General Knowledge Today

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Environment-5: Domestic Laws on Pollution

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Legal Framework around Pollution

Environment and Constitution of India

The provisions related to environment in the constitution of India are found among Fundamental Duties, Directive Principles as well as Fundamental Rights.

Fundamental Duties

Article 51-A(g) says that "*It shall be duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wild life and to have compassion for living creatures.*"

Directive Principles

Article 48-A of the constitution in Directive Principles focuses on protection and improvement of environment and safeguarding of forests and wild life. This article says: "*The State shall endeavour to protect and improve the environment and to safeguard the forests and wild life of the country*"

Further, article 47 and 48 also commensurate with the healthy environment. Article 47 provides that the "*State shall regard the raising of the level of nutrition and the standard of living of its people and the improvement of public health as among its primary duties.*" Protection and improvement of environment is necessary for improving the public health. Article 48 directs the state to take steps to organize agriculture and animal husbandry on modern and scientific lines.

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Fundamental Rights

Under Fundamental Rights (Part-III), Articles 21, 14 and 19 have been used by judiciary to establish Right to clean environment as one of the implied fundamental rights. Article 21 which says: *no person shall be deprived of his life or personal liberty except according to procedure established by law*", has been subject to maximum scrutiny by Supreme Court, which has mandated for more than once that the right to environment, free of danger of disease and infection are inherent in this act. The right to healthy environment was first recognized by Supreme Court as inherent in article 21 in the *Dehradun Quarrying Case* in 1988. In this case, Supreme Court gave direction to stop quarrying under Environment Protection Act. Similarly, the M.C. Mehta vs. Union of India, 1987 case also, the Supreme Court treated the right to live in pollution free environment as a fundamental right inherent under Article 21.

Supreme Court has also interpreted Article 19(1) to tackle the menace of noise pollution. The court has maintained in PA Jacob case 1993 that freedom of speech does not include freedom to use loud speakers or sound amplifiers. Further, Article 19(1) (g) confers the fundamental right over citizens to practice any occupation, trade or business. But this fundamental right is subject to reasonable restrictions and citizens can not practice the business activities that case health hazards to public.

Apart from the above, Supreme Court (Via article 32) and High Courts (Via article 226) have frequently admitted to public interest litigation related to environment.

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Air (Prevention and Control of Pollution) Act, 1981

The Parliament enacted the Air (Prevention and Control of Pollution) Act, 1981 to arrest the deterioration in the air quality.

The notable points from this act are as follows:

- The Act makes provisions for the establishing of **Central Pollution Control Board** (CPCB) at the apex level and State Pollution Control Boards at the state level.
- The CPCB advises the Central Government on any matter concerning the improvement of the quality of the air and prevention, control and abatement of air pollution. It also helps to plan and cause to be executed a nation-wide programme for the prevention, control and abatement of air pollution. It provides technical assistance to and guidance to the State Pollution Control Board. It also lays down the down standards for the quality of air.
- The SPCBs plan a comprehensive programme for prevention, control and abatement of air pollution and to secure the execution thereof.They also advise the State Government on any matter concerning prevention, control and abatement of air pollution.
- Kindly note that according to this act, the "**air pollutant**" means any solid, liquid or gaseous substance **(including noise)** present in the atmosphere in such concentration as may be or tend to be injurious to human beings or other living creatures or plants or property or environment.

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What are Air pollution control areas?

- This act provides that the State Government may, after consultation with the State Board, by notification declare any area or areas within the State as air pollution control areas. The state government is also powered to make any alternations in the area pollution control areas such as merging the areas. If the state government, after consultation with the State Board, is of opinion that the use of any fuel or burning of any non-fuel material other than an approved fuel, in any air pollution control area or part thereof, may cause or is likely to cause air pollution, it may, by notification, prohibit the use of such fuel in such area.
- The further provisions of the act say that no person shall, without the previous consent of the State Board, establish or operate any industrial plant in an air pollution control area. Every person to whom consent has been granted by the State Board, shall comply with the conditions and norms prescribed by the board such as prevention and control of the air pollution. Failure to do so brings penalty including jail term of at least 1.5 years.

Air Quality Control and Monitoring

Central Pollution Control Board (CPCB) with the help of concerned State Pollution Control Boards (SPCBs) and Pollution Control Committees (PCCs) is monitoring the ambient air quality in the

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country at 346 stations covering 130 cities and towns. This is done under the National Air Quality Monitoring Programme (NAMP).

Under this programme, Central Government provides funds through CPCB for National Air Monitoring Programme to various SPCBs and PCCs.

The objectives of the NAMP are to determine the status and trends of ambient air quality; to ascertain whether the prescribed ambient air quality standards are violated; to assess health hazards and damage to materials; to continue the ongoing process of producing periodic evaluation of air pollution situation in urban and industrial areas of the country; to obtain the knowledge and understanding necessary for developing preventive and corrective measures and to understand the natural cleansing processes undergoing in the environment through pollution dilution, dispersion, wind based movement, dry deposition, precipitation and chemical transformation of pollutants generated.

