been developed using per hectare figures of growing stock from original national data through interpolation and extrapolation techniques. The figures of extent of forests from National Reporting Table 1 were then used to calculate Growing Stock in the three reference years of FRA 2005.

Categories	**Reference Year**		
	1990	**2000**	**2005**
Per hectare Growing Stock in Forests (m^3 / hectare)	68.24	69.01	69.39
Extent of Forests in 000 ha	63939	67554	67701
Growing Stock in Forests in million m^3	4363	4662	4698

5.4 Reclassification into FRA 2005 Classes

Table: Reclassification (Percentage allocation) into FRA 2005 classes

National Classification	**Percentage of a National Class to a FRA Class**	
	Growing Stock	**Commercial Growing Stock**
Growing stock	100	
Commercial Growing Stock[1]		100

(Source: FSI, 2003. Note: 1. Commercial growing stock has been assumed as 40 percent of "Growing Stock)

5.5 Data for National Reporting Table T5

Table: Input for FRA 2005

FRA 2005 category	Volume (million cubic meters over bark)					
	Forest			Other wooded land		
	1990	2000	2005	1990	2000	2005
Growing Stock	4363	4662	4698	n. a	n. a.	n. a.
Commercial Growing Stock	1745	1865	1879	n. a	n. a.	n. a.

(Note: Figures for growing stock in OWL are not available)

Appendix 1 to National Reporting Table 5

Item	Unit	Complementary information
1. Minimum diameter at breast height[2] of trees included in Growing stock (X)	cm	10
2. Minimum diameter at the top end of stem (Y) for calculation of Growing stock	cm	10
3. Minimum diameter of branches included in Growing stock (W)	cm	5
4. Minimum diameter at breast height of trees in Commercial growing stock (Z)	cm	10
5. Volume refers to "Above ground" (AG) or "Above stump" (AS)	AG / AS	AG
6. Have any of the above thresholds (points 1 to 4) changed since 1990	Yes/No	No
7. If yes, then attach a separate note giving details of the change	Attachment	

[2] Diameter at breast height (DBH) refers to diameter over bark measured at a height of 1.30 m above ground level or immediately above buttresses if these are higher than 1.30 m.

6 T6. Biomass Stock

Country India

6.1 FRA 2005 Categories and Definitions

Category	Definition
Above-ground biomass	All living biomass above the soil including stem, stump, branches, bark, seeds, and foliage.
Below-ground biomass	All living biomass of live roots. Fine roots of less than 2mm diameter are excluded because these often cannot be distinguished empirically from soil organic matter or litter.
Dead wood biomass	All non-living woody biomass not contained in the litter, either standing, lying on the ground, or in the soil. Dead wood includes wood lying on the surface, dead roots, and stumps larger than or equal to 10 cm in diameter or any other diameter used by the country

6.2 National Data

6.2.1 National Data Sources

The Forest Survey of India (FSI) and the Forest Research Institute (FRI) have jointly worked the "Biomass Stock" in India's forests using specific gravity of dominant tree species with the forest cover information contained in SFR 1989 and SFR 1997. These two assessments are based on the field data of year 1984 and 1994 respectively. However, this data-set has not been yet published but reported in a pilot study done by FSI (FSI, 2003). A study (Chhabra and Dadhwal, 2004) which also provides estimate of above and below ground biomass has been used in this report to derive a ratio between below and above ground biomass for estimation of below ground biomass from FSI figures.

Source	Variable	Quality	Year
FSI, 1989. State of Forest Report 1989. Forest Survey of India, Ministry of Environment and Forests, Government of India.	Growing Stock	H	1984
FSI, 1997. State of Forest Report 1997. Forest Survey of India, Ministry of Environment and Forests, Government of India.	Growing Stock	H	1994
FSI, 2001. State of Forest Report, 2001. Forest Survey of India, Ministry of Environment and Forests, Government of India.	Extent	H	2000
FSI, 2003. India Pilot Study. Forest Survey of India, Ministry of Environment and Forests, Government of India. (Unpublished)	Biomass	H	1990 2000
Chabbra, A and V. K. Dadhwal, 2004. Assessment of Major Pools and Fluxes of Carbon in Indian Forests. Climate Change vol. 64.	Biomass	H	1993 1994
Brown, S. L. and P. E. Schroeder, 1999. Spatial Patterns of Above ground Production and Mortality of Woody Biomass for Eastern U.S. Forests. Ecological Applications 9(3).			
IPCC, 2003. Good Practice Guidance for Land Use, Land use Change and Forestry. IPCC.	Biomass	H	All

6.2.2 National Classification and Definitions

No standard national definitions and classes relating to forest biomass exist in India. The FSI is following IPCC definitions and classes of biomass to provide internationally compatible and harmonised information.

6.2.3 Original National Data

The following table presents the national data on "Above ground biomass" in "Forests" in India.

Categories	Unit	Reference Year	
		1984	1994
Above Ground (Stem) biomass	**million t**	2399	2395
Above Ground Growing Stock	**million m^3**	4328	4340

(Source: FSI, 2003)

6.3 Analysis and Processing of National Data

6.3.1 Calibration

It is not required in this case.

6.3.2 Estimation and Forecasting

The "Above Ground" (AG) biomass for the country for the year 1990 has been calculated for 1990, 2000 and 2005 by applying the average "ratio"(0.55) of biomass and growing stock (derived from the 1984 and 1994 original data national figures) to the "above ground growing stock" for 1990, 2000 and 2005 presented in the last National Reporting Table (T5).

Item	Unit	1990	2000	2005
Above Ground GS	million ha	4363	4662	4698
(Stem) BM/GS Ratio	t / m^3	0.55	0.55	0.55
(Stem) Above Ground Biomass	million t	2400	2564	2584

The growing stock figures in National Reporting Table (T5) are simply stem growing stock, which includes merchantable branches up to 5 cm in diameter. Therefore, a suitable biomass expansion factors (BEF) is necessary to calculate the "Total Above Ground Biomass". For this purpose, a BEF (1.584) was derived using formula (BEF=Exp(1.912-0.344*ln(GS/ha)) given by Schroeder (Brown and Schroeder, 1999).

Item	Unit	1990	2000	2005
(Stem) Above Ground Biomass	million t	2400	2564	2584
BEF	1.584	1.584	1.584	1.584
Total Above Ground Biomass	million t	3801	4062	4093

The "Total Below Ground" (BG) biomass has been calculated for 1990, 2000 and 2005 using the ratio of BG to AG derived from a recent study "Assessment of Major Pools and Fluxes of Carbon in Indian Forests"(Chabbra and Dadhwal, 2004).

Categories	Biomass in million tonnes		
	1990	2000	2005
Above Ground Biomass in Forests	3801	4062	4093
BG/AG Ratio	0.265	0.265	0.265
Below Ground Biomass in Forests	1007	1076	1085

The "Dead Wood Biomass" has been calculated for 1990, 2000 and 2005 using IPCC's default factor of 0.11 for tropical forests (IPCC, 2003). This default factor represents the default "ratio" between the "dead wood biomass" and the "live biomass".

Item	Unit	1990	2000	2005
Total AG Biomass	million t	3801	4062	4093
Total BG Biomass	million t	1007	1076	1085
Total Live Biomass	million t	4808	5138	5178
Default (Dead : Live) Ratio		0.11	0.11	0.11
Dead Wood Biomass	million t	529	565	570

6.4 Reclassification into FRA 2005 Classes

Table: Reclassification (Percentage allocation) into FRA 2005 classes

National Classification	Percentage of a National Class to a FRA Class		
	Above Ground	Below Ground	Dead Wood Biomass
Above Ground Biomass	100	0	0
Below Ground Biomass	0	100	0
Dead Wood Biomass	0	0	100

6.5 Data for National Reporting Table T6

Table: Input to Global Reporting Tables

Forest 2005 Category	Biomass in million metric tonnes					
	Forest			Other Wooded Land		
	1990	2000	2005	1990	2000	2005
Above Ground Tree Biomass	3801	4062	4093	n. a.	n. a.	n. a.
Below Ground Tree Biomass	1007	1076	1085	n. a.	n. a.	n. a.
Dead Wood Tree Biomass	529	565	570	n. a.	n. a.	n. a.
TOTAL	**5337**	**5703**	**5748**	**n. a.**	**n. a.**	**n. a.**

7 T7. Carbon Stock

Country India

7.1 FRA 2005 Categories and Definitions

Category	Definition
Carbon in above-ground biomass	Carbon in all living biomass above the soil, including stem, stump, branches, bark, seeds, and foliage.
Carbon in below-ground biomass	Carbon in all living biomass of live roots. Fine roots of less than 2 mm diameter are excluded, because these often cannot be distinguished empirically from soil organic matter or litter.
Carbon in dead wood biomass	Carbon in all non-living woody biomass not contained in the litter, either standing, lying on the ground, or in the soil. Dead wood includes wood lying on the surface, dead roots, and stumps larger than or equal to 10 cm in diameter or any other diameter used by the country.
Carbon in litter	Carbon in all non-living biomass with a diameter less than a minimum diameter chose by the country for lying dead (for example 10 cm), in various states of decomposition above the mineral or organic soil. This includes the litter, fumic, and humic layers.
Soil Carbon	Organic carbon in mineral and organic soils (including peat) to a specified depth chosen by the country and applied consistently through the time series.

7.2 National Data

7.2.1 National Data Sources

Forest Survey of India (FSI) and Forest Research Institute (FRI) have jointly worked out the carbon stock in India's forests using forest cover information of two assessment years – 1989 and 1997 referring to the information year 1984 and 1994. The 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.

Source	Variable	Quality	Year
FSI, 2003. India Pilot Study. Forest Survey of India, Ministry of Environment and Forests, Government of India. (unpublished report).	Carbon Stock	H	1990-2005
Chabbra, A and Dadhwal, V. K. 2004. Assessment of Major Pools and Fluxes of Carbon in Indian Forests. Climate Change vol. 64. Pages 341-360.	Carbon Stock	H	1988 1993 1994
IPCC, 2003. Good Practice Guidance for Land Use, Land use Change and Forestry. IPCC.	Carbon	H	All

7.2.2 National Classification and Definitions

There are no standard national definitions on this subject. FSI is following IPCC definitions.

7.2.3 Original National Data

The following table presents the national data on Carbon Stocks in forests in India in 1984 and 1994 (FSI, 2003)

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

7.3 Analysis and Processing of National Data

7.3.1 Calibration

Not Considered Necessary

7.3.2 Estimation and Forecasting

The carbon in living (above and below ground) biomass in 1990, 2000 and 2005 was calculated using the biomass figures from the National Reporting Table 6 and the average density of carbon (0.4524) in biomass derived from the original national data figures for 1984 and 1994 (FSI, 2003).

FRA Category	Unit	1990	2000	2005
Above Ground Biomass	million t	3801	4062	4093
Below Ground Biomass	million t	1007	1076	1085
Dead Wood Biomass	million t	529	565	570
Average Carbon Density		0.4524	0.4524	0.4524
Carbon in Above Ground Biomass	million t	1720	1838	1852
Carbon in Below Ground Biomass	million t	456	487	491
Sub Total: Carbon in Living Biomass		**2175**	**2324**	**2343**

The carbon in “deadwood” was calculated in the same manner i.e. using the biomass figures in the National Reporting Table 6 and the average density of carbon (0.4524) in biomass derived from the original national data figures for 1984 and 1994 (FSI, 2003).

FRA Category	Unit	1990	2000	2005
Dead Wood Biomass	million t	529	565	570
Average Carbon Density		0.4524	0.4524	0.4524
Carbon in Dead Wood Biomass	million t	239	256	258

The carbon in litter was calculated by using it's per hectare estimate (3.271 t/ha) derived from a recent study "Assessment of Major Pools and Fluxes of Carbon in Indian Forests" (Chabbra and Dadhwal, 2004) and the extent of forest in 1990. 2000 and 2005 from the National Reporting Table T1.

FRA Category	**Unit**	**1990**	**2000**	**2005**
Forest Area	million ha	63.939	67.554	67.701
Per hectare Carbon in Litter	t / ha	3.271	3.271	3.271
Carbon in Litter	**million t**	**209**	**221**	**222**

The carbon stock in Soil (up to top 1 meter) was calculated in a similar manner i.e. by using its per hectare estimates (106.075 t/ha) derived from a recent study "Assessment of Major Pools and Fluxes of Carbon in Indian Forests" (Chabbra and Dadhwal, 2004) and estimates of extent of forest from National Reporting Table T1.

FRA Category	**Unit**	**1990**	**2000**	**2005**
Forest Area	million ha	63.939	67.554	67.701
Per hectare Carbon in Soil up to top I m	t / ha	106.075	106.075	106.075
Soil Carbon to a depth of top 1 m	**million t**	**6782**	**7166**	**7181**

7.4 Reclassification into FRA 2005 Classes

It is not necessary as FSI is using IPCC categories which are same as FRA 2005 Categories.

7.5 Data for National Reporting Table T7

Table: Input to Global Reporting Tables

FRA 2005 Category	**Carbon (Million metric tonnes)**					
	Forest			**Other wooded land**		
	1990	**2000**	**2005**	**1990**	**2000**	**2005**
Carbon in above -ground biomass	1720	1838	1852	n. a.	n. a.	n. a.
Carbon in below-ground biomass	456	487	491	n. a.	n. a.	n. a.
Sub-total: Carbon in living biomass	**2176**	**2325**	**2343**	n. a.	n. a.	n. a.
Carbon in dead wood	239	256	258	n. a.	n. a.	n. a.
Carbon in litter	209	221	222	n. a.	n. a.	n. a.
Sub-total: Carbon in dead wood and litter	**448**	**477**	**480**	n. a.	n. a.	n. a.
Soil carbon to a depth of top 100 cm	**6782**	**7166**	**7181**	n. a.	n. a.	n. a.
TOTAL CARBON	**9406**	**9968**	**10004**	n. a.	n. a.	n. a.

8 T8. Disturbances affecting Health and Vitality

Country India

8.1 FRA 2005 Categories and Definitions

Forest Fire	Disturbance caused by wildfire, independently whether it broke out inside or outside the forest/OWL.
Forest Insect	Disturbance caused by insect pests that are detrimental to tree health.
Forest Disease	Disturbance caused by diseases attributable to pathogens, such as a bacteria, fungi, phytoplasma or virus.
Other Damages	Disturbance caused by other factors than fire, insects or diseases.

8.2 National Data

8.2.1 National Data Sources

Area affected by Fire

Following publication have been used for reporting area affected by forest fire.

Source	Variable	Quality	Year
ICFRE, 1997. Forestry Statistics, India, 1988-95. Indian Council of Forestry Research and Education, Dehradun, India.	Area damaged	L	1988 - 1993
ICFRE 1998. Forestry Statistics, India, 1996. Indian Council of Forestry Research and Education, Dehradun, India.	Area damaged	L	1994 - 1995
ICFRE, 2002. Forestry Statistics, India, 2000. Indian Council of Forestry Research and Education, Dehradun, India.	Area damaged	L	1996 - 1997
Bahuguna, V. K. 2002. "*Fire Situation in India*" in IFFN No. 26, 2002. IFFN - Global Fire Monitoring Centre. (www.fire.uni-freiburg.de/iffn/country/in/in_5.htm).	Area damaged	L	2000
FSI, 2003. India Pilot Study. Forest Survey of India, Ministry of Environment and Forests, Government of India. (unpublished report).	Area damaged	H	2003

Area affected by Insects and diseases

More than 21 major insect pests affect forest resources but no statistics are available on area affected by these insects. The figures are available mostly at local level or in some national reports or papers presented at conferences. The following sources of information available on the internet have been used to provide some information on the subject.

Source	Variable	Quality	Year
Sharma et al. 2000. 2000. Dalbergia Sissoo in India. In Proceedings of the Sub-Regional Seminar "Die-Back of Sissoo (Dalbergia Sissoo).	Area damaged by insects	L	1988 - 1993
GOI, 2001. Annual Report 2000-2001. Annual Report 2000-2001, Ministry Of Environment and Forests, Government of India. (Mentions about Sal borer problem).	Area damaged by insects	L	1994 and 1995
FSI, 2003. India Pilot Study. Forest Survey of India, Ministry of Environment and Forests, Government of India. (unpublished report).	Area damaged by insects	H	1990-2000

8.2.2 National Classification and Definitions

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

Forest Fire	Any fire on forest land which is not used as a tool in forest production or management in accordance with an approved plan.

There is no definition for area affected by insects or diseases.

8.2.3 Original National Data

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").

	Forest Land/Area Affected by forest fires in million hectares				
National Category	**1985**	**1987**	**1996**	**1997**	**2000**
Forest Area Affected	0.986	1.034	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 represent "reported" area of forest affected by forest fires (ICFRE, 1997, 1998 and 2002). The figure for 2000 is "estimated" area of forest that is annually affected by forest fires (IFFN 26, 2002).

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 8 400 square kilometres of Gangetic plains in north of Bihar (one of the States of India) alone. With a very conservative assumption that at least one percent of this figure spans forest land leads to an estimate of about 8,400 hectares of forest area affected by this disease.

The "Annual Report" of Ministry of Environment and Forests, Government India (GOI, 2001) indicate mortality of millions of trees of Shorea robusta due to a stem borer insect (Hoplocerambyx spinicornis). However, the report does not indicate the area of forest affected by this insect. Therefore, a very conservative assumption has been made that the insect has affected at least 1000 ha of forests during the year 2000.

8.3 Analysis and Processing of National Data

8.3.1 Calibration

This step is not considered necessary

8.3.2 Estimation and Forecasting

The figure for area affected by fire during 1990 has been assumed to be same as in 1987.

8.4 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.

8.5 Data for National Reporting Table T8

Table: Input for Global Reporting Table

FRA 2005 Category	Average Annual Area Affected "000"hectares			
	Forests		Other Wooded lands	
	1990	2000	1990	2000
Forest Fires	1034	3700	n. a.	n. a.
Forest Insects	n. a.	1000	n. a.	n. a.
Forest Diseases	n. a.	8400	n. a.	n. a.
Other Disturbances	n. a.	n. a.	n. a.	n. a.

9 T9. Diversity of Tree Species

Country India

9.1 FRA 2005 Categories and Definitions

Category	Definition
Number of native tree species	The total number of native tree species that have been identified within the country.
Number of critically endangered tree species	The number of native tree species that are classified as "Critically endangered" in the IUCN red list
Number of endangered tree species	The number of native tree species that are classified as "Endangered" in the IUCN red list.
Number of vulnerable tree species	The number of native tree species that are classified as "Vulnerable" in the IUCN red list.

9.2 National Data

9.2.1 National Data Sources

The Red List (IUCN, 2002) of IUCN is main source for information on this table but this list include trees, shrubs, climbers and herbs etc. Following table list all data sources for this table.

Source	Variable	Quality	Year
IUCN. 2002. Red List of Threatened Species. Gland, Switzerland: The World Conservation Union.	Number of species	H	2000
FSI, 2003. India Pilot Study. Forest Survey of India, Ministry of Environment and Forests, Government of India. (unpublished report).	Number of species	H	2000

9.2.2 National Classification and Definitions

There are no standard national definition or classification

9.2.3 Original National Data

There is no national data. Information is web pages of the Red List of IUCN (2003).

IUCN Category	Number of species year 2000
Native tree species	
Critically endangered tree species	**50**[1]
Endangered tree species	**126**[2]
Vulnerable tree species	**98**[3]

(Note 1, 2 and 3 are the numbers of total (all) species and not only of tree species)

9.3 Analysis and Processing of National Data

9.3.1 Calibration

Considered not necessary.

