

IAS COMPASS OF **ENVIRONMENT**

CURRENT AFFAIRS COMPILATION
UPSC CIVIL SERVICES
MAINS EXAM



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Preface

Dear students,

Environment section has a critical weightage in the UPSC exam. Sections related to environment, disaster management and environmental impact assessment are explicitly mentioned in Paper III of UPSC Mains syllabus. We have covered Disaster Management in the Geography book.

However, the topics from this book are also of use for addressing many themes from General Studies Paper I, Essay Writing and other general themes of sustainable development, which informs critical policy discourse nowadays. Thus, preparing this section well is very fruitful for the students. Our approach in preparing this book has been to make a book which comprehensively covers the demands of the UPSC mains exam.

The book has been developed in line with UPSC syllabus. This year's special highlight is the focus on economic geography, which students will find useful. For the best results, students should use this book along with Rau's IAS Mains QIP program and Mains Test Series which will together give you a proper orientation for the coming mains exam.

Regards,
Rau's IAS Study Circle

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1 CHAPTER ENVIRONMENT LEGISLATIONS

TOPICS TO BE COVERED

1. *Dam Safety Act, 2021*
2. *Biological Diversity Act, 2002*
3. *Biological Diversity (Amendment) Bill, 2021*
4. *Wildlife protection Act, 1972*
5. *WildLife (Protection) Amendment Bill, 2021*
6. *Forest Rights Act, 2006*
7. *Forest Conservation Amendment Bill 2023*
8. *Environment Protection Act, 1986*
9. *Coastal aquaculture Bill 2023*

1. DAM SAFETY ACT, 2021

The Bill proposes to help all states and Union Territories adopt uniform dam safety procedures. The safety of the dams is the primary responsibility of the dam owners, mainly being State Governments. The Dam Safety Act (DSA), 2021, provides for an institutional framework for prevention of dam failure related disaster through proper surveillance, inspection, operation and maintenance of the specified dams in India.

KEY FEATURES OF THE ACT

- **Applicability** – Act applies to all the dams having Height more than 15 metres, and Height between 10 to 15 metres, subject to certain design and structural conditions.
- **Obligation of dam owners**
Dam owners will be responsible for the safe construction, operation, maintenance and supervision of a dam. They must provide a dam safety unit in each dam. This unit will inspect the dams before and after monsoon season and during and after every earthquake, flood, calamity, or any sign of distress.
- **Dam safety authorities**
The Act provides for dam safety regulatory and monitoring authorities at the national and state level.
- **Offences and penalties**
Anyone obstructing a person in the discharge of his functions under the Act or refusing to comply with directions may be imprisoned for a year. In case of loss of life, the person may be imprisoned for two years.

MERITS

- **Institutionalization:** The Act provides for dam safety regulatory and monitoring authorities at the national level (National dam safety authority) and state level (State Dam Safety Organization).
- **Uniform operations:** It will bring uniformity as presently Most of the dams in India are constructed and maintained by the states, while some of the bigger dams are managed by autonomous bodies such as Damodar Valley Corporation or Bhakra Beas Management Board of Bhakra-Nangal Project.

- **Increasing safety and security** - provides for an institutional framework for prevention of dam failure related disaster through proper surveillance, inspection, operation and maintenance of the specified dams in India.
- **Resolving interstate disputes:** As per the Act, the NDSA will perform the role of the State Dam Safety Organisation for a dam located in one State and used by another. For e.g, the Mullaperiyar dam will come under the purview of the NDSA.
- **Ensuring accountability:** It lays the onus of dam safety on the dam owner and provides for penal provisions for commission and omission of certain acts.

ISSUES WITH THE LEGISLATION

- **Jurisdiction of Parliament to frame a law on intra-state river dams** - The Act applies to all specified dams in the country which also includes dams on both inter and intrastate rivers.

As per Entry 17 of the State List, states can make laws on water supply, irrigation and canals, drainage and embankments, water storage and waterpower, subject to Entry 56 of the Union List. Entry 56 of the Union List allows Parliament to make laws on the regulation of inter-state rivers and river valleys if it declares such regulation to be expedient in public interest.

- **Functions of authorities may be changed through notification** - It implies that the core functions of these bodies can be changed by the government through notification without prior amendment of the Act by Parliament.
- **Surveillance mechanism:** Bill provides for the surveillance, inspection, operation, and maintenance of all specified dams across the country.
- **Vaguely defined words:** Critics have also argued that Certain terms in the Act, had been deliberately defined vaguely for e.g 'specified dam'. If those definitions were followed, almost all dams in the country would fall under the purview of the Act.

DAM REHABILITATION AND IMPROVEMENT PROJECT (DRIP PHASE II)

This new Scheme will strengthen dam safety initiatives taken by Government of India through physical rehabilitation of selected dams by addressing various concerns to improve safety and operational performance, institutional strengthening in various ways, incidental revenue generation for sustainable operation & maintenance of dams etc. The Scheme is designed to infuse global know-how, innovative technologies in dam safety. Another major innovation envisaged under the project, that is likely to transform dam safety management in the country, is the introduction of a risk-based approach to dam asset management that will help to effectively allocate financial resources towards priority dam safety needs. Also, Scheme implementation will equip the Indian dam owners to gear up their human resources to comprehensively handle many important activities envisaged in proposed Dam Safety Legislation.

2. BIOLOGICAL DIVERSITY ACT, 2002

Aims at conservation of biological resources, managing its sustainable use and enabling fair and equitable sharing benefits arising out of the use and knowledge of biological resources with the local communities.

SALIENT FEATURES

- Three-tier structure to regulate access to biological resources:
 - National Biodiversity Authority (NBA)
 - State Biodiversity Boards (SBBs)

- Biodiversity Management Committees (BMCs) (at local level)
- Provides these authorities with special funds and a separate budget in order to carry out any research project dealing with the biological natural resources of the country.
- Under this act, the Central Government in consultation with the NBA Shall notify threatened species and prohibit or regulate their collection, rehabilitation and conservation and Designate institutions as repositories for different categories of biological resources.
- The act stipulates all offences under it as cognizable and non-bailable.

EXEMPTIONS FROM THE ACT

- Excludes Indian biological resources that are normally traded as commodities.
 - Such exemption holds only so far the biological resources are used as commodities and for no other purpose.
- Excludes traditional uses of Indian biological resources and associated knowledge and when they are used in collaborative research projects between Indian and foreign institutions with the approval of the central government.
- Uses by cultivators and breeds, Ex. farmers, livestock keepers and beekeepers and traditional healers Ex. vaidas and hakims are also exempted.

NATIONAL BIODIVERSITY AUTHORITY

- The National Biodiversity Authority (NBA) was established in 2003 by the Central Government to implement India's Biological Diversity Act (2002).
- It is a Statutory body that performs facilitative, regulatory and advisory functions for the Government of India on the issue of Conservation and sustainable use of biological resources.
- The NBA has its Headquarters in Chennai, Tamil Nadu, India.

STRUCTURE OF THE NBA

- The National Biodiversity Authority consists of the following members to be appointed by the central government, namely:
 - A Chairperson.
 - Three ex officio members, one representing the Ministry dealing with Tribal Affairs and two representing the Ministry dealing with Environment and Forests.

FUNCTIONS OF THE NBA

- Creating an enabling environment, as appropriate, to promote conservation and sustainable use of biodiversity.
- Advising the central government, regulating activities and issuing guidelines for access to biological resources and for fair and equitable benefit sharing in accordance with the Biological Diversity Act, 2002.
- Taking necessary measures to oppose the grant of intellectual property rights in any country outside India on any biological resource obtained from India or knowledge associated with such biological resources derived from India illegally.
- Advising the State Governments in the selection of areas of biodiversity importance to be notified as heritage sites and suggest measures for their management.

STATE BIODIVERSITY BOARDS (SBBS)

- The SBBS are established by the State Governments in accordance with Section 22 of the Act.
- Structure: The State Biodiversity Board consists of the following members:
 - A Chairperson

- Not more than five ex officio members to represent the concerned Departments of the State Government
- Not more than five members from amongst experts in matters relating to conservation of biological diversity, sustainable use of biological resources and equitable sharing of benefits arising out of the use of biological resources.
- All the members of the SBB are appointed by the respective State Governments.

FUNCTIONS OF SBBS

- Advise the State Government, subject to any guidelines issued by the Central Government, on matters relating to the conservation, sustainable use or sharing equitable benefits.
- Regulate by granting approvals or otherwise requests for commercial utilisation or bio-survey and bio-utilisation of any biological resource by people.

NOTE

- There are no State Biodiversity Boards constituted for Union territories.
- The National Biodiversity Authority exercises the powers and performs the functions of a State Biodiversity Board for the UTs.

BIODIVERSITY MANAGEMENT COMMITTEES (BMCS)

- According to Section 41 of the Act, every local body shall constitute the BMC within its area for the purpose of promoting conservation, sustainable use and documentation of biological diversity including:
 - Preservation of habitats
 - Conservation of Landraces
 - Folk varieties and cultivars
 - Domesticated stocks and breeds of animals
 - Microorganisms And Chronicling of Knowledge Relating To Biological Diversity

STRUCTURE

- It shall consist of a chairperson and not more than six persons nominated by the local body.
 - Out of total members of a BMC, not less than one third should be women and not less than 18% should belong to the Scheduled Castes/ Scheduled Tribes.
- The Chairperson of the Biodiversity Management Committee shall be elected from amongst the members of the committee in a meeting to be chaired by the Chairperson of the local body.
- The chairperson of the local body shall have the casting votes in case of a tie.

FUNCTIONS

- The main function of the BMC is to prepare People's Biodiversity Register in consultation with the local people.
- The register shall contain comprehensive information on availability and knowledge of local biological resources, their medicinal or any other use or any other.

PEOPLE'S BIODIVERSITY REGISTERS (PBR)

- The PBRs focus on participatory documentation of local biodiversity, traditional knowledge and practices.
 - The register shall contain comprehensive information on the availability and knowledge of local biological resources, their medicinal or any other use or any other traditional knowledge associated with them.

- They are seen as key legal documents in ascertaining the rights of local people over the biological resources and associated traditional knowledge.

BIODIVERSITY HERITAGE SITES (BHS)

- Under Section 37 of Biological Diversity Act, 2002 the State Government in consultation with local bodies may notify the areas of biodiversity importance as Biodiversity Heritage Sites.
- The Biodiversity Heritage Sites are the well-defined areas that are unique, ecologically fragile ecosystems - terrestrial, coastal and inland waters and marine having rich biodiversity comprising of any one or more of the following components:
 - richness of wild as well as domesticated species or intra-specific categories
 - high endemism
 - presence of rare and threatened species
 - keystone species
 - species of evolutionary significance
 - wild ancestors of domestic/cultivated species or their varieties
 - past pre-eminence of biological components represented by fossil beds
 - having significant cultural, ethical or aesthetic values; important for the maintenance of cultural diversity (with or without a long history of human association with them)
- Areas having any of the following characteristics may qualify for inclusion as BHS.

BIODIVERSITY HERITAGE SITE (BHS)	DISTRICT/STATE
Nallur Tamarind Grove	Bangalore, Karnataka
Hogrekan	Chikmagalur, Karnataka
University of Agricultural Sciences, Bengaluru	Karnataka
Ambaraguda	Karnataka
Glory of Allapalli	Maharashtra
Tonglu BHS and Dhotrey BHS under the Darjeeling Forest Division	Darjeeling, West Bengal
Mandasaru	Odisha
Dialong Village	Manipur
Ameenpur lake	Telangana
Majuli	Assam
Gharial Rehabilitation Centre	Lucknow, Uttar Pradesh
Chilkigarh Kanak Durga	West Bengal
Purvatali Rai	Goa
Naro Hills	Madhya Pradesh

Asramam

Kerala

3. BIOLOGICAL DIVERSITY (AMENDMENT) BILL, 2021

This bill proposes to amend Biological Diversity Act, 2002. The Act provides for the conservation of biological diversity, sustainable use of its components, and fair and equitable sharing of the benefits arising out of the use of biological resources. The Bill seeks to streamline research and patent applications, encourage cultivation of wild medicinal plants, and practice of indigenous medicine. Key amendments proposed by the Bill include:

ACCESS TO BIOLOGICAL RESOURCES AND INTELLECTUAL PROPERTY RIGHTS (IPR)

Under the Act, State Biodiversity Boards (SBBs) are set up by state governments to advise them on conservation of biodiversity. Indian citizens and organisations registered in India must give prior intimation to the concerned SBB before obtaining any biological resource for commercial utilisation. They must also get NBA's approval before applying for IPR.

- The Bill amends this to provide that anyone who does not need approval from NBA to access biological resources must give prior intimation to the concerned SBB. Further, they must: (i) register with the NBA before the grant of IPR, and (ii) get prior approval of the NBA before commercializing the granted IPR.

EXEMPTIONS

The Bill extends the exemption to registered AYUSH (Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homeopathy) practitioners, and cultivated medicinal plants and their products.

COMPOSITION OF NBA

The Bill provides for 11 additional members in the Authority. These include: (i) six ex-officio members dealing with wildlife, forestry research, and Panchayati Raj, (ii) four representatives from State Biodiversity Boards (on a rotational basis), and (iii) a Member-Secretary (must have experience in biodiversity conservation). The Member-Secretary will be the chief coordinating officer of the NBA.

THREATENED SPECIES

The Bill allows the central government to delegate this power to the state government. However, before notifying any threatened species, the state government must consult the NBA.

BIODIVERSITY MANAGEMENT COMMITTEE (BMC)

The Bill specifies that the state government will prescribe the composition of these BMCs, and they must have between seven to eleven members. Further, state governments may also constitute BMCs at the intermediate or district Panchayat level.

OFFENCES: The offences under the Act are cognizable and non-bailable. A cognizable offence is one for which a police officer may arrest an accused person without a warrant.