Under the NAMP, four air-pollutants viz., SOx , NOx , Suspended Particulate Material (SPM) and Respirable Suspended Particulate Matter (RSPM) have been identified for regular monitoring at all the locations.

National Air Quality Index (NAQI)

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The NAQI was prepared by an expert group, set up the Ministry of Environment and Forests, comprising of renowned medical practitioners from hospitals and research agencies.

The index is a part of the government's Swachh Bharat Mission. The index measures *eight major pollutants, namely, particulate matter (PM 10 and PM 2.5), nitrogen dioxide, sulphur dioxide, ozone, carbon monoxide, ammonia and lead. Currently, only particulate matter, nitrogen dioxide and sulphur dioxide*.

The index is based on real time monitoring, and the health risks are easily identified through *a colour coded system*. The risks will be signified through six levels – good, satisfactory, moderately polluted, poor, very poor, and severe. Air quality is qualified as good if the level of air pollution if at least 50% below the permissible limits set by the Pollution Control authorities.

The index will be extended to 46 cities having a population of more than one mn, and 20 state capitals over the next five years.

Purpose of the NAQI

The NAQI allows for easy dissemination of information pertaining to air quality and risks associated with it. The simplicity of the NAQI also makes it accessible to the common man. The use of the colour coded system makes is easier for people to comprehend instantly.

The index will also update the currently outdated system of monitoring air quality. 246 cities in India monitor their air quality in some for, however, only 16 cities have real time monitoring. Eventually, the index will be expanded to cover cities with a population of more than half a million. The real

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time information will help the authorities deal immediately and effectively to counter the impacts of the air pollution.

Legislation on water

Water in India is governed under three different Acts: the Environmental Protection Act (1986), the River Boards Act (1956) and the Inter-State Water Disputes Act (1956). Other Acts and Regulations affect water resources in different ways by addressing its importance for agriculture, biodiversity and conservation and drinking water. These three Acts, however, have the broadest scope in terms of how they affect all aspects of water management.

Water in Constitution of India

Water is a state subject via Entry 17 of State List, thus states are empowered to enact legislation on subject of water. But this entry is subject to the provisions of Entry 56 of Union List. The specific provisions in this regard are as under:

- Entry 56. Regulation and development of inter-State rivers and river valleys to the extent to which such regulation and development under the control of the Union is declared by Parliament by law to be expedient in the public interest.
- Entry 17. Water that is to say, water supplies, irrigation and canals, drainage and embankments, water storage and water power subject to the provisions of Entry 56 of List – I.

At the same time, the Articles 131 and 136 of the Constitution have been used by the States frequently for bringing the matters related to inter-State rivers before the Supreme Court via the *Special Leave Petitions*. Further, Article 143(1) of the Constitution has been used by the Central Government (via President) for seeking opinion of the Supreme Court on the matters related to inter-State rivers, under the advisory jurisdiction of the Supreme Court.

River Boards Act

The regulation and development of inter-state rivers and river valleys was to be entrusted to various River Boards when this Act was adopted in 1956. The River Boards were designed to advise the central government on development opportunities, coordinate activities and resolve disputes. Under their mandate, the Boards were required to provide advice to the government on various issues related to rivers. The Indian government has been unable to constitute a River Board since the Act was enacted, almost fifty years ago.

Inter-State Water Disputes (ISWD) Act, 1956

Interstate River Water Disputes Act, 1956 (IRWD Act) was enacted by the parliament of India under Article 262 of Constitution to resolve the water disputes that would arise in the use, control and distribution of an interstate river or river valley.

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Article 262 of the Constitution has made the following provisions:

- The power of legislation conferred upon Indian parliament for adjudication of any dispute or complaint with respect to the use, distribution or control of the waters of, or in, any inter-State river or river valley.
- By making a law, the parliament can also provide that neither the Supreme Court nor any other court shall exercise jurisdiction in respect of inter-state water disputes.

Thus, the constitution provides a role to the Central government in adjudicating conflicts surrounding inter-state rivers that arise among the states/regional governments. This Act further has undergone amendments subsequently and its most recent amendment took place in the year 2002.

Scope of the Act

IRWD Act is applicable **only to interstate rivers** / **river valleys**. If the action of one state affects the interests of one or more other states, then only water dispute is deemed to have arisen under IRWD Act. The action of the state can be of two types:

- Actions of a downstream state affecting the interest of an upstream state
- Actions of an upstream state affecting the interest of a downstream state

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Here we note that the action of the downstream state's action can affect the upstream state only when the downstream state is bulding a dam or barrage near the boundary or a submerging territory of the upstream state. However, the actions of the upstream state can affect the downstream state in many ways, which includes:

- Consumption and storage of water by upstream state
- Onstruction in flow of non-flood water by upstream state
- Alternation in the quality of water due to anthropogenic activities by upstream state

These come under the purview of the legal causes of water dispute to the downstream states.