9.3.2 Estimation and Forecasting

Necessary data and basis is not available for any estimation and forecasting.

9.4 Reclassification into FRA 2005 Classes

This step is not considered necessary.

9.5 Data for National Reporting Table T9

Table: Input to Global Reporting Table 9

IUCN Category	Number of species year 2000
Native tree species	
Critically endangered tree species	**50**[1]
Endangered tree species	**98**
Vulnerable tree species	**98**[2]

(Note 1 and 2 are the numbers of total (all) species and not only of tree species)

Following is the list of 98 endangered tree species out of a total of 126 endangered species on the web page of IUCN Red List (2000).

	Name
1	*Actinodaphne bourneae*
2	*Actinodaphne salicina*
3	*Adinandra griffithii*
4	*Anacolosa densiflora*
5	*Aporusa bourdillonii*
6	*Ardisia amplexicaulis*
7	*Ardisia blatteri*
8	*Ardisia sonchifolia*
9	*Atuna indica*
10	*Atuna travancorica*
11	*Bentinckia nicobarica*
12	*Byrsophyllum tetrandrum*
13	*Canthium ficiforme*
14	*Canthium pergracilis*
15	*Capparis pachyphylla*
16	*Chionanthus linocieroides*
17	*Cinnamomum chemungianum*
18	*Cinnamomum filipedicellatum*
19	*Cleistanthus travancorensis*
20	*Cryptocarya anamallayana*
21	*Cynometra bourdillonii*
22	*Cynometra travancorica*
23	*Dimorphocalyx beddomei*
24	*Dipterocarpus alatus*
25	*Dipterocarpus costatus*
26	*Dipterocarpus indicus*
27	*Drypetes andamanica*

28 *Drypetes porteri*
29 *Drypetes travancoria*
30 *Dysoxylum beddomei*
31 *Elaeocarpus blascoi*
32 *Eugenia discifera*
33 *Eugenia floccosa*
34 *Eugenia indica*
35 *Euodia lunuankenda*
36 *Euonymus assamicus*
37 *Euonymus paniculatus*
38 *Ficus andamanica*
39 *Garcinia imberti*
40 *Garcinia kingii*
41 *Glochidion pauciflorum*
42 *Glochidion sisparense*
43 *Glochidion tomentosum*
44 *Goniothalamus rhynchantherus*
45 *Homalium jainii*
46 *Hopea glabra*
47 *Hopea parviflora*
48 *Hopea ponga*
49 *Hopea racophloea*
50 *Hopea utilis*
51 *Hopea wightiana*
52 *Humboldtia bourdillonii*
53 *Ilex venulosa*
54 *Isonandra stocksii*
55 *Isonandra villosa*
56 *Ixora lawsoni*
57 *Ixora saulierei*
58 *Julostylis polyandra*
59 *Kingiodendron pinnatum*
60 *Lagerstroemia minuticarpa*
61 *Litsea beddomei*
62 *Litsea leiantha*
63 *Litsea nigrescens*
64 *Litsea travancorica*
65 *Madhuca bourdillonii*
66 *Madhuca diplostemon*
67 *Mangifera andamanica*
68 *Mangifera nicobarica*
69 *Melicope indica*
70 *Memecylon flavescens*
71 *Memecylon subramanii*
72 *Microtropis densiflora*
73 *Myristica magnifica*
74 *Orophea thomsoni*
75 *Palaquium ravii*
76 *Pittosporum eriocarpum*
77 *Polyalthia rufescens*
78 *Polyalthia shendurunii*
79 *Popowia beddomeana*
80 *Psychotria beddomei*
81 *Psychotria macrocarpa*
82 *Pterocarpus santalinus*
83 *Rapanea striata*
84 *Sageraea grandiflora*
85 *Shorea roxburghii*
86 *Sophora wightii*
87 *Symplocos anamallayana*
88 *Symplocos barberi*
89 *Symplocos nairii*
90 *Symplocos oligandra*
91 *Syzygium beddomei*
92 *Syzygium bourdillonii*
93 *Syzygium chavaran*
94 *Syzygium microphyllum*
95 *Syzygium myhendrae*
96 *Syzygium parameswaranii*
97 *Syzygium stocksii*
98 *Xylosma latifolium*

10 T10. Growing Stock Composition

Country

10.1 FRA 2005 Categories and Definitions

Growing Stock Composition	The composition of "growing stock" in "Forest" by ten most common (by volume) tree species in forests.

10.2 National Data

10.2.1 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.

Source	Variable	Quality	Year
FSI, 1989. State of Forest Report 1989. Forest Survey of India, Ministry of Environment and Forests, Government of India.	Growing stock	H	1984
FSI, 1995. State of Forest Report 1995. Forest Survey of India, Ministry of Environment and Forests, Government of India.	Growing stock	H	1990 (1989-91)
FSI, 1997. State of Forest Report 1997. Forest Survey of India, Ministry of Environment and Forests, Government of India.	Growing stock	H	1994
FSI, 2003. India Pilot Study Forest Survey of India, Ministry of Environment and Forests, Government of India. (Unpublished)	Growing stock	H	1990, 2000, 2005

10.2.2 National Classification and Definitions

There is no national standard definition for "Growing stock composition".

10.2.3 National Data

Both the 1984 and the 1994 assessment of growing stock indicate the relative percentage of the species or species group (strata). The relative ranking of these species is presented below.

Species name	Growing Stock in Forests in million cubic meters	
	1984	**1994**
Sal (Shorea robusta)	550.3	514.1
Teak (Tectona grandis)	294.7	286.1
Fir (Abies pindrow)	148.7	152
Chir-Pine (Pinus roxburghii)	96.2	95.6
Blue-Pine (Pinus wallichiana)	72.7	73.7
Deodar (Cedrus deodara)	26.8	30.4
Spruce (Picea smithiana)	12.4	13.7
Khasi pine (Pinus khasia)	6.1	6.3
Khair (Acacia catechu)	2.5	2.6
Salai (Boswellia serrata)	3.7	3.8
Rest	3113.9	3161.6
Total	4328	4340

10.3 Analysis and Processing of National Data

10.3.1 Calibration

Not considered necessary.

10.3.2 Estimation and Forecasting

It is assumed that the relative share of growing stock of the species or species group in 2000 and 1990 was same as assessed by FSI in 1994 and 1984 respectively.

National Category	Growing Stock in Forests in million cubic meters	
	1990	**2000**
Sal (Shorea robusta)	554.7	552.2
Teak (Tectona grandis)	297.1	307.3
Fir (Abies pindrow)	149.9	163.3
Chir-Pine (Pinus roxburghii)	97.0	102.7
Blue-Pine (Pinus wallichiana)	73.3	79.2
Deodar (Cedrus deodara)	27.0	32.7
Spruce (Picea smithiana)	12.5	14.7
Khasi pine (Pinus khasia)	6.1	6.8
Khair (Acacia catechu)	2.5	2.8
Salai (Boswellia serrata)	3.7	4.1
Rest	3139.2	3396.2
Total	4363.0	4662.0

10.4 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	**2nd**	**3rd**	**4th**	**5th**	**6th**	**7th**	**8th**	**9th**	**10th**	**Rest**
	Sal	**Teak**	**Fir**	**Chir-Pine**	**Blue-Pine**	**Deodar**	**Spruce**	**Khasi-Pine**	**Khair**	**Salai**	**Rest**
1990	12.71	6.81	3.43	2.22	1.68	0.62	0.29	0.14	0.06	0.09	71.95
2000	11.85	6.59	3.50	2.20	1.70	0.70	0.32	0.15	0.06	0.08	72.85

10.5 Data for National Reporting Table T10

Table: Input to Global Reporting Table 10

FRA 2005 Category	Growing Stock in Forests in million cubic meters	
	1990	**2000**
Sal (Shorea robusta)	554.7	552.2
Teak (Tectona grandis)	297.1	307.3
Fir (Abies pindrow)	149.9	163.3
Chir-Pine (Pinus roxburghii)	97.0	102.7
Blue-Pine (Pinus wallichiana)	73.3	79.2
Deodar (Cedrus deodara)	27.0	32.7
Spruce (Picea smithiana)	12.5	14.7
Khasi pine (Pinus khasia)	6.1	6.8
Khair (Acacia catechu)	2.5	2.8
Salai (Boswellia serrata)	3.7	4.1
Rest	3139.2	3396.2
Total	4363.0	4662.0

11 T11. Wood Removal

Country India

11.1 FRA 2005 Categories and Definitions

Industrial Wood Removal	The wood removed (volume of roundwood over bark) for production of goods and services other than energy production (wood fuel).
Wood Fuel (Fuelwood) Removal	The wood removed for energy production purposes, regardless whether for industrial, commercial or domestic use

11.2 National Data

11.2.1 National Data Sources

The "Forestry Statistics" complied and published by the Indian Council of Forestry Research and Education (ICFRE) Dehradun provides the basic information presented 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 convert their information into same measurement units. For example, some States report production of wooden poles in numbers while others report in cubic meters.

Source	Variable	Quality	Year
ICFRE, 1997. Forestry Statistics, India, 1988-95. Indian Council of Forestry Research and Education, Dehradun, Uttaranchal, India.	Removal	M	1988-1993
ICFRE, 1998, Forestry Statistics, India, 1996. Indian Council of Forestry Research and Education, Dehradun, Uttaranchal, India.	Removal	M	1994 – 1995
ICFRE, 2002. Forestry Statistics, India, 2000. Indian Council of Forestry Research and Education, Dehradun, Uttaranchal, India	Removal	M	1996-1997
FSI, 2003. India Pilot Study. Forest Survey of India, Ministry of Environment and Forests, Government of India. (unpublished report).	Removal	H	2003

11.2.2 National Classification and Definitions

No standard national definitions exist for "Industrial wood" and "Wood Fuel". However, the "Forestry Statistics", reports data separately on "fuelwood" (wood fuel) and "wood" (Timber, Wood Poles, Matchwood and Pulpwood).

11.2.3 National Data

To generate national totals from data in "Forestry Statistics", the units of the published "wood" removal figures, where necessary, were converted into "cubic meters of round wood" by using the factors below. The removal of wood, poles, pulp wood and match wood was added to derive the figures of industrial round wood removal. Similarly, to generate national totals of fuel wood removal, the removals of fuelwood, if in tonnes, were converted into "cubic meters of round wood" using the first of the following two conversion factors.

1 metric ton of wood = 1.37931 cubic meters round wood
1 wooden pole = 0.05 cubic meters

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". All figures are under bark.

Product	Unit	1990	1994	1995	1996	1997	1998	1999	2000
Wood	**Mill Cub M**	4.534	3.394	3.708	2.746	2.801	2.274	2.187	1.927
Fuel wood	**Mill Cub M**	3.293	3.025	3.452	2.609	2.575	3.174	3.686	n.a

(Source: Forestry Statistics, ICFRE)

11.3 Analysis and Processing of National Data

11.3.1 Calibration

This step was not considered necessary.

11.3.2 Estimation and Forecasting

National data on removal of "wood" for 1990 and 2000 is available. The removal of "wood" for 2005 has been forecasted through linear regression using data from 1998 to 2000 as it represents latest trend. However, for fuelwood, the data is not available for 2000. The fuelwood in Indian forests is produced during logging operations, therefore, a regression relationship between "fuelwood" and "wood" has been used to estimate fuelwood for the year 2000 and 2005. All data is in "under bark" units.

National Category	1990	2000	2005
Wood Removal in million m^3 under bark	4.534	1.927	1.088
Fuel Wood Removal in million m^3 under bark	3.293	3.060	3.019
Total Wood Fuel in million m^3 under bark	7.827	4.987	4.1073

The "under bark" data has been multiplied by a factor of 1.15 to covert it into "over bark".

National Category	1990	2000	2005
Wood Removal in million m^3 over bark	5.214	2.216	1.252
Fuel Wood Removal in million m^3 over bark	3.787	3.519	3.472
Total Wood Fuel in million m^3 over bark	9.001	5.735	4.723

11.4 Reclassification into FRA 2005 Classes

Table: Reclassification (Percentage allocation) into FRA 2005 classes

National Classification	Percentage of a National Class to a FRA Class	
	Industrial Round Wood	Wood Fuel
Wood	100	
Fuelwood		100

11.5 Data for National Reporting Table T11

Table: Input to Global Reporting Tables

FRA 2005 Category	Volume in "000" cubic meters in round wood over bark					
	Forests			Other Wooded Land		
	1990	2000	2005	1990	2000	2005
Industrial Wood Removal	5214	2216	1252	n. a.	n. a.	n. a.
Wood Fuel Removal	3787	3519	3472	n. a.	n. a.	n. a.
Total	9001	5735	4723	n. a.	n. a.	n. a.

12 T12. Value of Wood Removal

Country India

12.1 FRA 2005 Categories and Definitions

Value of industrial Wood Removal	Value of the wood removed for production of goods and services other than energy production (wood fuel).
Value of Woodfuel Removal	Value of the wood removed for energy production purposes, regardless whether for industrial, commercial or domestic use

12.2 National Data

12.2.1 National Data Sources

Following publication have been used for archiving National Data.

Source	Variable	Quality	Year
ICFRE, 1997. Forestry Statistics, India, 1988-95. Indian Council of Forestry Research and Education, Dehradun, Uttaranchal, India.	Value	M	1988-1993
ICFRE, 1998, Forestry Statistics, India, 1996. Indian Council of Forestry Research and Education, Dehradun, Uttaranchal, India.	Value	M	1994 – 1995
ICFRE, 2002. Forestry Statistics, India, 2000. Indian Council of Forestry Research and Education, Dehradun, Uttaranchal, India	Value	M	1996-1997
FSI, 2003. India Pilot Study. Forest Survey of India, Ministry of Environment and Forests, Government of India. (unpublished report).	Value	H	2003

12.2.2 National Classification and Definitions

The national statistics uses the terms “revenue” and not the market value. It does not include taxes, if any, imposed by central or state governments. The following is the definition of revenue is from the Institute of Chartered Accountant of India at their website http://www.icai/resource/as9_intro.html .

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. Explanations: 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.

12.2.3 Original National Data

The Forestry Statistics published by the ICFRE has many gaps or missing information in respect of revenue from "Wood" earned by various States of India. Such gaps have been treated as zero for arriving at national totals. Therefore, following table "under estimates" the contribution of "Wood" to the revenue. Further, the "Forestry Statistics" does not provide break down of total revenue between "Wood" and "Fuel wood" from 1997 to 2000. 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**
Revenue from Wood	5613	8913	9261	10992	11104	15561	14087	13438
Revenue from Fuel Wood	315	373	382	279	302	598	541	516

12.3 Analysis and Processing of National Data

12.3.1 Calibration

This step is not considered necessary.

12.3.2 Estimation and Forecasting

The figures for 2005 were estimated based on regression relationship developed with the help of latest information (years 1997 to 2000) having trend than the past.

12.4 Reclassification into FRA 2005 Classes

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

12.5 Data for National Reporting Table T12

Table: Input to Global Reporting Table (National Currency)

Round Wood Removal	Value of Round Wood Removal in Million Rupees					
	Forests			Other Wooded Land		
	1990	2000	2005	1990	2000	2005
Industrial Wood	**5613**	**13438**	**9076**	n.a.	n.a.	n.a.
Woodfuel	**315**	**516**	**349**	n.a.	n.a.	n.a.
Total	**5928**	**13954**	**9425**	n.a.	n.a.	n.a.

Table: Input to Global Reporting Table (US Dollars)

FRA 2005 Category	Value of Round Wood Removal (1000 US Dollars)					
	Forests			Other Wooded Land		
	1990	2000	2005	1990	2000	2005
Industrial Wood	310625	287444	208644	n.a.	n.a.	n.a.
Woodfuel	17432	11037	8023	n.a.	n.a.	n.a.
Total	328057	298481	216667	n.a.	n.a.	n.a.

3. Exchange rates for 1990 (US$ 1 = 18.07 Indian National Rupees) and 2000 (US$ 1 = 46.75 Indian National Rupees) taken from guidelines. Exchange rate for 2005 has been assumed to be same (US$ 1 = 43.5 Indian National Rupees) as in May 2004 (FAO-COIN).

13 T13. Non Wood Forest Products (NWFP) Removal

Country India

13.1 FRA 2005 Categories and Definitions

Non Wood Forest Products Removal	Annual removal of a Non Wood Forest Product (NWFP) from "Forest" and "Other Wooded Land".

Following sixteen categories have been identified for reporting removal of NWFP with eight categories each for plant products and animal products.

ID No	Name of Product	ID No	Name of Product
A. Plant Products / raw material			
1	Food	5	Raw material for utensils, handicrafts and construction
2	Fodder	6	Ornamental plants
3	Raw material for Medicine and Aromatic plants	7	Exudates
4	Raw material for Colorants and dyes	8	Other plant products
B. Animal Products/ raw material			
9	Living animals	13	Raw material for medicine
10	Hides, Skins and Trophies	14	Raw material for colorants
11	Wild honey and bee-wax	15	Other edible animal products
12	Bush meat	16	Other non-edible animal products

There are no global definitions for each of these categories.

13. National Data

13.2.1 National Data Sources

The "Forestry Statistics" provides the basic information on removal of NWFP presented 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 convert them into them into common 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". Following table list all the publications that have been used for archiving National Data for this National Reporting Table T13.

Source	Variable	Quality	Year
ICFRE, 1997. Forestry Statistics, India, 1988-95. Indian Council of Forestry Research and Education, Dehradun, Uttaranchal, India.	Removal	M	1988-1993
ICFRE, 1998, Forestry Statistics, India, 1996. Indian Council of Forestry Research and Education, Dehradun, Uttaranchal, India.	Removal	M	1994 – 1995
ICFRE, 2002. Forestry Statistics, India, 2000. Indian Council of Forestry Research and Education, Dehradun, Uttaranchal, India	Removal	M	1996-1997
FSI, 2003. India Pilot Study. Forest Survey of India, Ministry of Environment and Forests, Government of India. (unpublished report).	Removal	H	2003

13.2.2 National Classification and Definitions

There are no standard national definitions. The "Forestry Statistics" gives data on removal of NWFP under 11 classes (Sal seed, Tendu Leaves, Cane, Resin, Gum, Lac, Drug and Spices, Fodder and Grass, Tanning material, Others and Bamboo) but without their definitions. Information is not readily available on Animal NWFP

13.2.3 Original National Data

The data in multiple units in "Forestry Statistics" was converted to a single unit "metric tonnes" by using following conversion factors to provide national yearly removals.

Weight of Standard bag of Bidi Leaves: 40 Kg,
One billet = 3.65 metre,
Resin: One blaze (Lip & Cup Method) = 1 Kg,
Grass & Fodder: One bundle= 35 Kg,
Canes: Kaps = 1 billet, One bundle = 50 billet,
One meter = 0.5342 Kg,
Resin: One blaze under Rill Method= 3 Kg,
Bamboo: 2400 Running meter = 1 Metric Tonne

Year	Removal of NWFP (in 000 metric tonnes)										
	Sal Seed	Tendu leave	Cane	Resin	Gum	Lac	Drug& Spice	Fodder & Grass	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

13.3 Analysis and Processing of National Data

13.3.1 Calibration: Not considered necessary

13.3.2 Estimation and Forecasting

The data shows large variation in annual removal. Therefore, for Sal seeds and Tendu leaves, three year averages were developed and regressed against time to calculate figures for 2000 and 2005. For Bamboo, the data for 1996 on wards was used to develop regressions estimates for 2000 and 2005. For rest of the products the variations in figures did not allow use of regression, therefore, the figure of last removal was assumed for 2000 and 2005.