- **The Bill deletes this provision.**

ANALYZING THE RECENT AMENDMENT

Background –

- Currently, all foreign entities engaged in research and commercialisation involving any Indian biological resource, have to sign benefit-sharing agreements even before initiating research.
- Further, if any intellectual property (IP) rights are sought involving such research, both Indian and foreign entities must enter into benefit-sharing agreements in lieu of permission by the NBA.
- In addition, contravening the provisions attract criminal penalties.

To address some of the above concerns and to ensure that the Act is relevant in the current and future contexts, an amendment – Amendment Bill 2021 [henceforth referred to as “the Bill”] has been proposed before the Indian Parliament.

Key amendments: -

- **Widening of definition** - Bill has widened the definition of “biological resources” – it now includes plants, animals, micro-organisms, or parts of their genetic material.
- **Flexibility to entities incorporated in India** - existing provisions mandate an entity having foreign participation to obtain approval before accessing the biological resource. However, this bill exempts entities incorporated in India except when they are controlled by a foreign company.
- **Alternative Indian medicine** - amendments further propose an exemption to registered AYUSH (alternative Indian medicine) practitioners along with local people and communities of the area, including growers and cultivators of biodiversity from providing prior intimation to the state biodiversity board when the biological resources are accessed for commercial utilisation for codified traditional knowledge, cultivated medicinal plants and its products.
- **Change of Penalties** - Another significant change that the amendments propose is to withdraw the penal provision of imprisonment and limit the penalty only to a heavy fine upto Rs 1 cr.

Issues remaining -

- It does not include human genetic material as of now.
- Codified traditional knowledge is not defined - The Parliamentary Committee observed that most of the traditional knowledge in the AYUSH system of medicine is codified. It also observed that traditional knowledge registered in the people biodiversity register may also be taken as codified. This may lead to denial of benefit to a majority of local traditional knowledge holders.
- Under the Bill, a foreign-controlled company means a foreign company as per the Companies Act, 2013, which is under the control of a foreigner. The Companies Act defines a foreign company as a company or body corporate ‘*incorporated outside India*’.
- Several experts have also said that these amendments are favorable to industries and are in contradiction to the spirit of the CBD.
- Decriminalizing those who are in violation of the law and restricting the penalty only to a fine may encourage large players to do whatever they and get away by just paying the fines.

Recommendations by Joint parliamentary committee -

- **Defining Codified traditional knowledge** - It should be defined as the knowledge derived from authoritative books specified in the First Schedule of the Drugs and Cosmetics Act, 1940. The Schedule lists books on Ayurveda, Siddha, and other traditional medicine systems.

- **Defining foreign controlled company** - The Committee recommended that a foreign-controlled company should instead be defined as a company incorporated or registered in India, which is controlled by a foreigner as per the Companies Act.
- **Consultation of the state government** - Present act requires the central government to formulate national strategies and programmes for the promotion, conservation, and sustainable use of biodiversity. Committee recommends that the central government should formulate national strategies and plans in consultation with the state governments and union territories.
- **Proportionate penalty** - It recommended that the penalty should be proportionate to: (i) gains obtained by entities, and (ii) the size of the company.

4. WILDLIFE PROTECTION ACT, 1972

It provides for **protection to listed species of flora and fauna** and establishes a network of ecologically important protected areas. The Act consists of 60 Sections and VI Schedules- divided into Eight Chapters.

The Wildlife Protection Act, 1972 empowers the central and state governments to declare any area a wildlife sanctuary, national park or closed area. There is a blanket ban on carrying out any industrial activity inside these protected areas. It provides for authorities to administer and implement the Act; regulate the hunting of wild animals; protect specified plants, sanctuaries, national parks and closed areas; restrict trade or commerce in wild animals or animal articles; and miscellaneous matters.

The Act prohibits hunting of animals except with permission of authorized officer when an animal has become dangerous to human life or property or as disabled or diseased as to be beyond recovery.

The Act underwent many amendments.

1. 1982 Amendment introduced provisions permitting the capture and transportation of wild animals for the scientific management of animal population.
2. 1991 Amendment led to the insertion of the special chapters dealing with the **protection of specified plants and the regulation of zoos**. This also recognized the needs of tribal and forest dwellers and changes were introduced to advance their welfare. The near-total prohibition on hunting was made more effective.
3. **2002 Amendment:** A new chapter has been incorporated as Chapter VI-A to deal with the forfeiture of property derived from illegal hunting and trade. Further, this amendment Act also introduced the concept of co-operative management through conservation reserve management committee and community reserve committees.
4. **2005 Amendment:** Special Provisions for Tigers, Incorporation of NTCA and Statutory Status to Wildlife Crime Control Bureau (WCCB).

DEFINITION OF WILDLIFE

The Section 2(37) of the Act defines wildlife as wildlife includes any animal, bees' butterflies, crustacean, fish and moths; and aquatic or land vegetation which forms part of any habitat. **So, the meaning of the wildlife in this Act is very wide and inclusive of all kinds of flora and fauna.**

AUTHORITIES CONSTITUTED UNDER WILDLIFE (PROTECTION) ACT

As per the Sec. 3 of the Act, the Central Government may appoint a Director of Wildlife Preservation, Assistant Directors of Wildlife Preservation and such other officers and employees as may be necessary. As per the Sec. 4, the State Government may, for the purpose of this Act, appoint Chief Wildlife Warden, Wildlife Warden, Honorary Wildlife Wardens and other officers and employees as may be necessary. As per Sec. 6, the State

Governments and the Administrators in Union Territories shall constitute a Wildlife Advisory Board.

WILDLIFE ADVISORY BOARD (SEC. 6)

Sec. 6 of this Act enforces and enables the state governments and administrators of UTs to constitute a Wildlife Advisory Board in each state and UT.

It shall consist of the Minister in charge of Forests in the State or Union territory as the Chairman. If there is no such minister, then the Chief Secretary will be the Chairman of the Board.

Wildlife Advisory Board mainly constituted to advise the state government in the following matters.

- a) Selection of areas to be declared as Sanctuaries, National Parks and Closed areas and the administration thereof.
- b) Formulation of policy for protection and conservation of wildlife and specified plants.
- c) In any matter relating to the amendment of any schedule.
- d) In relation to the measure to be taken for harmonizing the needs of the tribals and other dwellers of the forests with the protection and conservation of wildlife.
- e) In any other matter connected with the protection of wildlife which may be referred to it by the state government.

HUNTING OF WILD ANIMALS (SEC. 9)

Sec. 2(16)(a) (b) (c) defines the word hunting as follows Hunting, with its grammatical variations and cognate expressions, includes; capturing, killing, poisoning, snaring, and trapping or any wild animal and every attempt to do so; driving any wild animal for any of purposes specified in sub clause; injuring or destroying or taking any part of the body of any such animal, or in the case of wild birds or reptiles, damaging the eggs of such birds or reptiles, or disturbing the eggs or nests of such birds or reptiles;

HUNTING OF WILD ANIMALS TO BE PERMITTED IN CERTAIN CASES

Chief Wildlife Warden may permit hunting of wild animals in certain situations. They are:

- Chief Wildlife Warden may, if he is satisfied that any wild animal specified in Schedule 1 has become dangerous to human life or is so disabled or diseased as to be beyond recovery, by order in writing and stating the reasons therefore, permit any person to hunt such animal or cause animal to be hunted.
- The Chief Wildlife Warden or the authorized officer may, if he is satisfied that any wild animal specified in Schedule. II or III or IV has become dangerous to human life or to property (including standing crops on any land) or is so disabled or diseased as to be beyond recovery, by order in writing and stating the reasons, therefore, permit any person to hunt such animal or cause such animal to be hunted.
- The killing or wounding in good faith of any wild animal in defense of oneself or of any other person shall not be an offence; Provided that nothing in this sub-section shall exonerate any person who, when such defense becomes necessary, was committing any act in contravention of any provision of this Act or any rule or order made there under.
- Any wild animal killed or wounded in defense of any person shall be Government property.

GRANT OF PERMISSION FOR HUNTING FOR SPECIAL PURPOSES

The Chief Wildlife Warden, permit, by an order in writing stating the reasons therefore, to any person, on payment of such fee as may be prescribed, which shall entitle the

holder of such permit to hunt, subject to such conditions as may be specified therein, any wild animal specified in such permit, for the purpose of,

- Education.
- Scientific research.
- Scientific management; means and includes
 - translocation of any wild animal to an alternative suitable habitat; or
 - population management of wildlife, without killing or poisoning or destroying any wild animals.
- Collection of specimens
 - for recognised zoos subject to the permission under section 38-1 or
 - for museums and similar institutions.
- derivation, collection or preparation of snake-venom for the manufacture of life saving drugs.

PROTECTION OF SPECIFIED PLANTS

Sec. 17A of **the Act prohibits picking, uprooting, etc., of specified plants** or as otherwise provided in this Chapter.

The **Chief Wild Life Warden may with the previous permission of the State Government, grant to any person a permit** to pick, uproot, acquire or collect from a forest land or the area specified under section 17A or transport, subject to such conditions as may be specified therein, any specified plant for the purpose of education; scientific research., collection, preservation and display in a herbarium of any scientific institutions; or propagation by a person or an institution approved by the Central Government in this regard.

SANCTUARIES

Section 18 provides that the **State Government may, by notification, declare its intention to constitute any area other than area comprised with any reserve forest or the territorial waters as a sanctuary** if it considers that such area is of adequate ecological, faunal, floral, geomorphological, natural or zoological significance, for the purpose of protecting, propagating or developing wildlife or its environment.

For the purposes of this section, it shall be sufficient to describe the area by roads, rivers, ridges, or other well-known or readily intelligible boundaries.

Chief Wildlife Warden may, on an application, grant to any person a permit to enter or reside in a sanctuary for the following purposes.

- a) Investigation or study of wildlife
- b) Photography
- c) Scientific research
- d) Tourism
- e) Transaction of lawful business with any person in the sanctuary.

Only a public servant on duty or permit holder or a person having a right over immovable property within the limits of a sanctuary, person passing through pathway in the sanctuary and dependants of the above can also enter or reside in the sanctuary.

NATIONAL PARK

The state government, for the purpose of protecting, propagating or developing wildlife may by a notification declare that an area, by reason of its ecological, faunal, floral, geomorphological or zoological association or importance, needed to be constituted as a National Park.

Once a National Park is declared, no alteration of the boundaries shall be made except on the resolution passed by the legislature of the state. In a National Park, the following activities are strictly prohibited.

- a) destroying, exploring or removing any wildlife,
- b) Destroying, damaging the habitat of any wild animal,
- c) Deprive any wild animal of its habitat,
- d) Grazing of any livestock

CENTRAL ZOO AUTHORITY

Central government shall constitute Central Zoo Authority, **consisting of a chairperson, ten members and a member secretary.** They shall hold office for a period of three years.

- a) The Central Zoo Authority shall perform the following functions
Specify the minimum standards for housing, upkeep and veterinary care of the animals kept in a zoo.
- b) Evaluate and assess the functioning of zoos with respect to the standards or the norms as may be prescribed.
- c) Recognize or derecognize zoos.
- d) Identify endangered species of wild animals for purposes of captive breeding and assigning responsibility in this regard to a zoo.
- e) Co-ordinate the acquisition, exchange and loaning of animals for breeding purposes.
- f) Co-ordinate research in captive breeding and educational programs for the purposes of zoos.

TRADE OR COMMERCE IN WILD ANIMALS, ANIMAL ARTICLES AND TROPHIES

The term trophy means the whole or any part of any captive animal or wild animal, other than vermin, which has been kept or preserved by any means, whether artificial or natural, and includes, rugs, skins, and specimens of such animals mounted in whole or in part through a process of taxidermy, and antler, horn, rhinoceros horn, feather, nail, tooth, musk, eggs, and nests. And uncured trophy means the whole or any part of any captive animal, other than vermin, which has not undergone a process of taxidermy, and includes a [freshly killed wild animal ambergris, musk and other animal products].

Sec. 39 of the Act declares that every wild animal other than vermin, which is hunted or kept or bred in captivity or found dead or killed by mistake, shall be the property of the State Government. Likewise, animal articles, trophy or uncured trophy, meat derived from any wild animal, ivory imported to India, article made from such ivory, vehicle vessel weapon, trap or tool that has used for committing an offence and has been seized shall be the property of the state government. If any of the above is found in the sanctuary or a National Park declared by Union Government then it shall be property of the Central Government.

WILDLIFE PROTECTION ACT 1972

- It has six schedules which give varying degrees of protection.
- Schedule I and part II of Schedule II provide absolute protection - offences under these are prescribed the highest penalties.
- Species listed in Schedule III and Schedule IV are also protected, but the penalties are much lower.
- Schedule V includes the animals which may be hunted.

- The plants in Schedule VI are prohibited from cultivation and planting.

5. WILDLIFE (PROTECTION) AMENDMENT BILL, 2021

Wildlife (Protection) Amendment Bill, 2021 amends the Wild Life (Protection) Act, 1972. The Act regulates the protection of wild animals, birds and plants. The Bill seeks to increase the species protected under the law and implement the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Key features of the Bill include:

- **The Bill seeks to implement these provisions of CITES.**
- **The Bill reduces the total number of schedules to four by:** (i) reducing the number of schedules for specially protected animals to two (one for greater protection level), (ii) removes the schedule for vermin species, and (iii) inserts a new schedule for specimens listed in the Appendices under CITES (scheduled specimens).
- **The Bill prohibits any person from modifying or removing the identification mark of the specimen.** Additionally, every person possessing live specimens of scheduled animals must obtain a registration certificate from the Management Authority.
- **The Bills empowers the central government to regulate or prohibit the import, trade, possession or proliferation of invasive alien species.**
- The Bill specifies that actions of the Chief Warden must be in accordance with the management plans for the sanctuary. These plans will be prepared as per guidelines of the central government, and as approved by the Chief Warden. For sanctuaries falling under special areas, the management plan must be prepared after due consultation with the concerned Gram Sabha. Special areas include a Scheduled Area or areas where the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 is applicable. Scheduled Areas are economically backward areas with a predominantly tribal population, notified under the Fifth Schedule to the Constitution.
- The Bill empowers the central government to also notify a conservation reserve.
- **The Bill provides for any person to voluntarily surrender any captive animals or animal products to the Chief Wildlife Warden.** No compensation will be paid to the person for surrendering such items. The surrendered items become property of the state government.
- The Act prescribes imprisonment terms and fines for violating the provisions of the Act. The Bill increases these fines.

