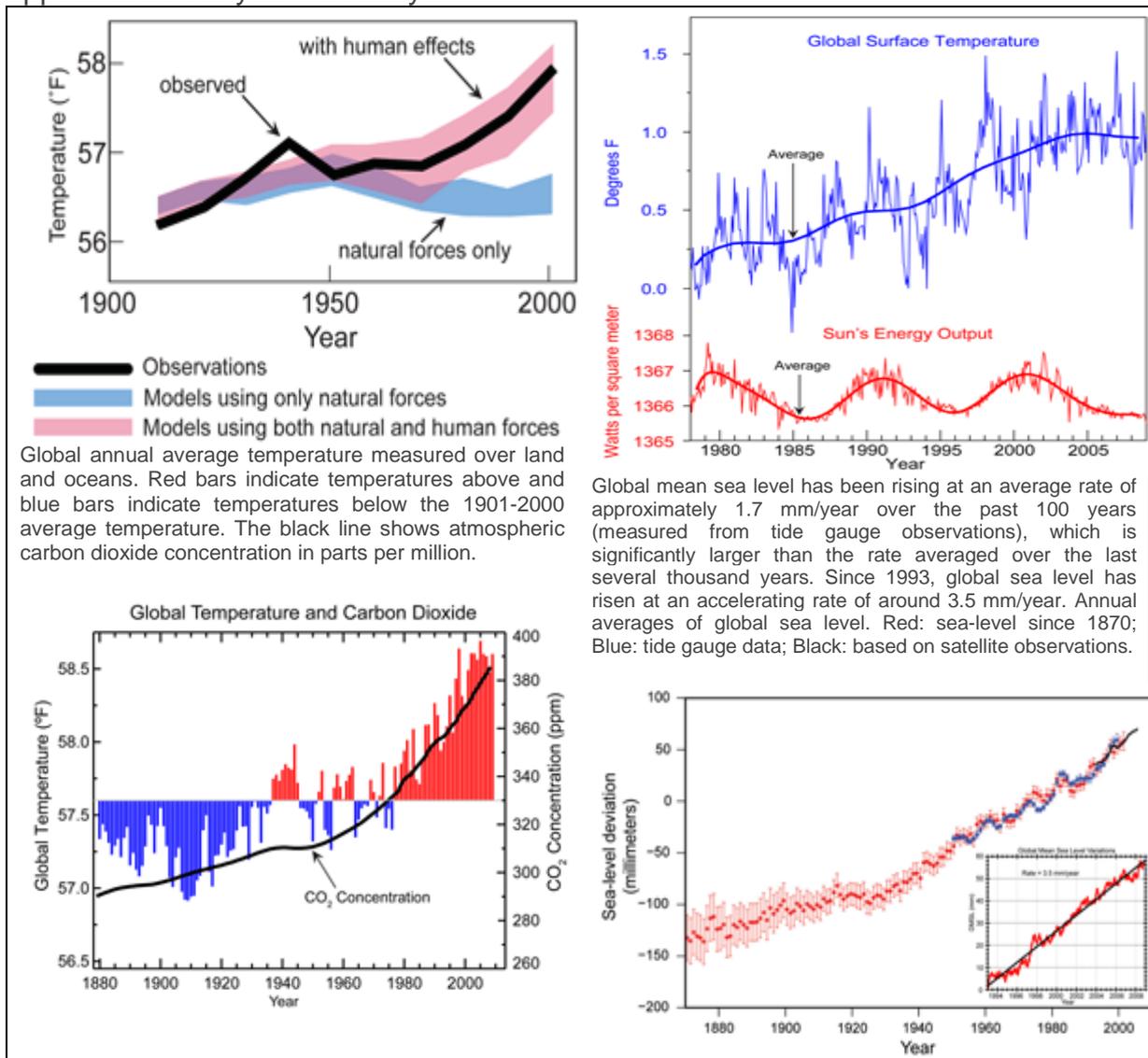


## Chapter 33 ENVIRONMENT AND FOREST

“What's the use of a fine house if you haven't got a tolerable planet to put it on?”  
– Henry David Thoreau, *Familiar Letters*

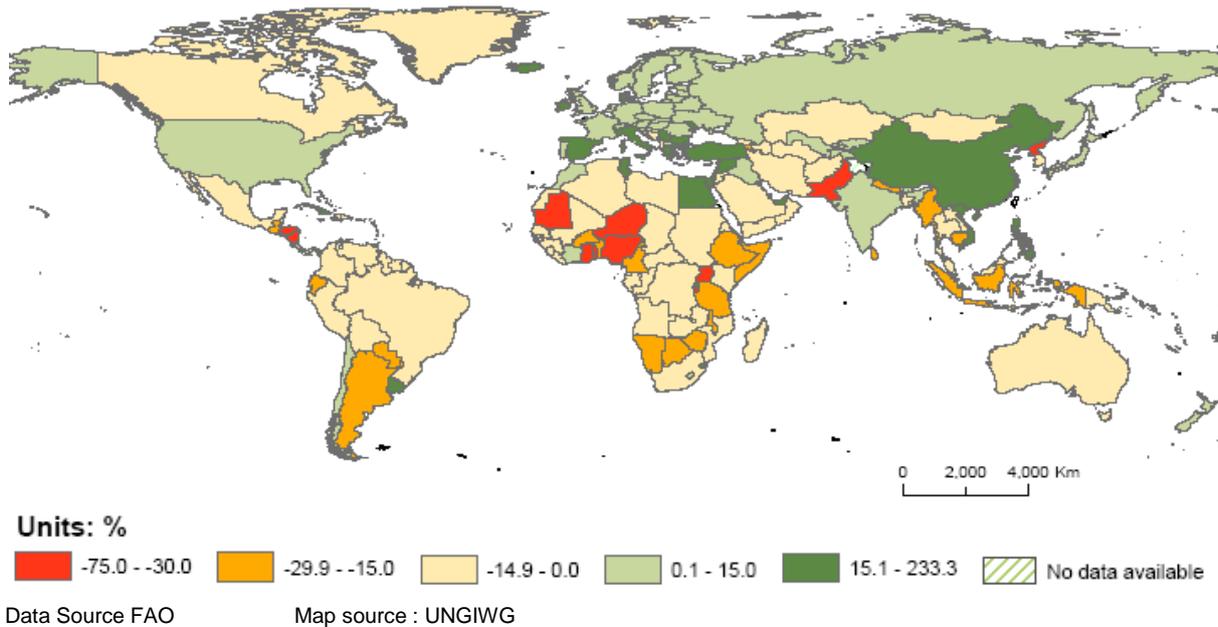
**33.1** Existence of human beings not only involves interaction with the environment around them but also impacts the same significantly due to their potential to alter it. Burgeoning population in pursuit of its never ending needs, has already made its imprints reducing forest covers, emitting green house & poisonous gases, releasing toxic chemicals. Quality of present life has been adversely impacted while that of future generations is in peril. No doubt, issue of climate change with its ensuing effects has shot into centre stage as human beings are faced with the inconvenient truth about their success story.

**33.2** Global climate models clearly show the effect of human-induced changes on global temperatures with global average temperature showing an increase of 1.4F approx since early 20<sup>th</sup> Century..



Source National Climate Data Center, USA

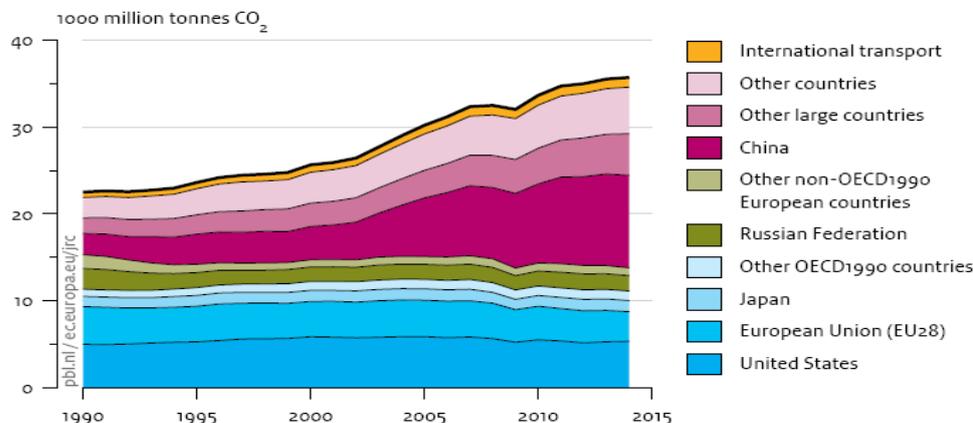
## Change of Forest Area from 1990 to 2010



**33.3** After a decade of very high annual growth rates of global CO<sub>2</sub> emissions of 4% on average, followed by two years of slowdown to about 1%, the growth in emissions almost stalled in 2014 with an increase of only 0.5% to 35.7 billion tonnes (Gt) CO<sub>2</sub>. At the same time, the world's population and economy continued to grow by 1% and 3%. Apart from the recent two years of recession, the 0.5% emission growth in 2014 was the lowest global growth rate since 1998. Where, in the previous years, it was debated whether or not the slowdown was accidental, now, after three years and trends over two or three quarters of 2015, we can conclude that the global slowdown is very likely due to structural changes. The slowdown in emissions and the continuing economic growth suggests a partial decoupling of the trend in global CO<sub>2</sub> emissions from that of the global economy. China, with 10.6 Gt CO<sub>2</sub> and a share of 30% in global CO<sub>2</sub> emissions, plays a pivotal role in this respect.

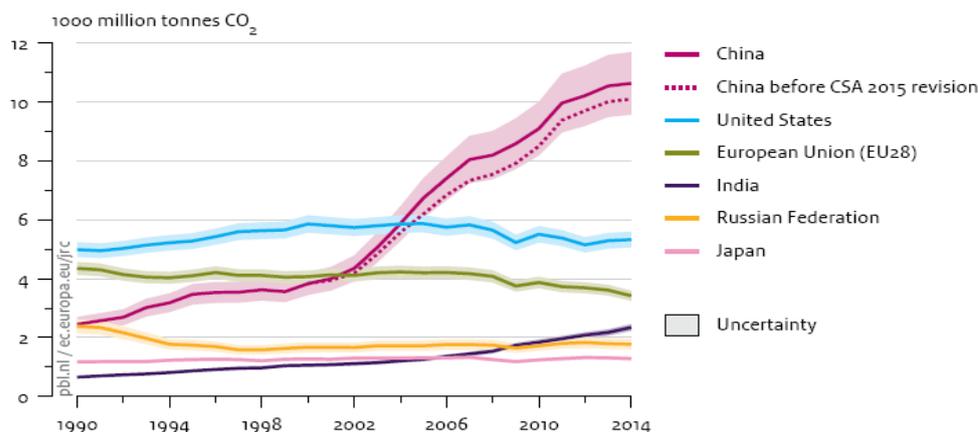
As for the weather, 2014 was the warmest year, globally, since records began in 1880. Including 2014, 9 of the 10 warmest years in the 135-year period on record occurred in this century. A large drop in demand for space heating (by 10%) in the European Union (EU-28) due to the warmest winter months on record contributed to plummeting gas consumption and the large drop (by 5%) in the EU's CO<sub>2</sub> emissions in 2014.

