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EV 20001: Environmental Science

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What does the syllabus say on the topics I am supposed to speak on?

- ✓ Intro Contd.., Env Laws and regulations
- ✓ Water Pollution and Wastewater Treatment
- ✓ Water and Wastewater
- ✓ Global environmental issues, Climate change, Sustainable Development
- ✓ Noise Pollution

There are many standard text books that discuss this topic. Parts of the materials given in the study materials and PPT slides are taken from various sources. You may consult the following books for some of the topics.

Introduction to Environmental Engg and Science, Gilbert Masters, Prentice Hall, 2008

Environmental Pollution and Control, Jeffreys Peirce, Butterworth, 1998.

What is the Background of such a Course? A Supreme Court Order

Definition of ENVIRONMENT

The definition varies from one country to another, but the sense remains the same

As per the UNEP Judicial Handbook on Environmental Law :
"ENVIRONMENT is a complex of natural and anthropogenic factors and elements that are mutually interrelated and affect the ecological equilibrium and the quality of life, human health, the cultural and human heritage and the landscape."

A one-liner from the Environment Protection Act of Bulgaria
"ENVIRONMENT is that part of nature which is or could be influenced by human activity"

Love for the environment and the urge to keep the environment clean have been pronounced since the early days of human civilization.

Environment and Human Civilization

- **The human civilization was characterized by exploitation, destruction and non-caring of the Environment**
- **The first chapter of Genesis: People are commanded by God to subdue Nature, procreate and to have dominion over all living things. Perhaps people were advised so for their survival.**
- **There are many counter-examples of love for Nature, considering Nature as God.**
- **On the whole, the problem of deterioration of the environment aggravated over centuries as a result of human actities**

"If seven maids with seven mops
Swept it for half a year,
Do you suppose," the Walrus said,
"That they could get it clear?"
"I doubt it," said the Carpenter,
And shed a bitter tear.

—Lewis Carroll

Was the Walrus positive and hopeful?

Air Pollution

Meuse Valley Fluoride Fog, 1930; Donora Fog, 1948, London Killer Fog, 1952

Meuse Valley Fog: First scientific proof of the potential of air pollution, December 1-5, 1930

Emissions from steel works, zinc smelters, glass manufacturing in the city of Liege on the river Meuse in Belgium and surrounded by small hills on all sides

Emissions contained SO2, fluoride, CO, particulates

Sixty people killed, Hundreds hospitalized

Donora Fog, 1948

The worst air pollution disaster in USA

Started on the Halloween night, October 25, 1948, continued for seven days

The town of Donora was on the river Monongahela in Pittsburgh, PA

Sources of emission were steel works, zinc smelters as in the Meuse valley

twenty people killed and hundreds hospitalized.

London Killer Smog, 1952

Occurred between Dec 5-9, 1952

Anticyclonic and windless condition, a large part of London covered with dense fog

Public life, transport (both road and rail) at standstill, flights cancelled

An estimated 4000 people killed (more recent estimate puts the figure at 12,000) and 100,000 ill

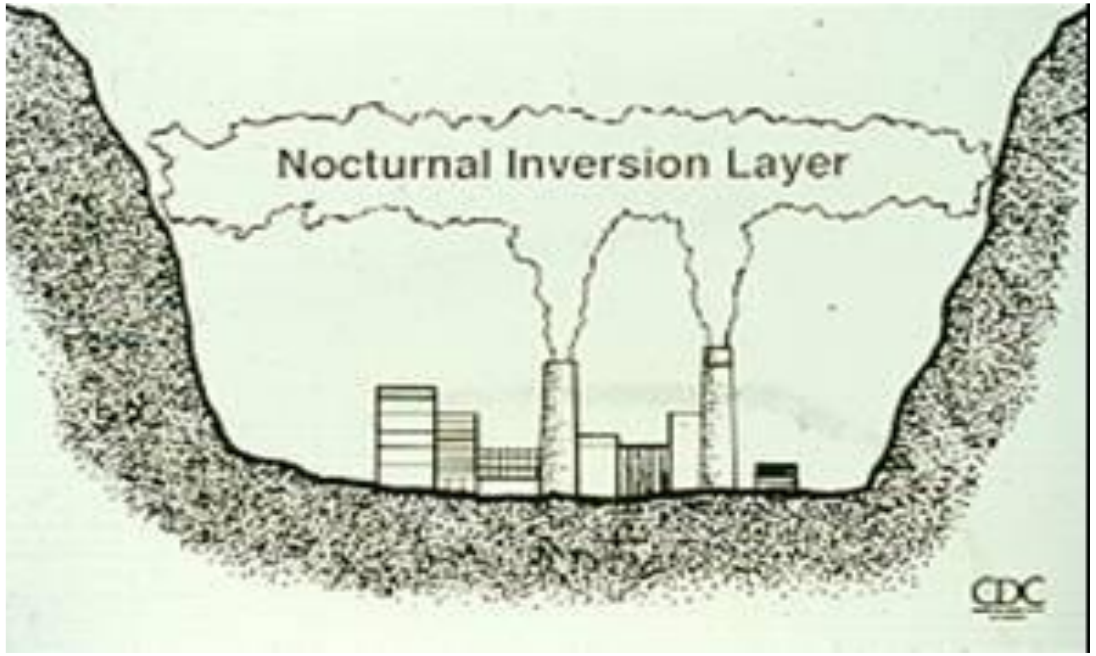
The fog disappeared quickly after Dec 9.