Creation of the Tribunal

When the riparian states are not able to reach amicable agreements on their own in sharing of an interstate river waters, section 4 of IRWD Act provides dispute resolution process in the form of Tribunal.

The tribunal such created as a **power of a Civil Court** but its **verdict is equivalent to Supreme Court verdict** when pronounced in the ambit of IRWD Act. When the tribunal final verdict issued based on the deliberations on the draft verdict is accepted by central government and notified in the official gazette, the verdict becomes law and binding on the states for implementation. *But at the same time, you must note that the verdict of the tribunal can be challenged in Supreme court via civil suits*.

The IRWD act was amended in 2002 for the following purposes

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- If there is any Tribunal award which predates 2002, it **can not be altered by new tribunals**
- If there is any tribunal award which post dates 2002, **can be altered by new tribunals.** The idea is to resolve fresh water disputes which were not addressed by earlier tribunals/ agreements as and when they surface.

So far, the awards of four Inter-State Water Tribunals have been notified.

- Godavari Water Disputes Tribunal (April 1969)
- Krishna Water Disputes Tribunal (April 1969)
- Narmada Water Disputes Tribunal (October 1969)
- Cauvery Water Disputes Tribunal (June 1990)

Out of them, the first three tribunal awards were issued before the year 2002 which cannot be altered by the new tribunals. The tribunals formed on sharing water of Ravi & Beas rivers, Vamsadhara River, Mahadayi / Mandovi River and Krishna River-2 are either yet to pronounce the verdicts or the issued verdicts are to be accepted by the Government of India.

National Green Tribunal

National Green Tribunal is a statutory body established by a Government Notification using the powers of Section 3 of the *NGT Act 2010*. It has replaced National Environment Appellate Authority.

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Objective

The objective of establishing a National Green Tribunal was as follows:

- To provide effective and expeditious disposal of cases relating to environmental protection and conservation of forests and other natural resources including enforcement of any legal right relating to environment.
- Giving relief and compensation for damages to persons and property
- Other Related Matters.

Chairperson and Members of NGT

- It has a full time chairperson and following members:
- At least 10 and maximum 20 Full time Judicial members
- At least 10 and maximum 20 Full time Expert Members

Qualification for Chairperson

- The person should have been either a Judge of India's Supreme Court or Chief Justice of a High Court in India.

Qualification for Judicial member

- A Judge of Supreme Court of India, Chief Justice of High Court, Judge of a High Court

Qualification for Expert members

- Either a degree in Master of Science (in physical sciences or life sciences) with a Doctorate degree or Master of Engineering or Master of Technology

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- Or an experience of fifteen years in the relevant field and administrative experience of fifteen years in Central or a State Government or in a reputed National or State level institution.
- Post retirement jobs
- Once retired, the chairman or judicial members can not take up any job related to matters of this tribunal for at least 2 years.

Other Notes

- Appointment of members is done by Central Government.
- Chairperson of NGT is appointed by the Central Government in consultation with the Chief Justice of India.
- Judicial Members and Expert Members ofthe Tribunal are appointed on the recommendations of such Selection Committee.
- Chairperson, Judicial Member and Expert Member hold office for 5 years.
- Maximum age of the chairman 70 years if he has been a Supreme Court Judge and 67 years, if he has been a high court judge.
- Chairperson can be removed from his office via an order made by the Central Government after an inquiry made by a Judge of the Supreme Court in which such Chairperson or Judicial Member has been informed of the charges against him and given a reasonable opportunity of being heard in respect of those charges.

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Jurisdiction

The National Green Tribunal has jurisdiction over all civil cases where a substantial question relating to environment (including enforcement of any legal right relating to environment), is involved and such question arises out of the implementation of the enactments specified in Schedule I of the National Green Tribunal Act 2010. The acts listed in Schedule 1 are:

- The Water (Prevention and Control of Pollution) Act, 1974;
- The Water (Prevention and Control o[Pollution) Cess Act, 1977;
- The Forest (Conservation) Act,
- The Air (Prevention and Control of Pollution) Act, 1981;
- The Environment (Protection) Act, 1986;
- The Public Liability Insurance Act, 1991;
- The Biological Diversity Act, 2002.

It would deal with all environmental laws on air and water pollution, the Environment Protection Act, the Forest Conservation Act and the Biodiversity Act.

Coastal Regulation Zone Notification

Coastal Regulation Zone (CRZ) Notification, 2011 was notified in January, 2011 for the main land and also the Island Protection Zone (IPZ) Notification, 2011 for Lakshadweep, Andaman & Nicobar

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Islands. It replaced CRZ of 1991, which was amended for 25 times and needed an update.