### Global CO<sub>2</sub> emissions per region from fossil-fuel use and cement production



Source: EDGAR 4.3 (JRC/PBL, 2015) (1970-2012; notably IEA 2014 and NBS 2015); EDGAR 4.3FT2014 (2013-2014); BP 2015; GGFR 2015; USGS 2015; WSA 2015

## CO<sub>2</sub> emissions from fossil-fuel use and cement production in the top 5 emitting countries and the EU



Source: EDGAR 4.3 (JRC/PBL, 2015) (1970-2012; notably IEA 2014 and NBS 2015); EDGAR 4.3FT2014 (2013-2014): BP 2015; GGFR 2015; USGS 2015; WSA 2015

## CO<sub>2</sub> emissions in 2014 (million tonnes CO<sub>2</sub>) and CO<sub>2</sub>/capita emissions, 1990-2014 (tonnes CO<sub>2</sub> per person)

Country	Emissions 2014	CO <sub>2</sub> /cap in 1990	CO <sub>2</sub> /cap in 2000	CO <sub>2</sub> /cap in 2010	CO <sub>2</sub> /cap in 2013	CO <sub>2</sub> /cap in 2014	Change '90-'14	Change '90-'14 in %	Change	Change in
									in CO <sub>2</sub>	population
									1990-2014	1990-2014
									in %	in %
United States *	5,330	19.6	20.6	17.6	16.5	16.5	-3.1	-16%	7%	27%
EU-28	3,420	9.2	8.4	7.7	7.1	6.7	-2.5	-27%	-21%	8%
- Germany	770	12.5	10.3	9.7	9.8	9.3	-3.2	-26%	-24%	3%
- United Kingdom	420	10.1	9.3	7.9	7.2	6.5	-3.6	-35%	-28%	11%
- Italy	340	7.5	8.0	7.0	6.0	5.5	-1.9	-26%	-20%	7%
- France	320	6.7	6.7	6.0	5.5	5.0	-1.7	-25%	-15%	14%
- Poland	300	9.4	8.1	8.4	8.1	7.8	-1.6	-17%	-17%	0%
- Spain	240	5.8	7.6	6.1	5.2	5.1	-0.7	-12%	7%	21%
- Netherlands	160	10.7	10.8	10.9	10.0	9.4	-1.3	-12%	0%	13%
Russian Federation	1,770	16.1	11.3	12.0	12.5	12.4	-3.7	-23%	-26%	-4%
Japan	1,280	9.6	10.1	9.8	10.3	10.1	0.5	5%	9%	4%
Canada	570	16.2	17.9	16.0	16.1	15.9	-0.3	-2%	26%	28%
Australia	410	16.1	18.5	18.7	17.9	17.3	1.2	7%	48%	38%
Ukraine	250	15.1	7.2	6.6	6.6	5.5	-9.6	-63%	-68%	-13%
<b>Other countries:</b>										
China	10,590	2.1	2.9	6.6	7.5	7.6	5.5	262%	333%	20%
India	2,340	0.8	1.0	1.5	1.7	1.8	1.1	146%	259%	46%
Iran	620	3.6	5.3	7.7	7.8	7.9	4.3	117%	203%	39%
South Korea	610	6.2	10.4	12.3	12.4	12.3	6.1	98%	128%	15%
Brazil	500	1.5	1.9	2.2	2.4	2.5	1.0	71%	131%	35%
Saudi Arabia	490	10.4	12.9	15.5	16.0	16.8	6.5	62%	194%	81%
Mexico	460	3.4	3.6	3.8	3.8	3.7	0.3	10%	58%	44%
Indonesia	450	0.9	1.4	1.7	1.8	1.8	0.9	101%	184%	42%
South Africa	390	7.3	6.8	7.9	7.3	7.4	0.1	1%	46%	44%
Taiwan	280	6.2	10.5	11.8	11.8	11.8	5.7	91%	121%	16%
Thailand	270	1.6	2.7	3.7	3.9	4.0	2.4	147%	193%	19%

Source of population data: UNPD, 2013 (WPP Rev. 2012)

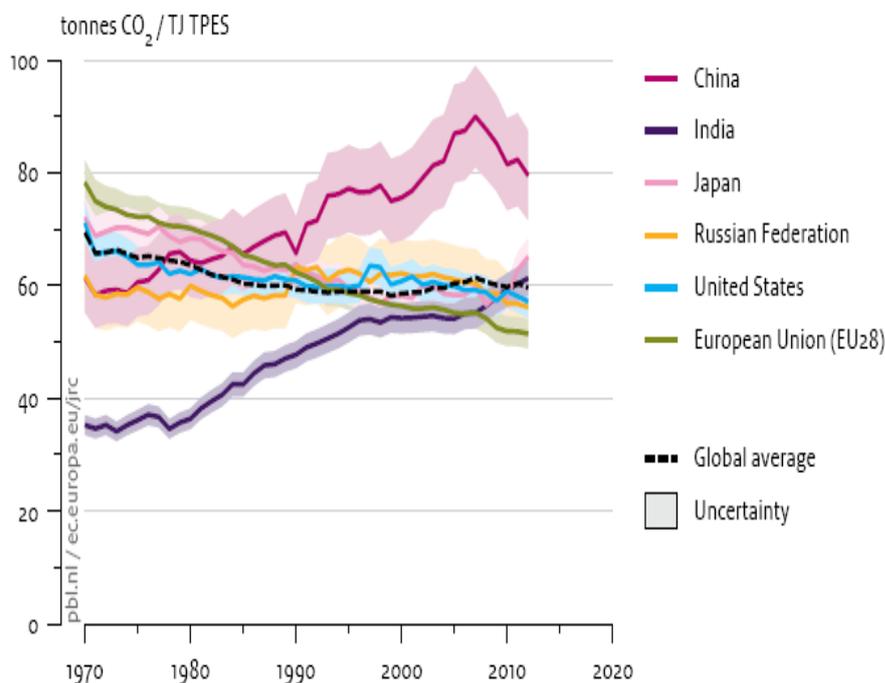
### 33.4 Global players determining global CO2 emissions in 2014

The very low global growth rate in 2014 was accompanied by a large drop in CO2 emissions of 5.4% to 3.4 Gt CO2 in the European Union (EU-28), which was mainly due to a decrease in fossil-fuel consumption for electricity generation and in manufacturing industries, and by a 10% lower demand for space heating than in 2013. The estimated growth of 0.9% to 5.3 Gt CO2 in 2014 for the United States was largely due to the increasing demand for natural gas for space heating, partly compensated by a small drop in coal used in power generation. Together, the United States and the EU-28 account for a quarter of global CO2 emissions. The large decrease in EU-28 emissions especially contributed to the low global growth in emissions by 0.5%. If India's CO2 emissions would continue to grow at the same average rate of 7% as they have over the past 10 years, they will surpass the current EU-28 emissions by 2020.

### 33.5 Largest emitting countries

In summary, the six largest emitting countries/regions in 2014 were: China (with 30%), the United States (15%), the European Union (EU-28) (9.6%), India (6.6%), the Russian Federation (5.0%) and Japan (3.6%). Remarkable trends were seen in the top three emitting countries/regions, which account for 54% of total global emissions. In China and the United States, emissions increased by 'only' 0.9%. The European Union saw a large decrease of 5.4% in 2014, compared to 2013, which offset the 7.8% growth in India. The Russian Federation and Japan saw their CO2 emissions decline by 1.5% and 2.6%, respectively.

### CO<sub>2</sub> emissions per unit of Total Primary Energy Supply (TPES) in the top 5 emitting countries and the EU



Source: IEA 2014; BP 2015

Note: Using substitution method for nuclear, hydro and other non-biomass renewables as in BP (2015) (i.e. assuming 38% conversion efficiency).

### 33.6 GDP vis-a-vis CO<sub>2</sub> emission

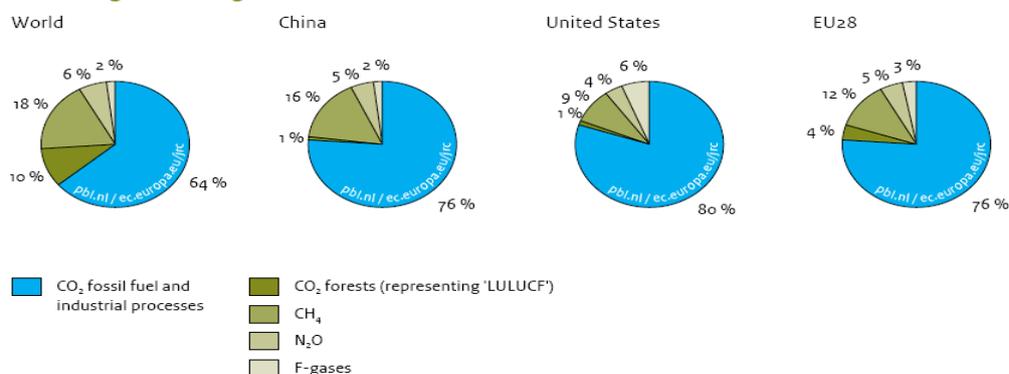
The moderate increases in global CO<sub>2</sub> emissions in 2012, 2013 and 2014 of around 1% (0.5% to 1.5%) seem remarkable in times when global economic growth was 3% annually, compared to average annual growth levels of 4% in emissions and 4.5% in GDP in the previous decade (with the exception of the recession years). In other words, a partial decoupling of global GDP and CO<sub>2</sub> emissions can be observed over the past three years, similar to the 1990s that saw average annual emission increases of 1.3%. Within these percentages, however, there are notable differences in the performance of various countries. The service sector is not energy-intensive and currently contributes about 70% to global GDP. Therefore, increases in total energy consumption are not always closely related to overall economic growth, since total energy consumption is dominated by more energy-intensive sectors (e.g. power generation and the manufacturing industry) that make up only a relatively small share of total global GDP in most 'developed' countries (World Bank, 2015a). Since the share of the service sector at country level ranges from 20% to 87%, differences in growth rates between countries also help explain why CO<sub>2</sub> emissions and GDP are only very weakly related on a global level. This also explains why annual growth rates in CO<sub>2</sub> emissions and CO<sub>2</sub> concentrations in the atmosphere also are only weakly related.

### 33.7 Fifth Assessment Report (IPCC, 2014a, b)

Main conclusions on anthropogenic global greenhouse gas emissions from the IPCC's

- The effects of anthropogenic greenhouse gas emissions have been detected throughout the climate system and are extremely likely to have been the dominant cause of the observed warming since the mid-20th century.
- Cumulative emissions of carbon dioxide will largely determine global mean surface warming by the late 21st century and beyond.
- It would be possible, using a wide array of technological measures and changes in behaviour, to limit the increase in global mean temperature to 2 °C above pre-industrial levels.
- Substantial emission reductions over the next few decades can reduce climate risks in the 21st century and beyond.
- Without additional mitigation efforts to those in place today, and even with adaptation, warming by the end of the 21st century will lead to high and very high risks of severe, widespread, and irreversible impacts, on a global scale.
- There are multiple mitigation pathways that can limit the increase in global mean temperature to 2 °C above pre-industrial levels. These pathways would require substantial reductions in emissions over the next few decades, and near zero emissions of CO<sub>2</sub>.
- Many adaptation and mitigation options can help address climate change, but no single option would be sufficient by itself. Mitigation options are available in every major sector.