Pictures of London smog

Temperature Inversion

The fog and disaster at all the above three places occurred because of temperature inversion

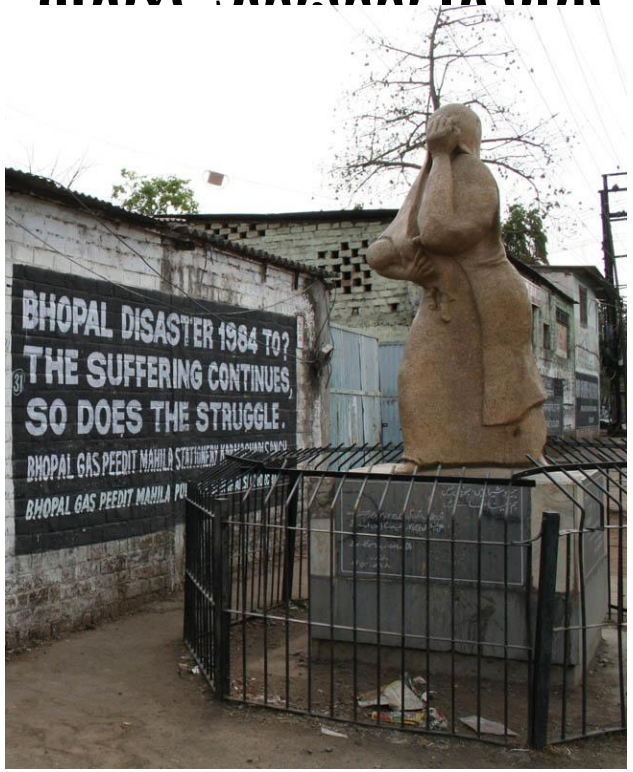
This means lower temperature near the ground and the reverse above the ground, preventing convective air movement. The phenomenon becomes more acute in valleys surrounded by hills.



Schematic of Temperature Inversion

THE BHOPAL DISASTER

Also known as Bhopal Gas Tragedy , caused by leakage of Methyl Isocyanate from the Union Carbide's pesticide plant in the night of Dec 2-3, 1984. Effects – 4000-8000 deaths (some say that the figure is much higher), 4000 permanent disabilities, above 500,000 people affected. Cleanup of the site is still pending.



July 5, 2018 BLOOD RAIN!!

BLOOD-RED rain pouring over a remote Siberian city in Russia called Norils sparked fear and confusion.

Streets and cars colored red

Huge quanties of red iron oxide dust from Nadenzinsky plant of metal processing giant Norcnickel created the blood rain

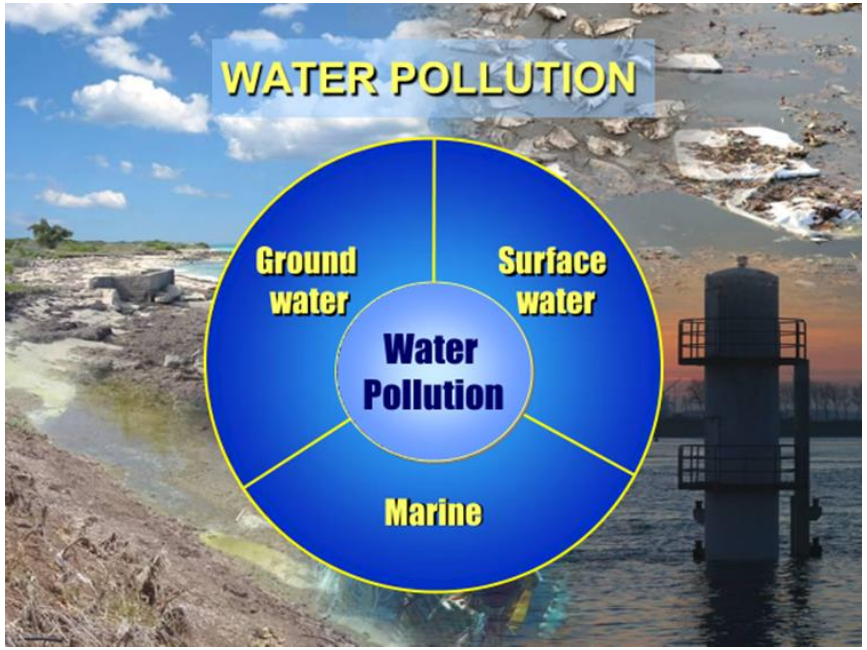
Many industries of sparsely populated Siberia release toxic gases and liquids with little regulation

Forest Fire - Amazon, 2019

Day became night on the afternoon of Monday (Aug. 19) in São Paulo, Brazil.

A FEW EXAMPLES OF DISASTROUS WATER POLLUTION

Minamata Disaster, Minamata Disease: The most massive pollution problem to strike Japan in the post WWII period. A neurological syndrome caused by **methyl mercury** in the industrial wastewater. Continued from 1932 to 1968 (**36** years) 2 cities of **Minamata** and **Niigata.** Mercury salts were released from the Nippon Chisso Corporation's Minamata Chemical Factory The Showa-Denko's Niigata Chemical Factory. 2**,955** victims (**2,009 people died**), over 2 million people consumed the fish contaminated with methyl mercury.



A Few Common Sights of Pollution of Water Bodies

Pollution of our Water Bodies

Pollution of the river Ganga is an enormous case.

MARINE POLLUTION – THE OIL SPILL DISASTERS

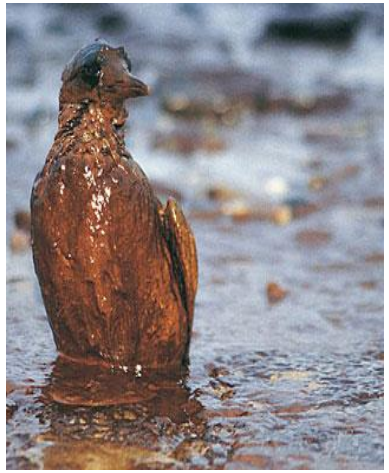
It is estimated that 1.7 to 8.8 million metric tons of oil is released into global waters

There have been a number of oil spills with catastrophic environmental effects –such as The 1967 black tides from the oil tanker Torrey Canyon that spilled 120,000 tons of crude at Sicily island;
The Exxon Valdez oil tanker spill near Alaska in 1989;
The British Petroleum Oil Rig Explosion in 1910 and many others.
BP was fined about 20 billion $, the largest environmental fine in USA.