Wildlife amendment Act 2022 – *The amendment is primarily aimed at revising four aspects of the law: allowing delegation of functions of the State Boards for Wildlife (SBWLs) to a select set of people (“standing committee”) as is currently the case with the National Board for Wildlife (NBWL); a rework of the schedules that list species according to the levels of protection they need in view of the threats they face; providing for the implementation of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES); and an exception to the requirement to obtain permission from the Chief Wildlife Warden for the transfer and transport of captive elephants for religious or other purposes.*

Positive Key features:

- **Holistic approach and widened scope** - In the long title of the Wild Life (Protection) Act, 1972 (hereinafter referred to as the principal Act), for the words "protection of wild animals, birds and plants", the words "conservation, protection and

management of wild life" shall be substituted which points towards the change of focus towards the holistic approach.

- **Rationalisation of schedules:** Number of schedules have been reduced from six to four with two schedules for protected animals. Further it has inserted a new schedule (VB) for specimens listed in the Appendices under CITES (scheduled specimens).
- **Invasive alien species** - It empowers the central government to regulate or prohibit the import, trade, possession or proliferation of invasive alien species. The central government may authorise an officer to seize and dispose the invasive species.
- **Management Authority** : it will be appointed by the central government for the issuance of permits and certificates for trade in scheduled specimens in accordance with the CITES. Until now, CITES provisions were enforced through the Customs Act and not the Wildlife (Protection) Act, which was a major lacunae.
- **Decentralized management:** For sanctuaries falling under special areas, the management plan must be prepared after due consultation with the concerned Gram Sabha.
- **Declaring conservation reserves by Centre:** It empowers both Central and State governments to declare areas adjacent to national parks and sanctuaries as conservation reserve, Earlier only the state government had this power.
- **Surrender of captive animals:** Any person having a certificate of ownership can voluntarily surrender any captive animals or animal products to the Chief Wildlife Warden.

Issues remaining -

- **Commercial trade:** It leaves the door open for commercial trade in elephants. There is concern that the amendments have not defined what purposes elephants can be used for and have perhaps made it easier for the animals to be transported across the country.
- **Dilution of federal framework:** It has also been criticized for diluting the federal framework by seeking to displace the State Boards of Wildlife, which are chaired by the Chief Minister, with a Standing Committee headed by the union Forest minister.
- **Using animals for religious purpose:** In Section 43, elephants, Schedule I animal, are permitted to be used for 'religious or any other purpose'. Experts have also criticized the term 'other purpose'
- **Lack of ownership:** There are 2,675 captive elephants in India and only 1,251 have ownership certificates. Experts believe that this unclear ownership was an issue and the provisions that are "weak and indeterminate which can cause problems.

6. FOREST RIGHTS ACT, 2006

Maharashtra Governor issued a notification modifying the Forest Rights Act (FRA), 2006 that will enable tribals and other traditional forest dwelling families to build houses in the neighbourhood forest areas.

FOREST RIGHTS ACT, 2006

- The act recognize and vest the forest rights and occupation in Forest land in Forest Dwelling Scheduled Tribes (FDST) and Other Traditional Forest Dwellers (OTFD) who have been residing in such forests for generations.
- The act also establishes the responsibilities and authority for sustainable use, conservation of biodiversity and maintenance of ecological balance of FDST and OTFD.

- It strengthens the conservation regime of the forests while ensuring livelihood and food security of the FDST and OTFD.
- It seeks to rectify colonial injustice to the FDST and OTFD who are integral to the very survival and sustainability of the forest ecosystem.

THE ACT IDENTIFY FOUR TYPES OF RIGHTS

- **Title rights:** Gives FDST and OTFD, the right to ownership to land farmed by tribals or forest dwellers subject to a maximum of 4 hectares. Ownership is only for land that is being cultivated by the concerned family and no new lands will be granted. It also provides for Community rights over minor forest produce and other resources.
- **Use rights:** The rights of the dwellers extend to extracting Minor Forest Produce, grazing areas, to pastoralist routes, etc.
- **Relief and development rights:** To rehabilitation in case of illegal eviction or forced displacement and to basic amenities, subject to restrictions for forest protection
- **Forest management rights:** It includes the right to protect, regenerate or conserve or manage any community forest resource which they have been traditionally protecting and conserving for sustainable use.

WHO CAN CLAIM THESE RIGHTS?

- Members or community of the Scheduled Tribes who primarily reside in and who depend on the forests or forest lands for bona fide livelihood needs.
- It can also be claimed by any member or community who has for at least three generations (75 years) prior to the 13th day of December 2005 primarily resided in forests land for bona fide livelihood needs.
- The Gram Sabha is the authority to initiate the process for determining the nature and extent of Individual Forest Rights (IFR) or Community Forest Rights (CFR) or both that may be given to FDST and OTFD.

CRITICAL WILDLIFE HABITAT (CWH)

Forest Rights Act, 2006 (FRA) defines CWHs as 'areas of national parks and sanctuaries where it has been specifically and clearly established, case by case, based on scientific and objective criteria, that such areas are required to be kept as inviolate for the purposes of wildlife conservation'.

To notify a CWH, the Act requires state governments to establish that the presence of right-holders is causing irreversible damage to wildlife and their habitats, and that co-existence between rights holders and wildlife was not a reasonable option.

NOTIFYING CWHs: KEY FEATURES OF GUIDELINES

- The Chief Wildlife Warden of a state will notify an Expert Committee for the purpose of identification of critical wildlife habitats (CWH) in a national park or sanctuary.
- The Expert Committee will identify areas within national parks and sanctuaries, based on scientific and objective criteria relevant to the protected area, required to be kept inviolate for the purpose of wildlife conservation.
- The Expert Committee shall issue a public notice on the intention to notify CWH. The public notice shall include details of areas required to be kept inviolate, criteria adopted for CWH identification, implication of the notification on existing rights, and all options of resettlement and rehabilitation schemes, if applicable.

ISSUES AND CONCERNS

In the existing guidelines, CWH notification does not stand any public scrutiny once consultations have been carried out. Contrast this to the notification of Eco-Sensitive

Zones (ESZ) around protected areas, where the draft notification of every ESZ is put up in public domain for at least 60 days before its finalisation. ESZ are often notified under Environment Protection Act, 1986.

FOREST DWELLERS VS. WILDLIFE

- Conservationists believe that wildlife needs absolutely “inviolable” areas — those devoid of humans and human activities.
- Many others believe human-wildlife co-existence is generally possible and must be promoted if we are to have “socially just conservation”.

7. FOREST CONSERVATION AMENDMENT BILL 2023

The Bill amends the Forest (Conservation) Act, 1980 to make it applicable to certain types of land. These include land notified as a forest under the Indian Forest Act, 1927 or in government records after the 1980 Act came into effect. The Act will not be applicable for land converted to non-forest use before December 12, 1996.

KEY FEATURES

- **Exemptions** - It exempts certain types of land, for e.g. land within 100 km of India's border needed for national security projects, small roadside amenities, and public roads leading to a habitation.
- **Approval from centre** - The state government requires prior approval of the central government to assign any forest land to a private entity. The Bill extends this to all entities, and allows the assignment to be made on terms and conditions specified by the central government.
- **Activities in forests** - The Act specifies some activities that can be carried out in forests, such as establishing check posts, fencing, and bridges. The Bill also allows running zoos, safaris and eco-tourism facilities.
- **Power to issue directions:** The Bill adds that the central government may issue directions for the implementation of the Act to any authority/organisation under or recognised by the centre, state, or union territory (UT).

KEY ISSUES AND ANALYSIS

- The Bill excludes two categories of land from the purview of the Act: land recorded as forest before October 25, 1980 but not notified as a forest, and land which changed from forest-use to non-forest-use before December 12, 1996. This provision may go against a 1996 Supreme Court judgement on preventing deforestation.
- Exempting land near border areas for national security projects may adversely impact the forest cover and wildlife in north-eastern states.
- A blanket exemption for projects like zoos may adversely affect forest land and wildlife. The Supreme Court (2023) has remarked that they do not appreciate the necessity of having a zoo inside tiger reserves or national parks.
- Activities like silvicultural operations, safaris, and eco-tourism facilities may help in economic development, and may even contribute to national priorities such as energy security and industrial growth. However, there may be a need to balance economic benefits of such activities with that of conserving forests. It is not clear why the requirement of a case-by-case examination by the central government to determine such balance is being replaced by a blanket exemption.

FOREST CONSERVATION RULES 2022

MOEFCC recently notified the Forest Conservation Rules, 2022 superseding earlier rules for forest diversion under the Act. Forest Conservation Rules deals with restrictions on dereservation of forests or use of forest for non-forest purposes. The rules are based on the principle of polluter pays and requires forest diversion to be compensated by compensatory afforestation. The rules are to operationalise the provision of the act.

SALIENT FEATURES

- **Project Screening Committee:** The rules propose constitution of a project screening committee in each State/UT for an initial review of proposal involving diversion of forest land. The 5-member committee will meet at least twice every month and will advise state governments on projects in a time-bound manner. Dilution of Forest Rights: Onus of ensuring forest rights of forest dwellers are rehabilitated is with state governments. Earlier, compliance with FRA was mandatory before the Centre granted stage II forest clearance to any project.
- **Dilution of Gram Sabha powers:** The procedural requirement for consent of Gram Sabha has been done away with. Forest Conservation Rules, 2016 had embedded the need for Gram Sabha consent as a procedural requirement for prior approval by environment ministry.
- **Undertaking compensatory afforestation in other States/UTs:** Under the rules, compensatory afforestation can be undertaken in another State/UT (having forest cover less than 20% of its geographical area) in case forest land is diverted is in a hilly or mountainous State/UT (having forest cover of more than 2/3rd of its area) or in other State/UT (having forest cover of more than 1/3rd of its geographical area).
- **Accredited compensatory afforestation:** This mechanism allows people to raise vegetation on their land and sell it to persons who need to meet compensatory afforestation targets under the Act. This land must at least be of 10 hectares and comprise trees that are at least 5 years old and have a density of 0.4 or more. Earlier, a project developer had to provide land which is not notified as forest against forest diversion and had to bear the cost of raising compensatory afforestation over the same piece of land.
- **Centre will formulate an accredited compensatory afforestation mechanism** for people interested in using their land for the scheme.
- **The total amount of land** that needs to be compensated can be reduced if the plantations or accredited compensatory afforestation are made available in a wildlife corridor or contiguous to a forest.
- **Land Bank:** States/UTs may for the purpose of compensatory afforestation can create a land bank under control of forest department. The minimum size of the land bank is 25 hectares. In case the land bank should be in continuity of a land declared or notified as forest, protected area, tiger reserve or within a designed or identified tiger or wildlife corridor, there shall be no restriction on size of the land, there shall be no restriction on size of the land. The lands covered under accredited compensatory afforestation may be included in the land bank.

8. ENVIRONMENT PROTECTION ACT, 1986

It was enacted under Article 253 of the Indian constitution and the expression in the say of environmental quality was taken at the United Nation Conference on the Human Environment held at Stockholm in June 1972.

SCOPE AND COMMENCEMENT OF THE ACT

The Environment Protection Act, 1986 extends to whole India.

Section 2 of the Environmental protection Act, 1986 (EPA) deals with some of the information about the definition of the Act and these definitions are as follows:

“Environment” the word environment includes water, air, land and the inter-relation between their existence. It also includes human beings and other living creatures such as plants, micro-organisms and property.

“Environmental Pollutants” means any substance in solid, liquid or gaseous form which in consideration is injurious to the health of living beings.

“Handling” means any substance which is in the relation of being manufactured, processed, collected, used, offered for sale or like of such substance.

“Environmental Pollution” includes the presence of environmental pollutants in the environment.

“Hazardous substance” includes the substance or the preparation by which the physical-chemical property is liable to harm the human beings or other living creatures such as plants, microorganisms and the property.

“Occupier” is in the relation of factory or any other premises which means a person who has control over the affairs of it.

From the above definitions given the Environmental protection Act tends to cover a wide range of matters related to the environment protection.

POWER OF CENTRAL GOVERNMENT FOR MEASURES TO PROTECT AND IMPROVE THE ENVIRONMENT

It is the power vested in the central government that they can take any reasonable and valid steps and measures for the purpose of the protection and improvement of the quality of the environment.

These measures are taken for the prevention, control and abatement of environmental Pollution.

SUCH MEASURES MAY INCLUDE MEASURES WITH RESPECT TO ALL NAMELY AS FOLLOWS

- Laying down the standards for the quality of the standards of the environment.
- Coordination of actions which are obliged to the state officers and other authorities under any law.
- Execution and proper planning of the worldwide national program for the prevention, controlling and the abatement of environmental pollution.
- Restrictions to be applied in any of the industries, process and any operation shall be carried out.
- It is the power and the duty of the government to lay down the procedure to carry forward safeguards for the prevention of many inevitable accidents which may inculcate in more environmental pollution.
- Proposal of remedies should be put forward for the protection and prevention of further incidents.
- Duty and power to lay down the procedures and safeguards to handle the hazardous substance.
- Examination of manufacturing processes should be done, materials, substances which are likely to cause environmental pollution.

- Power to inspect at various premises, equipment, material and the substances and power to direct the authorities for the prevention and control of environmental pollution.
- To collect the dissemination in the respect of information related to environmental pollution.
- Preparation of the manuals, codes, guides which are considered suitable enough for controlling environmental pollution.
- One of the most important tasks is to establish the laboratories.
- Serving other matters which are necessary for the central government to deal for the effective implementation of the Environmental Protection Act, 1986.

Under Section 3 of the following act, **the central government has the power to authorize or constitute other authorities for the accurate implementation of powers and duties which are mentioned above.**

Section 3 of the Environmental Protection Act holds importance due to the fact of a better regulatory mechanism.