13.4 Reclassification into FRA 2005 Classes

Table: Reclassification (Percentage allocation) into FRA 2005 classes

National Class	Percentage allocation of National Class to FRA 2005 classes							
	Food	Fodder	Raw Medicine	Raw Colorants	Raw Utensil	Orna-mental	Exudates	Other
Sal Seed	100							
Tendu leaves								100
Cane					100			
Resin							100	
Gum							100	
Lac								100
Drug& Spices			100					
Fodder & Grass		100						
Tanning Material				100				
Bamboo					100			
Others								100

13.5 Data for National Reporting Table T13

Table: Input to Global Reporting Table

FRA 2005 Category	Scale	Unit	NWFP Removal		
			1990	2000	2005
Plant products / raw material					
1. Food	000	Tonnes	36.50	52.87	61.06
2. Fodder	000	Tonnes	102.19	45.78	45.78
3. Raw material for medicine and aromatic products	000	Tonnes	26.53	62.70	62.70
4. Raw material for colorants and dyes	000	Tonnes	20.27	4.93	4.93
5. Raw material for utensils, handicraft & construct..	000	Tonnes	702.72	1130.66	1315.25
6. Ornamental plants	000	Tonnes	0.00	0.00	0.00
7. Exudates	000	Tonnes	118.99	3.38	3.38
8. Other plant products	000	Tonnes	559.40	582.08	547.47
TOTAL			1566.60	1882.40	2040.57
Animal products / raw material	n. a.	n. a.	n. a.	n. a.	n. a.

14 T14 Value of Non Wood Forest Product Removal

Country India

14.1 FRA 2005 Categories and Definitions

Value of NWFP Removal	The market value of total annual removal of all primary Non Wood Forest Products (NWFP).

This table needs value for the eight categories identified each for plant products and animal products falling under NWFP.

ID No	Name of Product	ID No	Name of Product
A. Plant Products / raw material			
1	Food	5	Raw material for utensils, handicrafts and construction
2	Fodder	6	Ornamental plants
3	Raw material for Medicine and Aromatic plants	7	Exudates
4	Raw material for Colorants and dyes	8	Other plant products
B. Animal Products/ raw material			
9	Living animals	13	Raw material for medicine
10	Hides, Skins and Trophies	14	Raw material for colorants
11	Wild honey and bee-wax	15	Other edible animal products
12	Bush meat	16	Other non-edible animal products

14.2 National Data

14.2.1 National Data Sources

Following publication have been used for procuring data for this national reporting table.

Source	Variable	Quality	Year
ICFRE, 1997. Forestry Statistics, India, 1988-95. Indian Council of Forestry Research and Education, Dehradun, Uttaranchal, India.	Value	M	1988-1993
ICFRE, 1998, Forestry Statistics, India, 1996. Indian Council of Forestry Research and Education, Dehradun, Uttaranchal, India.	Value	M	1994 – 1995
ICFRE, 2002. Forestry Statistics, India, 2000. Indian Council of Forestry Research and Education, Dehradun, Uttaranchal, India	Value	M	1996-1997

14.2.2 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.

Value of Wood Removal	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. Explanations: 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)

14.2.3 Original National Data

The Forestry Statistics published by ICFRE has many gaps in information. Such gaps have been treated as zero for arriving at national totals. Therefore, the revenue reported in following table "under estimates" the contribution "NWFP" to the forest revenue. For few of the NWFPs, the information is available from 1994 to 1997. For Tannin, it is available only from 1994 to 1996, therefore, to complete the matrix information for 1996 has been assumed for 1997 as well.

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
TOTAL	3066.0	5586.2	6287.7	6535.7

14.3 Analysis and Processing of National Data

14.3.1 Calibration

Not considered necessary

14.3.2 Estimation and Forecasting

Support of regression relationship has been taken to estimate revenue from NWFP during 1990 and 2000 as well as to forecast it for 2005. To make the result more realistic, outliers haves been excluded for example for Sal, Bidi, Drug and Spices, and "Others" the data for 1994 was excluded, for Lac the data of 1996 was excluded, and for Rattan , the data for 1997 was excluded. Further, for Sal, Bidi, and Rattan, the data for 1994 has been assumed to be same as that for 1990. 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 (Tendu Leaves)	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

14.4 Reclassification into FRA 2005 Classes

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

National Class	Percentage of a national class into a FRA class							
	Food	**Fodder**	**Raw Medicine**	**Raw Colorants**	**Raw Utensil**	**Orna-mental**	**Exudates**	**Other**
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

14.5 Data for National Reporting Table T14

Table: Input to Global Reporting Table 14 in domestic currency

FRA Classes	Value of NWFP Removal in Million Rs.		
	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	9.8	55.9	55.9
5	623.8	1614.5	1844.0
6			
7			
8	2091.9	5240.3	5740.0
Total	2737.5	7024.0	7792.2

Notes to the table

1. Revenue from class 7 (FRA class 8) is not available separately. It may be included in FRA Class 8.
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 .

Table: Input to Global Reporting Table 14 in US Dollars

FRA 2005 Category	Value of NWFP Removal (000 US dollars)		
	1990	**2000**	**2005**
Plant products / raw material			
1. Food	92	607	1162
2. Fodder	521	1403	1508
3. Raw material for medicine and aromatic products	54	415	831
4. Raw material for colorants and dyes	542	1196	1285
5. Raw material for utensils, handicrafts & const.	34519	34534	42392
6. Ornamental plants	0	0	0
7. Exudates	0	0	0
8. Other plant products	115765	112091	131954
Total	151493	150246	179132
Animal products / raw material	n.a.	n.a.	n.a.
9. Living animals			
10. Hides, skins and trophies			
11. Wild honey and bee-wax			
12. Bush meat			
13. Raw material for medicine			
14. Raw material for colorants			
15. Other edible animal products			
16. Other non-edible animal products			
TOTAL	151493	150246	179132

(Exchange rates for 1990 (18.07) and 2000 (46.75) taken from guidelines. Exchange rate for 2005 assumed same (43.5) as in May 2004 (FAO-COIN)..

15 T15. Employment in Forestry

Country India

.

15.1 FRA 2005 Categories and Definitions

Primary Employment	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.
Primary Activities	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".
Other Primary Activities	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".

15.2 National Data

15.2.1 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.

Source	Variable	Quality	Year
ICFRE, 1997. Forestry Statistics, India, 1988-95. Indian Council of Forestry Research and Education, Dehradun, Uttaranchal, India.	Employment, Plantation	M	1988-1995
ICFRE, 1998. Forestry Statistics, India, 1996. Indian Council of Forestry Research and Education, Dehradun, Uttaranchal, India.	Employment, Plantation	M	1996
ICFRE, 2002. Forestry Statistics, India, 2000. Indian Council of Forestry Research and Education, Dehradun, Uttaranchal, India.	Employment, Plantation	M	1997-2000
WB. 2000. India: Alleviating Poverty through Employment. The World Bank. 2000.	Employment, Plantation	M	1993
FSI, 2003. India Pilot Study. Forest Survey of India, Ministry of Environment and Forests, Government of India. (unpublished report).	Employment	H	2003

15.2.2 National Classification and Definitions

Principal "Usual Status" or Principal Activity	The activity on which the person spent relatively more time preceding 365 days.
Employed in Principal Activity or Usual Status	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).
Unemployed in Principal Activity or Usual Status	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.
Out of Labour Force (Primary Activities)	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.
Principal Status "Worker" or "Employed	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.
Subsidiary Status "Worker" or "Employed"	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.
Total Workers	Sum of Principal Status Workers and Subsidiary Status workers under "Usual Status" Classification.
Economic Activity	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 fro 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)

(Source: Source Census of India, 2001)

15.2.3 Original National Data

The following table presents the number of principal and subsidiary forest workers in 1993 in the eight forest related categories mentioned in a World Bank Study (WB, 2000).

National Class	Number in 1993 (in millions)
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
Forestry an logging	1.488
Plantations[1]	4.703
Planting, replanting and conservation of forestry	0.532
Forest services	0.344

(Source: WB, 2000.)
(Note. 1. The total estimated annual employment provided by plantations, which includes plantations of non forest species and on Other land with or without trees, is 9.406 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.)

Following table presents the actual data (1990, 1993 and 1997) and the estimated data (2000 and 2005) on the annual level of raising forest plantations.

Year	1993	1990	1997	2000	2005
Million ha	0.621	0.618	0.616	0.612	0.610

(Source: National data in National Reporting Table 4)

15.3 Analysis and Processing of National Data

15.3.1 Calibration

The figure on employment in study (WB, 2000) are taken as standard verified figures and therefore do not need for any calibration..

15.3.2 Estimation and Forecasting

To calculate the employment in 1990, 2000 and 2005, it has been assumed that the employment in the eight forest related employment groups of the World Bank Study (WB, 2000) will follow the temporal trend of the following FRA activities / variables.

Eight Employment Categories in the World Bank Report	**Assumption: Follow temporal trend of the following FRA Activities / Variables**
Firewood/fuelwood by exploitation of forest	Production of Fuel wood
Gathering of fodder from forests	Collection of Fodder
Uncultivated materials in forests	Collection of Medicinal and Aromatic Plants
Hunting, trapping, and game propagation	Extent of Multipurpose Forests[1]
Forestry and Logging	Production of Industrial Round Wood
Plantations	Annual Establishment of Plantations
Planting, replanting and conservation of forests	Extent of Forests
Forest services	Extent of Forests

(Note 1. Trend of multipurpose forests is assumed because most of the hunting trapping and game propogation is currently prohibited).

To implement the above, first the level of employment in the World Bank study period (1993) was assumed to come from the levels of related FRA activities/variables to derive the following unit factors which indicate the employment per "unit" of the activities or variables.

World Bank Categories	Employment in 1993	Level of FRA Activity	Factor Employment / Unit Activity or Variable
	(millions)	(millions)	(number/unit)
Firewood/fuelwood by exploitation of forest	0.049	3.123	0.015690
Gathering of fodder from forests	0.014	102.190	0.000137
Uncultivated materials in forests	0.300	26.530	0.011308
Hunting, trapping, and game propagation	0.067	25.000	0.002680
Forestry and Logging	1.488	3.715	0.400563
Plantations	2.352	0.621	3.786634
Planting, replanting & conservation of forests	0.532	63.939	0.008320
Forest services	0.344	63.939	0.005380

The employment in the three reference years of FRA 2005 has been calculated as under using the above unit factors.

Categories	Item	Unit	1990	2000	2005
Firewood/fuelwood by exploitation of forest	Activity	million m3	3.293	3.060	3.019
	Factor	no/m3	0.015690	0.015690	0.015690
	Employment	million nos	0.052	0.048	0.047
Gathering of fodder from forests	Activity	million t	102.19	45.78	45.78
	Factor		0.000137	0.000137	0.000137
	Employment	million nos	0.014	0.006	0.006
Uncultivated materials in forests	Activity	million t	26.53	62.7	62.7
	Factor		0.011308	0.011308	0.011308
	Employment	million nos	0.300	0.709	0.709
Hunting, trapping, and game propogation	Activity	million ha	24.9	28.6	28.7
	Factor		0.002680	0.002680	0.002680
	Employment	million nos	0.067	0.077	0.077
Forestry and Logging	Activity	million m3	4.534	1.927	1.088
	Factor		0.400563	0.400563	0.400563
	Employment	million nos	1.816	0.772	0.436
Plantations	Activity	million ha	0.618	0.612	0.61
	Factor		3.786634	3.786634	3.786634
	Employment	million nos	2.340	2.317	2.310
Planting, replanting and conservation of forests	Activity	million ha	63.939	67.554	67.701
	Factor		0.008320	0.008320	0.008320
	Employment	million nos	0.532	0.562	0.563
Forest services	Activity	Million ha	63.939	67.554	67.701
	Factor		0.005380	0.005380	0.005380
	Employment	million nos	0.344	0.364	0.364
TOTAL Employment			**5.465**	**4.855**	**4.513**

15.4 Reclassification into FRA 2005 Classes

Table: Reclassification (Percentage allocation) into FRA 2005 classes

National Classes of Employment	Percentage of a National Class to a FRA Class		
	Production of Goods	Provision of Services	Total
Firewood/fuelwood by exploitation of forest	**100**	**0**	**100**
Gathering of fodder from forests	**100**	**0**	**100**
Uncultivated materials in forests	**100**	**0**	**100**
Hunting, trapping, and game propagation	**100**	**0**	**100**
Forestry and Logging	**100**	**0**	**100**
Plantations	**0**	**100**	**100**
Planting, replanting and conservation of forests	**0**	**100**	**100**
Forest Admin services	**100**	**0**	**100**

15.5 Data for National Reporting Table T15

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

FRA 2005 Category	Employment (1000 person-years)		
	1990	2000	2005
Primary production of goods	2593	1976	1640
Provision of Services	2872	2879	2873
Unspecified forestry activities			
Total	**5465**	**4855**	**4513**

National Reporting 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 a comprehensive input for the 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 heath and vitality,
3) Biological diversity,
4) Productive functions of forest resources
5) Protective functions of forest resources
6) Social and Economic functions.

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.

1. Extent of Forests Resources and Contribution to Global Carbon Cycle

The theme deals with forest cover including trees outside forests, to support the social, economic and environmental dimensions of forestry. The theme encompasses ambitions to reduce degradation, deforestation and to maintain, rehabilitate and restore forest landscapes. This theme also includes the important function of sequestration of carbon and thereby contribute to moderating the global climate. 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.

1a. Extent of Forests Resources

This subsection provides information on national variables, that have been identified as complementary variables to the global variables in "National Reporting Table T1" to explain the state of "Extent of Forest Resources" in India

Relevant Variables

Following five national variables 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 is available to analyse and report.

a. Area of "Recorded Forest"
b. Proportion of "Dense" forest cover to "Open" forest Cover
c. Area of forest diverted for non-forest purposes
d. Extent of "Trees Outside Forests" (TOF)
e. Area of forests under management Plans

Source and Source Data

Following table indicates sources of data for the additional variables.

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

a. Area of Recorded Forest

In India, "forest" has a legal identity and is an "area" (with boundary and extent) of land recorded as "forest" in land revenue (government) records and or legally notified as "forest" under Indian Forest Act and or any other law (Act) relating to forests India. Such lands are

referred as "recorded forests" and they may and may not contain any forest. Due to this the physically recorded area of forests at the ground level is not always same as the area of identified patches of forest cover. The identification of smaller patches depends on the resolution of satellite camera 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^2 containing 423,311 km^2 of Reserved Forests, 217,245 km^2 of Protected Forests and 127,882 km^2 of Unclassed Forest.

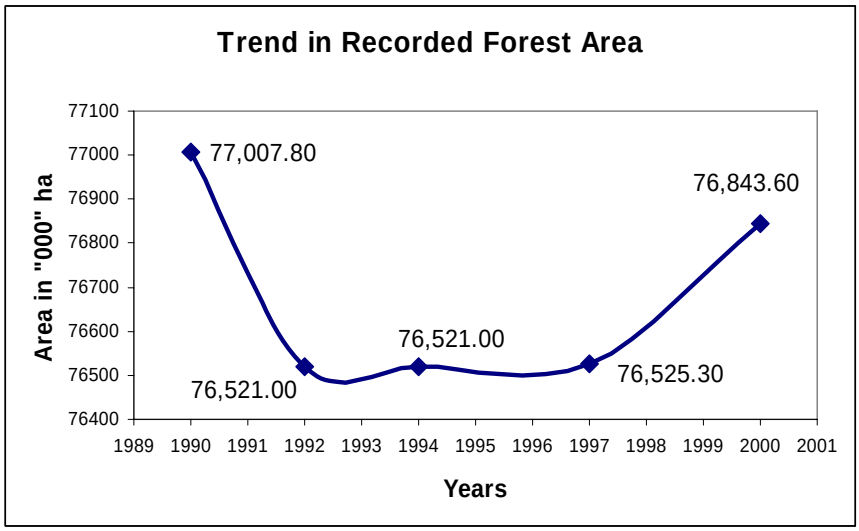
Definition

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

Data and Temporal Trend

Following figure presents the temporal data on recorded forest area in India.

Figure 1: Trend in Recorded Forest Area



(Source : FSI, 1993, 1995, 1997, 1999 and 2001)

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.

b Open and Closed Forest Cover

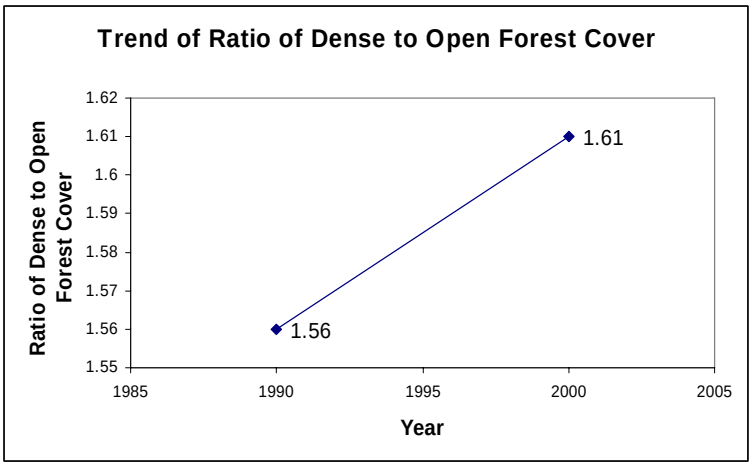
Sustenance and development of a society depends to a large extent on the judicious management of its natural resources - renewable as well as non-renewable. Therefore, it is essential to ensure the sustainability of forests resources. Periodic assessment of "forest cover" (National Reporting Table No. 1) 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.

Data and Temporal Trend

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



(Source: FSI, 1993 and FSI 2001)

Assessment

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

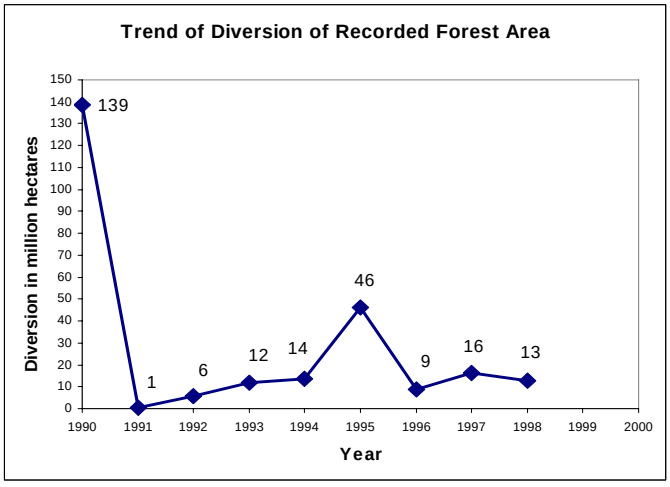
c. Area of Forest diverted for "Non-Forest Purposes"

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, (a) the cultivation of tea, coffee, spices, rubber, palms, oil-bearing plants, horticultural crops or medicinal plants; (b) 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)

Data and Temporal Trend

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



Assessment of Variable

The declining trend of diversion of forests for non-forest purposes is a good trend for forest conservation.

d Extent of Trees Outside Forests (TOF)

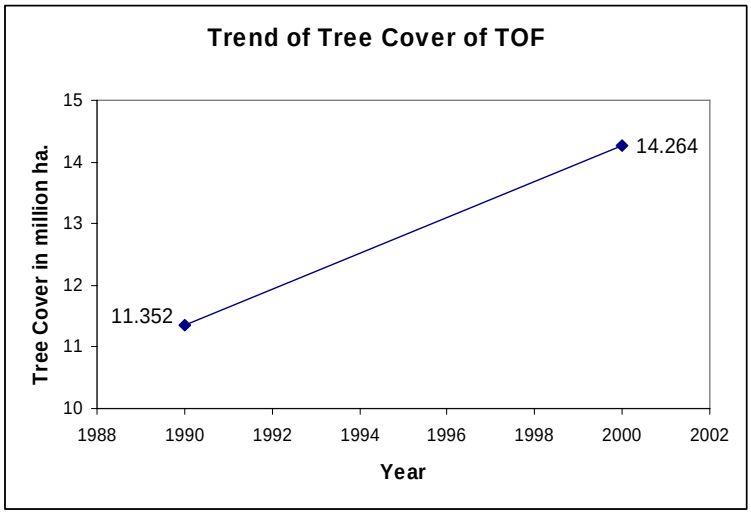
Since the late seventies, India has been supporting a massive programme to enhance, promote and support the development and conservation of the stock of "Trees Outside Forests" (TOF) to satisfy the demand of forest tree products and to reduce the pressure on natural forests. The inventory data provides an estimate of species-wise and diameter-wise average number of trees per hectare in each stratum or zone. A relationship between diameter and crown area of each tree species 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 e
stimated crown area of TOF with a theoretical crown density of 70 percent assuming that all trees are together at one place.