Objectives

- Protection of livelihoods of traditional fisher folk communities
- Preservation of coastal ecology
- Promotion of economic activity that have necessarily to be located in coastal regions.

Limit of the CRZ Area

- CRZ area now includes the water area up to 12 nautical miles in the sea and the entire water area of a tidal water body such as creek, river, estuary, etc.

Does the above area impose any restriction on Fishing activities?

- No, it does not impose any restrictions of fishing activities.

What is CZMP?

- The CRZ notification 2011 enshrines that concept of a Coastal Zone Management Plan (CZMP). It will be prepared with the fullest involvement and participation of local communities.

What is the definition of the No development Zone?

- The "no development zone" definition has been changed. It is reduced from 200 metres from the high-tide line to 100 meters only. This has been done to meet increased demands of housing of fishing and other traditional coastal communities.

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Importance of CRZ Notification

- India has a long coastline of 7516 km, ranging from Gujarat to West Bengal, and two island archipelagos (Andaman Island and Lakshadweep). Our coastal ecosystems provide protection from natural disasters such as floods and tsunamis to the 250 million people who live in our coastal areas. Coastal waters provide a source of primary livelihood to 7 million households. Our marine ecosystems are a treasure trove of biodiversity, which we are only beginning to discover and catalogue.
- Thus, our coastline is both a precious natural resource and an important economic asset, and we need a robust progressive framework to regulate our coast.

What is allowed and what is not allowed in Coastal Zones?

Mining of limestone and other similar minerals is prohibited in Coastal Regulation Zone (CRZ) area. The Coastal Regulation Zone (CRZ) Notification, 1991 and the recently issued CRZ Notification, 2011, prohibits the mining of sand, rocks and other substrata material including limestone except rare minerals like, monazite, rutile etc., and exploitation of oil and natural gas.

All activities which are permissible under these Notifications are required to obtain clearance under these Notifications. Mining of the sand, rocks and other substrata material is expected to cause damage to the Coastal environment including the Sea water intrusion.

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Eco-sensitive Zones

The Environment Protection Act, 1986 does not mention the word "Eco-sensitive Zones".

The section 3(2)(v) of the Act, says that Central Government can restrict areas in which any industries, operations or processes or class of industries, operations or processes shall not be carried out or shall be carried out subject to certain safeguards

Besides the section 5 (1) of this act says that central government can prohibit or restrict the location of industries and carrying on certain operations or processes on the basis of considerations like the biological diversity of an area, maximum allowable limits of concentration of pollutants for an area, environmentally compatible land use, and proximity to protected areas.

The above two clauses have been effectively used by the government to declare Eco-Sensitive Zones or Ecologically Fragile Areas (EFA). The same criteria have been used by the government to declare No Development Zones.

The MoEF (Ministry of Environment & Forests) has approved a comprehensive set of guidelines laying down parameters and criteria for declaring ESAs. A committee constituted by MoEF put this together. The guidelines lay out the criteria based on which areas can be declared as ESAs. These include Species Based (Endemism, Rarity etc), Ecosystem Based (sacred groves, frontier forests etc) and Geomorphologic feature based (uninhabited islands, origins of rivers etc).

Other Topics Related to Pollution

Fly Ash

When coal is burnt (e.g. in coal fed power plants), two types of ash is produced. One that falls in the bottom of the boiler is called bottom ash. Another is made of fine particles that are driven out along with the flue gases. These fine particles are captured using the electrostatic precipitators or some other filtration equipments when the flue gases reach at Chimney of the plant. This is called Fly Ash and is made of Silica, Aluminium oxide, calcium oxide and some potentially toxic elements such as arsenic, beryllium, cadmium, barium, chromium, copper, lead, mercury, molybdenum, nickel, radium, selenium, thorium, uranium, vanadium, and zinc etc.

Uses of Fly Ash

Fly Ash was once discarded as a waste but today, it is increasingly emerging as a major input material in several industries including cement, agriculture, construction, Paints etc.

- Fly Ash is added as a mixture to cement for building construction, laying of roads and landfills.
- The bricks and blocks made of fly-ash are stronger and cheaper than conventional bricks
- Fly ash can help transform barren wasteland into lush green forests
- Pigments extracted from Fly Ash can be very useful in manufacturing of paints

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Fly Ash bricks

In construction industry, Fly ash is used in making of bricks and concrete. Fly Ash Bricks are well proven building material and can be used as an alternate to the ordinary burnt clay bricks with equivalent strength. The Government promotes the use of Fly Ash Bricks. BIS (Bureau of Indian Standards) has issued the code IS:12894-2002 for ash bricks.