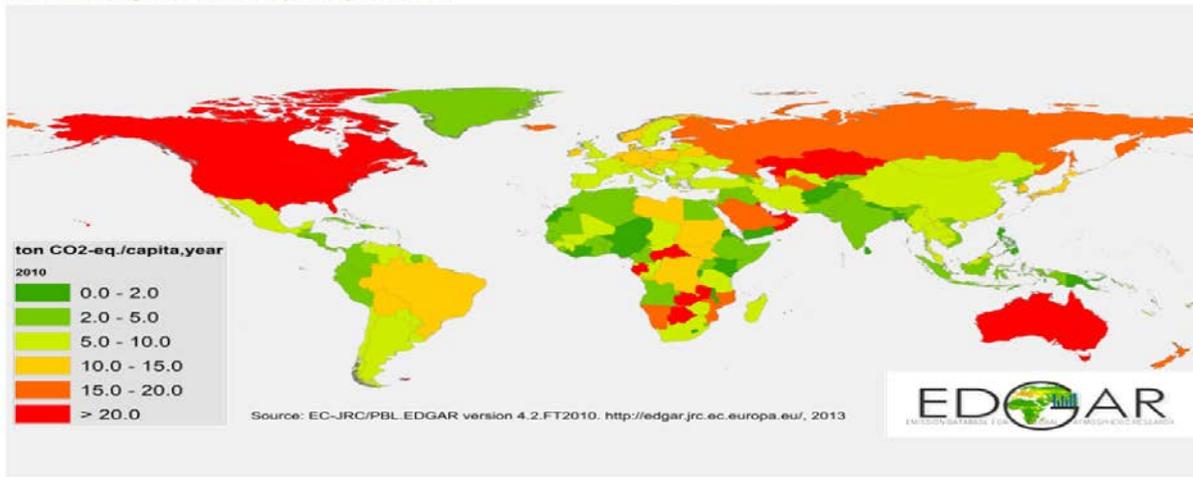
Shares of greenhouse gas emissions, 2010



Source: CO<sub>2</sub> fossil and processes: EDGAR 4.3 (JRC/PBL, 2015); others: EDGAR 4.2 FT2010 (JRC/PBL, 2012)

Note: In this report, CO<sub>2</sub> emissions are provided for Fossil fuel+Industrial process ('FF+IP emissions'), and other sources of emissions; CO<sub>2</sub> from forest fires and deforestation ('Forests', representing the emissions part of 'LULUCF'), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O) and the F-gases HFCs, PFCs, and SF<sub>6</sub> as shares in total greenhouse gas emissions (excluding CO<sub>2</sub> removals such as forest growth and afforestation and using GWP-100 values from the Fourth IPCC Assessment Report). The source used for other emission sources is EDGAR 4.2 FT2010 (EC-JRC/PBL, 2012).

## Greenhouse Gas Emission per capita, 2010



Source: <http://edgar.jrc.ec.europa.eu/overview.php?v=GHGt>

Note: Including emissions from forest fires/deforestation (emissions component of 'LULUCF'). Excluding CO<sub>2</sub> removals from forest growth and afforestation. For non-CO<sub>2</sub> greenhouse gases, the GWP-100 values were used from the Second IPCC Assessment Report.

### 33.8 Trends in global fossil-fuel consumption and fuel mix

The historical trend in the global energy mix a steady increase in the share of natural gas consumption in the total primary energy mix between 1970 and the early 2000s. The stagnation of the natural gas share since 2002 was not due to an absolute decrease in gas consumption, but trend breaks in the relative growth rate of natural gas and oil shares are due to the much higher growth rate of coal consumption since 2002. This strong increase in coal consumption was mainly caused by the rapidly developing economy of China, which shows a quite different primary energy supply mix than that of the United States and the European Union. The related CO<sub>2</sub> emissions in 2012 reported by the IEA are given in Table below:

CO<sub>2</sub> emissions from fossil fuel combustion in the top four countries in 2013, by main sector and fuel type (billion tonnes CO<sub>2</sub>) (source: IEA, 2015b)

China (including SCA revision)	Total	Coal	Oil	Natural gas	Other
Total sectors	9.0	7.5	1.1	0.3	0.0
Power and heat production *	4.4	4.28	0.01	0.06	0.03
Other energy industry own use	0.4	0.26	0.06	0.05	
Manufacturing industry **	2.8	2.55	0.17	0.08	
Road transport	0.6		0.58	0.03	
Other transport ***	0.1		0.13	0.00	
Residential sector	0.3	0.19	0.07	0.06	
Other buildings ****	0.3	0.22	0.10	0.02	
United States	Total	Coal	Oil	Natural gas	Other
Total sectors	5.1	1.7	2.0	1.4	0.0
Power and heat production *	2.1	1.60	0.03	0.49	0.02
Other energy industry own use	0.3	0.01	0.11	0.16	
Manufacturing industry **	0.4	0.10	0.07	0.25	0.01
Road transport	1.4		1.44	0.00	
Other transport ***	0.3		0.21	0.05	
Residential sector	0.3	0.00	0.05	0.27	
Other buildings ****	0.3	0.00	0.08	0.18	0.00
European Union (EU28)	Total	Coal	Oil	Natural gas	Other
Total sectors	3.3	1.1	1.3	0.9	0.1
Power and heat production *	1.3	0.93	0.05	0.24	0.04
Auto producers/other energy industry own use	0.2	0.03	0.09	0.04	0.00
Manufacturing industry **	0.4	0.12	0.09	0.20	0.02
Road transport	0.8		0.82	0.00	
Other transport ***	0.0		0.04	0.00	
Residential sector	0.4	0.04	0.12	0.26	0.00
Other buildings ****	0.2	0.01	0.10	0.13	0.00
India	Total	Coal	Oil	Natural gas	Other
Total sectors	1.9	1.3	0.4	0.1	0.0
Power and heat production *	0.9	0.89	0.03	0.03	0.00
Other energy industry own use	0.0	0.00	0.03	0.01	0.00
Manufacturing industry **	0.5	0.41	0.07	0.02	
Road transport	0.2		0.20	0.00	
Other transport ***	0.0		0.02	0.00	
Residential sector	0.1	0.01	0.07	0.01	
Other buildings ****	0.1	0.04	0.04	0.00	

Notes:

\* Includes auto producers power and heat production

\*\* Excludes emissions from non-energy and feedstock uses of fuels

\*\*\* Excludes international marine and aviation bunkers

\*\*\*\* Service sector; includes agriculture and forestry

Fossil fuel combustion accounts for about 90.5% of total global CO<sub>2</sub> emissions, excluding those from forest fires and the use of wood fuel (EDGAR 4.3; EC-JRC/PBL, 2015). Despite the fact that the global economy continued to grow (3.3%) in 2014 compared to 2013, the CO<sub>2</sub> emissions from global fuel combustion decreased by 0.17%, which is the first decline in the annual CO<sub>2</sub> growth over the past five years (BP, 2015). The diverging pattern of the CO<sub>2</sub> emission trends in OECD and non-OECD countries tends to moderate, with a decrease of 1.5% in OECD countries, which is the fifth decline in the past seven years, versus a 0.5% increase in non-OECD countries that is far below that of the average of the past decade (3.8%).

**33.9** As the threats of global warming and consequent flooding of coastal & low lying areas loomed large, global community became increasingly engaged with environmental concerns. It became an issue not only of ensuring quality of life in future but of the very sustenance itself. Talks of growth gave way to those of sustainable growth including the dimensions of environmental sustainability in acknowledgement of the age old saying that “we **do not inherit this planet from our ancestors, we borrow it from our children**”. Global community engaged itself in building new frameworks incorporating environmental concerns, greening its GDP, negotiating competing demands of growth & environment protection. Issues like **trading carbon credits** sprang up (e.g. an African country being paid to maintain its forest cover, (foregoing its economic benefits by exploiting it) by some industrialized country which buys the rights to engage in eco unfriendly practise up to a certain amount). Global concerns at times didn't go well with national interests as countries like China argued for per capita norms arguing further that most advanced countries had already exploited the resources ruthlessly to reach their present positions and could not argue against pro growth practices of fast developing countries which face immense energy and other requirements. (Most of the countries, particularly the industrialized countries, having large current emissions are also the largest historic emitters and the principal contributors to climate change. A relatively small number of such countries are responsible for the largest chunk of the stock of global GHG emissions. The industrialized countries with the largest total emissions also rank among those with the highest per capita emissions)

### **Key Steps in furtherance of Environmental Concerns:**

33.10 Some of the most well-known multinational agreements that have impressed upon the various pressing environmental concerns include the **Kyoto Protocol**, setting binding obligations on industrialized countries to reduce emissions of Green House Gases (GHGs) **Vienna Convention on the Protection of the Ozone Layer(1985)** ratified by 196 states & EU with a Chlorofluoro Carbons( CFCs) phase out plan under **Montreal Protocol** and **Rio Declaration on Environment and Development** . To effectively address environmental degradation concerns seriously affecting all countries of the world, recently in Nov, 2015 a conference was held in Paris on climate change.

**33.11** The Rio Declaration on Environment and Development, often shortened to Rio Declaration, was a short document produced at the 1992 **United Nations "Conference on Environment and Development" (UNCED)**, informally known as the **Rio Earth Summit**. The Rio Declaration consisted of 27 principles intended to guide future sustainable development around the worlds. The 1992 UN Conference on the Environment and Development resulted in **United Nations Framework Convention on Climate Change** ("FCCC" or "UNFCCC") to cooperatively consider

what could be done to limit average global temperature increases and the resulting climate change, and to cope with whatever impacts which were, by then, inevitable.

**33.12** By 1995, countries realized that emission reductions provisions in the Convention were inadequate. They launched negotiations to strengthen the global response to climate change, and, two years later, adopted the **Kyoto Protocol**. The Kyoto Protocol was adopted in Kyoto, Japan, on 11 December 1997. Due to a complex ratification process, it entered into force on 16 February 2005. Kyoto Protocol is what “operationalizes” the Convention. It commits industrialized countries to stabilize greenhouse gas emissions based on the principles of the Convention. The Convention itself only encourages countries to do so. The Kyoto Protocol legally binds developed countries to emission reduction targets. The Protocol’s first commitment period started in 2008 and ended in 2012. The second commitment period began on 1 January 2013 and will end in 2020.

**33.13** There are now 195 Parties to the Convention and 192 Parties to the Kyoto Protocol. The last two meetings of the conference of Parties to UNFCCC took place in December 2014 at Lima ,Peru and November 2013 in Warsaw, Poland. Earlier, milestones were achieved in various conferences including “**Bali Road Map**” Dec 2007, **The Cancun Agreements**, Dec 2010 to reduce greenhouse gas emissions, **Durban Climate Change Conference** 2011 and that in Doha , Qatar during 2012.

**33.14** The **United Nations Conference on Sustainable Development (UNCSD)**, also known as **Rio 2012**, **Rio+20**, or **Earth Summit 2012** was the third international conference on sustainable development aimed at reconciling the economic and environmental goals of the global community . Nations agreed to explore alternatives to GDP as a measure of wealth that take environmental and social factors into account in an effort to assess and pay for ‘environmental services’ provided by nature, such as carbon sequestration and habitat protection.

#### **Environment Frameworks (Statistical & Analytical):**

**33.15 Framework for the Development of Environment Statistics (FDES) :** United Nations Statistics Division (UNSD) developed and published in 1984 ‘A Framework for the Development of Environment Statistics (FDES).’ The FDES sets out the scope of environment statistics by relating the components of the environment to information categories that are based on the recognition that environmental problems are the result of human activities and natural events reflecting a sequence of action, impact, and reaction. Relevant information, therefore, refers to social and economic activities and natural events, their effects on the environment, and the responses to these effects by the society. The contents of the FDES are “statistical topics”; they are those aspects of environmental concerns that can be subjected to statistical description and analysis. It a flexible framework that is used for developing and organizing environmental and related socio-economic information .

**33.16** The FDES organizes environment statistics in a simple and flexible manner into components, subcomponents, statistical topics and individual statistics, using a multilevel approach.

## Box 2: The structure of the FDES

Component 1: Environmental Conditions and Quality

...

Sub-component 1.2: Land Cover, Ecosystems and Biodiversity

...