Exxon-Valdez Oil Tanker

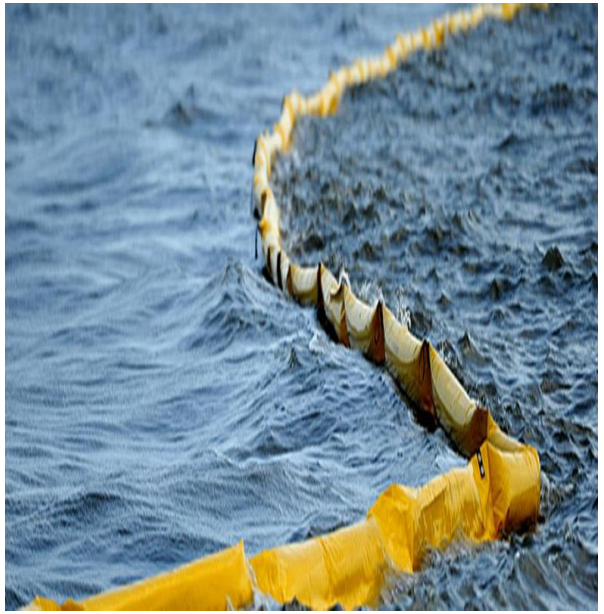
Oil Spill cleanup acivity

The Clean-up Work



BP Oil Rig ablaze in Gulf of Mexico

An oiled bird on the beach



Oil spill cleaning

Burning Iranian Oil Tanker Sinks in East China Sea in January, 2018

Smoke and flames coming from the oil tanker **The Sanchi** at sea off the coast of China.

It burst into flames and sunk, eight days after a collision with a cargo ship off the coast of China.

Thirty crewmen died. Chinese officials have played down fears of a major environmental disaster.
The Sanchi was carrying 136,000 tonnes of light crude oil from Iran.
The smoke reached a height of 800-1000 meter