POWER TO GIVE DIRECTION

The central government in the exercise of powers designated by the Act can issue the directions in writing to any of the person or any officer. They shall be bound to comply with these given directions.

The powers to issue directions will include the power to direct which are as follows:

- The direction of closure, prohibition or the regulation of any industry and its operational process.
- direction for the stoppage or regulation of the supply of electricity, including any other services.

PREVENTION, ABATEMENT AND CONTROL OF ENVIRONMENTAL POLLUTION

Section 7 of Environment Protection Act 1986 suggest that no person in the country shall be carrying any of the activity or operation in which there is a large emission of gases or other substances which may lead to excess environmental pollution.

The same section also provides certain standards that ought to be maintained in which it is a must that no person is allowed to damage the environment and if a person is found guilty of causing damage to the environment by polluting the pollution pay principle.

He can be asked for the 'exemplary damages' if he is found guilty of damaging the environment.

Section 8 provides that any person who is handling the hazardous substance needs to comply with the procedural safeguards.

If the emission is to a very large extent or is apprehended through an accident, the person responsible for it is obliged to mitigate from that place to reduce the environmental pollution.

He is also required to give an intimation to the higher authorities regarding the same and for that one receipt of remedies shall be required to prevent or to mitigate the environmental pollution.

In subsection (1), it is also provided that if a person wilfully delays or obstructs the person designated by the central government, he will be charged guilty under this act.

PENALTY FOR THE CONTRAVENTION OF RULES AND ORDERS OF THIS ACT

As it was stated earlier that the most important goal of the environmental protection act is to provide for the punishment of the offence of endangering the human environment, safety and health.

Section 15 states that any person who is not complying to the provisions stated in this act and its failure or contravention will make him liable and punishable as the following:

9. COASTAL AQUACULTURE BILL 2023

The Coastal Aquaculture Authority (Amendment) Bill, 2023 was introduced in Lok Sabha on April 5, 2023. It amends the Coastal Aquaculture Authority Act, 2005.

FEATURES	ORIGINAL ACT	AMENDMENT
Regulated units	The Act regulates coastal aquaculture farms which carry out activities such as culturing of shrimp, prawns or any other aquatic life under controlled conditions in saline or brackish water.	The Bill adds that any facility that is engaged in coastal aquaculture or any allied activity will be regulated as a coastal aquaculture unit. Allied activities include nucleus breeding centres, hatcheries, brood stock multiplication centres and farms. The Bill provides for the registration and regulation of such units.
Prohibitions	The Act prohibits coastal aquaculture: (i) within 200 metres from high tide lines and (ii) in creeks, rivers, and backwaters within Coastal Regulation Zones under the Environment (Protection) Act, 1986	The Bill replaces this to prohibit coastal aquaculture activities in: (i) ecologically sensitive areas or in geo-morphological features such as mountains, valleys, or volcanoes, (ii) no-development zones in seas and buffer zones in creeks, rivers, and backwaters, and (iii) creeks, rivers, and backwaters within Coastal Regulation Zones.
Coastal aquaculture authority	Functions of the Authority include: (i) regulating the construction and operation of aquaculture farms in coastal areas, (ii) registering coastal aquaculture farms, and (iii) removing/demolishing farms that cause pollution.	The Bill adds that the Authority shall: (i) fix standards or prohibit coastal aquaculture inputs, such as probiotics, in order to prevent harm to coastal aquaculture/environment, (ii) fix standards, monitor, and regulate such units to prevent diseases, and (iii) fix standards for emission/discharge of effluents from coastal aquaculture units.
Composition of authority	The Authority comprises 11 members including: (i) a High Court judge (Chair), (ii) experts	The Bill adds a representative from the Ministry of Fisheries,

	in the fields of coastal aquaculture and coastal ecology, (iii) representatives from the ministries of agriculture and commerce, and (iv) four members from coastal states.	Animal Husbandry and Dairying as a member.
Penalties	The Act penalises carrying out coastal aquaculture without registering with the Authority with imprisonment up to three years, or a fine of up to one lakh rupees, or both.	The Bill replaces the provision and specifies that if coastal aquaculture in contravention with the provisions of the Act is carried out: (i) the activity may be suspended, (ii) the structure may be removed/demolished, (iii) the standing crop may be destroyed, (iv) the registration may be cancelled, and/or (v) a penalty may be imposed. The Bill provides for different penalties for different contraventions.

2 CHAPTER CLIMATE & CLIMATE CHANGE

TOPICS TO BE COVERED

1. Net-Zero Emission
2. Climate on global table
3. Sixth Assessment Report of IPCC
4. 2nd Report Sixth Assessment Report of IPCC
5. Anthropogenic Aerosol Forcing
6. Impact of climate Change on Cryosphere
7. Impact of climate Change on Oceans
8. Carbon Market
9. Climate Finance
10. Loss and Damage Fund
11. Urban Heat Island
12. Assessment of Climate Change over Indian Region
13. Climate-smart agriculture
14. UNCBD
15. Biodiversity Financing

1. NET-ZERO EMISSION

As part of the Panchamrit Strategy to address climate change, India committed to net-zero emissions by 2070 at COP 26.

India has so far abstained from committing to a net zero goal but is on a climate pathway that is compatible with keeping global temperatures to below 2°C by the end of the century.

ABOUT NET-ZERO EMISSIONS

- Net-zero emissions will be achieved when all GHG emissions released by humans are counterbalanced by removing GHGs from atmosphere in a process known as carbon removal.
- First human-caused emissions (such as those from fossil-fuelled vehicles and factories) should be reduced as close to zero as possible.
- Any remaining GHGs should then be balanced with an equivalent amount of carbon removal, which can happen through restoring forests or using direct air capture and storage (DACs) technology etc. Reaching net-zero emissions is akin to achieving "climate neutrality".

INDIA'S APPROACH IN COP 26

PANCHAMRIT STRATEGY

Government has articulated and put across the concerns of developing countries at the 26th session of the Conference of the Parties (COP26) to UNFCCC held in Glasgow, United Kingdom. Further, India presented the following five nectar elements (*Panchamrit*) of India's climate action:

- i. Reach 500GW Non-fossil energy capacity by 2030.
- ii. 50 per cent of its energy requirements from renewable energy by 2030.
- iii. Reduction of total projected carbon emissions by one billion tons from now to 2030.
- iv. Reduction of the carbon intensity of the economy by 45 per cent by 2030, over 2005 levels.
- v. Achieving the target of net zero emissions by 2070.

ON CLIMATE FINANCE

The transfer of climate finance and low-cost climate technologies has become more important for implementation of climate actions by the developing countries. The ambitions on climate finance by developed countries cannot remain the same as they were at the time of Paris Agreement in 2015.

It was emphasized that just as the UNFCCC tracks the progress made in climate mitigation, it should also track climate finance. It was conveyed to the developed countries that India understands the suffering of all other developing countries, shares them, and hence raises the voice of developing countries.

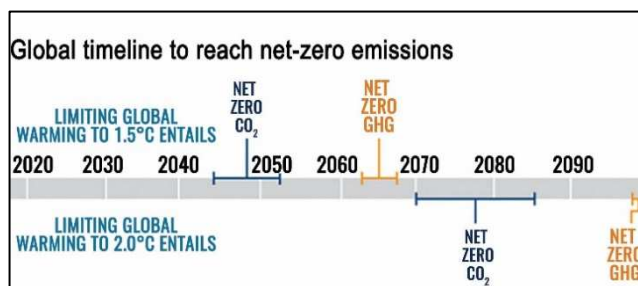
LIFE (LIFESTYLE FOR ENVIRONMENT)

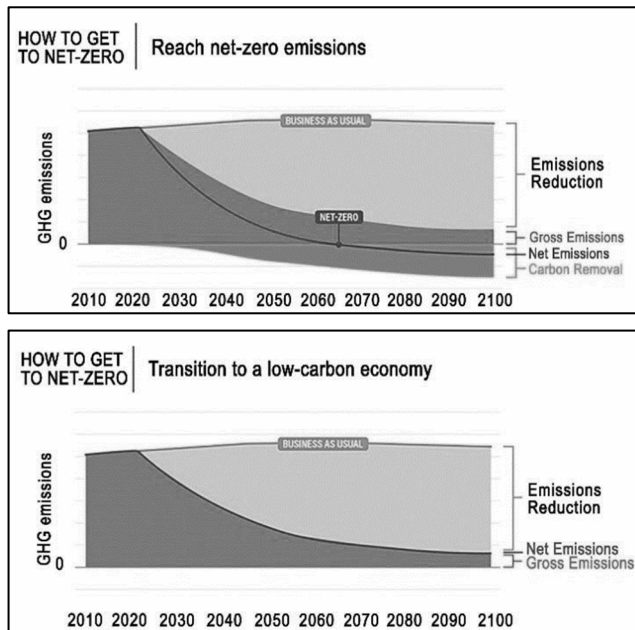
The mantra of LIFE- Lifestyle for Environment to combat climate change was shared in COP 26. It was stated that Lifestyle for Environment must be taken forward as a campaign to make it a mass movement of **Environment Conscious Lifestyles**. The message conveyed by India was that the world needs mindful and deliberate utilization, instead of mindless and destructive consumption.

INDIA'S OVERALL APPROACH

- Emphasised on the foundational principles of **equity, and common but differentiated responsibilities and respective capabilities**.
- Called that all countries should have **equitable access to the global carbon budget**, a finite global resource, for keeping temperature increase within the limits set by the Paris Agreement and **all countries must stay within their fair share of this global carbon budget**, while using it responsibly.
- India called developed countries for **climate justice**, and for **undertaking rapid reductions in emissions** during the current decade **to reach net zero** much earlier than their announced dates, **as they have used more than their fair share** of the depleting global carbon budget.
- India's interests have been articulated in decisions adopted at COP 26. The announcement to intensify India's climate action has the potential to bring investment and new technologies to support country's transition to a clean and climate resilient economy. Many nations in the World have applauded the five nectar elements (*Panchamrit*) of India's climate action.

NEED FOR NET-ZERO EMISSIONS





- Under Paris Agreement, countries agreed to limit warming well below 2°C, ideally to 1.5°C. Global climate impacts that are already unfolding under today's 1.1°C of warming — from melting ice to devastating heat waves and more intense storms — show urgency of minimizing temperature increase.
- In scenarios limiting warming to 1.5°C, carbon dioxide needs to reach net-zero between 2044 and 2052, and total GHG emissions must reach net-zero between 2063 and 2068.
- In scenarios limiting warming to 2°C, CO₂ needs to reach net zero by 2070. Total GHG emissions must reach net-zero by the end of the century or beyond.

Special Report on Global Warming of 1.5°C by IPCC finds that if the world reaches net-zero emissions by 2040, chance of limiting warming to 1.5°C is considerably higher.

This does not suggest that all countries need to reach net-zero emissions at the same time. Chances of limiting warming to 1.5°C, however, depend significantly on how soon highest emitters reach net-zero emissions. Equity-related considerations — including responsibility for past emissions, equality in per-capita emissions and capacity to act — suggest earlier dates for wealthier, higher-emitting countries.

It is important for countries to specify whether their net-zero targets cover CO₂ only or all GHGs. A comprehensive net-zero emissions target would include all GHGs, ensuring that non-CO₂ gases are also reduced.

POLICY FOR ACHIEVING NET-ZERO EMISSIONS

Policy, technology and behaviour need to shift across the board. In pathways to 1.5°C, renewables are projected to supply 70-85% of electricity by 2050. Energy efficiency and fuel-switching measures are critical for transportation. Improving efficiency of food production, changing dietary choices, halting deforestation, restoring degraded lands and reducing food loss and waste have significant potential to reduce emissions.

It is critical that structural and economic transition necessary to limit warming to 1.5°C is approached in a just manner, especially for workers tied to high-carbon industries. Solar and wind now provide cheapest power available for 67% of the world. Markets are waking up to these opportunities and to risks of a high carbon economy and shifting accordingly.

Investments in carbon removal are also necessary. The different pathways assessed by IPCC to achieve 1.5°C all rely on carbon removal to some extent. Removing CO₂ from atmosphere will compensate for emissions from sectors in which reaching net-zero

emissions is more difficult, such as aviation. Carbon removal can be achieved by several means, including through land-based approaches and technological approaches.

10 Key Solutions Needed to Reduce Greenhouse Gas Emissions







1.  PHASE OUT coal plants	6.  INCREASE public transport
2.  INVEST in clean energy & efficiency	7.  DECARBONIZE aviation and shipping
3.  RETROFIT buildings	8.  HALT deforestation & RESTORE degraded lands
4.  DECARBONIZE cement, steel & plastics	9.  REDUCE food loss and waste
5.  SHIFT to electric vehicles	10.  EAT more plants & less meat

WORLD ON TRACK TO REACH NET-ZERO EMISSIONS?

Despite benefits of climate action, progress is happening far too slowly for the world to reach net-zero by mid-century or meet emissions reductions necessary by 2030.

To avoid the worst climate impacts, global greenhouse gas (GHG) emissions will need to drop by half by 2030 and reach net-zero around mid-century.

CLIMATE ACTION MUST PROGRESS FAR FASTER TO KEEP 1.5C WITHIN REACH
 To help halve emissions by 2030, the world needs to:

 Ramp up renewables 6x FASTER	 Transition to electric vehicles 22x FASTER	 Increase tree cover 5x FASTER
 Phase out coal power 5x FASTER	 Increase use of low-carbon fuels 8x FASTER	 Electrify industry 1.5x Faster

Recognizing this urgency, **a rapidly growing number of national governments, local government and business leaders are making commitments to reach net-zero emissions within their jurisdictions or businesses.** To date, over fifty countries have communicated such “net-zero targets,” including the world’s largest emitters (China and the United States). On top of that, hundreds more regions, cities and businesses have set targets of their own.

The U.N. High Level Climate Champions’ Race to Zero campaign also calls on regions, cities, businesses, investors and civil society to submit plans to reach net-zero emissions by 2050 in advance of the United Nations climate negotiations (COP 26) in Glasgow in November 2021.