Statistical topic 1.2.3: Biodiversity

- a. Flora statistics - terrestrial, freshwater and marine
  1. Number of known species by status category (Tier 1)
  2. Species population (Tier 2)
  3. Number of endemic species (Tier 2)
  4. Number of invasive alien species (Tier 2)
  5. *Habitat fragmentation (Tier 3)*
- b. Fauna statistics - terrestrial, freshwater and marine

...

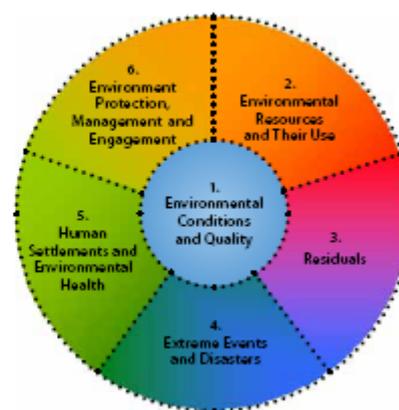


Figure 1. The FDES components

**33.17** The FDES is structured in a way that allows links to economic and social domains. It is compatible with and supports other state of the art frameworks and systems, both statistical and analytical, such as the **System of Environmental Economic Accounting (SEEA)**, the **Driving force—Pressure—State—Impact—Response (DPSIR) framework**, or the **MDGs indicator framework**.

**33.18** The **System of Environmental-Economic Accounting (SEEA)** contains the internationally agreed standard concepts, definitions, classifications, accounting rules and tables for producing internationally comparable statistics on the environment and its relationship with the economy. The SEEA framework follows a similar accounting structure as the System of National Accounts (SNA) and uses concepts, definitions and classifications consistent with the SNA in order to facilitate the integration of environmental and economic statistics. The SEEA is a system for organizing statistical data for the derivation of coherent indicators and descriptive statistics to monitor the interactions between the economy and the environment and the state of the environment to ensure better informed decision-making. The revised SEEA consists of three parts: the **Central Framework**, which was adopted by the UN Statistical Commission as the first international standard for environmental-economic accounting; **Experimental Ecosystem Accounting** and **Applications and Extensions** of the SEEA. Subsystems of the SEEA framework elaborate on specific resources or sectors, including: Energy, Water, Fisheries, Land and Ecosystems, and Agriculture. These 'sub-systems' are fully consistent with the overarching SEEA, but provide further details on specific topics and try to build bridges between the accounting community and the community of experts in each specific subject area.

**33.19** Ensuring Environmental Sustainability is one of the eight goals identified under **Millennium Development Goals**.

**33.20** **Legislations, Institutional Support & Recent Initiatives – Indian Context :** Ministry of Environment & Forests is the nodal agency dealing with diverse issues of environment & forests. The Policy and Law Division of the Ministry of Environment & Forests is partly implementing the Schemes “Assistance for Abatement of Pollution, Environment Policy and Law” and “Establishment of Environment Commissions and Tribunals “ and providing legislative and Institutional support to other thematic divisions whenever needed for any amendment to **Environment (Protection) Act, 1986** or implementation of the **National Environment Policy 2006, National Green**

**Tribunal Act (NGT), 2010**, Ecomark Scheme and work relating to setting up of **National Environment Assessment and Monitoring Authority (NEAMA)**. Forest Policy Division of Ministry of Environment & Forests (MoEF), on the other hand, coordinates the **National Forest Policy, 1988** and its implementation issues, **Indian Forest Act, 1927** and Policy and legislative issues of other Central Ministries/ Departments related to Forests and Scheduled Tribes & coordinating the State Forest Policies, State Forest Acts/Amendment etc. Forest Policy Division coordinates with Ministry of Panchayati Raj, Ministry of Tribal Affairs and Planning Commission on the matters related to various Acts and Policies.

**33.21** Host of other legislations govern/regulate various issues pertaining to environment & forest protection .

- **Biological Diversity Act 2002:** Taking cognizance of the International Convention on Biodiversity (CBD), and to address the excessive pressure on biodiversity, the Government of India has enacted **Biological Diversity Act, 2002 (BDA 2002)**. Accordingly, the national, state and local level mechanisms have been provided for implementation of the Act. At the national level, **National Biodiversity Authority (NBA)** has been established by Government of India in October, 2003 at Chennai (Tamil Nadu) under Section (8) of the Biological Diversity Act. The **State Biodiversity Boards (SBB)** have been established by the State Governments and **Biodiversity Management Committees (BMC)** have also been formed.
- As a major national initiative to protect coastal ecosystems- critical reservoirs of our biodiversity, the **Coastal Regulation Zone Notification** has been published in the gazette of India on 6 January, **2011**. The government of India and world Bank have signed a loan agreement for the implementation of an integrated coastal Zone Management Project, which will be implemented at a total cost of ₹ 1156 crore
- In order to ensure that there is no further degradation of wetlands, the Ministry of Environment and Forests, Government of India has notified the **Wetlands (Conservation and Management) Rules 2010**. The rules specify activities which are harmful to wetlands such as industrialization, construction, dumping of untreated waste and reclamation and prohibit these activities in the wetlands. Other activities such as harvesting and dredging may be carried out in the wetlands but only with prior permission from the concerned authorities.
- **Environment Impact Assessment (EIA) Notification, 2006 & its amendment 2009** : The Ministry of Environment and Forests (MoEF) has used Environmental Impact Assessment Notification 2006 as a major tool to regulate rapid industrial development of the country for minimizing the adverse impact on environment and reversing the trends which may lead to climate change in long run. The developmental projects have been re-categorised into category 'A' and category 'B' depending on their threshold capacity and likely pollution potential in the reengineered Environmental Impact Assessment (EIA) Notification of September 2006, requiring prior Environmental Clearance (EC) from MoEF or the concerned State Environmental Impact Assessment Authorities (SEIAAs). However EIA amendment 2009 exempts the biomass based power plants up to 15 MW, power plants based on non hazardous municipal solid waste and power plants based on waste heat recovery boilers without using auxiliary fuel from the EC process.

- The Ministry of Environment and Forests (MoEF), under the Environment (Protection) Act 1986, has notified the "**Rules for the Manufacture, Use, Import, Export and Storage of Hazardous Microorganisms / Genetically Engineered Organisms or Cells 1989**" (known as **Rules, 1989**) with a view ensure sound application of biotechnology making it possible to accrue benefits arising from modern biotechnology while minimizing the risks to environment and human health.
- Various rules have been framed for management of hazardous wastes like **E- Waste (Management & Handling) Rules, 2011, Plastic Waste (Management & Handling) Rules, 2011** etc whereas notifications of draft of some others were issued during 2011-12 like **Draft Bio Medical Waste (Management & Handling) Rules, 2011** and **Draft Hazardous Substance (Classification, Packaging & Labelling) Rules , 2011**.
- **Charter on Corporate Responsibility for Environmental Protection (CREP) (2002-03)**: Much of the environmental concerns emerge out of the process of economic growth. Hence it was felt that engagement of the main drivers of economic growth would facilitate the issue of environment protection to a large extent. CREP is a commitment for protection of environment for partnership and participatory action of the stakeholders i.e industry their associations & regulatory agencies. The charter has set targets concerning conservation of water, energy, recovery of chemicals, reduction in pollution, elimination of toxic pollutants, process & management of residues that are required to be disposed off in an environmentally sound manner.

**33.22** Several entities have been set up to monitor diverse issues relating to environment, forests & wild life protection:

- **National Green Tribunal** has been established for effective & expeditious disposal of cases related to environmental protection and conservation of forests & other natural resources including enforcement of legal rights relating to environment & for giving relief & compensation in related matters. As per the provisions of the **NGT Act 2010**, the National Environment Appellate Authority (NEAA), established under the NEAA Act, 1997 stands dissolved and the cases pending before NEAA stand transferred to the NGT
- **Conservation of Water Bodies ( Rivers & Wetlands) :** The **National River Conservation Directorate (NRCD)**, functioning under the Ministry of Environment and Forests is engaged in implementing the River and Lake Action Plans under the **National River Conservation Plan (NRCP)** and **National Lake Conservation Plan (NLCP)** by providing financial assistance to the State Governments. **National Ganga River Basin Authority (NGRBA)** constituted in 2009 decided that under Mission Clean Ganga it will be ensured that by 2020 no untreated municipal sewage and industrial effluent flow into Ganga. World Bank assistance for abatement of pollution of river Ganga at an estimated cost of Rs 7000 Cr has been approved for implementation along with Japan International Cooperation Agency (JICA) assisted development study (**Ganga Action Plan** project at Varanasi) approval for funding by Japan Bank for International Cooperation (JBIC) for 11.184 billion Yen. Financial assistance of 13.33 billion Yen has also been received from JICA for implementing **Yamuna Action Plan (YAP) Phase II**.

- **National Wetland Conservation Programme (NWCP)** was initiated in 1987 to lay down policy guidelines for conservation and management of wetlands in the country, provide financial assistance for undertaking intensive conservation measures in the identified wetlands, monitor implementation of the Programme and to prepare an inventory of Indian wetlands. Central Government notified the **Wetlands (Conservation and Management) Rules – 2010** and as per the provision under Rule 5 of these wetlands rules, **Central Wetlands Regulatory Authority (CWRA)** has been constituted.
- Two tier system at National and State level are in operation for effective coordination to implement the scheme on **Mangroves and Coral Reefs**. This includes the **National Committee on Mangroves & Coral reefs** at centre & State Level Steering Committees. For encouraging targeted research on both hard and soft corals in the country, a **National Coral Reef Research Centre** at Port Blair has been established. The four major coral reefs areas identified for intensive conservation and management are (1) Gulf of Mannar, (2) Gulf of Kutch, (3) Lakshadweep, and (4) Andaman and Nicobar Islands.
- **Wild Life Conservation:** Government of India provides technical and financial support to the State/ UT Governments for wildlife conservation under the various Centrally Sponsored Schemes – **Integrated Development of Wildlife Habitats, Project Tiger, and Project Elephant**, and also through Central Sector Scheme - **Strengthening of Wildlife Division** and Consultancies for Special Tasks, and through Grants in Aid to the **Central Zoo Authority** and **Wildlife Institute of India, Dehradun**. The **National Board for Wildlife (NBWL)** has been constituted as per the provisions of the **Wild Life (Protection) Act, 1972**, in 2003. **National Tiger Conservation Authority (NTCA)** ensures wildlife management, protection measures and site specific eco-development to reduce the dependency of local communities on tiger reserve resources. The centrally sponsored scheme “Project Tiger” was launched in 1973 . NTCA provides details on the tiger conservation, tiger population in the natural environment, tiger taskforce, tiger reserves in India legal and statutory provisions, crime against tigers etc. National Wildlife Action Plan (2002-2016) emphasizes the need for peoples' participation and support for wildlife conservation. Wildlife Wing in the Ministry of Environment and Forest is apex body for wildlife conservation. Zoos in India are regulated as per the provisions of the Wild Life (Protection) Act, 1972 and are guided by the **National Zoo Policy, 1998**. The **Central Zoo Authority** was established by the Government of India in the year 1992 through an amendment in the Wild Life (Protection) (1991 amendment) Act, 1972. The main objective was to enforce minimum standards and norms for upkeep and health care of animals in India zoos and restrain mushrooming of unplanned and ill conceived zoos. **Recognition of Zoo Rules, 1992** was revised and notified on 11.11.2009.
- For effectively control illegal trade in wildlife, a multidisciplinary Tiger and Other Endangered Species Crime Control Bureau (**Wildlife Crime Control Bureau**) has been constituted with effect from 6.6.2007.
- **National Afforestation & Eco Development Board (NAEB)** : In order to promote afforestation, tree planting, ecological restoration and eco development activities in the country, the National Afforestation and Eco-Development Board (NAEB) was set up in August 1992. Special attention is also given by NAEB to the regeneration of degraded forest areas and lands adjoining forest areas, national parks, sanctuaries and other protected areas

as well as the ecologically fragile areas like the Western Himalayas, Aravallis, Western Ghats etc. National Afforestation and Eco- Development Board (NAEB) operates the following three major schemes:

(a) **National Afforestation Programme (NAP) Scheme**

(b) **NAEB Scheme:** The major components of the Scheme are:

i. Grants in Aid for Greening India (GIA for GI) Scheme

ii. Monitoring and Evaluation (M&E)

iii. Communication

iv. Support to Regional Centres (RCs)

(c) **Eco Development Forces (EDF) Scheme**

- **Indian Network of Climate Change Assessment (INCCA)** was launched in 2009 to Assess the drivers and implications of climate change through scientific research; (b) Prepare climate change assessments once every two years (greenhouse gas estimations and impact of climate change, associated vulnerabilities and adaptation); (c) Develop decision support systems and (d) Build capacity towards management of climate-change related risks and opportunities.
- **Central Pollution Control Board (CPCB):** It performs functions as laid down under the **Water (Prevention & Control of Pollution ) Act , 1974**, and the **Air (Prevention & Control of Pollution ) Act, 1981**. It is responsible for planning & executing comprehensive nationwide programmes for the prevention and control of water and air pollution, for advisory activities to Central Government & for coordinating with & for providing technical assistance & guidance to State Pollution Control Boards/ Committees.
- **Botanical Survey of India (BSI) :** Established in 1890, BSI is the apex research organization under MoEF for carrying out taxonomic & floristic studies on wild plant resources of the country. Besides survey of flora. BSI documents indigenous knowledge of plant resources, carries out ex-situ conservation in botanic gardens & monitors implementation of “Assistance to Botanic Gardens Scheme” of MoEF.
- **Zoological Survey of India (ZSI) :** The Zoological Survey of India (ZSI), a premier institution under the Ministry, has been undertaking survey, exploration and research leading to the advancement of our knowledge on the exceptionally rich faunal diversity of the country since its inception in 1916. With its headquarters at Kolkata and 16 Regional Centers located at different parts of the country, ZSI in recent years reoriented its plan of work by grouping the survey and studies under the following six major programmes :
  - Fauna of States
  - Fauna of Conservation Areas
  - Fauna of Important Ecosystems
  - Status Survey of Endangered Species
  - Ecological Studies/Environment Impact Assessment Survey, and
  - Computerization and Dissemination of Data
- **Forest Survey of India :** Forest Survey of India (FSI), established in 1981 , is an organization under MoEF, Government of India , engaged in the assessment of the country's forest resources on a regular interval. Some main activities of Forest Survey of India include – **Forests & Tree Cover Assessment** and **Inventory of forests and Trees Outside Forests (TOF)**. FSI is also preparing for the first time an Atlas of forest types of India.

- **National Spatial Data Infrastructure** :This is an initiative undertaken by **Department of Science & Technology(DST), Government of India**. NSDI aimed at encouraging collection, aggregation and distribution of spatial data on different themes on a common defined set of standards and formats by different mapping agencies in India. FSI is the nodal agency for forestry sector for the DST endeavour aimed at creating a portal from which users may directly access and buy all kinds of spatial data generated by Indian mapping agencies.

**33.23** Various **Schemes** like **Intensification of Forest Management Scheme (IFMS)** (centrally sponsored scheme providing financial assistance on cost share basis – NE States & special category states namely J&K, Himanchal Pradesh & UK share 10% of the cost while rest share 25 % of the cost of the annual Plans of operations of forest protection) and scheme for “**Assistance for Abatement of Pollution**” (Centrally Sponsored Scheme being implemented by the Ministry of Environment and Forests since Seventh Five Year Plan (1990-1995) with an allocation of Rs 45 crore in the XI Five Year Plan (including Policy & law and Environmental Health Cell scheme)) focussing on diverse issues related to environment & forests are being implemented .Whereas those like **National Natural Resource Management System (NNRMS)** (an umbrella scheme of Planning Commission) intend to involve utilization of remote sensing technology for accurate inventory of resources such as land, water, forests, minerals, oceans etc and to utilize this information for monitoring changes in ecological system. Scheme on **National Forestry Database Management System (NFDMS)** aims to prepare a blue print towards the development of National Forestry Database Management System to monitor the programmes and to develop Forest Statistics Database and to ensure/ advocate networking with the State / UTs Forest Department. The database system will collect, compile and disseminate information on the production and consumption pattern of forestry products including Timber, Non Wood Forest Products, Forest Trade and data related to Export, Import of Forestry Products. Scheme aims for development of National Forest Management System integrated with information systems of the States to ensure effective monitoring with a universal access of all stakeholders. Forest Survey of India is its nodal agency.

### **33.24**

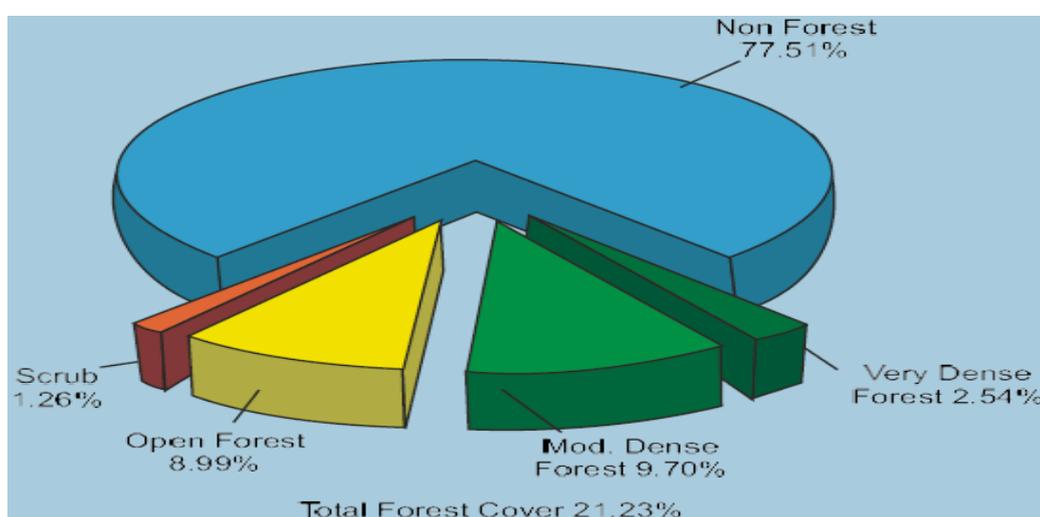
#### **Data Source :**

- Statistics related to different domains of environment & forests are collected, compiled and disseminated by various entities of **Ministry of Environment & Forests** monitoring different subjects like **Ozone Cell** (information on Ozone Depleting substances production use & trade etc), **Central Pollution Control Board** (information on air & water quality, noise pollution etc), **Forest Survey of India** ( forest, tree and mangrove cover including socio economic contribution of forests, published in **Indian State of Forest Reports** ), **Indian Council of Forestry Research & Education (ICFRE)** (information on wasteland, forest produce, revenue from & expenditure on forests etc), **National Afforestation & Eco Development Board, NAEB** (information on afforestation ) etc . Besides these **Annual Report** of MOEF & its publications like **State of Environment Report** provide some consolidated information.

**Central Statistics Office, Ministry of Statistics & PI** also brings out **Compendium of Environment Statistics India** which contains information on biodiversity, human settlements and impacts on atmosphere, land & soil and water .

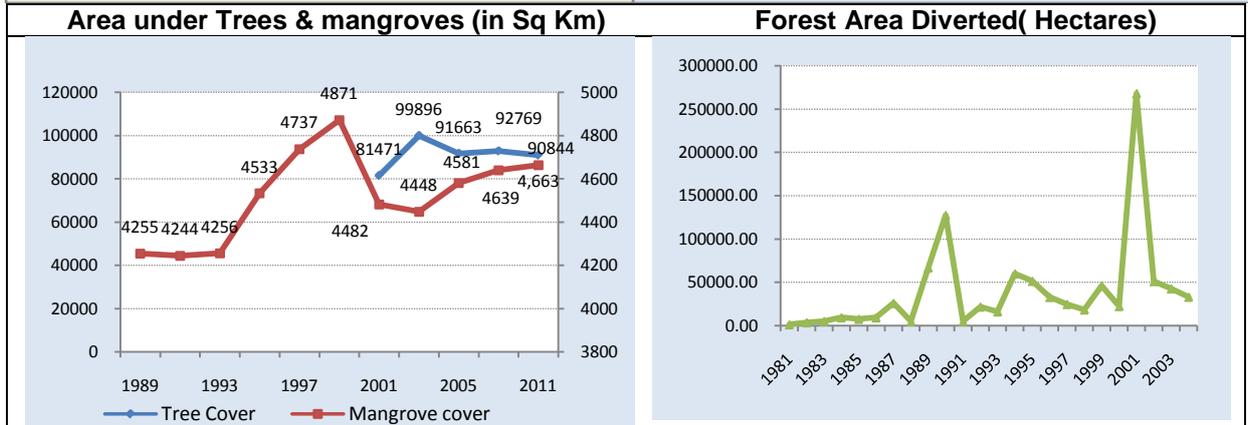
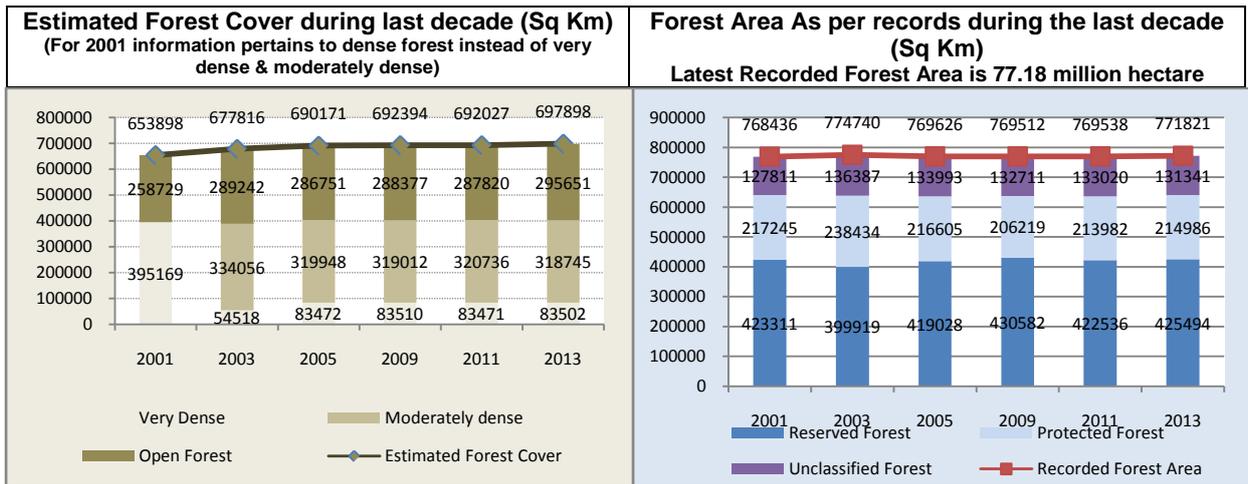
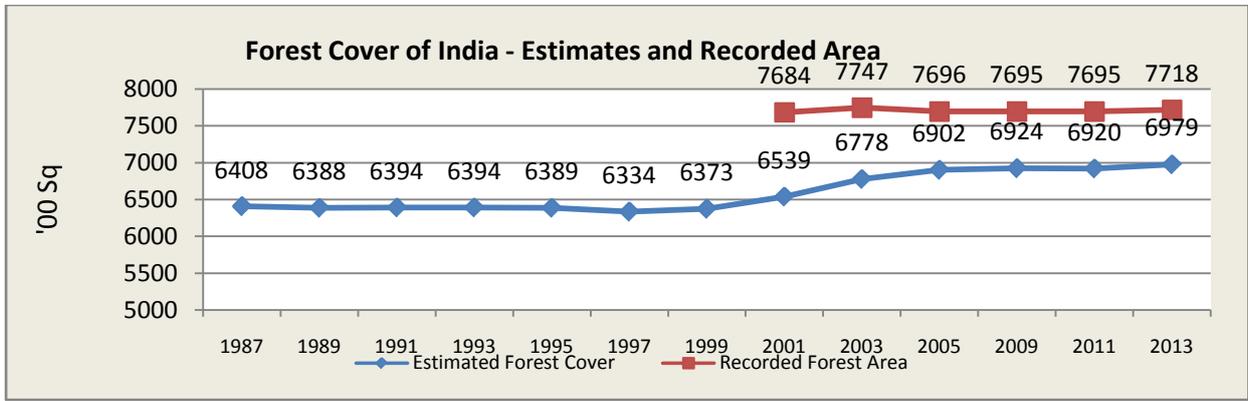
### Trends & Key Statistics :