Definition of Trees Outside of Forests

Terms	Definition
Trees	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.
Trees Outside Forests (TOF)	Trees on lands (rural and urban) outside the Recorded Forest Area.
Tree Cover	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.

(Source: FSI, 2001)

Temporal Trend



Assessment

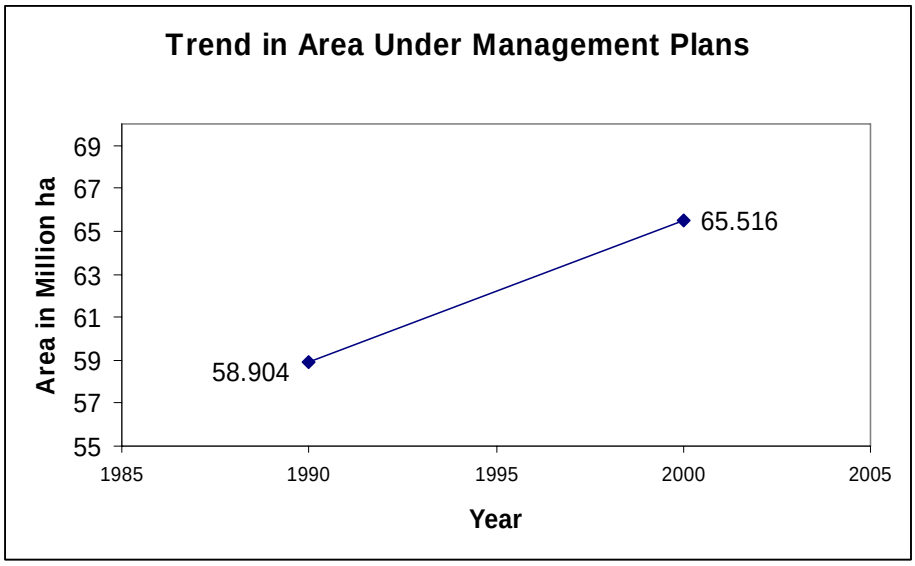
The tree cover is increasing is a healthy trend for the sustenance of forest resources.

e Area of Forest under Management Plans

The working plan (management plan) for the scientific management 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 the presence of a system to ensure sustainability of the forest resources. Specifically, the plans for working in forest area areas are called "Working Plans" and ones for for conservation of Protected Area are called "Management Plans". However, in general, the "management plans" stands for both "working plans" and "management plans".

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.

1b. Contribution to Global Carbon Cycle

This sub-section provides information on a national variable identified as a complementary variable to the global variables in "National Reporting Table T 7" to explain the sequestration of carbon by forest trees in India. It contains relevant definition, data, temporal trend and its assessment.

Relevant Variable

India has identified "Carbon stock in trees outside forests (TOF)" as a national variable, that in addition to the five global variables ("Carbon in above ground biomass", "Carbon in below ground biomass", Carbon in dead wood biomass", Carbon in forest litter" and "Soil Carbon") that only capture carbon sequestration by forests, is essential to explain the state of "Contribution to Global Carbon Cycle" in India and for which some information was available. The TOF now constitute a very significant part of ecosystem as well as production in India. 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.

Source and Source Data

Following table indicates sources of data for this additional variable.

Additional Variable	Source
Carbon in Trees Outside Forests	FSI, 2003. India Pilot Study to review sustainability of forests in India.. Forest Survey of India, Government of India. 2003 (unpublished report)

Definition

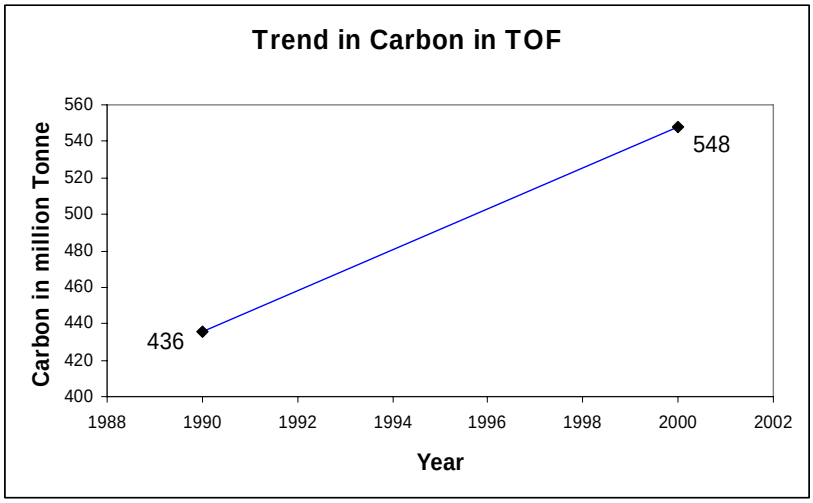
Term	Definition
Trees Outside Forests	Tree wealth existing outside recorded forest areas

Data and Temporal Changes

FSI has inventoried TOF both in rural and urban areas 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 the ratio method. While extrapolating, 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 most of the species to derive carbon content from the biomass estimates. It has used the default value of "45 % of biomass" for species for which such specific factors were not available. FSI has generated direct primary information for the

year 2000 based on its field work from 1997-2002. Following figure and table presents 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 (FSI, 2003) indicates that the estimated rate of increase of carbon content in TOF during the 1990 -2000 period is actually less than during the previous decade (1980-1990). This may be due to comparatively lower rates of planting in the previous decade.

2 Health and Vitality

This section examines effectiveness of forest management in containing damage to forest and wildlife and other natural resources. It mainly includes impacts of human induced disturbances.

Relevant Variables

Following seven national variables have been identified as national variables that in addition to the three global variables of "National Reporting Table T8" 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 information is either partial 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

Sources and Source Data

Following table indicates sources of data for the additional variables.

Additional Variable	Information Year	Source
Status of Natural Regeneration	**1982**	FSI,1987 State of Forest Resources 1987,. Forest Survey of India, Government of India
	1992	FSI,1995, State of Forest Resources 1993. Forest Survey of India, Government of India
Insects and Pests	**1930s**	Beeson, C.F.C. 1941. The Ecology and control of the Forest Insects of India and the Neighbouring Countries. Vasant Press, Dehra Dun.
	up to 1960s	Mathur, R.N. 1964. Forest Entomology in Entomology in India. The Entomological Society of India. Delhi
	up to 1970s	Roonwal, M.L. 1979. *Termite Life and Termite control in Tropical South Asia*, Scientific Publications, Jodhpur, p.177.
	up to 1980s	Sen-Sarma, P.K. 1988. Wood destroying insects. In : Handbook of Indian Wood and Wood Products :Ed. V.Ranganathan. Oxford Univ. Press, Delhi.
	up to 1980s	Singh, P. 1988. Insect pest problems in Forest nurseries, Natural and Man made Forests and their management. In Tree Protection ed. V.K. Gupta and N.K. Sharma.
	up to 1910	Stebbing, E.P. 1914. Indian Forest Insects of Economic Importance Eyre. and Spottiswoode Ltd., London..

	upto 1980s	Thakur, M.L. 1988. Forest Entomological Research in India : History, Pest problems and future strategies. In : Advances in Forestry Research in India ed. Ram Prakash. International Book Distributors, Dehra Dun.
	up to 1990s	Thakur, M.L. 2000. Forest Entomology, Ecology and Management, Sai Publishers, Dehra Dun.
Incidence of Weed Infestation	**1990s**	Kumar and Rohatgi (1999), The role of invasive weeds in changing floristic diversity, *Ann. For.* 7(1):147-150.
Incidence of grazing	**1993**	FSI, 1995, State of Forest Resources 1995. Forest Survey of India, Ministry of Environment and Forests, Government of India
Pollutants		No data is available and hence no source data
Density of forest canopy	**1982**	FSI, 1987 State of Forest Resources 1987. Forest Survey of India, Government of India.
	1986	FSI, 1989 State of Forest Resources 1989. Forest Survey of India, Government of India.
	1988	FSI, 1991 State of Forest Resources 1991. Forest Survey of India, Government of India.
	1990	FSI, 1993 State of Forest Resources 1993. Forest Survey of India, Government of India.
	1992	FSI, 1995 State of Forest Resources 1995. Forest Survey of India, Government of India.
	1994	FSI, 1997 State of Forest Resources 1993. Forest Survey of India, Government of India.
	1997	FSI, 1999. State of Forest Resources 1999. Forest Survey of India, Government of India.
	2000	FSI, 2000. State of Forest Resources 200. Forest Survey of India, Government of India.
Presence of Indicator Species		No data and no source
Forest fragmentation	**1990** **2000**	FAO, 2000. Independent Pan-Tropical Remote Sensing Survey, 2000. FAO Rome.
Recorded Forest Area	**1990**	FSI, 1993 State of Forest Resources 1993. Forest Survey of India, Ministry of Environment and Forests, Government of India.
	1992	FSI, 1995. State of Forest Resources 1995. Forest Survey of India, Government of India.
	1994	FSI, 1997. State of Forest Resources, 1997. Forest Survey of India, Government of India.
	1997	FSI, 1999. State of Forest Resources, 1999. Forest Survey of India, Government of India.
	2000	FSI, 2001. State of Forest Resources, 2001. Forest Survey of India, Government of India.

a. Status of Natural Regeneration

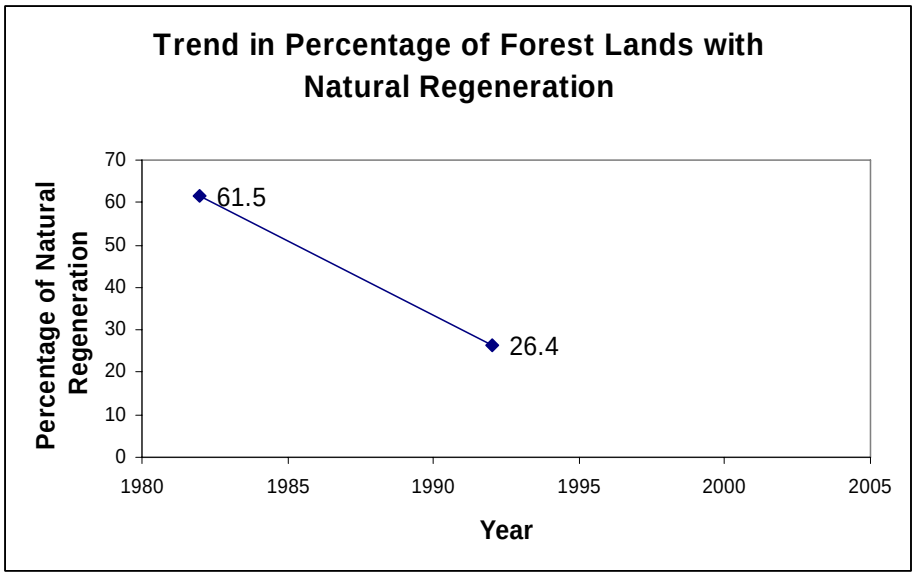
Natural regeneration indicates the capacity of ecosystem to sustain the "forests" in perpetuity. The information was collected by FSI while conducting forest inventories. FSI follows a systematic sampling method for its forest inventories where it overlays a 2 ½'x 2 ½' grid of latitudes and longitudes 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 (No standard national definition is available)

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

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 the period 1982-1992 is not good for the sustainability of forest resources in the country.

b. 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". The majority of insect pests are localized and general feeders but some are quite specific and confined to a particular hosts only. There is a lack of systematically recorded data on incidence and damage by forest insects and pest in forests in India.

Relevant Variables

India considered that more specific (name, location and year) information on the incidence of insects and pests rather than simple area affected reported in National Reporting Table T8 may be more useful to understand the nature of the disturbance.

Data and Temporal Changes

Sufficient quantitative information is not available to draw temporal changes. Following table present information in a descriptive tabular mode.

Table: Major insect pest problems in forests, plantations and nurseries in India

Insect pest species	Common name	Order/family	Year of epidemics / mortality
Cryptothelia cramerii 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.
Hoplocerambyx spinicornis Newman	Sal heart wood borer	- do -	Epidemic dates back to 1899 in Singhbhoom, Bihar. Reported from Assam (1906, 1961), H.P. (1'948 – 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.
Hypsipyla robusta Moore	Toon shoot borer	- do -	A serious pest of toon and mahogony, 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).

Ectropis deodarae 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 *Ectropis* deodarae, 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.
Eutectona machaeralis Walker	Teak skeletonizer	Lepidoptera : Pyralidae	Major pests of teak, 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.
Plecoptera reflexa 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.
Dioryctria abietella Devis & Schiffer Mudlor	Chilgoza cone borer	Lepidoptera : Pyralidae	The insect causes, damage to cones and seeds of coniferous species,. Reported 32.7% damage to *Pinus taeda* in 1973-74, 1.5-.4% in *Abies pindrow* in Pakistan in 1980 and almost 100% loss in seeds in fully developed cones of *Pinus wallichiana* in 1986 in Chakrata, Uttranchal.
Celosterna scabrator Fabr.	Babul shoot & root borer	Coleoptera : Cerambycidae	A most notorious pest of *Acacia nilotica* 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 *Acacia catechu, Cassia siamea, Casuarina equisetifolia, Eucalyptus spp., Prosopis juliflora, P.spocigera, Tectona grandis.*
Eligma narcissus Rothschild	Ailanthus defoliator	Lepodoptera: Noctuidae	Defoliates seedlings and young plants (upto 5 years old) in plantations of *Ailanthus excelsa* and *A.triphysa* in pennisulan India. During heavy infestation, about 20-40% larvae are found in each leaf, causing heavy damage whereas in nurseries complete defoliation (100%) may occur.
Eterusia pulchela	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.
Apriona cinerea Cheverolet	Poplar stem borer	Coleoptera : Cerambycidae	A serious problem for 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.

Atteva fabriciella Swedrus	Ailanthus webworm	Lepidoptera : Yponomentida	A major pest in young plantations of *Ailanthus excelsa* and *A.grandis* is greater part of India. Repeated defoliations result in increment loss, particularly in plantations growing and hostile soil conditions.
Eucosoma hypsidrves Meyrick	Spruce bud Worm	Lepidoptera : Eucosmidae	A major primary cause of mortality of Picea spp. in the Himalayas. Trees of all ages are attacked. Heavy and repeated infestation results in weakening of the host.
Calopepla leayana 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.
Melosoma populi Linn.	Poplar defoliator	Coleoptera : Chrysomelidae	A serious pest of Poplars and Willows in the temperate Himalayas from J&K to Arunachal Pradesh.
Clostera cupreata Butler & *C. fulgurita* (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 3rd year of plantation of Poplars.
Dichomeris eridantis Meyrick	Shisham leaf roller	Lepidoptera : Gelechidae	A major problem in Shisham plantations.
Lebeda nobilis Walker	Chir pine defoliator	Lepidoptera : Lasciocampidae	All age classes of Pines are attacked.
Lymantria obfuscate 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 1 year.
Malacosoma indica Walker	Forest tent cater pillar	Lepidoptera : Lascocampidae	Widespread defoliation epidemics occur in North-West Himalaya.
Tonica niviferana 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.
Hyblea puera Gram	Teak defoliator	Lepidoptera : Hybleaidae	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.

c. Incidence of Weed 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.

Data and Temporal Trend

Not much data is available on this important variable, therefore, temporal trend has not been developed.

Table: Main weeds in forests of India

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

Assessment

There is perception among experts that there is an increasing trend of weed infestation in forest areas.

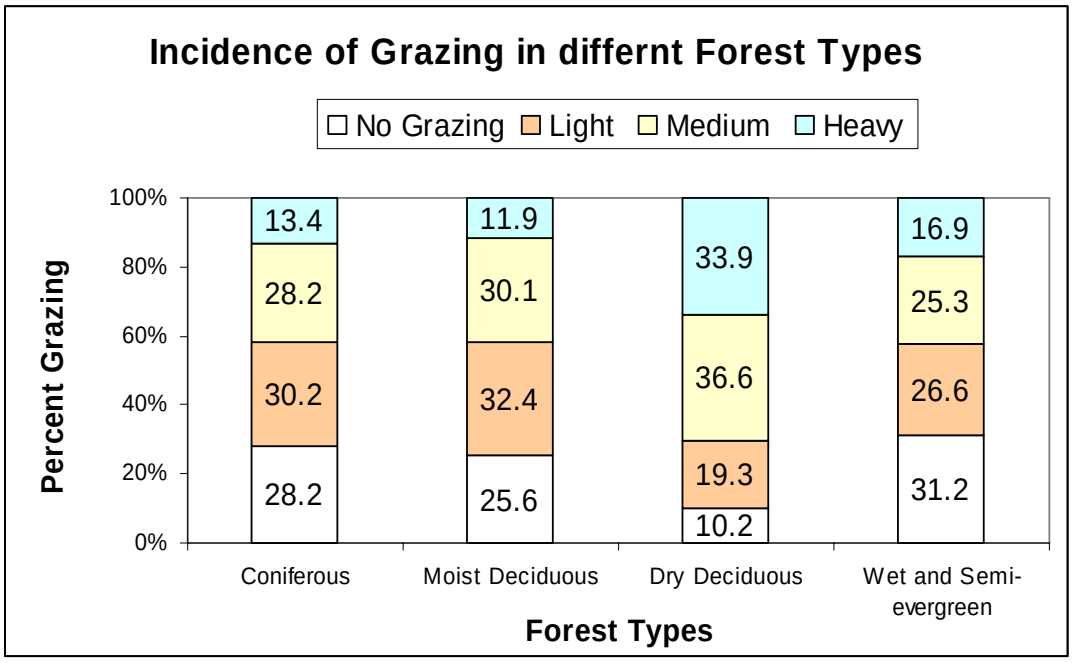
d. Incidence of grazing in different forest types

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 India. 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

Data and Temporal trends

FSI conducts a supplementary assessment of the extent of grazing while 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 dry deciduous forests are under very high incidence of grazing pressure and which may be more than their capacities. Therefore, it may endanger their long-term sustainability.

e. Incidence of Fire

Unplanned fire adversely affect forest stock as well as flow of its goods and services.