INDIA’S POLICY TO LOWER CARBON EMISSIONS

India is working to reduce its emissions, aligned with the goal of less than 2°C global temperature rise, seen in its headline pledge to cut the emissions intensity of GDP by 33%-35% by 2030 over the 2005 level. But it has not favoured a binding commitment towards carbon neutrality. It is also not aligned with the more ambitious goal of 1.5°C temperature rise. Among the contentious issues it faces is heavy reliance on coal.

Coal accounts for close to 70% of electricity generation in India. Cutting greenhouse gases which heat the atmosphere and contribute to climate change involves shifting power production away from coal, greater adoption of renewables, and transforming mobility through electric vehicles. India is praised by some for its renewables target: scaling up power from renewables such as solar and wind to 450 GW by 2030.

Union Environment Minister said net zero was not the only goal of national policy. Moreover, domestic political opinion favours room for some growth in CO₂ emissions before peaking. UNFCCC provides for common, but differentiated, responsibilities of nations, favouring countries like India. Some politicians support a net zero target as it can put India on a green development trajectory, attracting investment in innovative technologies.

There is a debate whether to set a target for net-zero greenhouse gas emissions by 2050 for India. Doing so would mean an overhaul of a coal-reliant energy sector, transport, heavy industry and even the nation's sluggish bureaucracy.

CHALLENGES TO INDIA'S NET ZERO EMISSIONS

The problem with India is that the target of Net Zero emissions must be achieved while the world's third-biggest emitter also meets the aspirations of 1.4 billion people for faster economic development, which will only happen with an accelerated pace of industrialization and energy demand.

- **Current oil mix is Carbon intensive:**
 - Just three fuels meet about 80% of India's energy demand: coal, oil and solid biomass such as fuelwood, animal waste and charcoal. Changing that mix will require more than simply adding more renewables.
 - Oil and petroleum are used to power not only cars, trucks and railways, but also industrial machinery and even the pumps which deliver water for India's agricultural sector. Tens of millions of homes still rely on cheap biomass fuels for cooking, and subsidies to switch them to cleaner liquefied petroleum gas cylinders have been trimmed.
 - Freight vehicles also pose a challenge, and account for about 45% of the country's road transport emissions. It will be difficult for India to replace oil as transportation fuel.
- **Usage of Coal is expected to increase:** Even if India stops building new power plants. That's because existing coal power plants are running far below capacity, which the country will look to maximize.
- **Rapid Energy Growth:** India's energy use doubled since 2000 as hundreds of millions of citizens added an electrical connection, and the nation's consumption is forecast to accelerate sharply. It'll be driven both by industry and households, which are adding appliances including air conditioners, refrigerators and space heaters.
- **Slow Adoption of e-Vehicles:** Global shift to electric vehicles is happening slowly in India, with the costs of battery powered-models too high, access to charging infrastructure limited and concerns over the reliability of power grids. By 2040, only about a third of new passenger cars sold will be battery-powered, compared with about 70% in China and Germany.
- **Energy needs of Industries:** As a still-industrializing economy, India's emissions from making steel, cement, chemicals and other carbon-intensive materials is set to rise regardless of a climate push. But India could make a dent in those emissions by deploying more energy-efficient measures, switching to cleaner fuels and embracing carbon-capture technology.

India can set up a **Climate Change Commission**, like the U.K. and New Zealand, to monitor progress and help devise mechanisms to achieve long-term emission reductions. The U.K.'s Climate Change Committee has been credited with pushing the government to set the most ambitious goal among G-20 nations.

WAY FORWARD

Increasing incentives for electrification of Transport systems: Although sales of electric vehicles have gone up in past two years, they will still account for less than a per cent of new vehicle sales. The government can:

- Establish a zero emission vehicles (ZEV) credit program. This requires manufacturers of vehicles to ensure that either a certain fraction of their sales are ZEVs or that they purchase ZEV credits from manufacturers who have sold more ZEVs than required by the credit program.
- The second is by putting in place a fuel efficiency/CO₂ emission standard stringent enough that it can best be met by making and selling ZEVs.
- Low carbon pathways for sustainable development should be explored.
- Focus should be mitigating the impact of climate change on the most vulnerable sections of society.
- Incentives to industries for cleaner fuels should be increased.
- At the international level, India should call for developed countries for negative net emissions even as India pushes towards the goals of net zero emissions.

2. CLIMATE ON GLOBAL TABLE

1992: EARTH SUMMIT, RIO DE JANEIRO

The meeting that set up the architecture for negotiations on an international climate change agreement. It finalized the UN Framework Convention on Climate Change (UNFCCC), the mother agreement that lays down the objectives and principles on which climate action by countries are to be based. It acknowledged that developing countries had fewer obligations and capabilities to bring down emissions. Developed countries agreed to a non-binding commitment to take measures aimed at returning to their 1990 emissions levels by 2000.

2009: COP15, COPENHAGEN

Attempt to finalize a new agreement to end in failure. Over 110 heads of nations assembled, but differences were too deep to be bridged. Countries agreed to try again a few years later. Developed countries committed to mobilising \$100 billion every year in climate finance for developing countries from 2020.

1997: COP3, KYOTO

Delivered the Kyoto Protocol, precursor to Paris Agreement. The Protocol assigned specific emission reduction targets for a set of developed countries, to be achieved by 2012. Others were supposed to take voluntary actions to reduce emissions. The Kyoto Protocol expired last year as Paris Agreement took its place.

2007: COP13, BALI

It reaffirmed the principles of CBDR in the efforts to find a replacement to the Kyoto Protocol, which developed nations were getting increasingly uncomfortable with, especially after the emergence of China as the world's leading emitter. Developed countries want emission reduction targets for everyone, or for nobody, their argument

being that without stringent action from China and India, the success of any climate action would not be possible.

2015: COP21, PARIS

The successor agreement was finally delivered. The Paris Agreement does not assign emission reduction targets to any country. Instead, it asks all to do the best they can. But the targets they set for themselves must be reported and verified. The objective is to limit the global rise in temperatures to within 2°C from pre-industrial times.

2021: COP26, GLASGOW

Was supposed to be held last year but postponed because of Covid. The rulebook for implementation of Paris Agreement is still to be finalised. The main remaining hurdle is an agreement over creation of future carbon markets, and the transition of pending carbon credits with some developing countries to that new market.

MECHANISMS OF CLIMATE FINANCING IN INDIA

- The largest source of climate financing in India is public funding, which is routed through budgetary allocation and several funds and schemes related to climate change established by the Government of India such as National Clean Energy Fund (NCEF) and National Adaptation Fund (NAF).
- The Government of India also provides funding through eight missions established under the National Action Plan for Climate Change.
- It has established a Climate Change Finance Unit (CCFU) in the Ministry of Finance, which is the nodal agency for all climate change financing matters.
- However, public funding in India is inadequate and misused.
 - For example, NCEF funds have been used to meet budgetary shortfalls in the Ministry of New and Renewable Energy (MNRE).

Additionally, there is no assessment of climate relevance of publicly funded projects in India, making it difficult to evaluate financial allocation towards climate action.

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC)

The IPCC provides regular assessments of the scientific basis of climate change, its impacts and future risks, and options for adaptation and mitigation. IPCC reports are also a key input into international climate change negotiations.

Created in 1988 by the World Meteorological Organization (WMO) and the United Nations Environment Program. For preparing the reports, IPCC does not conduct its own research, neither does it finance climate research. It bases its climate reports on the review of already published scientific research by a panel of scientists.

3. SIXTH ASSESSMENT REPORT OF IPCC

This is the sixth cycle of global review of climate change being conducted by IPCC. This report is significant as its findings will compel countries to up their climate commitments in Glasgow climate summit of UNFCCC.

SALIENT FINDINGS

a) Climate Change

1. Incontrovertible evidence now exists that demonstrates that **human influence has warmed the atmosphere, ocean and land**. Widespread and rapid changes in the

atmosphere, ocean, cryosphere and biosphere have occurred. Recent changes across the climate system are unprecedented over many thousands of years.

b) Global Warming:

1. Global surface temperatures are now **higher by 1.07⁰C** over the pre-industrial level.
2. Global surface temperature will continue to increase until at least the mid-century under all emissions scenarios considered. **Global warming of 1.5°C and 2°C will be exceeded during the 21st century** unless deep reductions in carbon dioxide (CO₂) and other greenhouse gas emissions occur in the coming decades.

c) Green House gases

1. The report notes that the Carbon dioxide has been and will continue to be the dominant cause of global warming under all greenhouse gas emissions scenarios.
2. GHG warming is assessed to be partially offset by aerosol cooling by almost 30%.

d) Solutions:

1. From a physical science perspective, limiting human-induced global warming to a specific level requires limiting cumulative CO₂ emissions, reaching at least net zero CO₂ emissions, along with strong reductions in other greenhouse gas emissions. Strong, rapid and sustained reductions in CH₄ emissions would also limit the warming effect resulting from declining aerosol pollution and would improve air quality.

ASSESSMENT FOR SOUTH ASIAN REGION

- **South and Southeast Asian monsoon has weakened** in second half of 20th century. Dominant cause of this decreased precipitation is anthropogenic aerosol forcing.
- **Both annual and summer monsoon precipitation will increase** during the 21st century, with enhanced interannual variability. Thus, we need to be prepared for higher incidence of flooding going forward.
- **Heatwaves and humid heat stress will be more intense** and frequent during the 21st century.

ASSESSMENT FOR MOUNTAIN REGIONS

- **Freezing level height in mountain areas is projected to rise** and will alter snow and ice conditions.
- Warming has occurred in the Himalayas, Alps and Central Andes and has increased with altitude. Such elevation-dependent warming could lead to faster changes in the snowline, the glacier equilibrium-line altitude and the snow/rain transition height.

With few exceptions, mountain glaciers have retreated since the second half of 19th century. This retreat has occurred at increased rates since the 1990s, with human influence being the main driver. Furthermore, glaciers will continue to lose mass at least for several decades even if global temperature is stabilised.

IMPACT ON HIMALAYAS

1. Snow cover has reduced since the early 21st century, and glaciers have thinned, retreated, and lost mass.
2. Karakoram glaciers have either slightly gained mass or are in an approximately balanced state.
3. Snow-covered areas and snow volumes will decrease during the 21st century, snowline elevations will rise.
4. Glacier mass is likely to decline with greater mass loss in higher greenhouse gas emissions scenarios.

5. Rising temperature and precipitation can increase the occurrence of glacial lake outburst floods and landslides over moraine-dammed lakes.

IMPACT OF GLOBAL WARMING ON MOUNTAIN GLACIERS

The global warming-induced earlier onset of spring snowmelt and increased melting of glaciers have contributed to seasonal changes in streamflow in low-elevation mountain catchments.

- Mountain glaciers will continue to shrink
- Snow cover will decline over most land regions in terms of water equivalent, extent and annual duration.
- Extreme precipitation will increase in major mountainous regions, with potential cascading consequences of floods, landslides and lake outbursts.
- Runoff from smaller glaciers will decrease due to glacier mass loss, while runoff from larger glaciers will generally increase with global warming levels until their mass becomes depleted.
- All the above-mentioned changes will pose challenges for water supply, energy production, ecosystems integrity, agricultural and forestry production, disaster preparedness, and ecotourism.

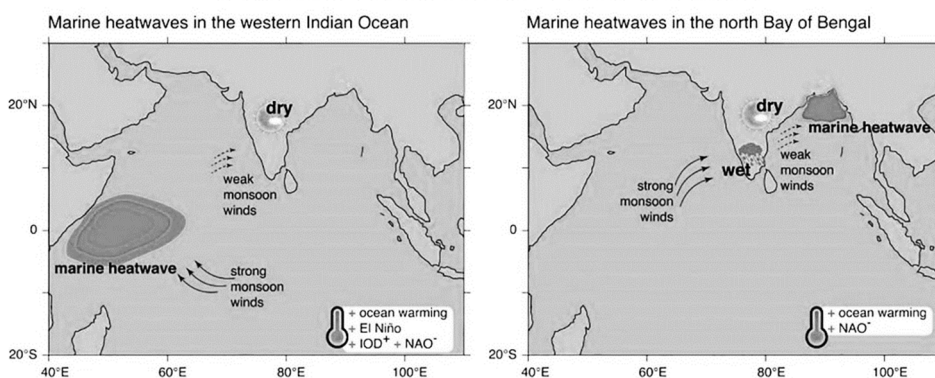
ASSESSMENT FOR OCEANS

- **Marine heatwaves will increase** in frequency in 21st century.
- Anthropogenic warming will **decrease ocean oxygen concentrations**, and this deoxygenation will persist over the coming centuries. Ocean acidification has increased globally in past decades.
- Global **mean sea level is projected to rise over** the 21st century due to continuing deep ocean heat uptake and mass loss from ice sheets.
- **For Indian Ocean:** The surface Indian Ocean has warmed faster than the global average.

MARINE HEAT WAVES

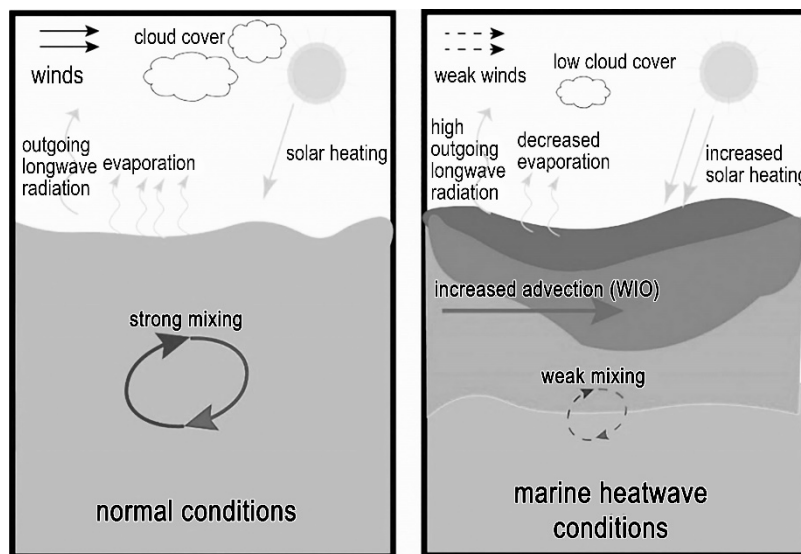
- Marine heat waves (MHW), which are periods of increased temperatures overseas and oceans, in the Indian Ocean region have increased significantly in the past few decades, according to a new report.