**33.25 Forests , Mangroves & Tree Cover:** As per India's State of Forest Report 2013, India's forest cover is 69.79 Million hectare (including 4,628 Sq Km under mangroves) which is 21.23% of the geographical area. There is an increase of 5,871 Sq Km in the forest cover of the country compared to 2011 assessment. The increase in hill and tribal districts of the country is about 40 Sq Km & 2,396 Sq Km respectively compared to the previous assessment whereas north eastern states accounting for one fourth of the country's forest cover (NE states constitute only 8 % of geographical area of India) , saw a net decline of 627 Sq Km compared to the previous assessment. In addition to the forest cover, the tree cover of the country is estimated to be 9.13 million hectare which is 2.78 % of the geographical area. While there is an increase in total forest cover in the country , there is a decrease in growing stock , both inside and outside forest area. The main reason for decline in growing stock within forest area is the loss of 1,991 Sq Km of Moderately Dense Forest (MDF). Loss of growing stock outside forest area is attributed to harvesting of mature tree crops. The total carbon stock in forest is estimated to be 6,941 million tonnes , an increase of 278 million tonnes compared to last assessment reported in ISFR2011, which corresponds to the year 2004. Out of the 21.23 % forest cover , 2.54% was very dense forest, 9.70% moderately dense forest, and the rest 8.99% was open forest; including 0.47 million hectare mangroves.



**33.26 Mangroves** comprise salt-tolerant, evergreen, broad leaved trees having aerial roots like pneuma tophores or stilt roots and viviparous germinated seedlings found mainly in tropical and subtropical inter-tidal regions of the world. As per SFR 2013, Mangroves in India cover **4,628 Sq Km** which is about 0.14% of country's total geographical area and accounts for about 3 % of the World's mangrove vegetation and 8 % of Asian Mangroves. Very dense mangrove comprise 29.2 % of the mangrove cover, moderately dense about 31.49 % and open mangrove about 39.31 % of mangrove cover. West Bengal has nearly half of the country's mangroves. Globally mangroves are disappearing at 0.66% per year; but, in India, mangrove cover increased by 58 sq. km (2005-07) and 23.34 sq. km (2009-11). It however decreased thereafter by 34 Sq Km (2011-13).

**33.27 Trees** include only a part of trees outside forests (TOF) as all TOF patches of 1 ha or more are included in forest cover. As per SFR 2013 India's tree cover (comprising sub hectare tree patches outside forest cover) has been estimated as **91,266 Sq Km** constituting 2.78% of geographical area of the country.



**33.28** Government of has been making efforts to maintain forest cover through afforestation , on the other hand forest areas have been diverted to other uses at an alarming rate since the implementation of Forest Conservation Act 1980.

## Forest cover of India

Class	Area (sq km)	percent of Geographical Area
<b>Forest Cover</b>		
Very Dense Forest	85,904	2.61
Moderately Dense Forest	315,374	9.59
Open Forest	300,395	9.14
<b>Total Forest Cover*</b>	<b>701,673</b>	<b>21.34</b>
Scrub	41,362	1.26
Non Forest	2,544,228	77.40
<b>Total Geographic Area</b>	<b>3,287,263</b>	<b>100.00</b>

\*Includes 4,740 sq km under mangroves

The total forest cover of the country, as per current assessment is 701,673 sq km which constitutes 21.34 percent of the geographical area of the country. In terms of density classes, area covered by VDF is 85,904 sq km, that with MDF is 315,374 sq km and OF is 300,395 sq km. The VDF class constitutes 2.61 percent, the MDF class constitutes 9.59 percent and the OF class constitutes 9.14 percent of total forest cover of the total geographical area of the country.



## Forest cover of India

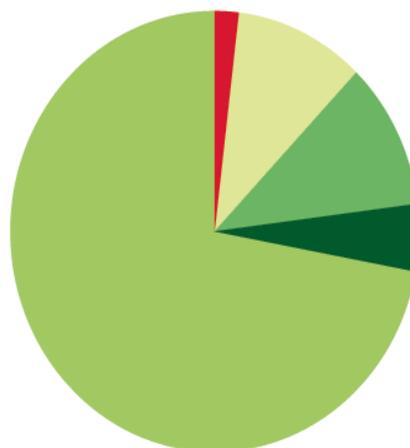


Fig. 2.3 Pie Chart showing Forest Cover of India



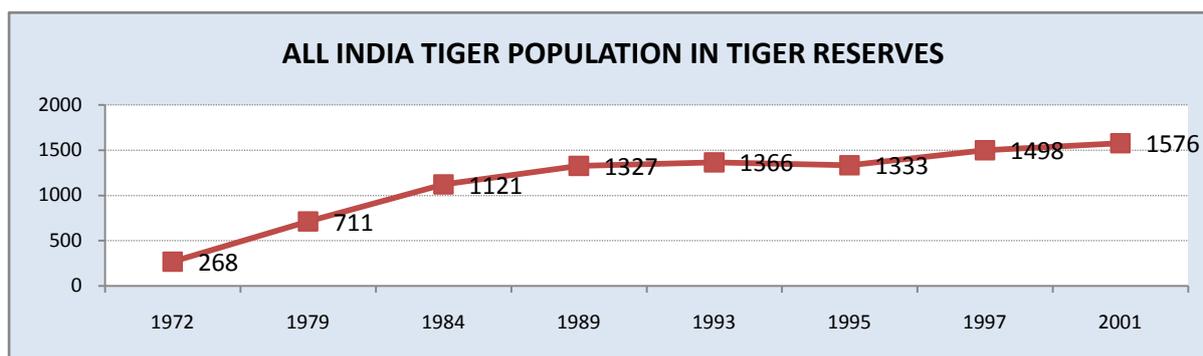
## Wildlife Conservation: National Parks & Sanctuaries

**33.29** There has been about six per cent increase in protected area (National Parks & Wild Life Sanctuaries) since 2000 as the total area under these increased from 155476 Sq Km in 2000 to 164309 Sq Km in 2013. The number of national parks during the period increased from 89 to 102 whereas that of wildlife sanctuaries increased from 498 to 526. As per the latest data (Nov 2014) available on the website of Wild Life Institute of India, the number of national parks and wild life sanctuaries in India was 103 and 525 respectively and they were spread across 40,333 and 116251 Sq Km respectively. (All protected areas includes conservation reserves and community reserves in addition to national parks and wild life sanctuaries).

	2000	2006	2007	2008	2009	2010	2011	2012	2013
Number of protected areas <sup>(2)</sup>									
National parks	89	96	98	99	99	102	102	102	102
Wildlife sanctuaries	489	506	510	513	513	516	517	524	526
All protected areas <sup>(2)(3)</sup>	578	606	619	661	661	669	675	686	689
Area of protected areas <sup>(2)</sup>									
National parks (sq. kms.)	37 594	38 183	38 220	39 233	39 233	40 074	40 074	40 074	40 074
Wildlife sanctuaries (sq. kms.)	117 882	120 244	120 544	122 138	122 138	122 586	122 616	123 548	124 235
All protected areas (sq. kms.) <sup>(2)(3)</sup>	155 476	158 470	158 879	162 651	162 651	164 063	164 512	165 642	166 348

**33.30** Various centrally sponsored schemes like **Project Tiger** (launched in 1973) and **Project Elephant** (launched in 1992) were launched to protect these animals through their habitat management by declaration of tiger and elephant reserves. The tiger population, in the reserves has shown some improvement over the years. As

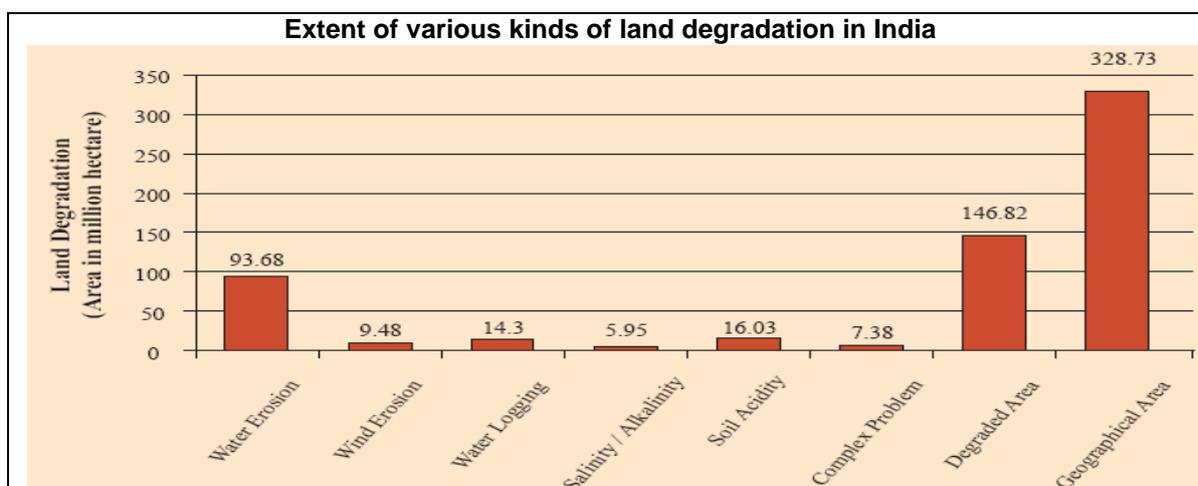
per refined methodology being used since 2006, about 20 % increase in the estimated number of Tigers was recorded in 2010 with the population of 1706 (1520-1909) . During 2006 , the estimated number of tigers was 1411(1165-1657).