Soil Pollution Examples

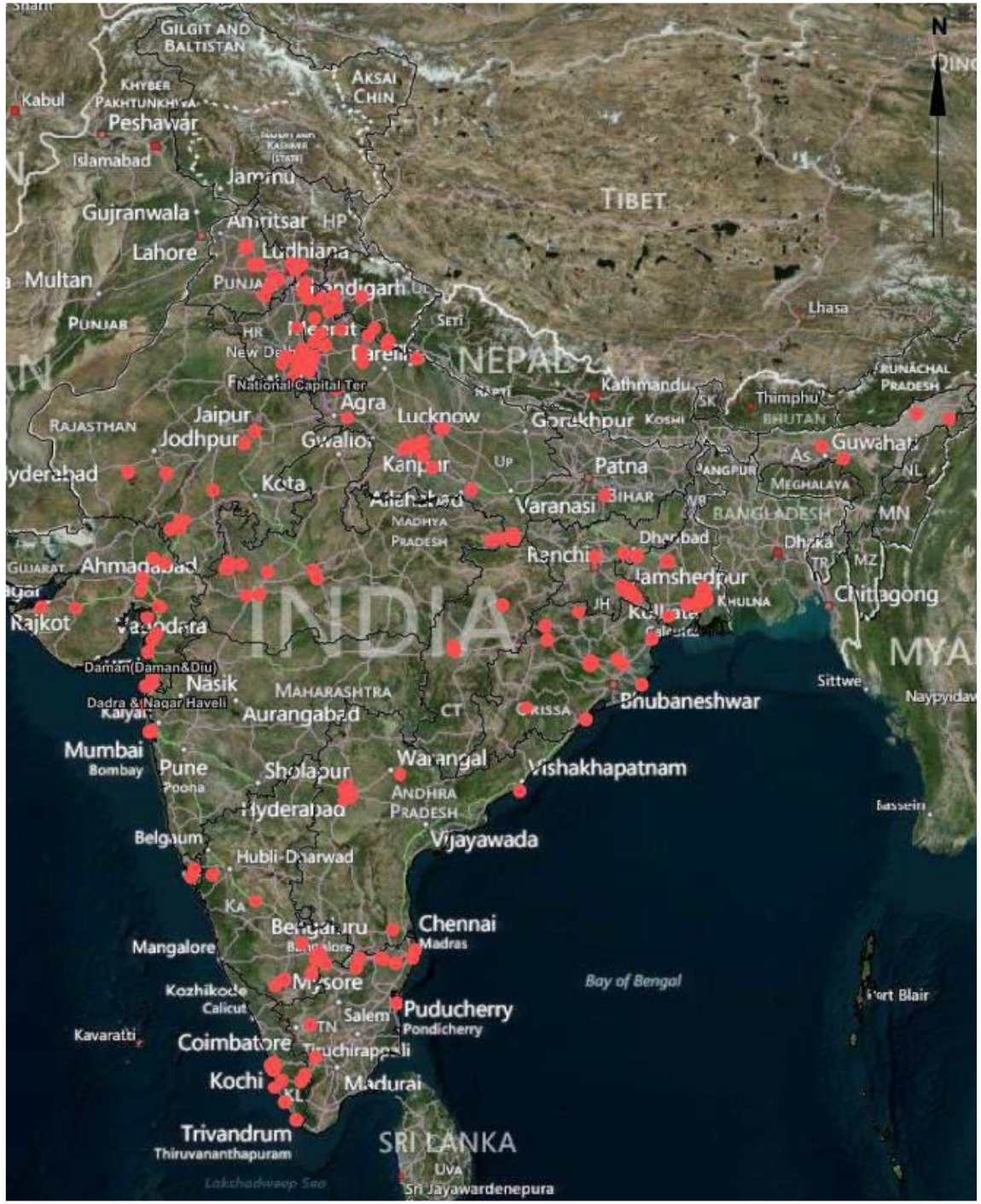
Love Canal Case in USA

1896 William Love begins digging a canal between upper and lower Niagra river to generate hydro-electricity for the local industry. The project was abandoned halfway.
1942 A local chemical company starts dumping toxic wastes into the canal and this continues for several years. An estimated 21,000 tons of acids, pesticides and other toxic wastes filled in old drums goes into the canal. The area was covered with clay. By 1970, a school was built on the clay-covered dump site. Many people built home there. Soon the people fell sick with mysterious disease. There were many cases of birth defect in children. Eventually it was found that most of the sick people had cancer. The Government was alerted. The government bought the houses and the Love Canal was declared a disaster area. It took 20 years and $250 million to clean up Love Canal.

Contaminated sites in India

There are many contaminated sites in India. The contaminants are Cr(VI), Copper compounds, pesticides, Polynuclear hydrocarbons (such as naphthalene). An inventory was prepared by a group of companies led by COWI of Denmark under a World Bank funded project. The report called "Inventory and Mapping of Contaminated Sites in Inda" was prepared in 2015. All these substances have acute health effects and many of them are carcinogenic. Decontamination of soil of these sites is being planned at the Govt level.

Chromium-contaminated sites near the Krebs and Cies Chromate manufacturing plant in Orissa



Location of the 320 probably contaminated sites in India

Global Meets on Environment

- ✓ Deterioration of the environment in general got the attention of environmentalists as well as world leaders in 1960's.
- ✓ It was strengthened after publication of the book **Silent Spring by Rachel Carson**, a marine biologist, in 1962.
- ✓ She passionately examined and described the effect of chlorinated pesticides on the living world.
- ✓ The United Nations General Assembly organized the **United Nations Conference on the Human Environment** in 1972.
- ✓ The Swedish Government hosted the conference in Stockholm. Leaders from 113 countries (that included the then Prime Minister of India) participated in the 12-day long conference (June 5-12, 1972), discussed the issues at length and **converged on a 26 point action program** to regulate and control environmental pollution.

The Stockholm Conference was the driver of change.

- ✓ Some of the principles of the Stockholm Declaration were broadbased: Human rights must be asserted, apartheid and colonialism condemned, Natural resources must be safeguarded, The Earth's capacity to produce renewable resources must be maintained, Wildlife must be safeguarded, etc

The Preamble of the Stockholm Declaration said: "To achieve this environmental goal will demand the acceptance of responsibility by citizens and communities, and by enterprises and institutions at every level, all sharing equitably in common efforts".

Major Follow-up Actions in India

- ✓ **Enactment of the first Environmental Legislation - The Water Act, 1974**
- ✓ **Central Pollution Control Board was established – formation of State PCB's followed.**
- ✓ **Also two more Acts and a set of Rules were adopted and were amended from time to time.**

42nd Amendment of the CONSTITUTION in 1976

- ✓ **Article 48A (Responsibilities of the State): The State shall endeavor to protect and improve the environment and safeguard the forests and wild life of the Country.**
- ✓ **Article 51A (Responsibilities of the Citizens): It is the duty of every citizen to protect and improve the natural environment including forests, lakes, rivers and wild life.**

Water (Prevention and Control of Pollution) Act, 1974 – often called the Water Act, 1974

Main objectives of this act:

-Prevention, control and abatement of water pollution.

-The act also aims at restoration of wholesomeness of water

-The water act is designed to assess pollution levels and punish polluters

-The central government and state governments have set-up pollution control boards to monitor water pollution

Central and state boards have been created under this act for preventing water pollution

-The act empowers the board to take:

- **water samples for analysis**
- **govern discharge of sewage**
- **trade effluents**
- **study or inspect appeals**
- **revision of policies**
- **set minimum and maximum penalties**
- **publication of names of offenders**
- **offences by companies or government departments**
- **establish or recognize water testing laboratories and standard testing procedures**

-Prevention and control of water pollution is achieved through a 'permit' or a 'consent administration' procedure

-Discharging effluents is permitted by obtaining the consent of state water boards

Air (Prevention and Control of Pollution) Act, 1974 – often called the Air Act, 1981

-The Air act aims at prevention, control and abatement of air pollution

-pollution beyond certain limits due to various pollutants discharged through industrial emission is monitored by pollution control boards set up in every state

-The Central Pollution Control Board (CPCB) implements legislation to improve quality of air, prevent and control air pollution in the country.

-The board advises the central government on matters concerning quality of air. It also coordinates activities, provides technical assistance and guidance to state boards in addition to setting the standards for quality of air.

-It collects and disseminates information in respect to air pollution and performs functions prescribed by the act.

-The state boards advise the state government on matters concerning prevention and control of air pollution

-The state boards possess the right to inspect at all reasonable times any control equipment, industrial plant or manufacturing process and give orders to take necessary steps to control pollution.

Air Act, Contd..

-The state board inspects air pollution control areas at regular intervals or whenever necessary.

-They are empowered to provide standards for emissions to be laid down for different industrial plants with regard to quantity and composition of emissions.