Marine heatwaves in the Indian Ocean and their impact on the monsoon



- Such heat waves are caused by an increase in the heat content of oceans, especially in the upper layers. Worldwide, they are one of the major results of human-induced global warming.
- During an MHW, the average temperatures of the ocean surface (up to a depth of 300 feet) goes 5-7°C above normal.

- Around 90 per cent of the warming caused by greenhouse gas emissions is absorbed by the oceans. The year 2021 broke all previous records for ocean heat, according to the National Oceanic and Atmospheric Administration of the United States.



- These events cause habitat destruction due to coral bleaching, seagrass destruction, and loss of kelp forests, affecting the fisheries sector adversely.
- **Local dynamics involved in the genesis of marine heatwaves**
- Other than rapid ocean warming, the co-occurrence of either an El Nino, positive Indian Ocean Dipole (IOD), or the negative North Atlantic Oscillation (NAO) can trigger and intensify the marine heatwaves. The local ocean-atmospheric dynamics through which these marine heatwaves manifest over the Indian Ocean is shown in the figure.

POLAR REGIONS

- **Annual mean surface air temperatures and precipitation will continue to increase** in both polar regions.
- Mean precipitation and precipitation intensity will increase in polar regions. In the Arctic region precipitation will be dominated by rainfall and in Antarctica rainfall will increase over coastal regions.
- **Glaciers have lost mass in all polar regions and will continue to lose mass** in coming decades, even if global temperature is stabilised.
- Both major ice-sheets – Greenland and Antarctica – have been losing mass since at least 1990, with pace accelerating during 2010-2019.

FOR ARCTIC REGION

- **Arctic region has warmed at more than twice the global rate during last 50 years**, surface warming in the Arctic will continue to be more pronounced than average global warming in 21st century.
- **Extreme heat events have increased in Arctic.** Minimum temperatures have increased at about three times the global rate.
- **Fire weather season is projected to lengthen** together with encroachment of fire regimes into tundra regions.
- **Permafrost warming and thawing has increased in the Arctic region.**
- **Reductions in spring snow cover extent.**

- Relative Sea level rise contributing to more frequent and severe coastal flooding and shoreline retreat along sandy coasts.
- Arctic sea ice cover is expected to reach practically ice-free conditions at its summer minimum at least once before 2050.

For Antarctic region:

- Strong warming trend since the 1950s in the Antarctic region. The Antarctic region is projected to warm at a higher rate than average global warming.
- Antarctic snowfall and net snow accumulation have increased over the 20th century.
- However, mass losses from Antarctic outlet glaciers, mainly induced by ice shelf basal melt, outpace mass gain from increased snow accumulation on the continent.
- At sustained warming levels between 2°C and 3°C, the West Antarctic Ice Sheet will be lost almost completely and irreversibly over multiple millennia.

FOR URBAN AREAS

Urban Heat Island effect

This effect results from several factors, including reduced ventilation and heat trapping due to the proximity of tall buildings, heat generated directly from human activities, the heat-absorbing properties of concrete and other urban building materials, and the limited amount of vegetation. Urban centers and cities are warmer than surrounding rural areas due to Urban Heat Island effect.

Three main factors contributing to amplification of warming of urban areas:

- **Urban geometry:** tall buildings close to each other absorb and store heat and reduce natural ventilation.
- **Heat from human activities:** Due to heat released from domestic and industrial heating or cooling systems, running engines and other sources.
- **Heat-retaining materials:** These materials are used in building construction and road building. These are very good at absorbing and retaining heat and then re-emitting that heat at night.
- Urban heat island effect is further amplified in cities that lack vegetation and water bodies.

- Urbanisation **alters the water cycle**, generating increased precipitation over and downwind of cities and increasing surface runoff intensity.
- Urbanisation can also induce phenomena such as the **urban dryness island** referring to conditions where lower humidity values are observed in cities relative to more rural locations, and to slower wind speed compared to adjacent suburbs and countryside.
- Despite having a negligible impact on global annual mean surface-air warming urbanization has exacerbated the effects of global warming in cities.
- **Air Pollution:**
 - Warmer climate is expected to increase surface ozone over polluted regions.
 - Climate change will be more pronounced in extreme air pollution episodes in heavily polluted environments.
- **Coastal cities:**
 - Both sea levels and air temperatures will rise in coastal settlements.
 - Combination of extreme sea level, increased by both sea level rise, storm surge and rainfall/river flow events will increase the probability of flooding.

FUTURE PROJECTIONS FOR URBAN AREAS

- Future urbanisation will amplify projected air temperature change in cities.

- Increased frequency of extreme climate events such as heatwaves, with more heat days and warm nights adding to heat stress in cities.
- Impact assessments and adaptation plans in cities require high-spatial-resolution climate projections.

INDIA'S STAND ON THE REPORT

- Developed countries have usurped more than their fair share of the global carbon budget. Reaching net zero alone is not enough, as it is the cumulative emissions up to net zero that determine the temperatures that is reached.
- India's cumulative and per capita current emissions are significantly low and far less than its fair share of global carbon budget.
- Thus, this report vindicates India's position that historical cumulative emissions are the source of the climate crisis today.
- The report is clarion call for the developed countries to undertake immediate, deep emission cuts and decarbonisation of their economies.

4. 2ND REPORT SIXTH ASSESSMENT REPORT OF IPCC

The UNFCCC report reaffirms India's call for equity and climate justice and stated that Developed countries must take lead in urgent mitigation and providing finance for adaptation, loss and damage.

KEY FINDINGS OF THE REPORT

- The report affirms that climate change due to **historical emissions** is leading to serious impacts which are already being felt globally including in developing countries with low contribution to cumulative emissions. These impacts will rise as warming proceeds and will rise rapidly at higher levels of warming.
- It emphasizes that **action on adaptation is urgently needed** – as urgently as action on mitigation.
- It underlines the need for **climate action based on equity and climate justice** to ensure the well-being of humanity and the planet. The science of climate resilience now fully acknowledges the importance of equity and climate justice that India has always championed and had brought into the Paris Agreement.
- It acknowledges the importance of **Indigenous and Local Knowledge** in adaptation to climate change. Vulnerable and marginalized communities, regions and populations face rising exposure to hazards. It notes that vulnerability is enhanced by lack of development, social and economic inequalities.
- It is a clarion call for the world to **abandon their unsustainable production and consumption** and move urgently to climate resilient development. Reference to sustainable lifestyles has already been introduced in the Paris Agreement thanks to India's efforts, led by the India's Prime Minister at Paris in 2015.
- It notes that impacts and consequent limitations to adaptation would rise beyond 1.5°C warming above pre-industrial levels. It had made clear that developed countries need to rapidly decrease their emissions and reach net zero by 2050.
- **Provision of finance** is critical for helping developing countries and vulnerable populations act quickly and effectively. Public finance is the key enabler for adaptation.

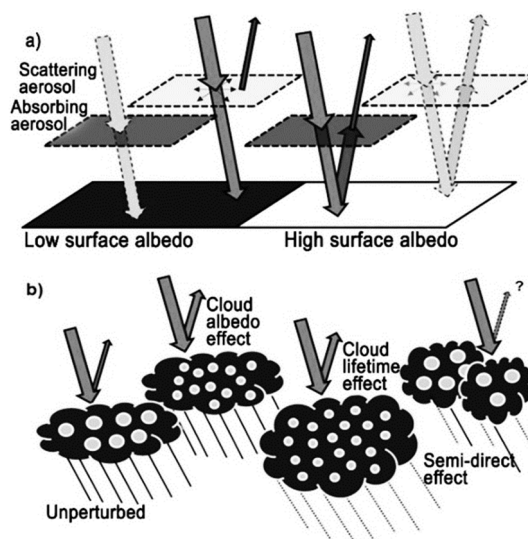
- **Development to reduce non-climatic drivers of vulnerability** is critical to promoting adaptation and is already reducing vulnerability. Rapid progress on achieving the SDGs will help in enhancing adaptive capacity and resilience.
- It re-affirms that the **balance between adaptation and mitigation in climate resilient development** depends on national circumstances according to countries' capabilities including resources and past contributions to global emissions.
- It fully acknowledges the importance of losses and damages arising from climate change. Inadequate adaptation due to lack of financial and technological resources, capacity building and other constraints lead to losses and damages. Further losses and damages would increase as some limits to adaptation are being reached and more would be at higher levels of warming.
- Adaptation suffers from a tremendous lack of finance, with only a small proportion of climate finance devoted to it, while the overwhelming proportion goes to mitigation.
- **Ecosystem based adaptation and Nature-based approaches** such as green infrastructure offer multiple benefits and synergies between adaptation and mitigation. Though the Report refers to the prospects and limitations of Nature-based Solutions (NbS) in climate mitigation, the SPM acknowledges the reservations of developing countries that NbS will be promoted as the sole or the major solution to climate mitigation which is obviously not the case.
- It recognizes the **key role of agriculture** and the great importance of food security in adaptation.
- It notes that future climate-resilient development pathways depend on climate risks, adaptation measures and the remaining carbon budget.

India is already walking the path of climate resilient development with its combination of several adaptation-oriented development actions and its contribution to mitigation. At COP26, as the implementation of the Paris Agreement began, India reaffirmed its commitment to climate actions, including the goal of net zero by 2070, and the one-word mantra of **L.I.F.E. (lifestyles for environment)**. India notes that future reports should strengthen the "solution space" and more comprehensively assess knowledge regarding effectiveness, costs and benefits.

5. ANTHROPOGENIC AEROSOL FORCING

All atmospheric aerosols scatter incoming solar radiation, and a few aerosol types can also absorb solar radiation. BC is the most important of the latter, but mineral dust and some OC components are also sunlight absorbers. Aerosols that mainly scatter solar radiation have a cooling effect, by enhancing the total reflected solar radiation from the Earth.

Strongly absorbing aerosols have a warming effect. In the atmosphere, there is a mixture of scattering and absorbing aerosols, and their net effect on Earth's energy budget is dependent on surface and

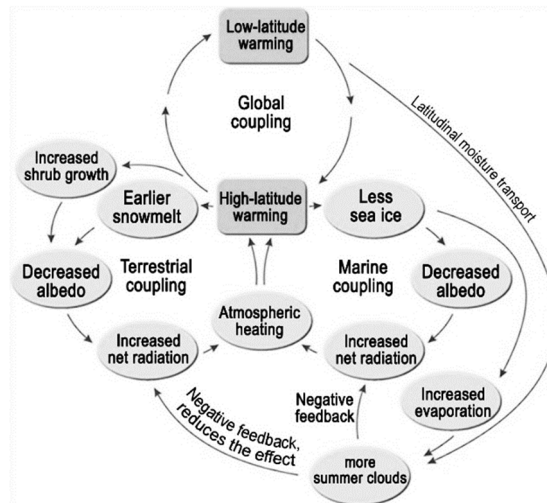


cloud characteristics. Scattering aerosols above a dark surface and absorbing aerosols above a bright surface are most efficient (see Figure).

Scattering (absorbing) aerosol above a bright (dark) surface is less efficient because solar radiation is reflected (absorbed) anyway. Absorbing aerosols are particularly efficient when positioned above clouds, which are a main contributor to the total reflection of solar radiation back to space.

ELEVATION DEPENDENT WARMING

The phenomenon that the warming rate of air temperature is amplified with elevation is termed elevation-dependent warming (EDW).



INDIA'S EFFORTS FOR COMBATING CLIMATE CHANGE

- **Commitments under Paris Climate Deal**
 - Cut greenhouse gas emissions intensity of its gross domestic product 33% to 35% by 2030,
 - Increase non-fossil fuel power capacity to 40% from 28% in 2015
 - Substantially boost forest cover to reduce Carbon Dioxide.
 - **As per the BUR, the emission intensity of India's GDP has reduced by 21 per cent over the period of 2005-2014 which is the result of India's proactive and sustained actions on climate change.**
- **National Action Plan on Climate Change (NAPCC):** It identifies several measures that simultaneously advance the country's development and climate change related objectives of adaptation and mitigation through focused National Missions.
 - **National Solar Mission:** It aims to increase the share of solar energy in the total energy mix. Under the total target of 100 GW, 32.5 GW of solar electric generation capacity has been installed.
 - **National Water Mission:** It focuses on monitoring of ground water, aquifer mapping, capacity building, water quality monitoring and other baseline studies. It seeks to increase water use efficiency by 20%.
 - **National Mission for a Green India:** It seeks to increase tree and forest cover by 5 mha. It also seeks to increase the quality of existing forests by additional 5 mha.
 - **National Mission on Sustainable Habitat:** It is being implemented through three programs: Atal Mission on Rejuvenation and Urban Transformation, Swachh Bharat Mission, and Smart Cities Mission. Energy Conservation Building Rules 2018 for commercial buildings has been made mandatory.