Definition: There is no national definition for fire

Data and Temporal Trend

FSI studied the forest fire in 1995 on 1:1 million scale and did intensive ground verification. The study revealed that about 2.31 percent of forest cover was affected by fire. About 54.7% of India's forest 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).

Assessment

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

f. Incidence of Pollutants

The capacity of plants to bear impact of pollutants may be judged either looking their absorbing and mitigation potential or looking the damages due to pollutants.

Definition : No national standard definition is available

Data and Temporal Trends: No Data is available

Assessment

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

g. Presence of Indicator Species

Certain indicator species help to judge the health and vitality of a forest**.** For example, the presence of certain palms, orchids, ferns, arboreal mammals, owls, honey bees and butterflies may reflect a stable and healthy forests.

Definition No standard national definition is available

Data and Temporal trend

No assessment has been done for various species as indicators of forest health. Recently, few Protected Areas have started systematic monitoring of vegetation structures and rare plants.

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

h. Density of Forest Canopy

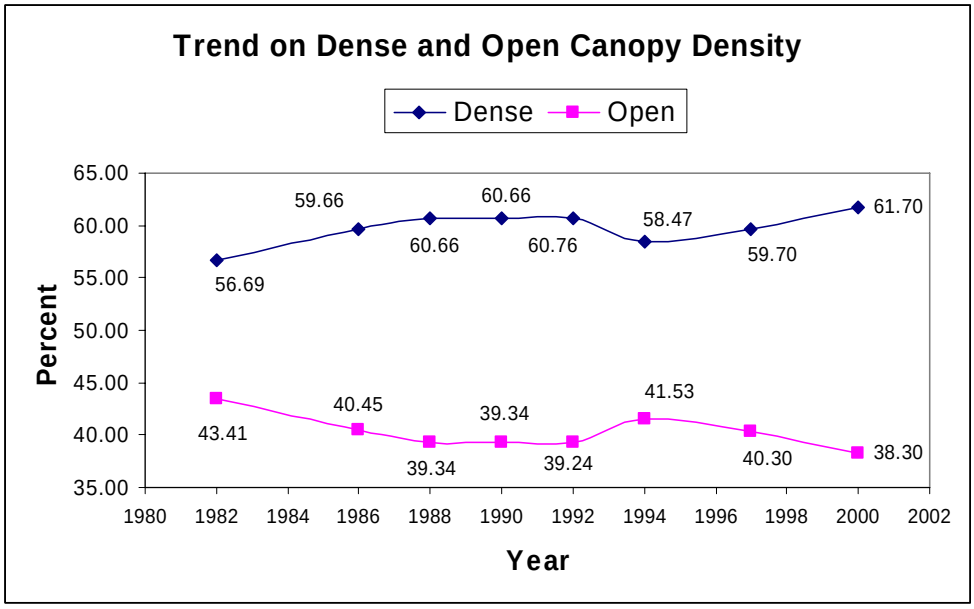
This variable is very important because it expresses the distribution of the canopy defines the composition, rates of growth and regeneration of forest stands as the canopy controls the distribution of sunlight to plants. Any significant change in the forest canopy may have effect on forest succession,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

Definition

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

Data and Temporal Trend

The following figure presents the information on the percent of "dense" (more than 40 % canopy cover) and "open" (10 to 40 % canopy cover) forest in India.



Assessment

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

i. Status of Forest Fragmentation

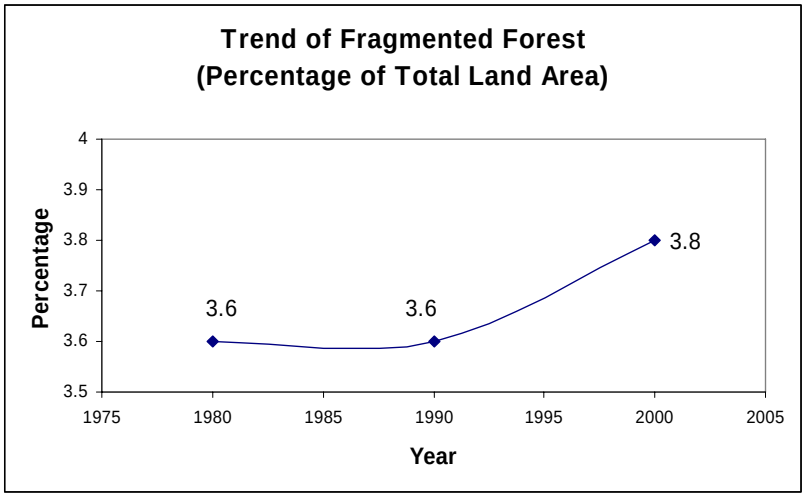
The forest fragmentation directly affects the local ecological processes both in the short as well as in the long term and may endanger sustainability of resulting smaller patches of forests. The loss of connectivity between two patches may threaten the existence of certain floral and faunal species and may also reduce the 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, "forest fragmentation" has been identified as a complementary national variable 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).

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 Biodiversity

This section provides information on national variables complementary to the global variables in "National Reporting Tables T9 and T10 that indicate level of biodiversity and its conservation and management at the ecosystem (landscape) and species level in forests in India.

Relevant Variables

India has identified the following five national variables in addition to the four global variables (Conservation forests, Conservation "Other Wooded lands", Forest Tree Species, Forest Composition) are essential to describe the level of biodiversity and its conservation and management (FSI, 2003).

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

Source and Source Data

The following table lists the sources of data for the additional variables.

Additional Variable	Source
Extent of Protected Areas	Gadgil, M. and Meher-Homji, V.M. 1986. Localities of great significance to conservation of India's biological diversity. Proc. IAS. Suppl. 1986.
	The Wildlife (Protection) Act, 1972, India
	National Wildlife Database.. Wildlife Institute of India (WII), India.
Status of Endemic species	Chowdhary, H.J. & Murti, S.K. 2000. *Plant Diversity and Conservation in India – An Overview.* B.S.I. Dehradun.
	Nayar, M.P. 1996. *Hot-spot of Endemic Plants of India, Nepal and Bhutan.* Thiruvananthapuram, Kerala.
Status of Nationally Threatened Species	Nayar, M.P. and A.R.K. Sastry 1987. *Red Data Book of Indian Plants Vol. 1 to 5.* BSI, Calcutta.
Introduced Species	
Species Richness and Diversity	

a. 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. It includes both the National Parks and Sanctuaries. The area under PAs indicates a social and

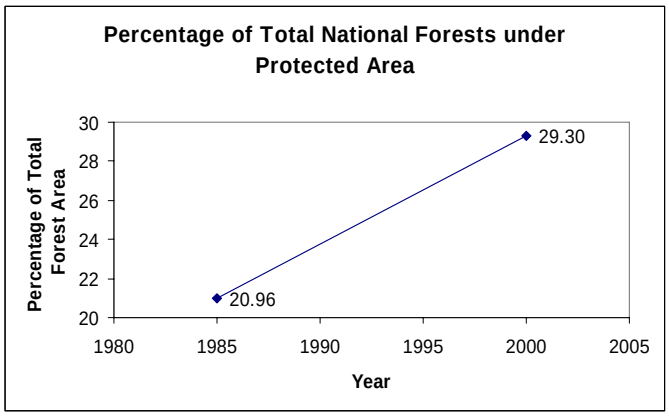
political commitment of the country for conserving biodiversity and also the extent to which forest resources are better conserved.

Definitions

National Park	An area declared as a National Park under Wildlife (Protection) Act, 1972
Sanctuary	An area declared as a Wildlife Sanctuary under Wildlife (Protection) Act, 1972

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) covering 15.404 million ha in 2000.



Assessment

An increasing trend in number, area and forested area under PAs indicates better conditions for sustaining biodiversity in the country.

b. Status of Endemic Species (Flora)

Endemism represents the uniqueness of the flora of a region or local area and leads to better understanding of local spatial patterns or boundaries of bio-diversity.

Definition (CBD)

Endemic Species	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.

Data and Temporal Trend

India has about 6000 endemic species. However, information is not readily available as to how much of these are in forests. The Eastern Himalayas and Western Ghats are included in the list of the 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). Some important centres include 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 from the peninsular region & 239 are from Andaman & Nicobar.

There are different estimates of endemics shown by different authors as a 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 later 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 has been 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.

c. 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)

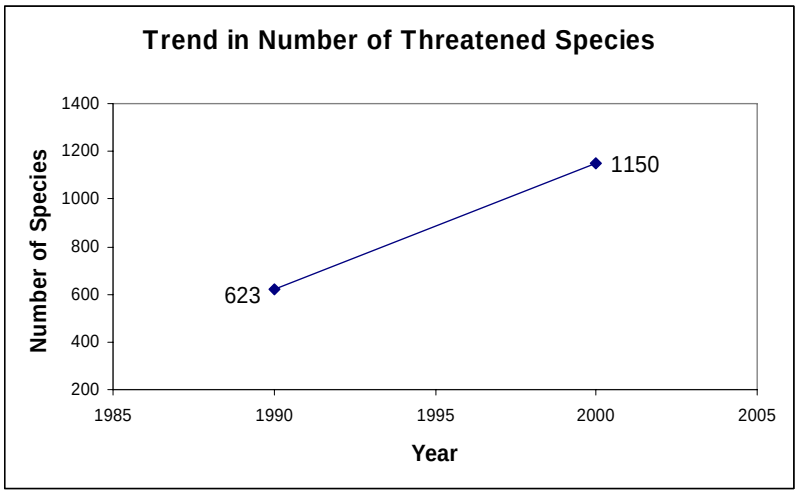
Threatened Species	A taxa classified in any of the three IUCN categories namely Critically Endangered, Endangered, or Vulnerable species.

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) However it is not clear how many of these species are in forests.



Assessment

The data indicates an addition of 527 (1150-623) species to the list of threatened species but in absence of complete details it is not clear whether these new species have been surveyed for the first time in 2000 or whether they were also surveyed in past and were not threatened. Assuming that these species were surveyed earlier and form major component of forests, it can be said that the increase in the number of threatened species indicates conditions adverse for the sustainability of forest resources.

d. Introduced and Invasive Species (Flora)

Introduced species are introduced with some specific objectives while invasive alien 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)

Data and Temporal Trend

The following table provides some of the available information on the introduced species.

Species	**Place of introduction**	**Country of origin**
Acacia auriculiformis	FRI West Bengal, Bihar	Queensland, Australia
Acacia decurrents	Nilgiris (1524m to 2133m)	-do-
Acacia mangium	Dinga,coastal area of south-west Bengal	Australia
Acacia mearnsii	Nilgiris (in 1677at 2286m) Palni Hills (in 1828 at 2438m)	Australia (S.victoria) and Tasmania
Acacia dealbata	Nilgiris (in 1832 above 1524m)	Tasmania and south Australia.
Acacia pyenantha	Nilgiris and U.P.	-do-
Acacia tortillas	Jodhour, Rajasthan	Israel
Adenthera microsperma	F.R.I., Dehra Dun	Indonesia, Jawa.
Agathis robusta	F.R.I., Dehra Dun	Queensland, Australia.
Albizia falcate	Assam	Indonesia
Araucaria cunninghamii	F.R.I., Dehra Dun	Queensland, Australia
Bambusa burmenica	F.R.I., Dehra Dun	Burma
Bambusa glaucescens	F.R.I., Dehra Dun	China
Broussonetia papirifera	Bengal, Maharastra, Karnataka, Tamilnadu	China
Castenea sativa	Manali (H.P.). Chakrata (U.P.)	Europe
Casuarina equestifolia	Tamil Nadu (in 1860)	Indonesia
C. Cunninghamiana	West Coast of Saurashtra (in 1950)	Thailand
C. junghaniana	Tamilnadu	Thailand
Chlorisia specisoa	New Forest	S. Brazil
Cinnamomum camphora	New Forest, UP, Tamil Nadu Karnataka.	China and Japan
Christomaria japonica	Darjeeling (West Bengal)	Japan
Dendrocalamus giganteus	New Forest	Burma
Eucalyptus Alba	New Forest	Indonesia, N. America
E.Camaldulensis	Punjab, U.P.	Australia
E.Citriodora	Londha, Dandeli	Australia
E.deglupta	New Forest	Indonesia
E.globulus	Nilgiris (Tamil Nadu)	Australia
E.grandia	Kerala	Australia
E.maculata	Shahapur (Maharastra)	Australia
E.paniculata	New Forest	Australia
E. tereticornis	U.P., Assam, Punjab	Australia
Fagus sylvatica	Kulu, Manali (H.P)	Europe
Fraxinus excelsa	Kulu, J& K	Europe
Havea brasiliensis	Kerala, Tamil Nadu	Brazil
Grevillea pteridifolia	Amar Kantak (Shahdol), Madhya Pradesh	Australia
Grivellea robusta	New Forest, Mussoorie	-
Leucaena leucocephala	New Forest, Maharastra, Gujarat, Bihar.	Hawaii, Philippines, El Salvador, Peru.
Ocroma lagopus	Tamil Nadu, Karnataka.	Central America
Parkinsonia aculeate	Rajasthan, U.P., Delhi	Mexico
Pinus carebaea	Assan, New forest, M.P.	Br.Honduras
P. nigra	West Bengal, H.P.	Europe
p.patula	West Bengal, Bihar, H.P.	Mexico
P.taeda	H.P.	U.S.A.
P. deltoids	H.P., U.P., Punjab.	US and European Countries
Prosopis juliflora	Rajasthan, M.P. Maharasta, Tamil Nadu	Mexico

(Source: FSI, 2003)

Similar information is nor readily available on invasive species.

Assessment

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

e. Species Richness and Diversity

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

Definition

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

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.

4 Productive Functions

Forests provide a wide range of goods including wood and non-wood forest products. This theme monitors sustainability of flows of goods from forests by examining stock of forest including efforts to improve it, if any, and its rate of increment to compare it with the flows.

Relevant Variables

The 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 sustainability of the "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

Source Data

Additional Variable	Source
Per hectare growing stock	FSI, 1987 State of Forest Resources 1993. Forest Survey of India, Ministry of Environment and Forests, Government of India.
	FSI, 1993 State of Forest Resources 1993. Forest Survey of India, Ministry of Environment and Forests, Government of India.
	FSI, 1997. State of Forest Resources 1995. Forest Survey of India, Ministry of Environment and Forests, Government of India
Rate of annual volume Increment	FSI, 1991 State of Forest Resources 1993. Forest Survey of India, Ministry of Environment and Forests, Government of India.
	FSI, 1993 State of Forest Resources 1993. Forest Survey of India, Ministry of Environment and Forests, Government of India.
	FSI, 1997 State of Forest Resources 1993. Forest Survey of India, Ministry of Environment and Forests, Government of India.
Area under improved planting Stock	Gurumurthi, K. 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.
	IFGTB, 2000. Seedling Seed Orchard for Breeding Tropical Trees. Institute of Forest Genetics and Tree Breeding, ICFRE, India.

a. Per hectare Growing Stock

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

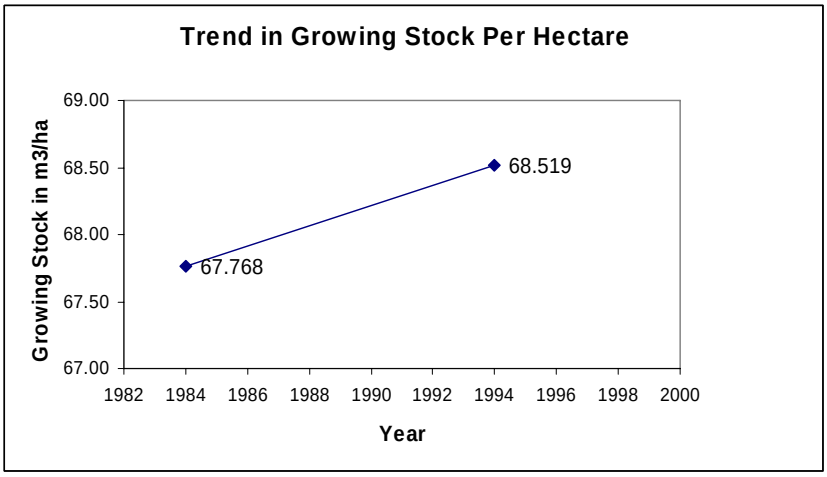
Definition

Term	**Definition**
Per hectare growing stock	The growing stock per unit area (hectare) of forests

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 (000 ha)	Growing stock (million m^3)	Growing Stock/ha
1984	63880	4329	67.768
1994	63340	4740	68.519



Assessment

The increasing trend in growing stock per hectare is a good sign for sustainability of the forest resources in India.

b. Rate of Annual Volume Increment

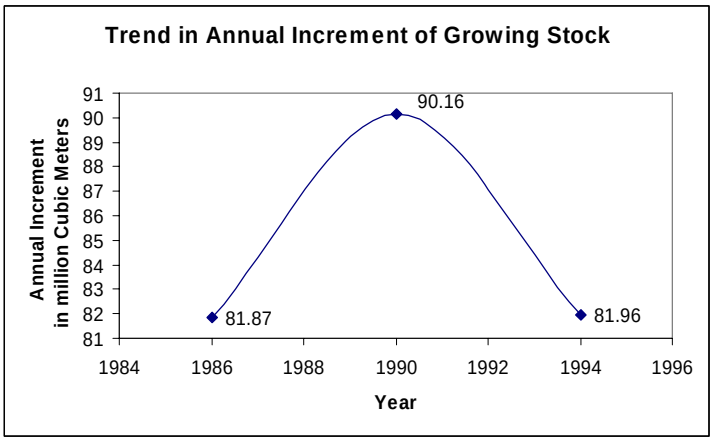
The rate of annual increment of growing stock defines sustainable level of potential flows of good and services from a forests. The management and silvicultural systems have the capacity to manipulate the annual rate of increment of a forest within a given ecological and biological range. It is a an important complimentary variable for sustainable forest management and it basically fixes the value of a forest.

Definition

Standard national definition not available.

Data and Temporal Trends

It is difficult to make an estimation of the annual increment because statistical measurements from well laid out plots are not available for the last decades. The FSI has opted for an alternative approach and has used Von Mental's formula (Increment =2* growing stock/ rotation) to estimate this variable. Following figure presents these for 1986, 1990 and 1994.



Assessment

The rise and then decline in the annual increment is within a 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".

c. Extent of Planting Stock Improvement

India is one of leading country in terms of the age and the area under forest plantations but unfortunately not in terms of survival and productivity. Therefore, India has initiated tree improvement programs since 1960sconsisting of improving planting stock through establishment of high quality and productive "seed production areas" (SPA), "seedling seed orchards" (SSOs) and "clonal seed orchards" (CSOs).

Definition No standard national definitions are available

Data and Temporal trends

The SPAs have been established over about 10,727 hectares, SSOs over 3,018 hectares and CSO over about 1569 hectares. However, year-wise break down of above achievement is not available to develop a temporal trend for this variable.

Assessment

The variable is important and provides a solid foundation to increase productivity of plantations but sufficient information is not available for an assessment.

5 Protective Functions

This theme attempts to capture the societal value of forests in maintaining and augmenting forest ecological, soil and aquatic systems to sustain animal and plant lives including reduction and mitigation of impacts of droughts, erosion, floods and avalanches.