-A state board may recognize or establish a laboratory for this purpose.

-State government has powers to declare air pollution control areas after consulting with state boards. In the same manner, state government can give instructions to ensure standards of emission from automobiles and restrict operation of certain industrial units.

-Penalties are imposed by the state board and it might appeal to the court to restrain persons for causing air pollution.

ENVORONMENTAL PROITECTION ACT, 1986 – An Umbrella Act

- ✓ Take all necessary measures for protecting quality of environment,
- ✓ Co-ordinate actions of States, officers and other authorities under this Act,
- ✓ Plan and execute a nationwide programs for prevention, control and abatement of environmental pollution,
- ✓ Lay down standards for discharge of environmental pollutants,
- ✓ Empower an officer to enter, inspect, take samples and test, establish or recognize environmental laboratories,
- ✓ Appoint or recognize government analysts, lay down standards for quality of environment,
- ✓ Restrict areas in which any industries, operations or processes may not be carried out subject to certain safeguards,
- ✓ Lay down safeguards for prevention of accidents and take remedial measures in case of such accidents,
- ✓ Lay down procedures and safeguards for handling hazardous substances,
- ✓ Constitute an authority for exercising powers,
- ✓ Issue directions to any person, officer or authority including the power to direct closure, prohibition or regulation of any industry, operation or process,
- ✓ Require any person, officer or authority to furnish any prescribed information and
- ✓ Make necessary rules to implement the Act.

A List of the more Important Environmental Statues (ACTS and Rules)

1. **Water (Prevention and Control of Pollution) Act, 1974**
2. **Air (Prevention and Control of Pollution) Act, 1981**
3. **Environment (Protection) Act, 1986**

Rules

- **The Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989 replaced by Hazardous Waste (Management, Handling and Transboundary Movement) Rules, 2008, amended again in 2016**
- **The Coastal Regulation Zone Notification, 1991**
- **The Chemical Accidents (Emergency, Planning, Preparedness, and Response) Rules, 1996**
- **The Biomedical Waste (Management and Handling) Rules, 1998**
  - **– latest version Biomedical Waste Management Rules, 2016**
- **Recycled Plastic manufacture and uses (Amendment) Rules, 2003**
- **The Plastics Waste Management Rules, 2011, latest version of 2016**
- **The Municipal Solid Waste (Management and Handling) Rules 2000, latest version - Solid Waste Management Rules, 2016**
- **The Hazardous & Other Waste Management Rules 2016**
- **E-Waste (Management) Rules, 2016**
- **Construction and Demolition Waste Rules, 2016**
- **The Batteries (Management and Handling) Rules, 2001.**
- **The Noise Pollution (Regulation and Control) (Amendment) Rules, 2000**

Essential Features of a Few of the Rules

Plastic Waste Management Rules, 2016

More than 15,000 tonnes of plastic waste are generated across India every day

These rules shall apply to every

- Waste Generator
- Local body,
- Gram Panchayat,
- Manufacturer,
- Importers and producer.

Responsibilities of local bodies and gram panchayat.
Responsibilities of Waste Generator.
Collect back system and Extended Producer's Responsibility or liability (EPR).
Responsibility of retailers and street vendors.
Registration of shopkeepers and street vendors

Recycled Plastic not to be used for packaging of edibles.

- **Thickness of plastic shall be not less than 50 Microns.**
- **Plastic sheet forming part of integral packaging shall be not less than 50 Microns.**
- **Only Registered Producer to be provided Raw material.**
- **Plastic Sachets not be used for packaging Gutka, Pan masala, Tobacco**

Responsibilities of the Local Body (Municipality/Panchayat/O)thers)

- Ensuring segregation, collection, storage, transportation, processing and disposal of plastic waste;
- Ensuring that no damage is caused to the environment during this process;
- Ensuring channelization of recyclable plastic waste fraction to recyclers;
- Ensuring processing and disposal on non-recyclable fraction of plastic waste in accordance with the guidelines issued by the CPCB;
- Creating awareness among all stakeholders about their responsibilities;
- Engaging civil societies or groups working with waste pickers;
- Ensuring that open burning of plastic waste does not take place.

Responsibility of Waste Generator (Extended Producer's Responsibility)

- ✓ Waste generator shall minimize generation of plastic waste and segregate Not litter plastic waste and handover segregated plastic waste – local bodies
- ✓ All institutional waste generator shall segregate and store in accordance with municipal solid waste management rules
- ✓ All waste generator shall pay user fee.
- ✓ Every person responsible for organising an event in open space, which involves service of food stuff in plastic or multilayered packaging shall segregate and manage the waste generated during such event.

The shopkeepers and street vendors supplying plastic carry bags shall register with local body on payment of a minimum fees of Rs. 48,000 i.e. Rs. 4000 p.m. as plastic waste management fees. Only the registered shopkeepers or street vendors shall be eligible to provide plastic carry bags for dispensing the commodities

Solid Waste Management Rules (SWM), 2016

First introduced in 2000 as Municipal Solid Waste (Handling and Management) Rules. 2000
It included all other kinds of non-hazardous wastes such as construction and demolition wastes
Separate Rules have been made for such wastes in 2016

SMW Rules suggest the well known hierarchy

- ✓ **Prevention**
- ✓ **Minimization**
- ✓ **Reuse**
- ✓ **Recycling**
- ✓ **Recovery, utilization including co-processing**
- ✓ **Safe disposal**

What are new?