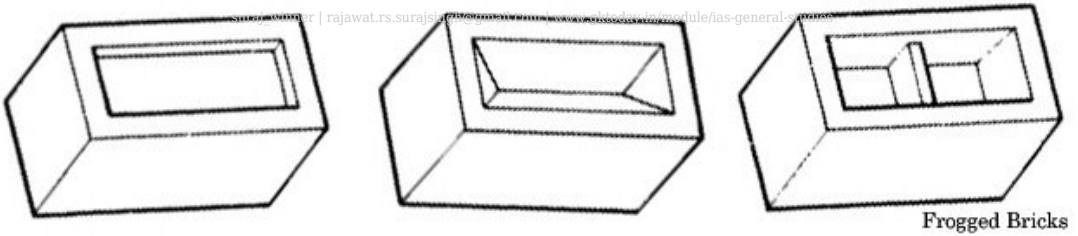
Further, an MOEF notification mandates that every construction agency engaged in the construction of buildings within a radius of 100 km. from a coal or lignite based thermal power plant shall use only fly ash based products for construction.

Construction of Fly Ash Bricks

The raw material to make Fly Ash bricks includes Fly Ash, Sand and Lime (or Cement). All of these are mixed with water in a pan mixer to produce a semi dry mix. It is then placed in moulds of a machine (a hydraulic or vibratory press) to produce bricks of uniform size. These bricks are air dried for one/two days in a shed and then water cured for 14-21 days.

Advantages of Fly Ash Bricks

Fly ash bricks are produced with/without frog. Fogged Bricks have depression in one face as shown below:



Frogged Bricks

These bricks require less plaster thickness and save cement mortar. They are environment friendly because they are produced by by-product of thermal power stations. They save agriculture land used in brick kilns. In comparison to clay bricks, the Fly Ash bricks are less energy intensive. Further, they can be made at the construction site itself.

Fly Ash Concrete

In comparison to cement only, the Fly Ash improves the performance and quality when used in concrete. Fly ash as a part of the concrete saves water ; lowers heat of hydration; reduces the corrosion of steel and makes the concrete becomes strong quickly. This is because the fly ash reaches its maximum strength more slowly than concrete made with only Portland cement.

Environmental Impacts of Concrete

Surface concretization is one of the major environmental issues in urban areas around the world. Concretization is not always harmful but depends upon the circumstances. Since cement is major component of concrete; the it contributes a lot in the harmful environmental impacts caused by

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concrete. Such impacts include:

- Cement Industry is a major contributor for carbon dioxide, a major GHG. It leads to global warming and climate change.
- Concrete causes surface runoff of the water. This might result in soil erosion, water pollution and flooding.
- Concrete is a major contributor of Urban Heat Island because of the massive rise in temperatures since concretised surface gets heated up much faster and also loses heat at night at faster rate.
- Concretised surface emits / radiates harmful Ultraviolet-B rays, which are hazardous to human / animal health. Further, concrete has presence of many substances which might causes toxicity and health problems.
- Concrete can also lead to radioactive pollution because of presence of various natural radioactive elements (K, U and Th) in concrete dwellings. However, it depends on the type of raw material used for the creation of the concrete.
- Excessive concretised surface also causes 'visual pollution' as a concretised surface looks barren in contrast with the aesthetically beautiful green area.
- Concrete dust is a source of air pollution.

However, despite of various impacts listed above, planned use of concrete can help us to have many sustainable benefits. For example, concretization is used in creation of dams, diversion and deflection of flood water; so it is a valuable tool for flood control.

Indicator Species

Indicator species are those flora and fauna which define a particular trait or change in the environment. Such species are sensitive to environmental change and can act as early warning regarding adverse environmental changes in particular area.

Lichens as Indicator Species

Lichens are capable to indicate air pollution, water pollution, heavy metals as well as radioactive particles.

Algae as Indicator Species

Algae (seaweeds) are good indicators of heavy metal levels in marine environments and could be used for monitoring such pollutants in seas. According to a new study in the Gulf of Kutch, which receives discharges containing heavy metals from several industries, various species of brown, red and green algae accumulate heavy metals from seawater and sediments. Heavy metals enter various organisms and trigger tissue damage.

Birds as Indicator Species

Birds are considered to be excellent indicator species. There are three main reasons for this. *Firstly,*

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they live in every climate and biome; *Secondly,* they respond quickly to environmental change and *Thirdly,* they are relatively easy to track and count.

Other Notes

- Certain molluscs indicate water pollution, while some mosses indicate soil pollution.
- The Mussel Watch Programme is a global project to assess environmental impacts in coastal regions.

Photochemical Smog

Photochemical smog was first described in the 1950s. It is the chemical reaction of sunlight, nitrogen oxides and volatile organic compounds in the atmosphere, which leaves airborne particles and ground· level ozone. This noxious mixture of air pollutants can include the following:

- Aldehydes
- Nitrogen oxides, such as nitrogen dioxide
- Peroxyacyl nitrates
- Tropospheric ozone
- Volatile organic compounds

All of these harsh chemicals are usually highly reactive and oxidizing. Photochemical smog is therefore considered to be a problem of modern industrialization. It is present in all modern cities, but it is more common in cities with sunny. warm, dry climates and a large number of motor vehicles. Because it travels with the wind, it can affect sparsely populated areas as well.