**33.31** Elephant population in the reserves has also shown an increase from 1993 to 2012 as tabulated below:

Year	1993	1997	2002	2007	2012
Estimated Elephant Population	25604	25877	26413	27694	30051

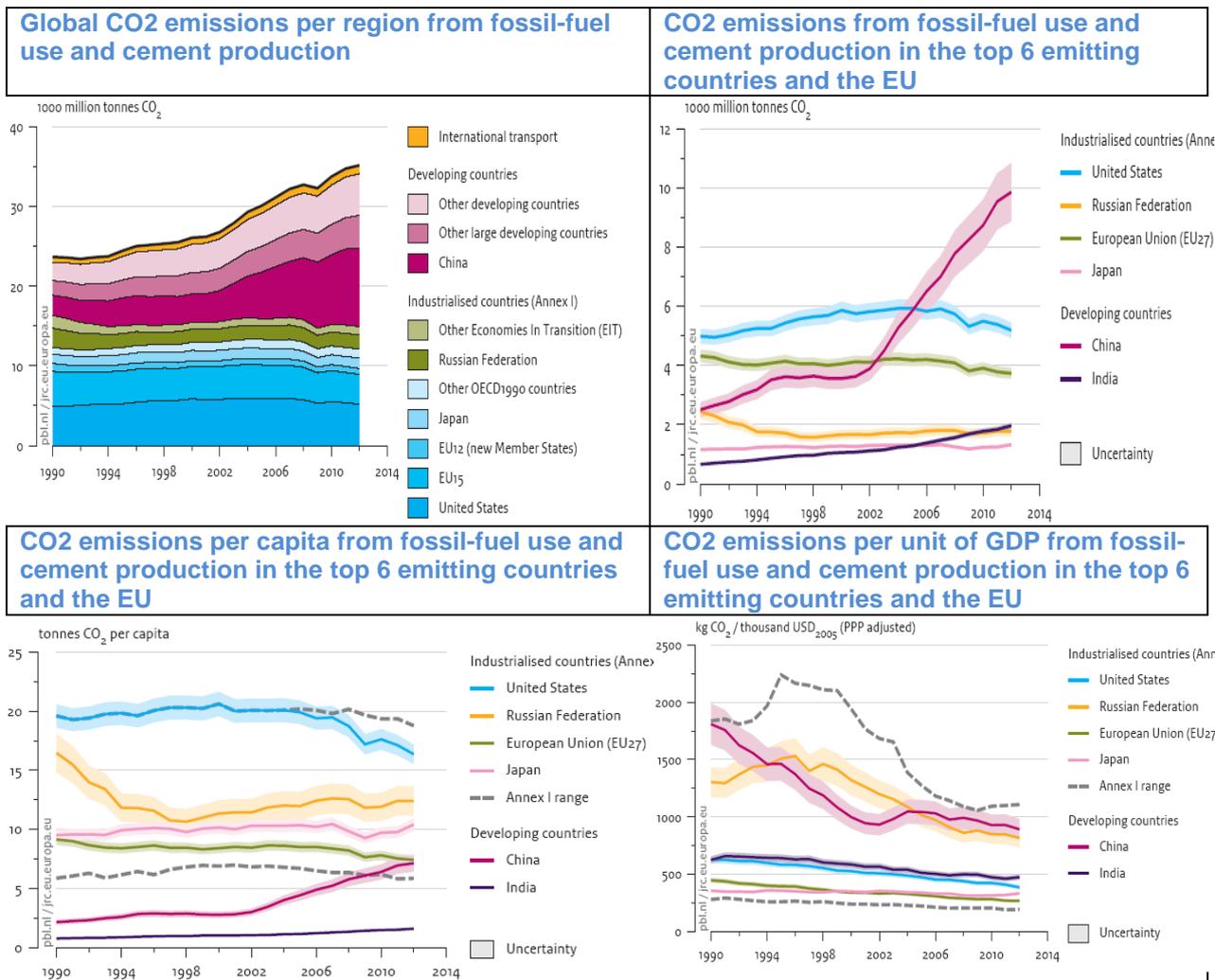
**33.32 Human Impact:** In India, an estimated 146.82 Million hectare area suffers from various forms of land degradation due to water and wind erosion and other complex problems like alkalinity/salinity and soil acidity due to water logging as per as per National Bureau of Soil Survey & Land Use Planning (NBSS&LUP) and ICAR-2005.



**33.33** Besides degradation in the land quality, significant adverse impact has been noticed in air and water quality as well. Some trends in emission of **Green House Gases(GHGs)**, production & consumption of **Ozone Depleting Substances(ODS)** & release of various gases on account of vehicular and other emissions are summarized below:

**33.34 Greenhouse Gases (GHG):** Global GHG emissions have risen sharply since 1945. As per a working paper published by the World Resources Institute, total GHGs were estimated at 44,153 MtCO<sub>2</sub> equivalents (million metric tons) in 2005. CO<sub>2</sub> was the predominant gas accounting for 77 per cent of world GHG emissions in 2005 followed by methane (15 per cent) and nitrous oxide (7 per cent).North America accounted for 18 per cent of world GHG emissions, China for 16 per cent, and the EU for 12 per cent in 2005. India's share stood at 4 per cent in 2005. India ranks fifth in aggregate GHG emissions in the world, behind USA, China, EU, and Russia, in

2007. The emissions of USA and China were almost four times that of India, in 2007. It is also noteworthy that the emissions intensity of India's GDP declined by more than 30% during the period 1994–2007. Although India ranks in the top five countries in terms of absolute GHG emissions, the per capita emissions are much lower compared to those of the developed countries.



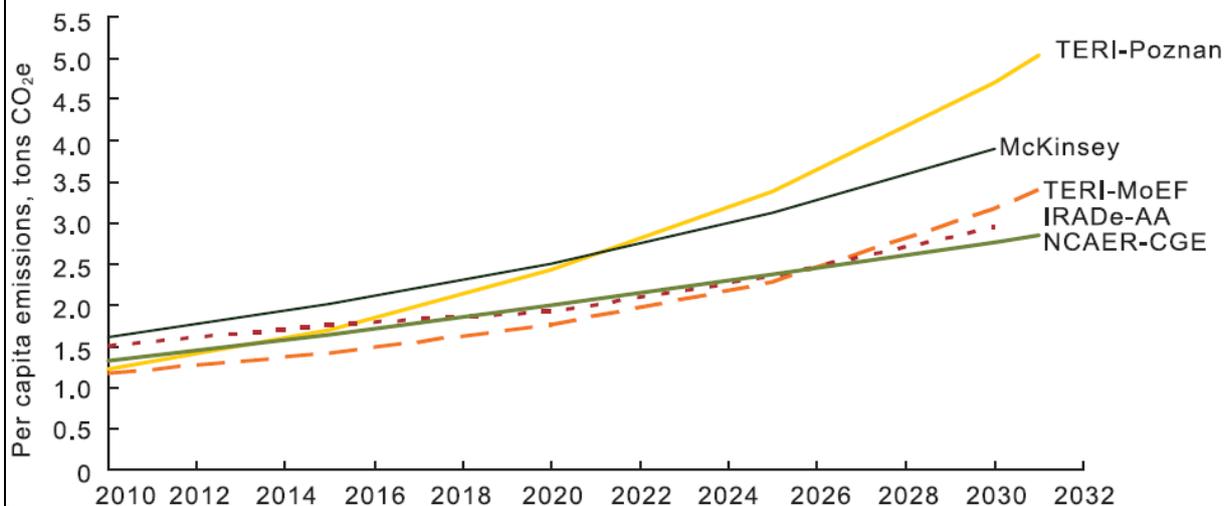
Source: EDGAR 4.2FT2010 (1990–2010); UNDP (WPP, Rev. 2013), 2013

**33.35** The most recent data available for India is based on the assessment carried out by the INCCA in May 2010. India's per capita CO<sub>2</sub> eq. emissions, including land use, land-use change and forestry (LULUCF) was 1.5 tonnes per capita in 2007. The key results of the assessment are that the total net GHG emissions from India in 2007 were 1727.71 million tons of CO<sub>2</sub> equivalent (eq.) of which carbon dioxide emissions were 1221.76 million tons, methane 20.56 million tons and nitrous oxide 0.24 million tons.

**33.36** Estimates of India's per capita GHG emissions in 2030-31 vary from 2.77 tonnes to 5.00 tonnes of CO<sub>2</sub>eq, with four of the five studies estimating that India's GHG emission per capita will stay under 4 tonnes per capita. This may be compared to the 2005 global average per capita GHG emissions of 4.22 tonnes of CO<sub>2</sub>eq per capita. In other words, four out of the five studies project that **even two decades from now, India's per capita GHG emissions would be well below the global average 25 years earlier**. In absolute terms, estimates of India's GHG emissions in 2031 vary from 4.0 billion tonnes to 7.3 billion tonnes of CO<sub>2</sub>eq, with four of the five studies estimating that **even two decades from now, India's total GHG emissions will remain under 6 billion tonnes of CO<sub>2</sub>eq**.

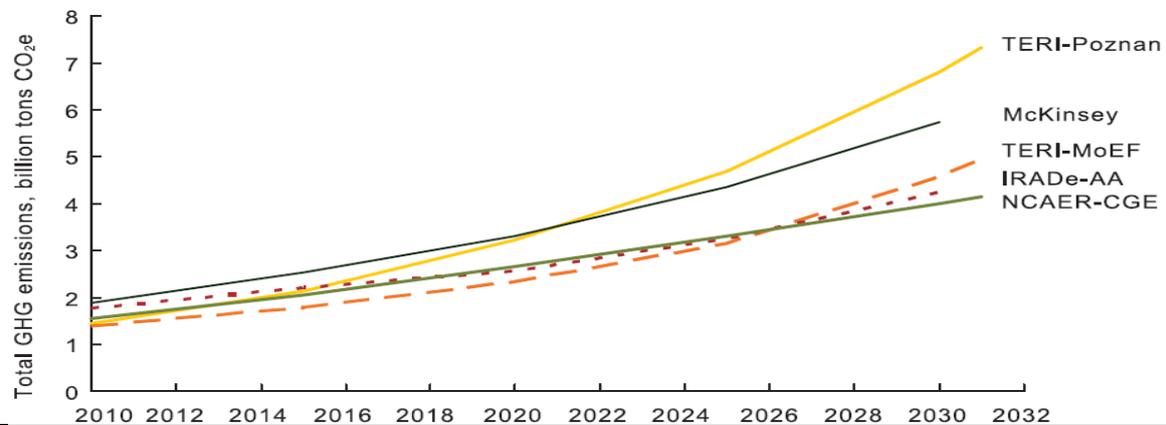
### Per capita GHG emissions

Per capita GHG emissions projections for India from 5 studies in Illustrative Scenarios (2010-2031)



### Total GHG emissions

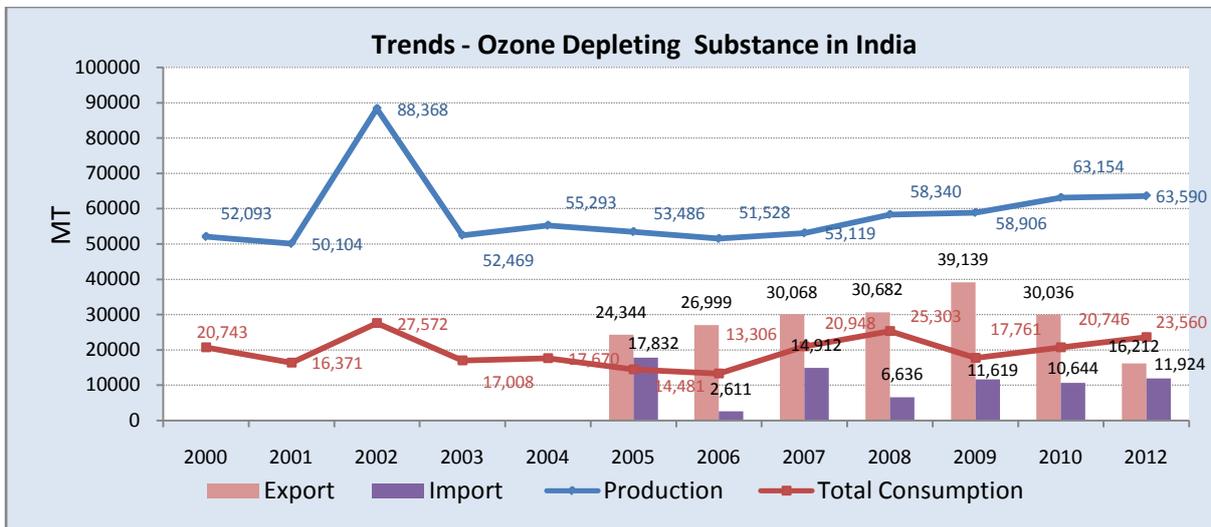
GHG emissions projections for India from 5 studies in Illustrative Scenarios (2010-2031)