- **Segregation at Source – three bag formula, degradable, non-degradable, domestic hazardous waste**
- **Local bodies empowered to collect 'User Fee' and levy 'Spot Fine' after framing suitable bylaws**
- **Bulk generators to develop composting facilities**
- **Promotion of compost marketing, Fertilizer Corporations to help in promoting compost**
- **Bringing policy on Waste to Energy; Tariff for energy from waste to be decided**
- **Integration of Rag pickers, Self Help Groups etc. in waste collection system after registration**

The E-Waste (Management) Rules, 2016

First introduced as E-Waste (Management and Handling) Rules, 2011, effective from May 1, 2012

The Rules enabled recovery and/or reuse of useful materials from the plethora of E-Wastes.

For the first time, the concept of Extended Producer Responsibility (EPR) was introduced – this was to make the manufacturers liable for safe disposal of their products.

Formation of Producer Responsibility Organization (PRO) was stipulated. PRO would be a professional organization authorized or financed collectively or individually by the Producer(s) to take responsibilities for collection and channelizing E-wastes.

A PRO is an additional channel for implementing EPR.

An Amendment to the 2016 Rules was made in 2018 with the objectives of channelizing the wastes generated to dismantlers and recyclers and with reduced collection targets.

Collection target to increase by 10% every year.

Collection is entirely under EPR

The Producer may introduce Deposit Refund Scheme (as a security for return of the goods after service life)

Dismantlers and recycles to have authorization.

National Policies on Environment and Natural Resources

Government of India adopted a number of policies relating to the Environment, Natural Resources and Sustainable Development.

The National Environment Policy (NEP) was adopted in the Parliament in 2006. Its essential features are:

- **Conservation of Critical Environmental Resources: To protect and conserve critical environmental resources and invaluable natural and man- made heritage which are essential for life-supporting livelihoods and welfare of the society.**
- **Inter-generational Equity: To ensure judicious use of environmental resources to meet the needs and aspirations of present and future generations.**
- **Efficiency in Environmental Resources Use: To ensure efficient use of environmental resources in the sense of reduction in their use per unit of economic output and to minimize adverse environmental impacts on society.**
- **Environmental Governance in the Management of Resources: To apply the principles of good governance (i.e. transparency, rationality, accountability, reduction in costs and time, and public participation) to the management of environmental resources.**
- **Enhancement of Resources: Appropriate technology and traditional knowledge for conservation and enhancement of resources.**
- **Livelihood Security for the Poor: To ensure equitable access to environmental resources for poor tribal community.**
- **Integration of Environmental Concerns for Socio-economic Development**

National Water Policy was first adopted in 1987 and has been modified a few times The latest modification was done in 2002 highlights the importance of water for human existence as well as for all economic and development related activities. It addresses the problem of scarcity of water and the need to conserve this resource through optimal, economical, sustainable and equitable means.

Legislations in a few other countries:

- ✓ **Clean Air Act, 1955 in USA.**
- ✓ **The Act has since been modified from time to time to cope with the growing need on more strict monitoring and regulation - 1963 Clean Air Act, The Clean Air Quality Act of 1967, 1970 Clean Air Act Amendments, 1977 Clean Air Act Amendments, 1990 Clean Air Act Amendments.**
- ✓ **The US National Environmental Policy Act (NEPA) 1970 was signed on Jan 1, 1970 and the US Environmental Protection Agency (US EPA) was formed on December 2 of the same year.**
- ✓ **US EPA has the overall responsibility of environmental monitoring and regulation. There are State Level agencies as well in the US.**
- ✓ **Japan enacted the first comprehensive environmental law in 1967.**

A number of major global conferences were held as continuation to the Stockholm Conference.

- ✓ **1992 Rio Conference on Environment and Development l Agenda 21, chapter 30: "Strengthening the Role of Business and Industry", including "Promoting responsible entrepreneurship" l**

- ✓ **2002 World Summit on Sustainable Development (Earth Summit 2 or Rio + 10) Political Declaration: "duty of the private sector to contribute to the evolution of equitable and sustainable communities and societies" and (para. 27) and "need for the private sector to enforce corporate accountability, …within a transparent and stable regulatory environment" (para 29)**

- ✓ **2012 "Rio+20" Conference held at Johannesburg: "Green Economy, Green Growth"?**

Towering Principles that Influence today's Environmental Laws

- ✓The Precautionary Principle (PP)
- ✓The Prevention Principle (P2)
- ✓The Polluter Pays Principle (PPP)
- ✓The Sustainable Development Principle

PRECAUTIONARY PRINCIPLE (PP)

✓**Natural Environment has a limited capacity of absorbing the ill-effects of contamination. Beyond certain limits, they cause damage to life and property.**

- ✓ **Environmental Laws regularly operate in areas complicated by high levels of scientific uncertainty!**
- ✓ **The Precautionary Principle has been defined in Principle 15 of the Rio Declaration (Agenda 21)**
- ✓ **In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. *Where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation*.**

Precautionary Principle (PP) in Practice

- Precautionary Principle is manifest in several multilateral Environmental Agreements
- The Montreal Protocol on ODS, 1987
- The Rio Declaration on Environment and Development, 1992
- UN Framework Convention on Environment and Development, 1992
- Convention on Biological Diversity, 1992
- Cartagena Protocol on Bio-safety, 2000
- Stockholm Convention on POP's, 2001

PP is not explicitly mentioned in our environmental laws

It is explicitly mentioned in the environmental laws of many African (South Africa, Mozambique, Cameroon) and Latin American countries (Argentina, Peru, Costa Rica)
It has been amply referred to and enunciated in a number of cases by Hon'ble Supreme Court of India – for example

✓Vellore Citizens' Welfare Forum Case on tannery effluents
✓Taj Trapezium Case (this refers to the effect of SO2 on the Taj Mahal and over a 10,400 sq km area around the Taj): PIL by M C Mehta
✓Calcutta Tanneries Case

Prevention Principle, P2…

- In essence, Pollution Prevention is largely based on clean and green technologies, and adoption of green operating practice.
- Pollution Prevention has a great role in Sustainable Development
- In most of the countries, Pollution Prevention remains at the policy level.
- In the US, Pollution Prevention Act was passed by the Congress in 1990. This act and associated executive orders allow a number of opportunities for prevention of pollution.