Environmental Concerns of PET Bottles

Serious concerns and voices have been raised in recent times to ban the use of PET or Polyethylene terephthalate bottles.

Terephthalic acid- a major chemical precursor of PET increases the chances of breast cancer. PET leaches harmful chemical compounds like- di-ethylhexyl phthalate, endocrine disruptors, bisphenol A (BPA), antimony, acetaldehyde and other estrogenic compounds. BPA which acts as a faux-estrogen, interferes with various reproductive hormones in women- pre-term birth, low birth weight, congenital defects, pregnancy loss, impaired immune development, impairment of fertility and reproduction in both mother and child. Excessive and continued used of PET bottles can lead to leaching of endocrine disruptors which cause chromosomal abnormalities, birth defects and developmental disabilities in uterus like early onset of puberty in children. BPA can also cause hyperactivity disorders and aggressive behaviour in young girls. Another toxin DEHA di-(2-ethylhexyl)adipate is said to be leached and cause liver problems, cancer etc. in humans.

Biofuels

Biofuels are fuels which are in some way derived from biomass. The term covers solid biomass,

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liquid fuels and various biogases and also denotes Biodiesel, Bio alcohol and bio-gasoline.

Common Biofuel Crops

The most common Biofuel crops include Corn, Rapeseed/Canola, Sugarcane, Palm Oil, Jatropha, Soyabean, Cottonseed, Sunflower seeds, Wheat , Sugarbeet, Cassava, Algae, Coconut, Jojoba, Castor Beans etc.

Biodiesel

Biodiesel is vegetable oil- or animal fat-based diesel fuel consisting of long-chain alkyl esters. It is used as a blend to Petro Diesel and denoted by B factor. This means that 100% biodiesel is referred to as B100, while 20% biodiesel, 80% petro diesel is labelled B20. Similarly 5% biodiesel, 95% petro diesel is labelled B5.

Global biodiesel production was around 4 million tons in 2006 and around 85% of biodiesel production came from the European Union.

Jatropha Plant

- Belongs to family Euphorbiacae, thus taxonomically related to Castor oil plant.
- Resistant to drought and pests, and produces seeds containing 27-40% oil.
- In India, Jatropha is known as Ratanjot shows resemblance with castor. Apart from Ratanjot, about nine species are reported out of which Jatropha Curcus has economic value by virtue of oil present in its seed.
- In 2006, the Indian Council of Agricultural Research identified first ever Jatropha variety, SDAUJ I (Chatrapati) with higher oil content and yield for commercial cultivation. The seeds contain 49.2 per cent oil and the non-edible protein in defatted seed case is 47.8 per cent.
- Farmers can get an average yield of 1000-1100 kg per hectare under rainfed conditions. The ICAR recommended it for the semi-arid and arid regions of Gujarat and Rajasthan. It is drought resistant and can be raised successfully in areas where annual rainfall is 300-500mm. The plant attains a height up to 8 feet and shows resistance to all major pests.

National Policy on Biofuels

National Policy on Biofuels was released in 2009. Its salient features are as follows:

- Bio-diesel production will be taken up from non-edible oil seeds in waste /degraded / marginal lands.
- Achieve 20% blending of bio-fuels, both for bio-diesel and bio-ethanol, by 2017.
- Announce Minimum Support Price (MSP) for non-edible oil seeds.
- Announce Minimum Purchase Price (MPP) for purchase of bio-ethanol and bio-diesel.
- Major thrust will be given to research, development and demonstration with focus on plantations, processing and production of bio-fuels, including Second Generation Bio-fuels.
- A National Biofuels Coordination Committee, headed by the Prime Minister, will be set up to

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provide policy guidance and coordination.

- A Biofuel Steering Committee, chaired by Cabinet Secretary, will be set up to oversee implementation of the Policy.

Cassava as source of Bioethanol

Cassava / Tapioca has been shown to have potential of being a feedstock for the production of *bio-ethanol as fuel.* This crop is cultivated in tropical and subtropical regions for its edible starchy, tuberous root, a major source of carbohydrates. It is the third-largest source of food carbohydrates in the tropics, after rice and maize. Cassava is a major staple food in the developing world, providing a basic diet for over half a billion people. It is one of the most drought-tolerant crops, capable of growing on marginal soils. *Nigeria is the world's largest producer of cassava.*

Cassava has a high energy content, low maintenance and ability to grow under a wide range of climatic conditions. All these qualities render it a potential for production of bio-ethanol. The technology for cassava alcohol, patented by the CTCRI in the 1980s, requires refinement for commercial scale production.