- **National Mission for Sustainable Agriculture:** It aims at enhancing food security and protection of resources.
- **National Mission for Sustaining the Himalayan Ecosystem:** It aims to evolve suitable management and policy measures for sustaining and safeguarding the Himalayan Ecosystem.
- **National Mission on Strategic Knowledge for Climate Change:** It seeks to build a knowledge system that would inform and support national action for ecologically sustainable development. Key achievements include setting up of 11 Centers of Excellence and 10 State Climate Change Centers.
- **National Mission for Enhanced Energy Efficiency (NMEEE):** Under it, The Perform, Achieve and Trade (PAT) scheme was designed on the concept of reduction in Specific Energy Consumption.
- **Climate Change Action Program (CCAP):** Central sector scheme to build and support capacity at central and state levels, strengthening scientific and analytical capacity for climate change assessment, establishing appropriate institutional framework and implementing climate actions.
- **Energy Efficiency Measures:** Energy Conservation Building Code (ECBC) 2017 prescribes energy performance standards for new commercial buildings to be constructed across India to achieve a 50 per cent reduction in energy use by 2030 translating to energy savings of about 300 Billion Units by 2030 and peak demand reduction of over 15 GW in a year. Schemes like UJALA for LED bulb distribution has crossed 360 million whereas under streetlight national program, 10 million conventional streetlights have been replaced by LED streetlights thus cumulatively saving 43 million tons of CO₂ emission.
- **Promotion of Electric Vehicles:** National Electric Mobility Mission Plan (NEMMP) 2020, Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles in India (FAME India) scheme was formulated in 2015 to promote manufacturing and sustainable growth of electric and hybrid vehicle technology
- **Promotion of Biofuels:** The National Bio-fuels Policy 2018 targets 20 per cent blending of ethanol in petrol and 5 per cent blending of biodiesel in diesel by 2030.
- **Separate Fund for Climate Change:** National Adaptation Fund on Climate Change (2015) supports concrete adaptation activities for the States/UTs that are particularly vulnerable to the adverse effects of climate change and are not covered under on-going schemes. The Scheme has been taken as Central Sector Scheme with National Bank for Agriculture and Rural Development (NABARD) as the National Implementing Entity.
- **Green Bonds:** Green bonds are debt securities issued by financial, non-financial or public entities where the proceeds are used to finance 100 per cent green projects and assets. India has the second largest Emerging green bond market after China. Several Government agencies have contributed to issuance: Indian Renewable Energy Development Agency (IREDA) and the Indian Railway Finance Corporation (IRFC). In 2018, the SBI entered the market with an US\$ 650 million Certified Climate Bond.
- **International Platform on Sustainable Finance (IPSF):** The IPSF acknowledges the global nature of financial markets which has the potential to help finance the transition to a green, low carbon and climate resilient economy by linking financing needs to the global sources of funding. India joined the International Platform on Sustainable Finance (IPSF) in October 2019.
- **International Solar Alliances (ISA):** Lead by India, the primary objective of the alliance is to work for efficient consumption of solar energy to reduce dependence on fossil fuels.

- **FAME Scheme – for E-mobility:** To promote adoption of electric/ hybrid vehicles (EVs) in India.
- **Atal Mission for Rejuvenation & Urban Transformation (AMRUT) – for Smart Cities**
- **Pradhan Mantri Ujjwala Yojana – for access to clean cooking fuel**
- **UJALA scheme - for embracing energy efficient LED bulbs**
- **Swachh Bharat Mission**

6. IMPACT OF CLIMATE CHANGE ON CRYOSPHERE

SIGNIFICANCE OF POLAR REGIONS

- Global ocean circulation is influenced by polar processes. Polar Regions also affect drawdown of atmospheric heat and carbon.
- Sea ice influences climate, weather, marine ecosystems and human activities: Ice sheets and glaciers discharge freshwater that influences ocean circulation, ecosystems and sea level globally.
- Polar Regions are resource rich. There is increasing focus on resource extraction. Commercial activity is increasing bringing risks, opportunities and governance challenges.
- Very high albedo which reflects all the heat and keeps temperature cooler.

IMPACT OF CLIMATE CHANGE ON CRYOSPHERE

1. Sea ice

- Reflects a high proportion of incoming solar radiation back to space
- Provides thermal insulation between ocean and atmosphere
- Influences thermohaline circulation
- Provides habitat for ice-associated species.

2. Changes in Arctic climate

- Air temperature in Polar Regions has increased faster than global average.
- Reasons for increased warming of polar regions are:
 - Reduced summer albedo due to sea ice and snow cover loss.
 - Increase of total water vapour content in the polar region's atmosphere.
 - Changes in total cloudiness in summer.
- Additional heat generated by newly formed sea areas and more extensive open water areas in the autumn.
- Northward transport of heat and lower rate of heat loss to space from Arctic.
- According to projections, the Arctic will be practically ice-free during summers by 2050.
- Ice loss from Greenland will intensify with surface melt contributing most to it.

3. Changes in Antarctic climate

- The loss of ice in Antarctic region has not been as clear as in Arctic region.

4. Changes in Terrestrial cryosphere

- Thawing of Polar Permafrost: It refers to ground (soil or rock and included ice and organic material) that remain at or below 0°C for 21 at least two consecutive years.

The permafrost region has locked vast amounts of carbon and methane, if released will further accelerate global warming.

- Glaciers are expected to reduce in ice-mass and thin.

IMPACT OF CHANGES IN POLAR CRYOSPHERE

- The loss sea ice will be positive for shipping industry as it will find new shorter routes.
- Changes in the range of animals and biodiversity. This will create risks for some animals such as Polar Bears, Reindeers, and Snow Leopard which are totally dependent on the snow ecosystem.
- Thawing of snow will lead more tourists to access these areas, which can further add to their degradation.

IMPACT OF CHANGES IN MOUNTAIN CRYOSPHERE

- Changes in river runoff. It is expected that water yields of rivers will first increase to hit a peak as glaciers melt at an accelerated pace, and then decrease when no glaciers are there to feed perpetual rivers.
- Changes in river run-offs will also affect hydro-power generation.
- Agriculture sector will be affected adversely due to want to water for irrigation.
- Permafrost degradation and thaw as well as increased water flow into frozen slopes can increase the rate of movement of frozen debris bodies and lower their surface due to loss of ground ice. Increasing landslide incidents.
- Snow avalanches can occur either spontaneously due to meteorological factors such as loading by snowfall or liquid water infiltration.

7. IMPACT OF CLIMATE CHANGE ON OCEANS

- **Ocean Heat:** Four independent analyses show that the amount of heat stored in the ocean has increased substantially since the 1950s. Ocean heat content not only determines sea surface temperature, but also affects sea level and currents.
- **Sea Surface Temperature:** Ocean surface temperatures increased around the world during the 20th century. Even with some year-to-year variation, the overall increase is clear, and sea surface temperatures have been consistently higher during the past three decades than at any other time since reliable observations began in the late 1800s.
- **Enhanced Ocean Stratification:** Ocean Stratification refers to the process of forming of layers of (ocean) water with different properties such as salinity, density and temperature that act as barrier for water mixing. The strengthening of near-surface stratification generally results in warmer surface waters, decreased oxygen levels in deeper water, and intensification of ocean acidification in the upper ocean.
- **Sea Level:** When averaged over all the world's oceans, sea level has risen at a rate of roughly six-tenths of an inch per decade since 1880. The rate of increase has accelerated in recent years to more than an inch per decade. Changes in sea level relative to the land vary by region. Along the U.S. coastline, sea level has risen the most along the Mid-Atlantic coast and parts of the Gulf coast, where several stations registered increases of more than 8 inches between 1960 and 2020. Sea level has decreased relative to the land in parts of Alaska and the Pacific Northwest.
- **Changes in ocean currents:** Ocean currents will change due to changes in wind stress. Western boundary currents have already started shifting pole ward. For ex.

Atlantic Meridional Ocean Circulation is expected to weaken in future affecting the Gulf Stream.

- **A Closer Look: Land Loss along the Atlantic Coast:** As sea level rises, dry land and wetlands can turn into open water. Along many parts of the Atlantic coast, this problem is made worse by low elevations and land that is already sinking. Between 1996 and 2011, the coastline from Florida to New York lost more land than it gained.
- **Coastal Flooding:** Flooding is becoming more frequent along the U.S. coastline as sea level rises. Every site measured has experienced an increase in coastal flooding since the 1950s. The rate is accelerating at most locations along the East and Gulf coasts. The East Coast suffers the most frequent coastal flooding and has generally experienced the largest increases in the number of flood days.
- **Ocean Acidity:** The Ocean has become more acidic over the past few decades because of increased levels of atmospheric carbon dioxide, which dissolves in the water. Higher acidity affects the balance of minerals in the water, which can make it more difficult for certain marine animals to build their protective skeletons or shells.
- **Ocean deoxygenation:** The loss of oxygen in the ocean. It results from ocean warming, which reduces oxygen solubility and increases oxygen consumption and stratification, thereby reducing the mixing of oxygen into the ocean interior. Deoxygenation can also be exacerbated by the addition of excess nutrients in the coastal zone.
- **Marine Heatwaves:** Marine heatwaves – sustained periods of anomalously high near-surface temperatures that can lead to severe and persistent impacts on marine ecosystems – have become more frequent over the 20th century.

FUTURE ACTION

1. Conclude an internationally legally binding instrument on the conservation and sustainable use of marine biodiversity in areas beyond national jurisdiction, under UNCLOS.
2. Protect at least 30% of the Ocean by 2030, with a focus on biodiversity and ecosystem in protected areas and other OECMs.
3. Moratorium on deep sea mineral exploitation in marine areas beyond national jurisdiction. Vigilance to ensure that human activities do not further contribute to loss of marine biodiversity.
4. Scale up marine and coastal Nature based solutions (NbS) for climate change.
5. Negotiate a internationally legally binding agreement on plastic pollution.
6. Enhance ocean science as a basis for informing UN Decade of Ocean Science for Sustainable Development.

VOLUNTARY COMMITMENTS

Protecting Our Planet Challenge will invest at least \$1 billion to support the creation, expansion and management of marine protected areas by 2030.

India Committed to Coastal Clean Seas Campaign and will work towards a ban on single use plastics.

INDIA'S COMMITMENT

- India has joined the High Ambition Coalition for Nature and People, which aims to promote an international agreement to protect 30% of world's land and ocean by 2030.
- Coastal Clean Seas Campaign

- Ban on Single Use Plastics.
- India is preparing draft Blue Economic Policy of India and Deep Ocean Mission to harness the resources of deep-sea biodiversity.
- India partners with many countries on Integrated Ocean Management and frameworks for marine spatial plans for sustainable development and conservation of ecosystems.
- India has proposed to establish Sustainable Coastal and Ocean Research Institute (SCORI) to meet the needs of Pacific Island Countries.

8. CARBON MARKET

Carbon markets are one of the tools to tackle the climate change problem. The argument behind carbon trading is that the best way to take climate action is to reduce emissions where it is least costly to do so.

Article 6 under Paris Agreement contains three separate mechanisms for “voluntary cooperation” towards climate goals: two based on markets and a third based on “non-market approaches”

CARBON MARKETS UNDER PARIS AGREEMENT (ARTICLE 6)

- **Market Mechanism 1 (Article 6.2)** - It sets up a carbon market which allows countries on voluntary direct bilateral cooperation basis to sell any extra emission reductions {called as Internationally Transferred Mitigation Outcomes (ITMO)} they have achieved compared to their Nationally Determined Contributions (NDCs) target.
- **Market Mechanism 2 (Article 6.4)** - A new international carbon market would be created for the trading of emissions reductions created anywhere in the world by the public or private sector. This new market referred to as the “Sustainable Development Mechanism” (SDM) seeks to replace the CDM.
- **The non-Market Approach:** to boost “mitigation, adaptation, finance, technology transfer and capacity building”, in situations where no trade is involved. This could involve similar activities without the added element of trading. E.g., a country could support a renewable energy scheme overseas via concessional loan finance, but there would be no trading of any emissions cuts generated.

WHY IS ARTICLE 6 IMPORTANT?

Within the Sustainable Development Mechanism, the notion of Overall Mitigation in Global Emissions (OMGE) has the potential to go beyond the Kyoto markets' "zero-sum game" to accomplish "global" mitigation.

Currently, international carbon market mechanisms operate under the Kyoto Protocol's regulations, which provide those transfers between Parties result in no net decrease in global emissions.

Trading could aid in the reduction of emissions by making it easier and less expensive for governments to accomplish their climate goals, so encouraging them to set more ambitious targets.

- According to a World Bank Report, some 96 country climate pledges - about half of all NDCs - refer to the use of carbon pricing initiatives.
- According to IETA, trading could save \$250bn every year by 2030. This could be invested into further emissions cuts to raise ambition.

It also includes a provision that a “share of the proceeds” earned under SDM be used to assist developing nation parties that are particularly vulnerable to the negative consequences of climate change in meeting adaptation expenses. This might become

a new way for richer countries to channel climate funds to developing countries, complementing existing initiatives like the Green Climate Fund.

Article 6 might potentially be used to incorporate company climate pledges into the larger UN process. The only component of the legislation that specifically mentions private sector participation in the Paris process is Article 6.

The carbon market system must progress beyond offsets to something better. Rather than offering a cheap way out and substituting someone else's work, it should try to accelerate the change. Offsetting methods should be phased out in favor of climate programs that accelerate the zero-carbon transition.

ABOUT CARBON PRICING

- Carbon pricing is a tool that captures the external costs of greenhouse gas (GHG) emissions - costs that the public bears, such as crop damage, health care costs from heat waves and droughts, and property loss from flooding and sea level rise - and ties them to their sources through a price, usually in the form of a price on the CO₂ emitted.

TYPES OF CARBON PRICING

There are 2 major types of carbon pricing:

- **Emissions Trading Systems (ETS):** The ETS, also known as a cap-and-trade system, sets a limit on total GHG emissions and permits low-emitting companies to sell their excess allowances to higher-emitting industries.
- **Carbon Tax:** It places a price on carbon by imposing a tax on greenhouse gas emissions or, more typically, the carbon content of fossil fuels. It differs from an ETS in that the carbon tax's emission reduction effect is not pre-determined, but the carbon price is.

OTHER MECHANISMS TO PRICE CARBON EMISSION

- **Results-Based Climate Finance (RBCF)** is a funding strategy in which payments are paid in response to pre-determined outputs or outcomes connected to climate change management, such as emission reductions.
 - Many RBCF programs also simultaneously aim to reduce poverty, improve access to clean energy and offer health and community benefits.
- **GHG emission reductions from project-** or program-based activities are referred to as offset mechanisms, and they can be traded domestically or internationally.
 - Offset programs have their own register and award carbon credits according to a system.
 - These credits can be utilised to address GHG mitigation compliance requirements under international agreements, domestic policies, or corporate citizenship goals.
- **Internal carbon pricing** is a tool that an organisation utilizes to steer its decision-making process in relation to the impacts, risks, and opportunities of climate change.