The Polluter Pays Principle (PPP)

- ✓ There are ramifications of this principles in ancient literature.
- ✓ There is no agreed definition of PPP
- ✓ PPP was explicitly mentioned in Principle 16 of the Rio Declaration (1992):

National Authorities should endeavor to promote the internalization of environmental costs and the use of economic instruments, taking into account the approach that the polluter should, in principle, bear the cost of pollution, with due regard to the public interest and without distorting international trade and investment.

➢**United Nations Environmental Program (UNEP) says: The Polluter Pays Principle for damage to the environment should bear the costs associated with it.**

➢**PPP is a method for internalizing the externalities. Internalization requires that all the environmental costs be borne by the producer/consumer instead of the community as a whole. Polluter should pay for the pollution cost measures – such as construction and operation of anti-pollution installations, investment for control equipment, etc.**

The Polluter Pays Principle in the Ancient Society

The principle has been stated in different forms in ancient literature

An excerpt from **The Dialogue of Plato:**

"If anyone intentionally spoils the water of another … let him not only pay damages, but purify the stream or cistern which contains the water."

- Vol 4, book 8, section 485

सुकूपानां तड़ागानां प्रपानां च परंतप।
सरसां चैव भैत्तारो नरा निरयगामिन:।।

- Padmapurana, Bhimi 96.7.8

Those who pollute pure water from wells, rivers, fountains, or ponds must go to hell.

The Polluters-Pay Principle in Practice

- There are numerous examples of application of this principles and imposition of heavy penalties in developed countries.

Example: Oil spill cases – Exxon-Valdez oil spill, Exxon had to pay about $1 billion;
Gulf of Mexico oil spill in 2010, BP agreed to pay $18.7 b

- An escape route is "Cap-and-Trade' (Carbon Trade)

- Bhopal disaster – an out of court settlement was made, reportedly far below the damage, Govt had to take a lot of burden.
- The Indian Supreme court imposed fines for pollution in many cases, the biggest one being Rs 100 crore fine on Starlite a multinational for mining and metallurgical polluting activity.
  Imposed fines on many other industries big and small
- Pollution tax imposed on heavy vehicles for entering
  Delhi (varying from Rs 700 to 1300 per entry)

Sustainable Development Principle

Sustainable Development was defined as : The development that meets the needs of the present without compromising the ability of the future generations to meet their own needs.

The Brundtland Report was central in framing the discussion at the United Nations Conference on Environment and Development (UNECD) well known as the Earth Summit at Rio.

Poverty has been identified as a major factor for environmental deterioration.
Eradication of poverty occupied a key position in the Sustainable Development Goals adopted by UN General Assembly in 2015.

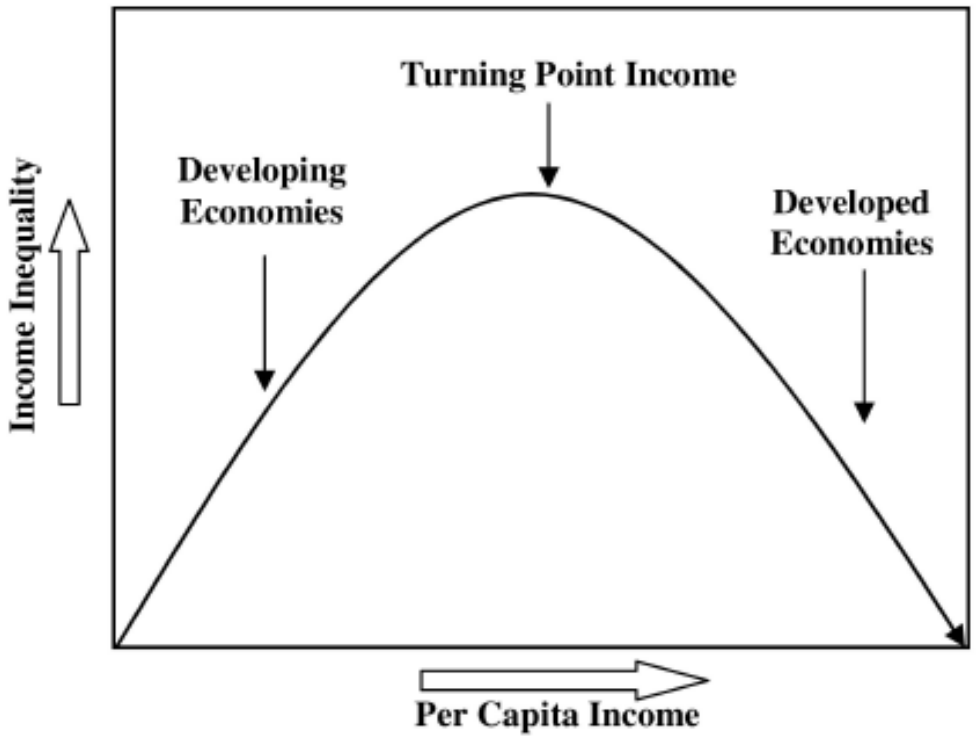
How are Prosperity and Eradication of Poverty related to Environmental Quality?

- The principles of Sustainable Development stipulates eradication of poverty as a criterion or objective.
- Is environmental quality in a country related to its prosperity or per capita income?

The answer is given by the **Environmental Kuznets Curve (EKC)**

What is Kuznets Curve?