Relevant Variables

Following 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 forests
e. Extent of forest in hilly region
f. Extent of forest in mangroves

5.3 Source Data

Additional Variable	Source
Extent of Forests under Watershed Treatment	GOI, 2001. 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.
Status of Forest Soil Fertility	No national level information is available
Extent of Degraded forests	FSI, 1987. State of Forest Resources 1993. Forest Survey of India, Ministry of Environment and Forests, Government of India.
	FSI, 1989. State of Forest Resources 1993. Forest Survey of India, Ministry of Environment and Forests, Government of India.
	FSI, 1991. State of Forest Resources 1993. Forest Survey of India, Ministry of Environment and Forests, Government of India.
	FSI, 1993. State of Forest Resources 1993. Forest Survey of India, Ministry of Environment and Forests, Government of India.
	FSI, 1995. State of Forest Resources 1995. Forest Survey of India, Ministry of Environment and Forests, Government of India.
	FSI, 1997. State of Forest Resources, 1997. Forest Survey of India, Ministry of Environment and Forests, Government of India.
	FSI, 1999. State of Forest Resources, 1999. Forest Survey of India, Ministry of Environment and Forests, Government of India.
	FSI, 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	No published national data is available
Extent of Forest In Hilly Region	FSI, 1995. State of Forest Resources 1995. Forest Survey of India, Ministry of Environment and Forests, Government of India.
	FSI, 1997. State of Forest Resources, 1997. Forest Survey of India, Ministry of Environment and Forests, Government of India.

	FSI, 1999. State of Forest Resources, 1999. Forest Survey of India, Ministry of Environment and Forests, Government of India.
	FSI, 2001. State of Forest Resources, 2001. Forest Survey of India, Ministry of Environment and Forests, Government of India.
Extent of Forest in Mangroves	FSI, 1987. State of Forest Resources 1993. Forest Survey of India, Ministry of Environment and Forests, Government of India.
	FSI, 1989. State of Forest Resources 1993. Forest Survey of India, Ministry of Environment and Forests, Government of India.
	FSI, 1991. State of Forest Resources 1993. Forest Survey of India, Ministry of Environment and Forests, Government of India.
	FSI, 1993. State of Forest Resources 1993. Forest Survey of India, Ministry of Environment and Forests, Government of India.
	FSI, 1995. State of Forest Resources 1995. Forest Survey of India, Ministry of Environment and Forests, Government of India.
	FSI, 1997. State of Forest Resources, 1997. Forest Survey of India, Ministry of Environment and Forests, Government of India.
	FSI, 1999. State of Forest Resources, 1999. Forest Survey of India, Ministry of Environment and Forests, Government of India.
	FSI, 2001. State of Forest Resources, 2001. Forest Survey of India, Ministry of Environment and Forests, Government of India.

a. Extent of forests under watershed "treatment"

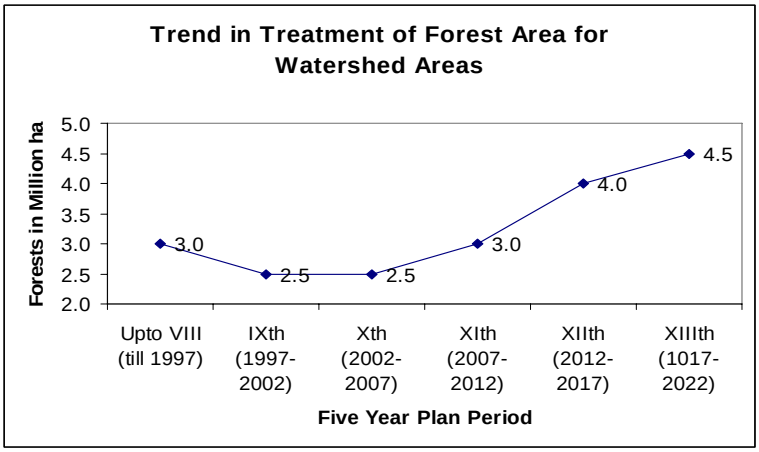
Treatment of watershed areas helps to maintain its hydrological regime and includes conservation and development of forest areas. Treatment spans activities like control measures for soil and water erosion and controlled access or disturbances to fragile areas. The "extent of forest under such "treatment" 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 of Watershed (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)

Data and Temporal Trends

The following figure indicates the magnitude of "treatment" in successive "Five Year Plans" including level of the activity proposed for future plans.



Assessment

It indicates increasing commitment of the society for protection of watershed areas.

b. Status of Forest Soil Fertility

Forests protect and contribute to soil fertility. The trend of soil fertility indicates level of protection and conservation afforded to forest and soil resources. In other words it is a direct measure of one of the protective function 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 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.

Data and Temporal trend

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.

c. Extent of Degraded Forests

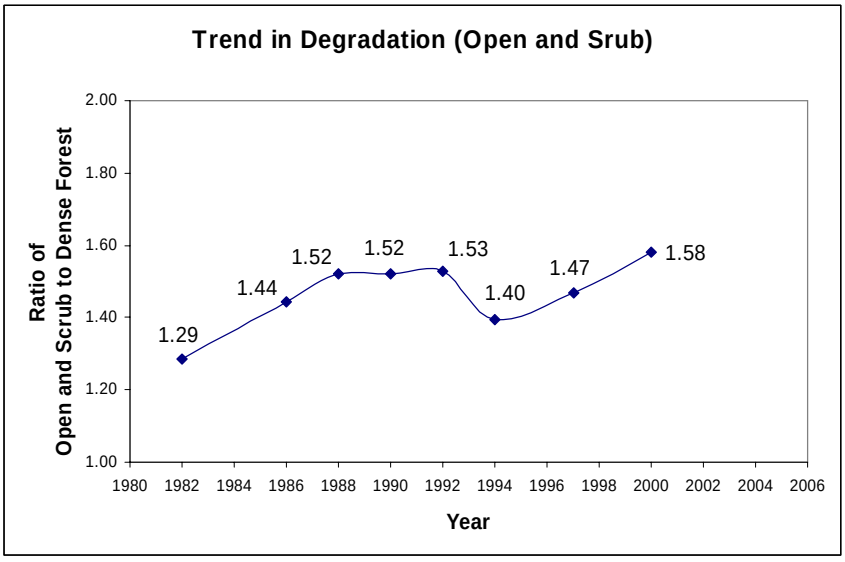
Healthy forests are necessary to maintain their protective and protective flows of goods and services. Over use, misuse, and or unscientific use of forests leads to transformation of "forest" into "degraded" forests. Monitoring of the extent of degraded forest is important because increases in the area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

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 the 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.

d. Ground Water Table in Vicinity of Forests

Forest affect and are affected by the ground water regime. Ground water resources in India are depleting at a very fast rate and the condition is likely to worsen in the future. Monitoring of ground water in areas near to forests is therefore very important for ensuring the sustainability of forest resources.

Definition (No standard national definition is available)

Term	Definition
Ground Water	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. (http://ohioline.osu.edu/aex-fact/0460.html)
Water Table	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. (http://oaspub.epa.gov/trs/trs_proc_qry.alphabet)
Water level	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. (http://ohioline.osu.edu/aex-fact/0460.html)

Data and Temporal Trend

Sufficient information is not available to develop temporal trend. There is a public consensus based on local studies that level of ground water has an overall declining temporal trend.

Assessment

No assessment is possible as national level information on this variable is not available.

5.4e Extent of Forests in Hills

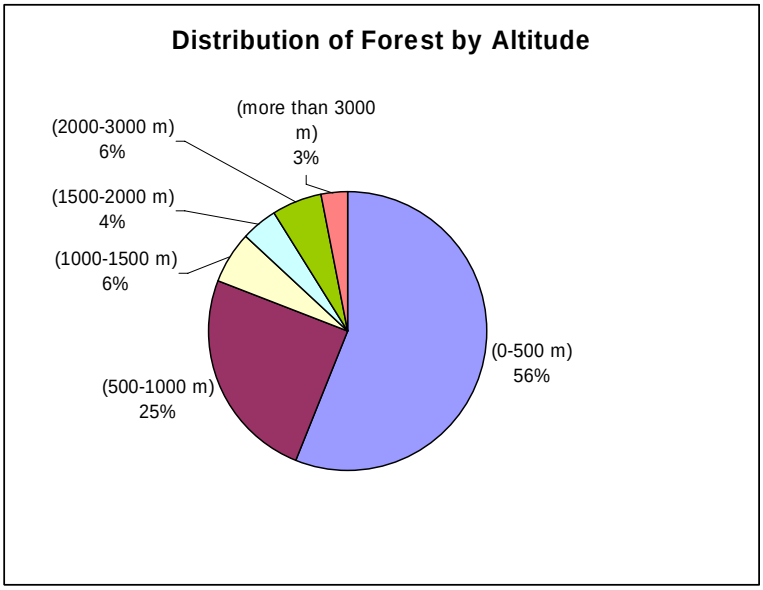
The variable helps to understand the existence of protective forest cover to conserve soil and water regimes in hill regions which are fragile landscapes of India. The monitoring of forest cover in hills is important for long term sustainability of hilly landscapes.

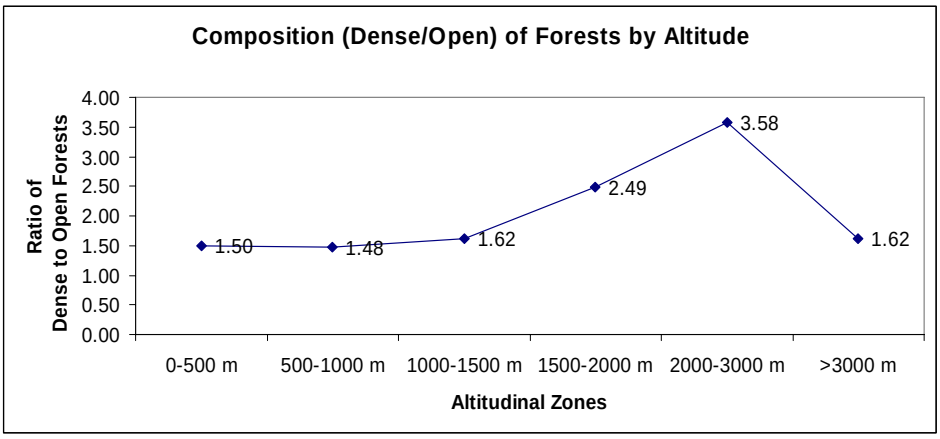
Definition

Term	Definition
Hilly Region	A region above 500 meter altitude

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.





FIS has nation wide data on forest cover in hill districts from 1994 onwards only (FSI, 1997, FSI, 1999, and FSI, 2001).

Item	1994	1997	2000
Percentage of forest cover	36.8	37.0	37.0 %

Assessment

The temporal trend 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.

5.5f Extent of Mangroves

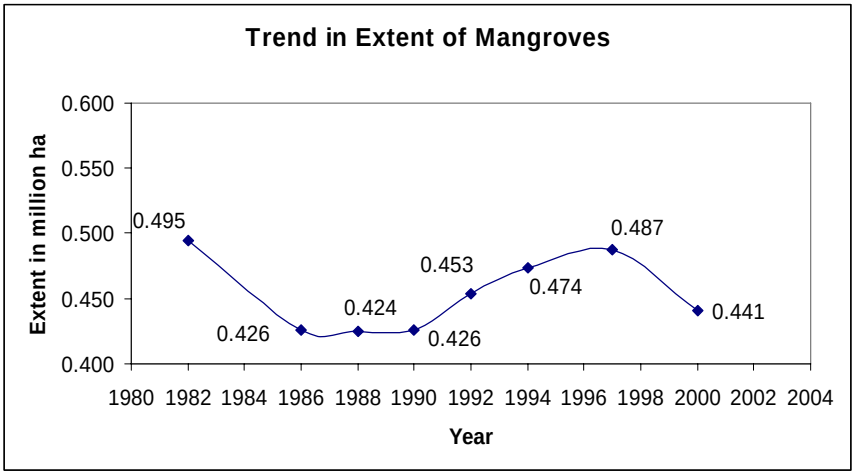
Mangrove forests are wetland forest ecosystems. They protect coastal areas from tidal action of waves, strong winds and cyclones and also provide livelihood to local people.

Definition

Term	Definition
Mangroves	Salt tolerant forest ecosystem found mainly in tropical and sub- tropical coastal and/or inter-tidal regions.
Mangrove Cover	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).

Data and Temporal Trends

Except for periodic survey by FSI, there are very few studies on Mangroves in India. The 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 the total area has increased because small additional patches of mangrove could be identified and the 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.

6a Social Functions

The theme focuses on the non-market oriented functions of forest recognised by the society like landscapes and services that have cultural, spiritual or recreational values and includes aspects of indigenous knowledge, privileges, participatory management systems etc. knowledge.

Relevant Variables

The following variables 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 (to local people and communities)
c. Extent of cultural/sacred Forests
d. Extent of grazing (cattle population dependent on forest)
e. Number of participatory institutions & area under it

6a.3 Source Data

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

a. Use of Traditional knowledge

The local "Traditional knowledge" (TK) related with a biological resource is an inseparable part of that resource. India is making a determined effort to use TK to promote the sustainable management of its forest resources. It has developed three laws (the Protection of Plant Varieties and Farmers' Rights Act, 2001, the Biological Diversity Bill, 2000, and the

Patents Bill, 1999) that also provide protection and support to the traditional knowledge related with the biological resources.

Definition (There is no standard national definition)

Term	Definition
Traditional knowledge	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. Explanation: 1. It is "traditional" only to the extent that its creation and use are part of the cultural traditions of communities. 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. 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.
Tradition-based	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.

Data and Temporal Trends

Sufficient data is not available for developing the 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.

b. 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 and maintain their sustainability. In many states of India, the forests are 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.

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 the condition of forests.

Assessment

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

c. 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 declines with their social values.

Definition Not standard national definition

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 by scattered studies in various parts of India indicates that there is a decline in the number and extent of the cultural and sacred forest. This indicates a loss in the social value of forests at the local level which is not a good sign for the conservation of forests.

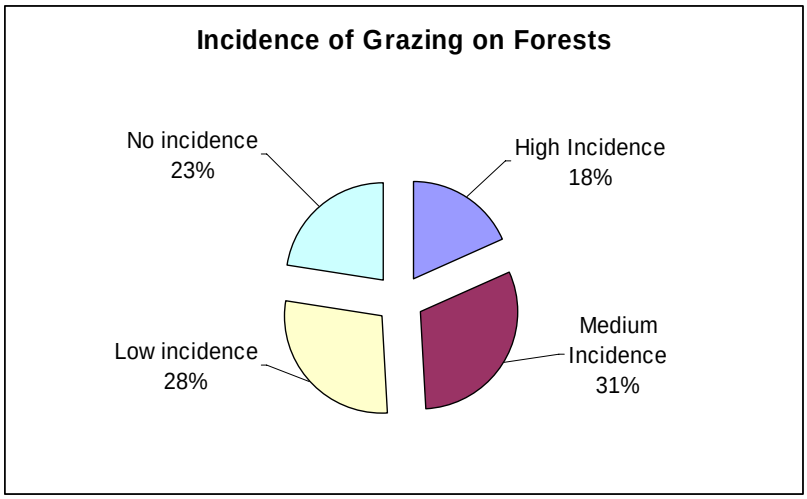
f. Extent of Grazing (Cattle Population Dependent on Forests)

The forest in India meet about 30 percent of national 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 forests and the conditions in which forests reside. The cattle, on the other hand, provide social and economic benefits and support mostly to the poorer 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, especially when it is beyond its resilience limits.

Definition (No standard national definition)

Data and Temporal Trend

A study at FSI (FSI, 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 incidence of grazing (18% high, 31% medium and 28% low). Since then FSI has not visited these locations to collect information on change, if any, in the level of incidence of grazing. However, decadal census of cattle indicates that number of cattle are increasing every year although slowly than in the past.



Assessment

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

f. Participatory Management

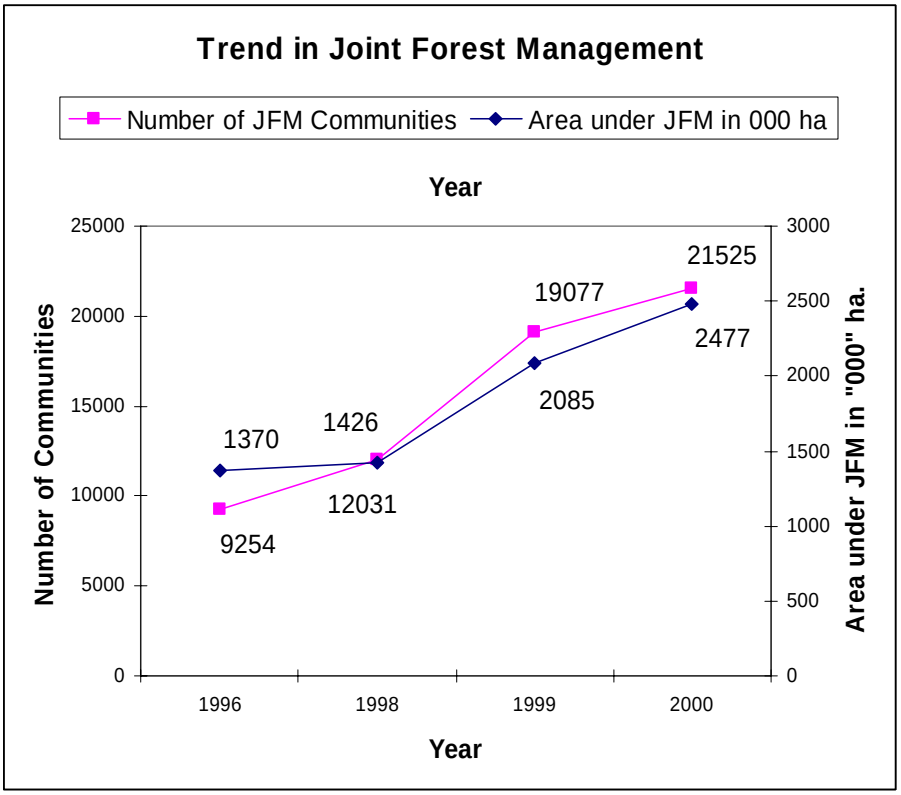
The utility and efficiency of participation between the "state" (state government) and local institutions for promoting sustainable management of forest resources is now well recognized. FIS has identified "number of participatory institutions" and "extent of forest under Joint Forest Management (JFM)" as the two national level complimentary variables 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.

Data and Temporal Trends

The following figures indicates past progress in this respect (FSI, 2003).



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.

6b Economic Functions

This sub-theme monitors the economic contributions of forest resources to the national economy like investments in the forest sector, revenue from forests, trade, contribution to gross national product and employment.