Biodiesel in Cold climates

Generally the biodiesel made from vegetable oil *does not perform well in cold climates*. This is because the *vegetable oil is high in saturated fats and the ice crystals tend to form in the biodiesel*. Further, the biodiesel obtained from certain crops such as *canola oil is low in saturated fat,* it is harder for ice to materialize in frigid temperatures, it is found to be showing excellent performance in cold climates too.

Green GDP

All uses of biodiversity are not incorporated in economic accounts and this leads humans to under-value biodiversity. Ecosystem services and resources such as mineral deposits, soil nutrients, and fossil fuels are capital assets but traditional national accounts do not include measures of the depletion of these resources. This means a country could cut its forests and deplete its fisheries, and this would show only as a positive gain in GDP (gross national product) without registering the corresponding decline in assets (wealth). This is where Green GDP comes into play. The green GDP is the measurement of GDP growth with the environmental consequences of that growth factored in.

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Green GDP Means
1 monetization of the loss of biodiversity
2 accounting for costs caused by climate change
3 substracting resource depletion, environmental degradation from traditional GDP figures
4 helping to manage both economies as well as resources

Green GDP Does not mean
1 Monetary value of the Forests etc.
2 Growth of Green Investments.

The relationship between biodiversity and ecosystem function is clear but a major question in ecology is how much biodiversity is required to maintain ecosystem function.

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Green Gross Domestic Product is the index of the Economic growth of a particular country which enshrines the environment consequences of the economic growth.

Kindly note the following observations:

- Green GDP means that it accounts the monetized loss of biodiversity, costs caused by climate change.
- Green GDP is conventional gross domestic product figures adjusted for the environmental costs of economic activities. It's a measure of how a country is prepared for sustainable economic development.

Biodigester Technology and Biotoilet

Biodigester Bio-toilets are an innovative technology, developed by the DRDE, Gwalior and Defence Research Laboratory (DRL), Tezpur under DRDO-Ministry of Defense, for disposal of human waste in eco-friendly manner. DRDO's bio-toilet is based on anaerobic biodegradation of organic waste by unique microbial consortium and works at a wide temperature range.

Features of Biotoilet

Technology used to decompose biological waste generated by soldiers deployed in high-altitude regions such as Siachen and Ladakh.

Low Cost

- Can function at any atmospheric temp between -55 to 60 degree C.
- Uses a bacterial consortium that degrades night soil at temp as low as -55 degree C and

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produces colorless, odorless and inflammable bio gas containing 50 – 70% methane.

- Disposes human waste in a 100 % eco-friendly manner and allows complete elimination of pathogens.
- Generates color less, odor less inflammable bio gas (can be used for cooking heating) and absolutely clear odor less water. Water is full of nutrients and minerals and is good for irrigation purpose of nearby gardens, lawns etc.
- Suitable for subzero temperature of Himalayan region, glaciers, railway coaches, Buses, highways, remote areas, sea ports, mining area, metro cities etc.
- 100% maintenance free, continuous biological process and economically viable.
- No dependence on the limited and costly conventional energy sources.
- Inoculums charging is only once during the entire life of bio-toilet.
- No need of connectivity to the sewage line, septic tank. No disposal of sludge is required.
- Routine cleaning chemicals like phenyl, soap, kerosene etc. do not harm bio-toilet or the inoculums.

The process involves the bacteria, which feed upon the faecal matter inside the tank, through anaerobic process which finally degrades the matter and releases methane gas that can be used for cooking, along with the treated water.

Bharat Stage Emission Standards

In the backdrop of rising industrial and vehicle pollution, air quality become an issue of social concern worldwide. Vehicular exhaust is one of the important sources of air pollution and there is an urgent need to check the extent of vehicular pollution in India.

History of vehicular emission control in India

In India, the vehicular emissions norms were first introduced in 1991. Fuel specifications based on environmental consideration were notified for the first time in 1996. They were incorporated in BIS 2000 standards. In 1999, the Supreme Court of India ordered that all the vehicles in India should have BIS 2000 or Euro I norms by June 1999. Based on the court order, the governmnent had notified Bharat StageI (BIS 2000) and Bharat Stage II vehicle emission norms which are equivalent to Euro I and Euro II respectively for introduction in rest of the India and NCR and other Metros respectively.Then, in 2002, the *Mashelkar committee* came up with a roadmap so that the emission can be phased in in India.

In 2003, the National Auto Fuel Policy was announced, a roadmap was created. In line with the National Auto Fuel Policy (2003) the BS III and BS II norms came into existence from April 2005 for 13 major cities and in the rest of the country respectively. Similarly, BS IV and BS III norms came into effect from April 2010 in 13 major cities and in the rest of the country respectively.In 2012,

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thegovernment had constituted an *Expert Committee under Saumitra Chaudhuri*to draft Auto Fuel Vision and Policy, 2025 to bring country's fuel quality at par with global norms. The Committee submitted its report in May, 2014 and ithas made various recommendations including a Roadmap for phased introduction of BS-IV and BS-V Auto Fuels in the entire country.Currently, BS-IV petrol and diesel are being supplied in whole of Northern India and the rest of the country has BS-III grade fuel. The rest of the country is scheduled to get supplies of BS-IV from April, 2017.