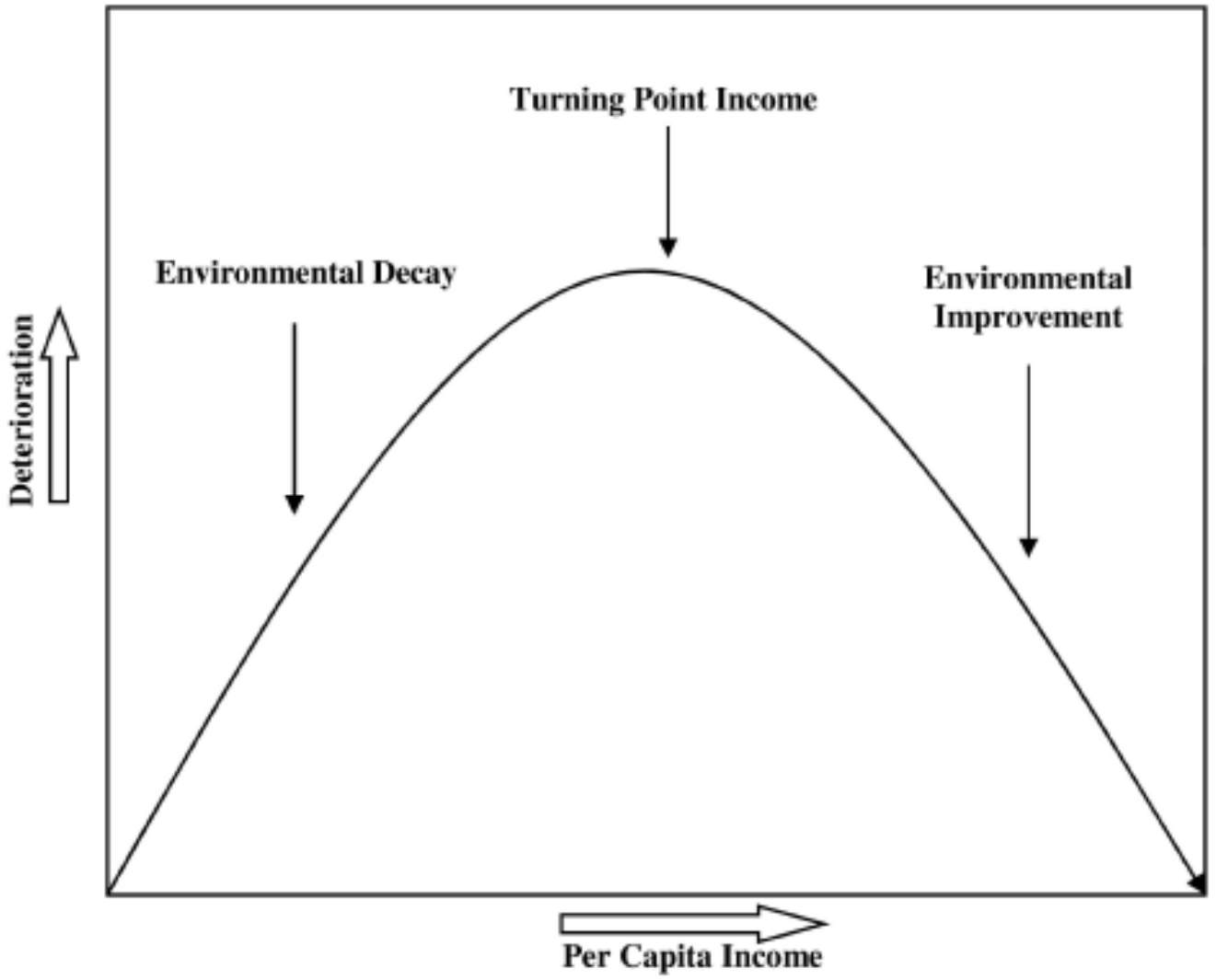
Simon Kuznets, in his Presidential Address in the 76th annual meeting of American Economic Association, 1954, suggested a relation between Economic Growth and Income Inequality.
The graphical representation of the relation is the famous Kuznets Curve.



The Kuznets Curve

- The plot of Income Inequality against Per Capita Income is an inverted U-shaped curve.
- Distribution of income becomes more unequal at early stages of economic growth, but eventually moves back to greater equality.
- There has been a lot of discourse on the Kuznets Curve.

In 1991, The Kuznets Curve took on a new existence. The World Bank Report entitled World Development Report, 1992, popularized the Environmental Kuznets Curve. The data on ambient air and water quality in cities worldwide were regressed on a polynomial in GDP per capita and the plot was called the Environmental Kuznets Curve



The Environmental Kuznets Curve (EKC)

Other functional forms including higher order polynomials have been attempted.
The turning point of the EKC for individual pollutants differ across countries.

How we in India are doing?

Environmental Performance Index (EPI)

The Center for Environmental Law and Policy, Yale University and The Center for International Earth Science and Information Network of Cornell University developed the concept of Environmental Performance Index (EPI)

It is based on a number of criteria and factors.

There are 24 performance indicators across ten issue categories covering environmental health and ecosystem vitality.

These metrices provide a gauge at a national scale of how close countries are to established environmental policy goals. The EPI thus offers a scorecard that highlights leaders and laggards in environmental performance, gives insight on best practices, and provides guidance for countries that aspire to be leaders in sustainability.

According to the 2016 listing of 180 countries, Finland was on the top and India's position was 141. 2018 ranking places India at 177 followed by Democratic Republic of Congo, Bangladesh and Burundi. Switzerland tops the 2018 list.

Environmental Performance Index (EPI) – Center for Environmental Law and Policy, Yale Univ and Center for International Earth Science Information, Cornell Univ