Source : India's GHG Emissions Profile , MoEF, 2009

**33.37 Ozone Depleting Substances(ODS) :** Ozone Depleting Substances (Regulation & Control) Rules, 2000 regulate production, consumption & trade of ODS in India . India had earlier signed the Montreal Protocol in 1992 and a country program to phase out ODS was prepared in accordance with national industrial development policy. Ozone Cell in M/o Environment & Forests has been given operational and administrative responsibility for India's overall ODS phase out program. The new phase out Plan as per the 19<sup>th</sup> Meeting of Parties (MOP) is :

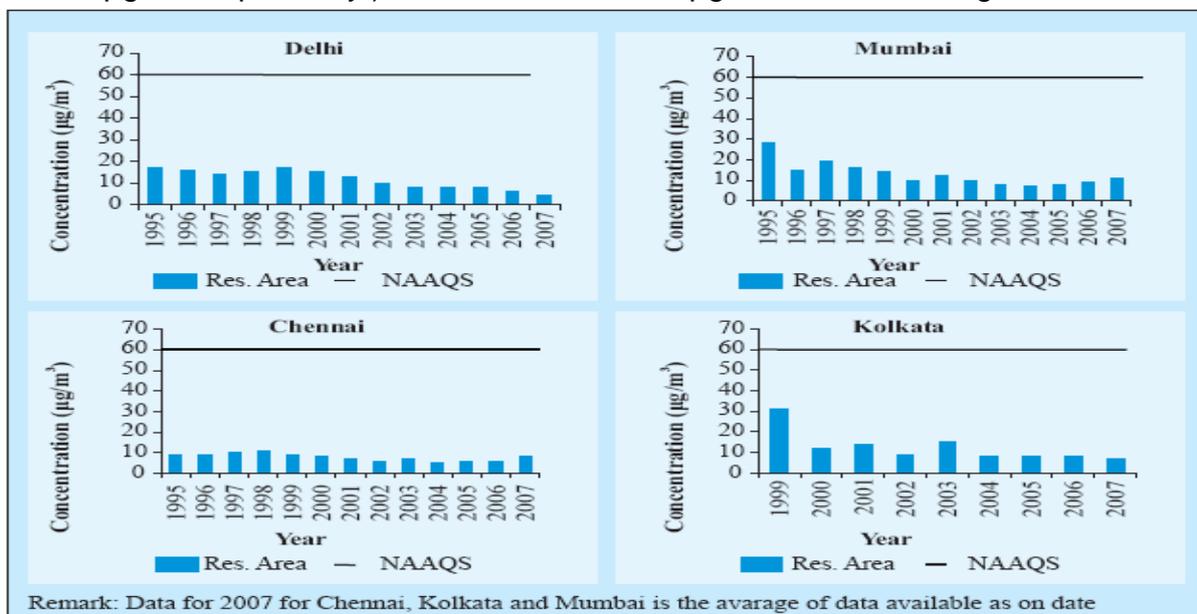
- Base-level for production & consumption:the average of 2009 and 2010
- Freeze= 2013 at the base-level
- 10% reduction in 2015
- 35% reduction in 2020
- 67.5% reduction in 2025
- 100% reduction in 2030 with a service tail of 2.5% annual average during the period 2030-2040.



Source Ozone Cell, MoEF

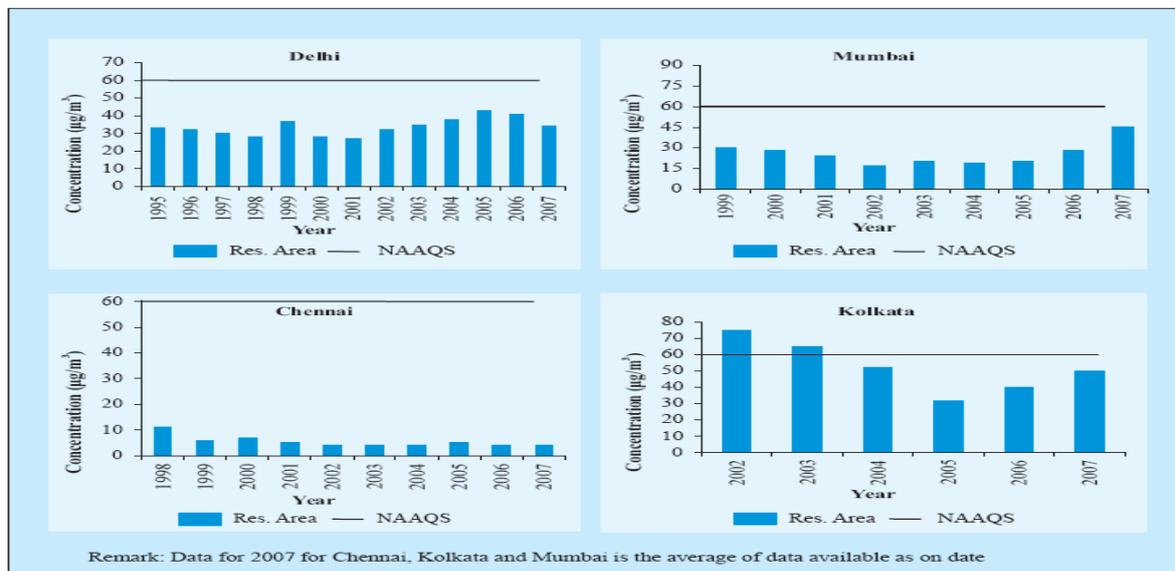
**33.38 Air Quality : National Ambient Air Quality Standards (NAAQS)** have been notified by Central Pollution Control Board(CPCB) to monitor air quality in view of increasing industrialization, vehicular use etc. Presently Revised NAADQ 2009 is in vogue. A decreasing trend has been observed in SO<sub>2</sub> levels in many cities like Delhi and Mumbai, during the last few years. This trend may be due to various measures taken, such as reduction of sulphur in diesel etc. and use of LPG instead of coal as a domestic fuel.

**33.39 Trends in Annual Average Concentration of SO<sub>2</sub> in Residential Areas of four metro cities of India is given below.** During 2008, the levels in the four metro cities of Delhi, Mumbai, Chennai and Kolkata were 6.6, 8.7, 9.5 & 7.7µg/m<sup>3</sup> respectively. During 2012, the concentration of SO<sub>2</sub> in various states/UTs of India ranged from 2 to 26 µg/m<sup>3</sup>. The concentration in Uttarakhand and Jharkhand was above 20 (26 and 23 µg/m<sup>3</sup> respectively) and the same was 5 µg/m<sup>3</sup> in Delhi, during 2012.



**33.40** During the last few years, a decreasing trend has been observed in nitrogen dioxide levels due to various measures taken for vehicular pollution control such as stricter vehicular emission norms. Vehicles are one of the major sources of NO<sub>2</sub> in the country. However, Delhi observed an increasing trend in the past few years, especially after the introduction of CNG. This alternative fuel is known to emit, comparatively, more NO<sub>2</sub> than diesel and petrol. During 2008, the levels in the four metro cities of Delhi, Mumbai, Chennai and Kolkata were 56.7, 39.3, 15.4 & 6.4

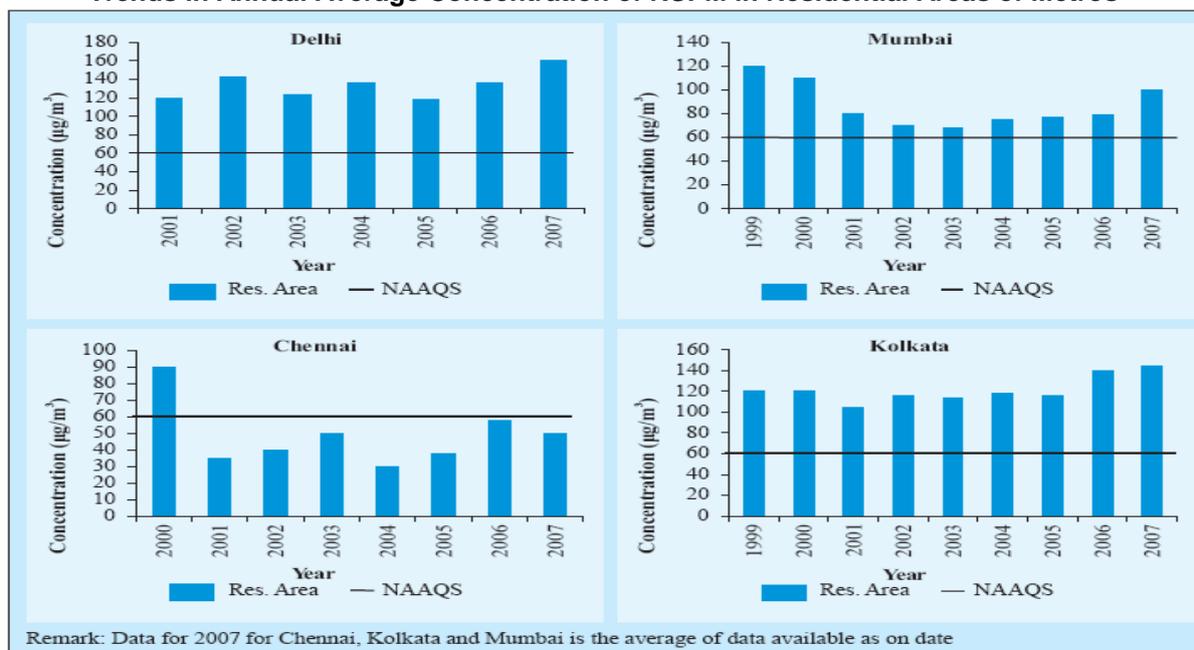
$\mu\text{g}/\text{m}^3$  respectively. The  $\text{NO}_2$  concentration in India, during 2012, ranged from below  $10 \mu\text{g}/\text{m}^3$  to high of  $59 \mu\text{g}/\text{m}^3$  observed in Delhi. West Bengal & Jharkhand with  $\text{NO}_2$  concentration of  $58$  &  $41 \mu\text{g}/\text{m}^3$  respectively also had comparatively higher figures. Trends in Annual Average Concentration of  $\text{NO}_2$  in Residential Areas of four metro cities of India is given below



### Trends in Annual Average Concentration of $\text{NO}_2$ in Residential Areas of Metros

**33.41** Annual average concentrations of Respirable Suspended Particulate Matter (RSPM) and Suspended Particulate Matter (SPM) exceeded the NAAQS in most of the cities. During 2008, the levels in the four metro cities of Delhi, Mumbai, Chennai and Kolkata were  $214$ ,  $127$ ,  $63$  &  $103 \mu\text{g}/\text{m}^3$  respectively. The concentration of Particulate Matter ( $\text{PM}_{10}$ ) during 2012, in India, varied from around  $50 \mu\text{g}/\text{m}^3$  to a high of  $237 \mu\text{g}/\text{m}^3$  observed in case of Delhi.

### Trends in Annual Average Concentration of RSPM in Residential Areas of Metros



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- Trends in Global CO<sub>2</sub> Emissions 2015 Report, PBL Netherland Environment Agency & Joint Research Centre , European Commission.