Relevant Variables

The following five variables, in addition to the global variables ("Value of Wood Removal" and "Value of NWFP Removal" and "Employment in Forestry") in the National Reporting Tables, have been identified as complementary variables to better 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 the forest sector to GDP

Source Data

Additional Variable	Source
Financial Investment in Forests	ICFRE, 1996, Forestry Statistics, 1996. Indian Council Of Forestry Research and Education. Dehradun, India
	ICFRE, 2000. Forestry Statistics, 2000. Indian Council Of Forestry Research and Education. Dehradun, India
	ICFRE, 2002. Forestry Statistics, 2002. Indian Council Of Forestry Research and Education. Dehradun, India
Revenue From Forests	Same as above
Trade of Wood	GOI. 'Monthly Statistics of Foreign Trade of India," Vol (I)- EXPORTS and Vol (II) - IMPORTS published by Directorate General f Commercial Intelligence & Statistics, Calcutta.
Trade of NWFP	Same as above
Contribution of Forest Sector to GDP	GOI, 1999. National Forest Action Plan. 1999. Ministry of Environment and Forests, Government of India
	ICFRE, 2002. Forestry Statistics, 2002. Indian Council Of Forestry Research and Education. Dehradun, India

a. Financial investments in forests

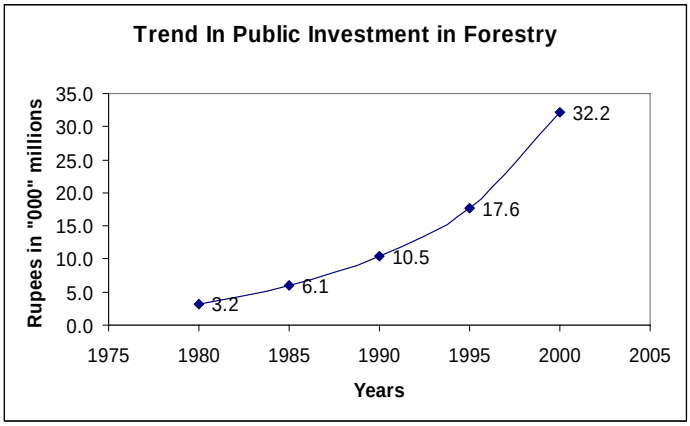
Financial investment in forests demonstrates the commitment of society to develop and sustain forest resources. It also defines the economic activity and support to livelihood that results from this investment. All this makes it an important variable to monitor regularly.

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.

Data and Temporal Trends

The following figure presents public investment in forestry activities. The investment represents the total government expenditure on forestry. The figure (32.2 billion rupees) for 1999 has been assumed for the year 2000.



Assessment

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

b. Revenue from forests

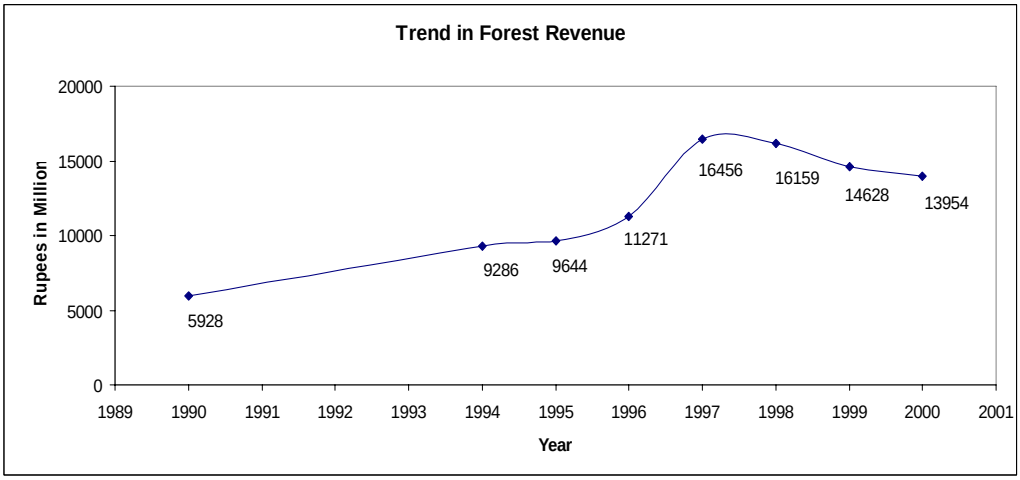
Revenue from forests is direct indicator of its economic function. The more is the revenue from the forest, the more is the economic contribution to or service of society by forests. It has a multiplier effect on the economic and social support system in a country.

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.

Data and Temporal Trend

The revenue from forests indicates an increasing trend till 1997 but shows a declining trend since then.



Assessment

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

c. Trade of Wood

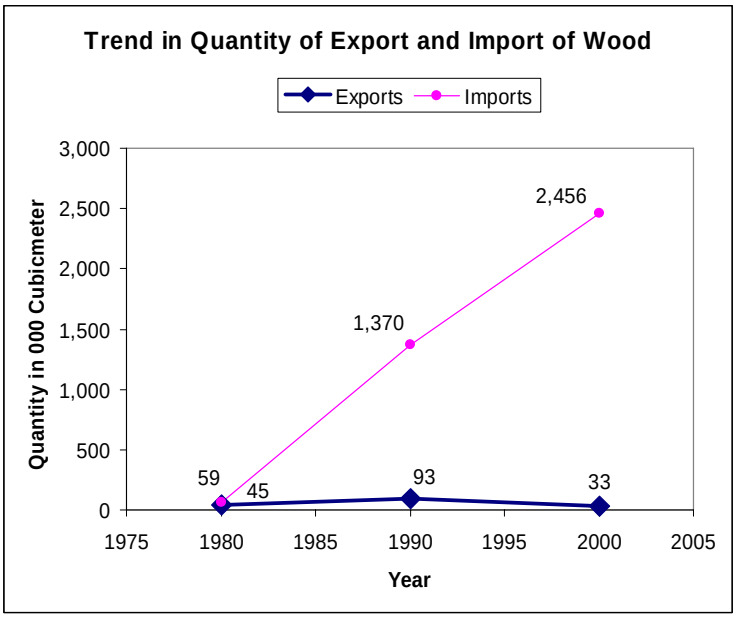
The domestic and international trade of wood directly affects the demand and the pressure on forest resources. Therefore, it is an important variable to monitor the sustainability of forests.

Definition (There is no national standard definition)

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

Data and Temporal Variable

The total requirement for 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, nearly twenty percent comes from 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, an increase in imports and a decrease in exports. The following figure present the situation of export and import of Wood in a graphical manner.



Assessment

The situation looks unsatisfactory and indicates need to increase the productivity of forests and plantations (public and private) to address this situation.

d. Trade of NWFP

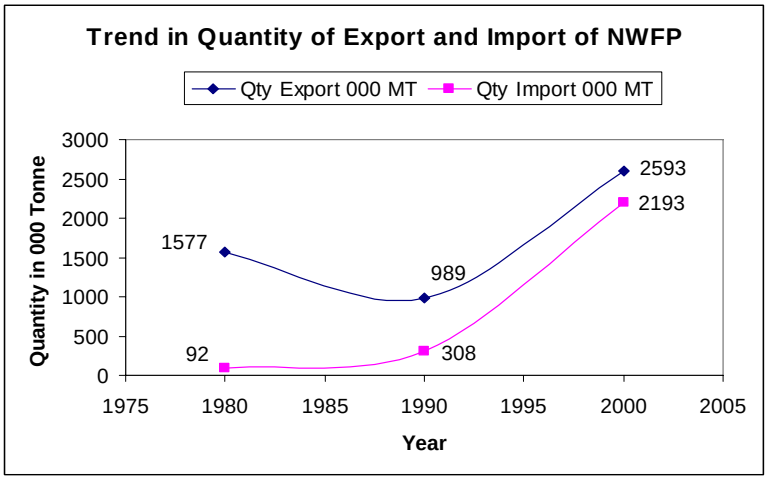
The variable derives importance from the fact that many indigenous and local people depend on NWFP to meet their daily needs and to economic supplement through their trade.

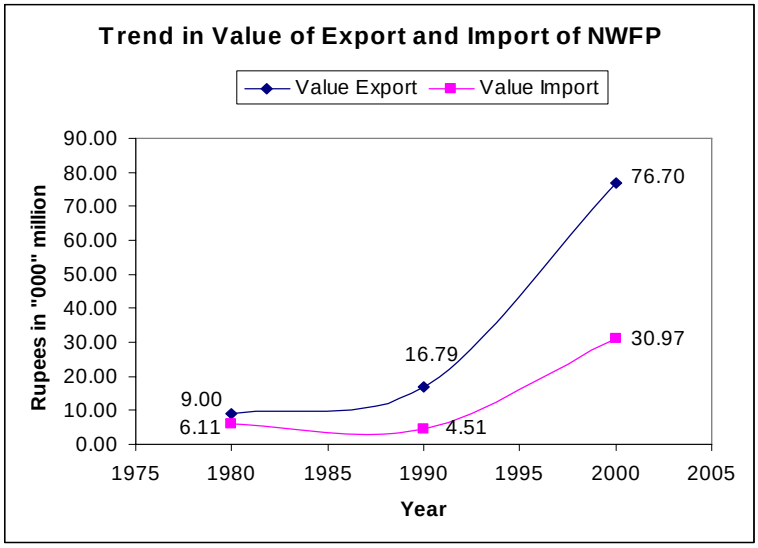
Definition (There is no national standard definition)

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."

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, the quality of information on export and import of NWFP is better than the production. The following figures presents 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. The benefit of such an 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.

e. Contribution of Forest Sector to Gross Domestic Product (GDP)

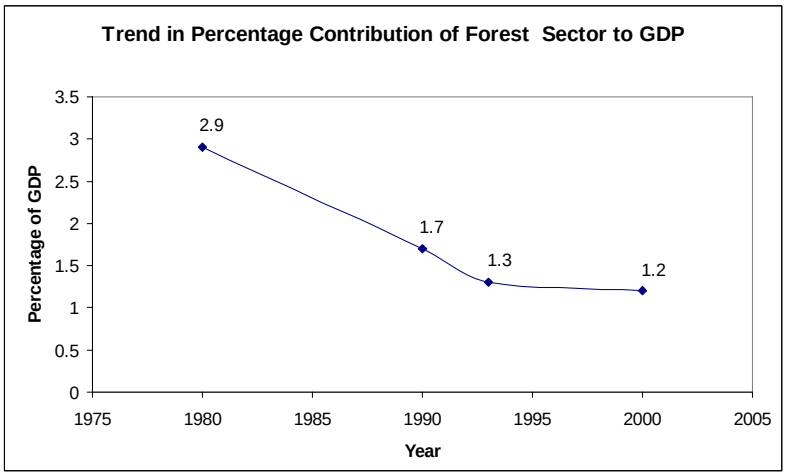
It is a direct measure of the contribution of the forestry sector to the national economy and can be used to estimate its multiplier effects on other sectors of the economy. It provides one of the basis for allocation of resources in the national planning system and thus the availability of for resources for forest development. Further, the GDP is considered more useful to measure of 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.

Data and Temporal Trend

In India, the contribution of the forestry sector to GDP includes the value of "round wood" and "NWFP" but does not include the contribution of forest-based industries which is included in the "manufacturing sector" and is, therefore, difficult to isolate. The national accounting figures of the contribution by forestry 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 the amount of the royalty (revenue) received by the state.



Assessment

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

Review and Assessment of Sustainability of Forest Resources

1 Back ground

The sustainability of forest resources ensures not only continuous supply of goods and services for the future generation but also healthy environment and ecological system. Wisdom demands, that the resources should be handed over to the next generation in enhanced and improved conditions by taking advantage of modern scientific technology and by resorting to sound resource management principles. Therefore, a need was felt to develop a system to review the sustainability of forest resources at the national and global level.

Demand for forest related information is continuously growing and new variables are being added as a result of growing scientific endeavour to understand the relationships of forest related variables with that of other disciplines. More and more regional and international processes are demanding forest related information from the countries on structure and multiple functions of forests across social, economic and ecological dimensions. Informed civil society who is aware of the consequences of depletion and degrading forest resources is also keen to understand the state and trend of the sustainability of their forest stocks as well as goods and services from them.

The global FRA 2005 has, therefore, conceptualized a global process to review the sustainability of forest resources using the framework of "criteria" or "thematic areas" that are common among various international/ regional processes. It has also developed a method (Group Convergence Method[3]) to implement this process. This is based on the recommendations of the Fourth Expert Consultation on "Global Forest Resources Assessment – Linking National and International Efforts" at Kotka, Finland (called Kotka IV) which suggested use of "criteria" of C&I processes for the "broad assessments" that include review of sustainability of forest resources. Specifically, the framework suggests use of the following six of the seven "Criteria" or " Thematic Areas" (after the recommendations of the International Conference on Criteria and Indicator (C&I), held in Guatemala in February 2003) that are common among the nine regional C&I processes. It divides the first and the last of the six "thematic areas" into two sub- thematic areas.

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

3

The framework suggests use of an expert "group convergence method (GCM)" to qualitatively value, aggregate and integrate the relevant information for reviewing the sustainability. The Advisory Group to global FRA, in its first meeting in recommended that the suggested methodology be first tested by conducting pilot studies in a few countries.

The Ministry of Environment & Forests, Govt. of India volunteered for such a pilot study to review sustainability of its forests resources and requested one of its organization the Forest Survey of India, Dehradun to coordinate the study with the technical and financial collaboration of Food & Agricultural Organization of the United Nations. The aim of the pilot study was to implement and test the proposed methodology for the review and assessment of sustainability of forest resources in the country and to actually make the first rough assessment of sustainability of its forest resources in the process.

2 Group Convergence Method

The "group convergence method" (GCM) is an iterative process to converge on some common valuation similar to "Delphi" method and functions well with small as well as large groups. GCM method needs a facilitator to facilitate the process and like most of the qualitative valuation methods, it is also subject to the bias of facilitator but provides maximum transparency to contain the bias. The GCM addresses equity issues, which means being impartial, fair and just to all stakeholders (individuals or institutions) in an efficient manner to incurrent biases of facilitator and experts. It demands and provides basis for strengthening and building capabilities of all the stakeholders by discussing about the variable at length and thereby ensuring their complete and effective participation in the expert consultation.

The GCM ensures equity considerations through proper representation of all stakeholders in the group irrespective of gender, class or entitlements. Accordingly, it proposes to select individuals with better or best information to implement the "Group Convergence Method" so that they are able to explain, reveal and share their basis of valuation rather than selecting individuals randomly as advocated in most of the other valuation method which may not result in selecting individual with best information. The GCM works on a round by round basis and enhances the quality of discussion and inputs in every round till the convergence in valuation is reached among the members of the group.

For developing a weighting scheme for criteria each expert is asked to give a mark between 1 and 100 to each criterion on the basis of his or her perception about its importance and contribution towards sustainability of forest resources. The range of 1 to 100 was decided by Forest Survey of India to enable to capture smaller variation. These marks are then converted to a percentage figure so that the total for all the eight criteria for each expert added upto 100. The mean value of all the participants for this converted figure is then intimated to the participants and those participants/experts whose figures or values are far from the mean are invited to explain the reasons for giving such marks by justifying their view in order to persuade others to change their marking. After a debate all other experts are asked to give a revised marking for the particular criterion in the second iteration. Many experts modify their evaluations during the process. The differences between mean values and an experts' marked

values is debated again and many experts revise their valuations. A new mean is calculated for next iterative round. This process is repeated till the new mean falls well within 10 percent of the mean in the previous iterative round. These figures are then taken to have "converged". The same process is also conducted for weighting schemes of criteria, variables within each criterion, and for valuation of each variable within criterion.

The qualitative assessment of variables to examine sustainability of forest against each "criteria" needs a classification and threshold scheme. It is pre-decided to see if a particular variable, on the basis of data and trends, represented "sustainable" or "un-sustainable" forest resources or whether it indicated movement "towards sustainability" or "towards un-sustainability".

On the basis of the presentations and ensuing discussion for each of the variables, experts for each of the variables give a score between 1 and 100. This score for a variable reflects the valuation of each expert on the status of forest sustainability on the basis of importance and trend for a particular criterion or variable within a criterion. Threshold are then set. For example, FSI selected following thresholds. A score between 1 and 25 would be interpreted to mean "unsustainable", from 26 and 50 would mean "towards un-sustainability", from 51 to 75 would be interpreted as "towards sustainability" and a score of 76 or above would mean "sustainable." The classification is divided into an even number of classes to avoid making a neutral category in the very middle, to which participants sometimes tend to gravitate due to fatigue or unwillingness to commit themselves to a clear decision. This classification and threshold scheme not only provides the status but also provide basis for assessing and reviewing the sustainability of forest resources.

The evaluation of variables for assessing the status of sustainability of forest resources, depends largely on the quality of the available data corresponding to the variable concerned. In this connection it is very important to know the reliability of data in terms of precision and accuracy and completeness of data in terms of coverage. This information also enable the group to identify the variables corresponding to which field data is appropriately available or deficient so that necessary actions could be initiated to generate reliable data. To address this aspect each expert is also asked to rate the "reliability" and "completeness" of data compiled by the individual resource person (at stage III) and presented to group, on a scale of 1 to 5 where on an average basis 1-1.5 represented "very poor", 1.5-2.5 represented "poor", 2.5-3.5 represented "satisfactory", 3.5-4.5 represented "good" and 4.5-5 represented "very good".

Within the above framework, two step qualitative assessment and aggregation protocol is required. At the first step each variable defining criteria is qualitatively assessed and then aggregated on the basis of weights decided using GCM to assess the sustainability of forest against each criterion. At step 2, these criteria wise assessed status of forests are qualitatively aggregated on the basis of weights decided by the group at stage-II, to review the sustainability of forest resources as a whole.

3 Process of Reviewing Sustainability

The Forest Survey of India implemented the GCM to review the sustainability of forest resources in India among a group of selected experts. It organised two expert consultations

for this purpose and accomplished it through following five stages excluding organization of the expert group.

Stage I	Identification of variables
Stage II	Assigning of weights to each criterion and variable
Stage III	Compilation of national data and trends
Stage IV	Valuation of each variable by scoring
Stage V	Assessment of overall status of sustainability of forest resources

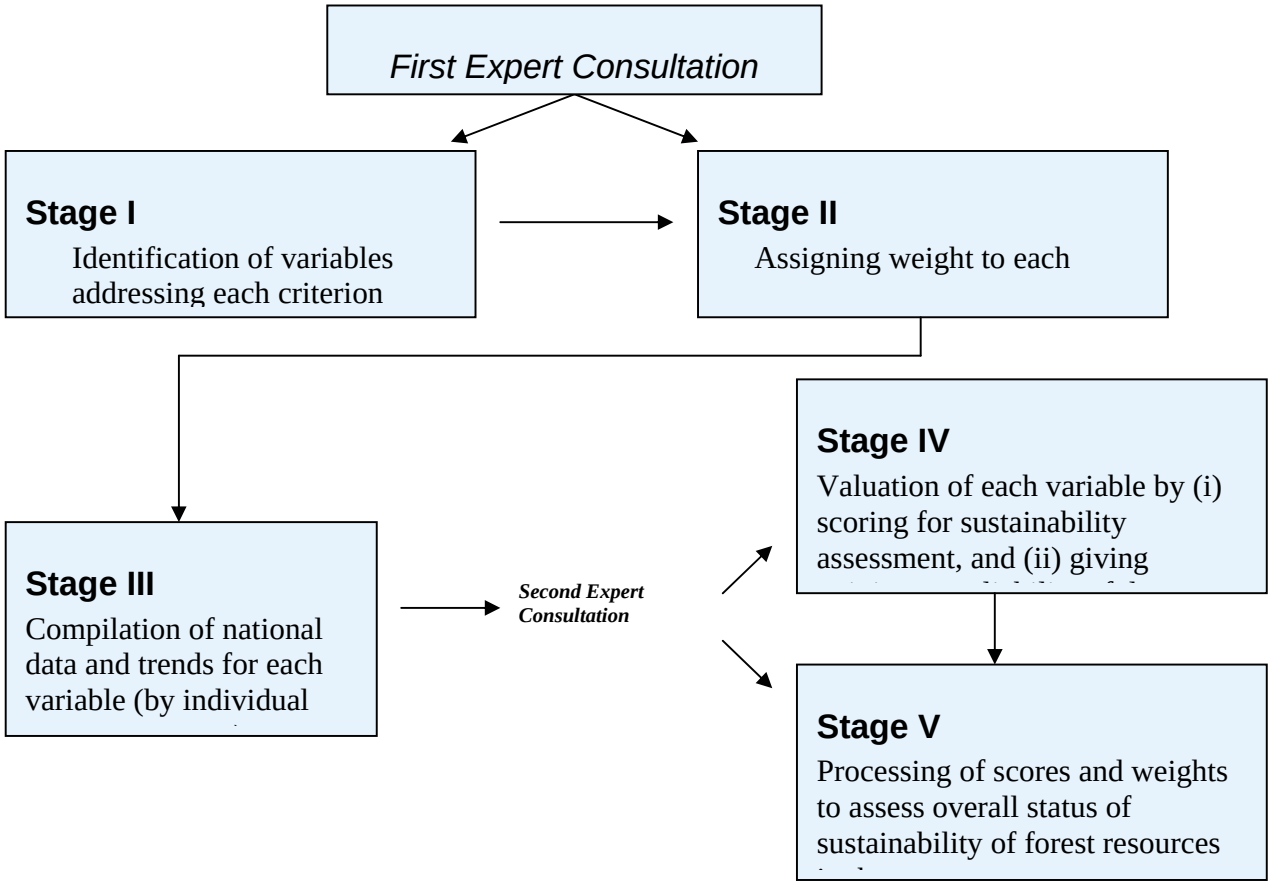


Figure 1: Process of Reviewing sustainability

Constitution of Expert Group

FSI constituted a group of 33 experts representing a number of stakeholders in forest management to participate in the study. It also identified an external facilitator to implement the process in a fair manner. It comprised of foresters, conservationists, academicians and

biologists representing government departments and institutions (both central and state). However, experts from forest industry, non-government organizations and sections of people living near or in the forest were not included in this group due to time and logistic constraints and also because in this first attempt, FSI aimed to emphasis the development of methodology rather then equity consideration. The selected participants or experts had worked in and or had experience in different parts of the country and, in a way, they represented a satisfactory cross-section of the country. A concept paper was sent to each of the participants so that they knew in advance about the problem, the technical framework, the process and the methodology for their effective participation. The group implemented the review through following five stages.