Recently, in January 2016, the government announced to skip the BS-V norms and directly move from the existing BS-IV to BS-VI by April 2020.As per the original timeline in the Auto Fuel Policy, BS-IV is to be adopted across the country by 2017, BS V by 2020 and BS-VI by 2024.

The Bharat Stage Standards

The evolution of the various stages is coterminous with decreasing amount of pollution a vehicle can cause. For example, the Euro 1 or BS I emits more amount of toxic gases than Euro 2 or BS II.In terms of stringency or emission limits, the Bharat Stage and Euro norms are equivalent. However, India uses Euro standards with only one modification — lower maximum speed of 90 km/h instead of 120 km/h as mandated in the EU norms. This is the maximum speed at which the vehicle is tested. The conditions of the road and general climate of India must have been taken into account while fixing this.

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The harmful emissions that are identified for regulations in different Bharat Stages (BS) are carbon monoxide (CO), unburnt hydrocarbons (HC), Nitrogen Oxides (NOx) and Particulate matter (PM). CO emissions are more prevalent in petrol engines. Continuous exposure to them can prevent oxygen transfer and increases nausea/headaches. HC emissions are also more prevalent in petrol engines. Short term exposure to them can cause headaches, vomiting and disorientation.NOx emissions are more evident in diesel engines. Long Term exposure can cause Nose and eye irritation and damage lung tissue. PM is more prevalent in diesel engines and long term exposure to it can harm the respiratory tract and reduce lung function.

Another difference between each standard is the sulphur content. For example, BS-IV fuels contain far less sulphur than BS-III fuel.Sulphur in fuel makes it dirtier and lowers the efficiency of catalytic converters, which control emissions.

The following tables show the emission norms for different vehicles:

Emission norms for passenger cars (Petrol)

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Norms	CO(g/km)	(HC+ NOx)(g/km)
1991Norms	14.3-27.1	2.0(Only HC)
1996 Norms	8.68-12.40	3.00-4.36
1998 Norms	4.34-6.20	1.50-2.18
Bharat stage-I	2.72	0.97
Bharat stage-II	2.2	0.5
Bharat Stage-III	2.3	0.35(combined)
Bharat Stage-IV	1.0	0.18(combined)

Emission norms for Heavy diesel vehicles:

Norms	CO (g/kwhr)	HC (g/kwhr)	NOx (g/kwhr)	PM (g/kwhr)
1991 Norms	14	3.5	18	-
1996 Norms	11.2	2.4	14.4	-
Bharat stage-I	4.5	1.1	8.0	0.36
Bharat stage-II	4.0	1.1	7.0	0.15
Bharat Stage-III	2.1	1.6	5.0	0.10
Bharat Stage-IV	1.5	0.96	3.5	0.02

Emission Norms for 2/3 Wheelers (Petrol)

Norms	CO (g/km)	HC+NOx (g/km)
1991 norms	12-30	8-12 (only HC)
1996 norms	4.5	3.6
Bharat stage-I	2.0	2.0
Bharat stage-II	1.6	1.5
Bharat Stage-III	1.0	1.0

As we can see from the tables, the content of harmful emissions reduces while moving to the next standard. The BS-VI norms not yet defined.

Issues in implementation of BS-VI by 2020

The two major industries that face problem in implementation of BS-VI norms are:

1. Oil refineries needs huge investment to upgrade the fuel.
2. Automobile manufacturers who have to manufacture emission norms compliant vehicles.

Though the Oil Ministry has assured the supply of BS-VI fuel by 2020, to meet this, two-thirds of India's state-owned refineries will need upgradation and it will cost them Rs. 60,000 crores.

Though there is no difference between BS-V and BS-VI norms, the engines have to be compliant to

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use the fuel. In BS-V, the vehicles have to be fitted with a diesel particulate filter and it needs to be optimised for road conditions in India. In BS-VI, selective catalytic reduction technology has to be optimised. And in each stage, the technology needs to be validated over 6-7 lakh km. Because of these complexities, the automobile firms said we can optimise the technologies in series but not simultaneously. They are resisting the direct move to BS-VI stage.

The nation-wide availability of BS-VI fuel will also be an issue. Without the uniform fuel availability, vehicles travelling across various states will face the difficulty.

Implications of BS-VI standard on environment

BS-IV fuels contain 50 parts per million (ppm) sulphur, while BS-V and BS-VI grade fuel will have 10 ppm sulphur. According to the Centre for Science and Environment, the move to Bharat Stage-VI will bring down Nitrogen Oxide emissions from diesel cars by 68 per cent and 25 per cent from petrol engine cars. Cancer causing particulate matter emissions from diesel engine cars will also come down by a phenomenal 80 per cent.

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