Stage I: Identification of variables

Forest Survey of India (FSI) constituted a group of experts covering many disciplines to test and implement the suggested methodology. However for this pilot study, it drew the experts only from the national agencies. FSI provided an initial list of 57 plausible variables to the group for consideration. It took help of an imminent international forestry expert to serve as facilitator for this purpose.

During the first expert meeting (Feb.17-18, 2003), the list of plausible variables under each of the eight criteria was deliberated at length by the experts. The facilitator explained to the group that this list of variables was just for initiate the discussion and if the group is free to delete or add variables provided there is consensus among the group members to do so. The group decided to delete 14 variables and add 5 more variables leading to a shorter list of 48 variables. These 48 variables were identified as important indicators of respective criterion without any serious consideration on ready available data for on them. Further, classification of these variables into “global” or “regional” was not considered necessary at this stage.

Stage II: Assigning of weights to each criterion and variable

Each criterion was given weights pertaining to their relative contribution to the sustainability of forest resources. Similarly, within each criterion, various variables were given weights corresponding to their relative importance to that criterion. Perception of each expert towards these criteria and variables was reflected in the weights assigned by them. There were substantial differences of opinion regarding the weight assigned to each of the criterion and the related variables. However, the iterative process of “Group Convergence Method” (GCM) enables convergence on these issues just after two iterative rounds implemented the facilitator. A workbook was created in MS Excel with formula and related linkages to derive mean value/weight and individual scores/weight to the group members during the iteration process as quick as possible for each criterion and each variable within a criterion. This step lead to a consensus with regard to weights to be assigned to all the 8 criteria (thematic areas) and identification of the 48 variables.

Stage III: Compilation of national data and trends

FSI requested more than two dozen experts from various national agencies to act as resource persons and assigned variables related to their field of expertise to compile and analyse the readily available national data and trends for each of the 48 variables within a period of two weeks. These experts then presented their reports and supporting documents and references in the second expert consultation. The compilation of national data and trends corresponding to each identified variable was felt necessary to provide input for qualitatively assessing the concerned variables. The task of qualitatively assessing the variable was taken up in the second expert consultation.

Stage IV: Evaluation of data and trends

In the second consultation (March 5-6, 2003), the facilitator initiated the process by explaining the task at hand. The facilitator invited each experts to present his/her report on the status and trend of the variable, studied by them, along with their assessment on the reliability and completeness of the data. The group of experts was then asked to discuss whether a particular variable represented "sustainable" or "un-sustainable" condition (state and trend) of forest resources or did it indicate movement towards "sustainability" or "un-sustainability". On the basis of these presentations and ensuing discussions each expert individually gave a score between 1 and 100 to each of the 48 variable to represent capacity of these variables to capture the sustainability of forest resources in India. Each expert also rated the "reliability" and "completeness" of data presented on a scale of 1 to 5. A score of 5 represented "very good" and a score of 1 represented "very poor" reliability and completeness. There was significant variation in these initial scores among the experts. Only two rounds of GCM were implanted by the facilitator as the second round of the GCM implemented by the facilitator lead to a converged score or mean value for each of the variable within 10 percent of the first iteration.

Stage V: Assessment of sustainability of forest resources

In the fifth and the final stage, the expert group assessed the contribution of each criterion towards sustainability of forest resources by using the mean scores for the variables and their weights. Overall assessment of sustainability of forest resources in the country was computed by multiplying these figures with corresponding weights of criterion. The mean value was 55.8 with standard error of 1.7. An exercise to check the variability among the individual assessments of the sustainability indicated that out of 33 experts assessment, only 3 assessment were below 51 and the rest 30 assessment were above 51. Thus the group by and large agreed with the composite average assessed during this exercise. The results for each variable and criterion are presented in the next chapter.

4 Outcomes of Review Process

The following sub-sections provide the outcomes of the iterative rounds of GCM including relative weights, scores and weighted scores in respect of each variable for each criterion.

The sub-sections also present the mean scores for reliability and completeness of data and trends for each variable.

Criterion 1a: Extent of Forests

The expert group considered the initial list of 7 variables and after deliberation rejected two and maintained the rest five variables. It implemented the GCM process to give weights and scores to the variables based on their state and temporal trend (See National reporting tables 1 to 15 and National thematic report). It gave the variable 'forest cover' the highest relative weight. This weightage implies that this variable is most important in defining the capacity of the criterion 'extent of forests' to explain the sustainability of forest resources. The group gave the highest score (value) to 'forest area' instead of 'forest cover'. These values attempt to capture the state and trend of each of these variables in the context of the sustainability of forest resources.The Table given below presents these weights and scores. It indicates that all the variables under this criterion indicate a movement 'towards sustainability' because the scores of all the variables are more than 50.

The group was of the opinion that quality of data is very good for 'forest area', good for 'forest cover' and 'TOF' and satisfactory for rest of the variables. The group also recognised the need to improve the data quality for the remaining two variables ("diversion of forest lands" and "forest under management plans").

S.No.	Variables	Relative Weight	Score	Weighted score	Reliability/ Completeness
V1	Forest area	22.0	73.2	16.1	4.6
V2	Forest cover	23.9	69.9	16.7	4.3
V3	Diversion of forest lands	16.8	59.2	9.9	3.2
V4	Trees Outside Forest (TOF)	19.2	72.7	13.9	3.6
V5	Forest under management plans	18.1	68.8	12.4	3.3
	Total	**100.0**		**69.2**	

Criterion 1b: Contribution to Carbon

The group identified only three variables corresponding to this criterion. It implemented the GCM process to give weights and scores to the variables based on their state and temporal trend (See National reporting tables 1 to 15 and National thematic report). The group felt that the variable 'carbon stock in forest biomass' is most important and gave it highest relative weight whereas the variable 'carbon stock in TOF' was considered to be least important. However, the group gave the highest score (value) to 'carbon stock in TOF' because it has an increasing trend over time and was considered to posses more potential than others to sequester carbon. The Table below presents these relative weights and scores of the three variables. The group felt that the over all trend of forest resources against this criterion is towards "sustainability".

The group observed that the quality of existing data is just satisfactory, since the carbon stocks in underground biomass and in forest soil have not been assessed due to lack of data. These data needs are being addressed by FSI for the whole country and may be available after two years.

S.No.	Variables	Relative Weight	Score	Weighted score	Reliability/ Completeness
V1	Carbon stock in forest biomass	36.4	60.1	21.9	3.0
V2	Carbon stock in TOF	31.0	65.6	20.3	3.2
V3	Carbon stock in forest soil	32.5	57.7	18.8	3.2
	Total	**100.0**		**61.0**	

Criterion 2: Forest Health & Vitality

The group decided to exclude 4 variables out of the initial list of 11 variables and include 2 new variables leading to a list of 9 variables for detailed examination under this criterion. It implemented the GCM process to give weights and scores to the variables based on their state and temporal trend (See National reporting tables 1 to 15 and National thematic report). The group identified that the variable "density of forest canopy" is most important and the variable 'pollutants' is least important and it accordingly awarded the weights to all the nine variables. Similarly, the group felt that the density of forest canopy is increasing and therefore gave it high score. It also observed that the trend of "natural regeneration" is not satisfactory and hence gave it a low score (value) to this variable. The following table provides these weights and scores. The group felt that the over all trend of forest resources against this criterion is towards "sustainability".

The quality of data was rated "good" for "density of forest canopy", "satisfactory" for "status of natural regeneration", "incidence of fire", "presence of indicator species" and "forest fragmentation' and "poor" for other variables.

S.No.	Variables	Relative Weight	Score	Weighted score	Reliability/ Completeness
V1	Status of natural regeneration	13.9	36.4	5.0	3.2
V2	Incidence of pest & disease	10.9	46.1	5.0	2.5
V3	Incidence of weed infestation	10.2	39.3	4.0	1.8
V4	Incidence of grazing	11.2	37.0	4.1	2.4
V5	Incidence of fire	10.6	50.2	5.3	2.5
V6	Pollutants	7.3	59.6	4.4	1.8
V7	Density of forest canopy	14.1	69.5	9.8	3.9
V8	Presence of indicator species	10.2	49.5	5.1	2.8
V9	Forest fragmentation	11.6	45.6	5.3	3.0
	Total	**100.0**		**48.0**	

Criterion 3: Biodiversity Functions

The group identified 5 variables for reviewing th esustainability of forest resources against this criterion. It implemented the GCM process to give weights and scores to the variables based on their state and temporal trend (See National reporting tables 1 to 15 and National thematic report). It felt that the "area under protected areas" is most important gave it the highest relative weight and the score. It considered that the variable "introduced/invasive species (flora & fauna)" is least important and gave it the lowest relative weight and the score. The following table presents these relative weights and scores. It indicates that overall state and trend of forest resources against this criterion indicates the movement towards sustainability. This is mainly because the "area under protected areas " is continuously increasing over the last two decades, and the "species richness and diversity including micro-organism" and "status of endemic species (flora & fauna)" are indicating good conditions. The group, however, recognised that the data on the two of the five variables ("status of threatened species" and "introduced/invasive species") indicates a movement away from the "sustainability".

The group inferred that the data quality is good for the variable "area under protected areas" because its information is being updated every year, "satisfactory" for the three variables ("status of endemic species (flora & fauna)", "status of threatened species" and "species richness & diversity"), and "poor" for the variable "introduced/ invasive species" as information for this variable is neither collected regularly nor it is a part of any national survey.

S.No.	Variables	Relative Weight	Score	Weighted score	Reliability/ Completeness
V1	Area under protected areas (PA)	21.3	69.4	14.8	3.8
V2	Status of endemic species (flora & fauna)	20.4	57.7	11.8	3.2
V3	Status of threatened species as per IUCN categorization (flora & fauna)	19.7	48.8	9.6	3.3
V4	Species richness & diversity including micro-organisms	21.2	64.7	13.7	3.0
V5	Introduced/invasive species (flora/ fauna)	17.3	48.4	8.4	2.0
	Total	**100.0**		**58.3**	

Criterion 4: Production Function

The group decided to exclude 3 variables and include 2 new variables in the initial list of 7 variables leading to the final list of 6 variables for review of this criterion. The group implemented the GCM process to give weights and scores to the six variables based on their state and temporal trend (See National reporting tables 1 to 15 and National thematic report). It ranked "growing stock" as the most important variable and gave it the highest weight and the score. It gave lowest weight to the variable "areas under SPA, SSO, CSO" but least score to the variable "rate of increment in volume". The group concluded that the over all status of the criterion indicates the movement towards "sustainability".

The group rated the quality of data as "good" for the variable "growing stock" as its information is reliable and collected regularly on a scientific basis covering the whole of the country. It rated quality of information for rest of the variables as "satisfactory" due to lack of scientific methodology, coverage and reliability.

S.No.	Variables	Relative Weight	Score	Weighted score	Reliability/ Completeness
V1	Growing stock	21.1	59.6	12.5	3.7
V2	Removal of wood from forests	16.2	39.5	6.4	2.6
V3	Rate of increment in volume	19.3	52.1	10.1	3.1
V4	Removal of important NWFPs	15.2	46.2	7.0	3.4
V5	Extent of area under SPA, SSO, CSO	12.0	57.2	6.8	2.8
V6	Area under improved planting stock	16.2	55.9	9.1	2.5
	Total	**100.0**		**52.0**	

Criterion 5: Protection Function

The group decided to include 2 new variables to the initial list of 5 variables leading to the final list of 7 variables for review of this criterion. The group implemented the GCM process to give the weights and the scores to the seven variables based on their state and temporal trend (See National reporting tables 1 to 15 and National thematic report). The group inferred that the "forest area under watershed treatment" is the most important variable and gave it the highest weight, however it gave the highest "scores" to the variable "extent of mangroves". The following table presents these relative weights and scores. The group felt that all the variables except "extent of degraded forests" are leading forest resources towards sustainability. The group concluded that the over all trend of forest resources against this criterion is towards "sustainability".

The group rated the quality of the data as "good" for the four variables ('extent of degraded forest area', 'forest cover on hills' and 'extent of mangroves') since these are assessed scientifically and data updated regularly for the last 15 years for the entire country. The quality of data for rest of variable was rated 'satisfactory' due to incompleteness.

S.No.	Variables	Relative Weight	Score	Weighted score	Reliability/ Completeness
V1	Forest area under watershed treatment	15.4	65.1	10.0	3.1
V2	Forest soil fertility status	13.1	61.2	8.0	3.0
V3	Extent of degraded forest area	14.1	47.7	6.7	3.5
V4	Ground water table in vicinity of forest	13.2	52.9	7.0	2.5
V5	Extent of Protective forests	15.0	59.0	8.9	2.9
V6	Forest cover on hills	15.4	61.9	9.5	4.1
V7	Extent of mangroves	13.8	69.1	9.5	4.0
	Total	**100.0**		**59.7**	

Criterion 6a: Social Function

The group decided to exclude 1 variables from the initial list of 8 variables leading to the final list of 7 variables for review of this criterion. The group implemented the GCM process to provide the weight and the scores to the variables based on their state and trend (See National reporting tables 1 to 15 and National thematic report). The group inferred that the "human & cattle population dependent on forests" is most important variable and gave it highest weight and considered the 'extent of cultural/sacred forests' as the least important variable. The group appreciated increasing trend of "number of participatory institutions' and gave highest scores to this variable.

The reliability of data for all variables except 'extent of cultural/sacred forests' is rated as 'satisfactory' because of lack of appropriate methodology and coverage. Though the number of participatory institution and area under those is known but the data, which can explain their role in sustainability of social function of forest is not available for the country and that is why it is also rated only as 'satisfactory'. The quality of data for variable 'extent of cultural/sacred forests' is rated as 'poor' since very less data is available.

S.No.	Variables	Relative Weight	Score	Weighted score	Reliability/ Completeness
V1	Use of traditional Knowledge	12.3	56.1	6.9	2.8
V2	Quality & extent of privileges	13.7	39.0	5.3	2.6
V3	Extent of cultural/sacred forests	11.8	53.5	6.3	2.4
V4	Energy from wood resources	15.9	36.1	5.7	3.0
V5	Recreation services	12.7	57.5	7.3	2.7
V6	Human & cattle population dependent on forests	17.9	33.9	6.1	2.5
V7	Number of participatory institutions & area under it	15.6	60.1	9.4	3.1
	Total	**100.0**		**47.1**	

Criterion 6b: Economic Function

The group decided to exclude 5 variables from the initial list of 11 variables leading to the final list of 6 variables for review of this criterion. The group implemented the GCM process to provide the weight and the scores to the variables based on their state and trend (See National reporting tables 1 to 15 and National thematic report). The group inferred that the "financial investment in forests" as the most important variable and awarded it with the highest weight but gave it the least score (value) as the group considered the current level and trend of financial investment in forest as inadequate to sustain economic function of forests. The following tables presents the weights and the scores given by the group. The group concluded that the review of the current state and trend of the variables against this criterion indicates that forest resources are moving away from the sustainability.

The group rated the quality of data as "satisfactory" for two variables ("financial investment in forests", and "contribution of forest sector & forest based industries to GDP") and as

"poor" for the rest four variables ("consumption of wood & NWFPs", "value of trade of wood and NWFPs", "employment in forestry & forest based industries" and "revenue from forests") due to poor reliability and incomplete data.

S.No.	Variables	Relative Weight	Score	Weighted score	Reliability/ Completeness
V1	Financial investment in forests	18.3	45.7	8.4	3.2
V2	Consumption of wood & NWFPs	16.9	46.7	7.9	2.3
V3	Trade of wood and NWFPs	16.5	49.2	8.1	2.4
V4	Employment in forestry & forest based industries	17.3	48.3	8.4	2.2
V5	Contribution of forest sector & forest based industries to GDP	16.6	58.9	9.8	3.0
V6	Revenue from forests	14.3	47.0	6.7	2.2
	Total	**100.0**		**49.3**	

5 Assessment of Sustainability of Forest Resources

The group combined the relative weight it had awarded to each criteria with their scores accrued to each variable from the above exercise. Following tables weights the scores with relative weights to provide a weighted score for the set of the six "Criteria" (Thematic Areas). A comparison of the weighted scores earned by each criterion indicates that "Extent of Forest" is the most important than others in defining the sustainability of the forest resources. The group concluded that the final weighted score of 55.8 for the combined set of the six "criteria" demonstrates that the over all trend of forest resources is towards "sustainability" even though the review of the state and trend of forest resources against the three criterion ("Forest Health & Vitality", "Social Function", and "Economic Function") indicate that forest resources are moving away from the "sustainability".

Criteria		Relative Weight	Score	Weighted Score
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
	Total	**100.0**		**55.8**

FSI has carried out the quantitative review of the sustainability of forest resources in India using the group convergence method that has 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 should be a cause for concern. The following table presents the scores by each Criterion or Thematic Area. It indicates that the three thematic areas (Forest health and Vitality, Social Function and Economic Function) need more attention from policy makers to ensure the long term sustainability of forest resources in India. The study has also indicated need to improve the periodic measurements and quantitative assessment of identified forest related parameters. This is important because the expert group rated quality of the information as "very good" for only one variable, "good" for 8 variables, "satisfactory" for 30 variables and "poor" for 9 variables.

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.

Conclusion

FSI by developing this process of reporting has institutionalized the process at the national level and has identified the data needs to report to FRA 2005. This working paper sets the baseline for further improvement and refinement for the final input from India to FRA 2005.