IMPORTANCE OF CARBON PRICING

It holds the emitters responsible for the emissions, rather than deciding on who should reduce emissions where and how. It incentivizes the emitters to transform their process to lower the emissions. In this way, the overall environmental goal is achieved in the most flexible and least-cost way to society.

Placing an adequate price on GHG emissions is of fundamental relevance to internalize the external cost of climate change in the broadest possible range of economic decision making and in setting economic incentives for clean development.

It can help to mobilize the financial investments required to stimulate clean technology and market innovation, fueling new, low-carbon drivers of economic growth.

For governments, carbon pricing is one of the instruments of the climate policy package and a source of revenue needed to reduce emissions.

Businesses use internal carbon pricing to evaluate the impact of mandatory carbon prices on their operations and as a tool to identify potential climate risks and revenue opportunities.

Long-term investors use carbon pricing to analyze the potential impact of climate change policies on their investment portfolios, allowing them to reassess investment strategies and reallocate capital toward low-carbon or climate-resilient activities.

CHALLENGES TO CARBON PRICING

Ineffective use of revenues: effectiveness of many carbon pricing initiatives depends on how these revenues are spent.

Carbon leakage: It occurs when there is an increase in greenhouse gas emissions in one country because of an emissions reduction by a second country with a strict climate policy

Policy overlaps or inconsistency: Policy makers must work carefully and deliberately to avoid potential overlap of and interaction between policies instruments, which could undermine the effectiveness of carbon pricing mechanisms.

9. CLIMATE FINANCE

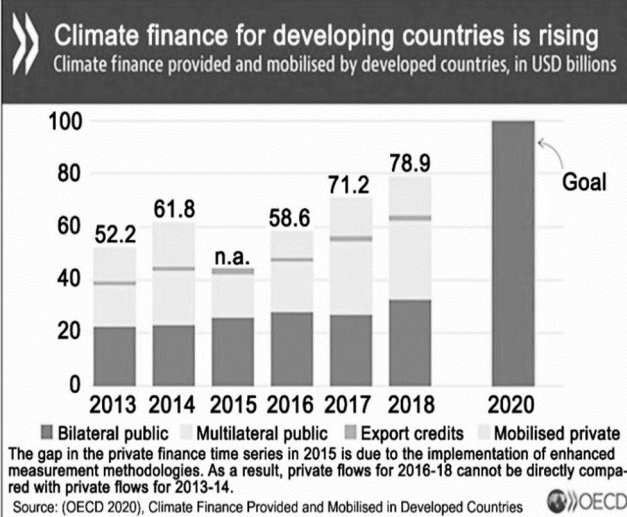
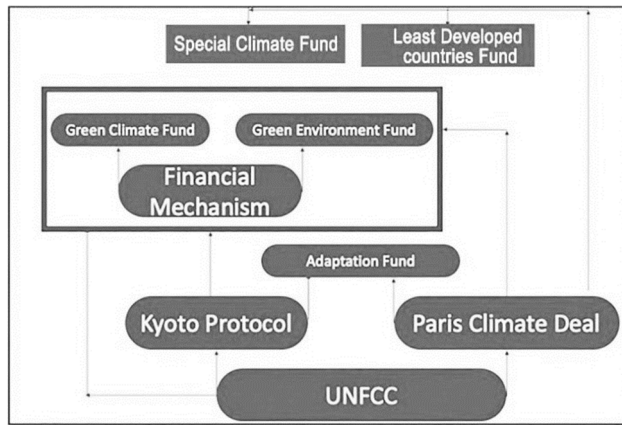
According to the United Nations Framework Convention on Climate Change (UNFCCC) Standing Committee on Finance, climate finance is "finance that aims at reducing emissions and improving greenhouse gas sinks, as well as reducing vulnerability of, and maintaining and increasing the resilience of, human and ecological systems to negative climate change impacts."

The term has been used in a narrow sense to refer to transfers of public resources from developed to developing countries, considering their UN Climate Convention obligations to provide "new and additional financial resources", and in a wider sense to refer to all financial flows relating to climate change mitigation and adaptation.

UNFCCC, Kyoto Protocol and Paris Agreement call for financial assistance. In accordance with the principle of "common but differentiated responsibility and respective capabilities" set out in the Convention, developed country Parties are to provide financial resources to assist developing country Parties in implementing the objectives of the UNFCCC.

The Convention has created Financial Mechanisms to offer cash to developing nation Parties to help with this.

- Since the Convention's entrance into force in 1994, the **Global Environment Facility (GEF)** has acted as the financial mechanism's operating institution.
- **Copenhagen Accord:** Parties agreed for a "goal" for the world to **raise \$100 billion per year by 2020**, from "**a wide variety of sources**", to help developing countries cut carbon emissions (mitigation). New multilateral funding for adaptation will be delivered, with a governance structure.
- **COP 16 (2010):** Parties established the Green Climate Fund (GCF) and in 2011 (COP 17) also designated it as an operating entity of the financial mechanism.
- **Establishment of special funds:** Special Climate Change Fund (SCCF), the Least Developed Countries Fund (LDCF), both managed by the GEF; and the Adaptation Fund (AF) under the Kyoto Protocol in 2001. (See Diagram)



Financial commitments towards climate action are on an upward trend

CLIMATE CHANGE PERFORMANCE INDEX (CCPI)

This is a scoring system designed by the German environmental organization Germanwatch to enhance transparency in international climate politics.

No country performs well enough in all CCPI index categories to achieve an overall very high rating. The first three positions in the overall ranking therefore remain empty. This says a great deal.

Even if all countries were as committed as the current frontrunners, it would still not be enough to prevent dangerous climate change.

The countries with high rankings also have no reason to ease up. Even greater efforts and actions by governments are needed to set the world on track to keep global warming well below a 2°C increase. Even better, 1.5°C.

CHALLENGES IN CLIMATE FINANCE

- **Insufficient Amounts:** For instance, global annual fossil fuel subsidies together with their externalities cost about \$5.3 trillion.
- US had stopped further funding for the GCF.
- According CCPI, no country performs well enough in all CCPI index categories to achieve an overall very high rating. The first three positions in the overall ranking therefore remain empty.
- Although countries agreed at Katowice COP 24 to initiate formal discussions on the new post-2025 mobilization goal in 2020, countries such as India believe that a

decision to initiate deliberations is weaker than a decision to start the process of setting this goal.

- **Climate Finance Governance:** Equally challenging is how international climate change funding should be effectively governed and delivered to developing countries.
- **Definitions & reporting of climate finance:** Even 10 years after COP 15, there is no general agreement on what form of funding can be counted as climate finance under the GCF in support of the Copenhagen pledge. Even 6 years after the Paris Climate Deal, there is no agreement regarding definition of climate finance.
- Additionality (On top of or as part of official development assistance) and Predictability of Climate Finance.
- **Inclusion of even non-financial efforts (capacity building/ Technology Transfer)** under Climate Finance (COP 24).
- **Reporting and Verification:** Currently there is a lack of mandatory verification mechanism in reporting. A two-year lag in reporting also limits the ability to properly verify the flows of climate finance. Reporting requirements around the projected financing provisions remain weak.
- **Market mechanism:** According to Article 6 of the Paris Agreement, a portion of the earnings from the new market mechanism will be used to promote adaptation in developing countries. This revenue will mostly certainly go to the Adaptation Fund. The magnitude of this share, as well as whether it should be applied to all or merely some of the mechanisms created under Article 6, are hotly debated matters.

10. LOSS AND DAMAGE FUND

The United Nations Climate Change Conference COP27 closed with a breakthrough agreement to provide “loss and damage” funding for vulnerable countries hit hard by climate disasters.

What is it?

- “Loss and damage” refers to costs being incurred from climate-fuelled weather extremes or impacts, like rising sea levels.
- The fund will be aimed at helping developing countries that are “particularly vulnerable” to the effects of climate change.
- Developing countries made strong and repeated appeals for the establishment of a loss and damage fund, to compensate the countries that are the most vulnerable to climate disasters, yet who have contributed little to the climate crisis.
- Loss and damage refers to the negative consequences that arise from the unavoidable risks of climate change, like rising sea levels, prolonged heatwaves, desertification, the acidification of the sea and extreme events, such as bushfires, species extinction and crop failures.

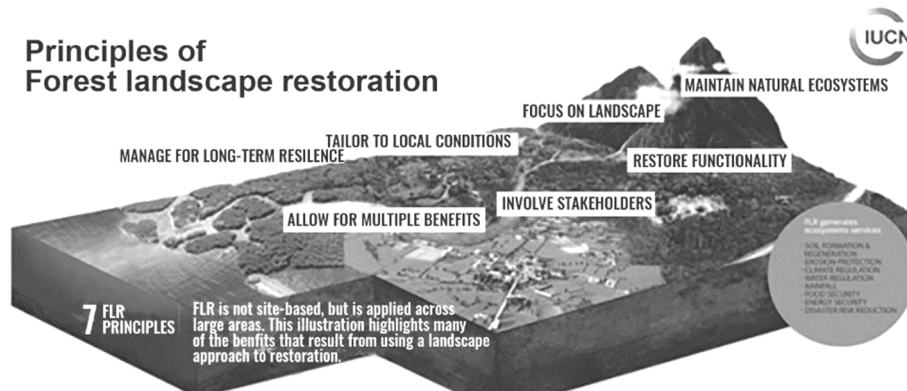
Merits:

- **Shift of focus:** Climate funding so far has focused mostly on cutting carbon dioxide emissions in an effort to curb global warming, while about a third of it has gone towards projects to help communities adapt to future impacts.
- **Urgency of the fund:** A report by 55 vulnerable countries estimated their combined climate-linked losses over the last two decades totalled \$525bn, or 20 percent of their collective gross domestic product (GDP). Some research suggests that by 2030, such losses could reach \$580bn per year.

Issues:

- No agreement yet over what should count as “loss and damage” caused by climate change.
- No agreement over who will pay. Vulnerable countries and campaigners in the past argued that rich countries that caused the bulk of climate change with their historical greenhouse gas emissions should pay. The United States and European Union had resisted the argument, fearing spiralling liabilities. The EU has argued that China – the world’s second-largest economy, but classified by the UN as a developing country – should also pay into it.

Huge chance of shifting responsibilities and deadlock.

FOREST LANDSCAPE RESTORATION

Successful FLR is forward-looking and dynamic, focusing on strengthening the resilience of landscapes and creating future options to adjust and further optimise ecosystem goods and services as societal needs change or new challenges arise. It integrates several guiding principles, including:

- **Focus on landscapes:** FLR takes place within and across entire landscapes, not individual sites, representing mosaics of interacting land uses and management practices under various tenure and governance systems. It is at this scale that ecological, social and economic priorities can be balanced.
- **Maintain and enhance natural ecosystems within landscapes:** FLR does not lead to the conversion or destruction of natural forests or other ecosystems. It enhances the conservation, recovery, and sustainable management of forests and other ecosystems.
- **Engage stakeholders and support participatory governance:** FLR actively engages stakeholders at different scales, including vulnerable groups, in planning and decision-making regarding land use, restoration goals and strategies, implementation methods, benefit sharing, monitoring and review processes.
- **Tailor to the local context using a variety of approaches:** FLR uses a variety of approaches that are adapted to the local social, cultural, economic and ecological values, needs, and landscape history. It draws on latest science and best practice, and traditional and indigenous knowledge, and applies that information in the context of local capacities and existing or new governance structures.
- **Restore multiple functions for multiple benefits:** FLR interventions aim to restore multiple ecological, social and economic functions across a landscape and generate a range of ecosystem goods and services that benefit multiple stakeholder groups.
- **Manage adaptively for long-term resilience:** FLR seeks to enhance the resilience of the landscape and its stakeholders over the medium and long-term. Restoration

approaches should enhance species and genetic diversity and be adjusted over time to reflect changes in climate and other environmental conditions, knowledge, capacities, stakeholder needs, and societal values. As restoration progresses, information from monitoring activities, research, and stakeholder guidance should be integrated into management plans.

11. URBAN HEAT ISLAND

IPCC 6th assessment report has stated that urban areas will be warmer than the surrounding rural areas due to the urban heat island effect.

By 2050, 66% of the global population is expected to be living in cities. The largest urbanization is anticipated to be in Africa and Asia, where some countries are expected to experience more than a five-fold increase in urban population by 2050

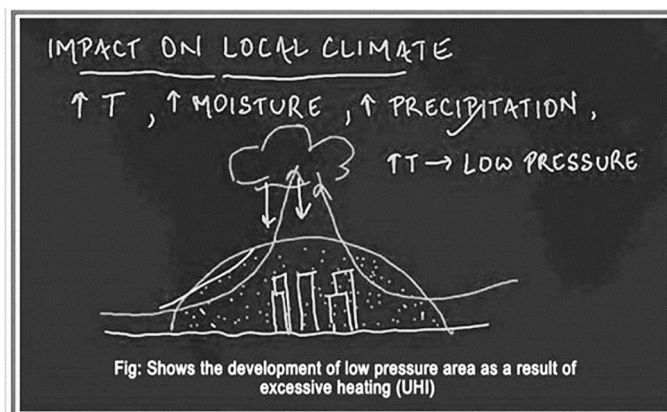
According to IPCC 6th Assessment Report, despite having a negligible impact on global annual mean surface-air warming (very high confidence), urbanization has exacerbated the effects of global warming in cities (very high confidence).

ABOUT URBAN HEAT ISLANDS

- IPCC report points towards Anthropogenic forcing which has exacerbated urban heat islands in India.
- Mean daytime temperature of surface urban areas going up by around 2°C if compared to neighboring areas.

REASONS FOR URBAN HEAT ISLAND EFFECT

- Main cause of urban heat island effect is from modification of land surfaces.
 - Urban Spaces have higher absorption.
 - Less Tree cover → Low evapotranspiration
- Waste heat generated by energy usage is a secondary contributor
- As a population center grows, it tends to expand its area and increase its average temperature.

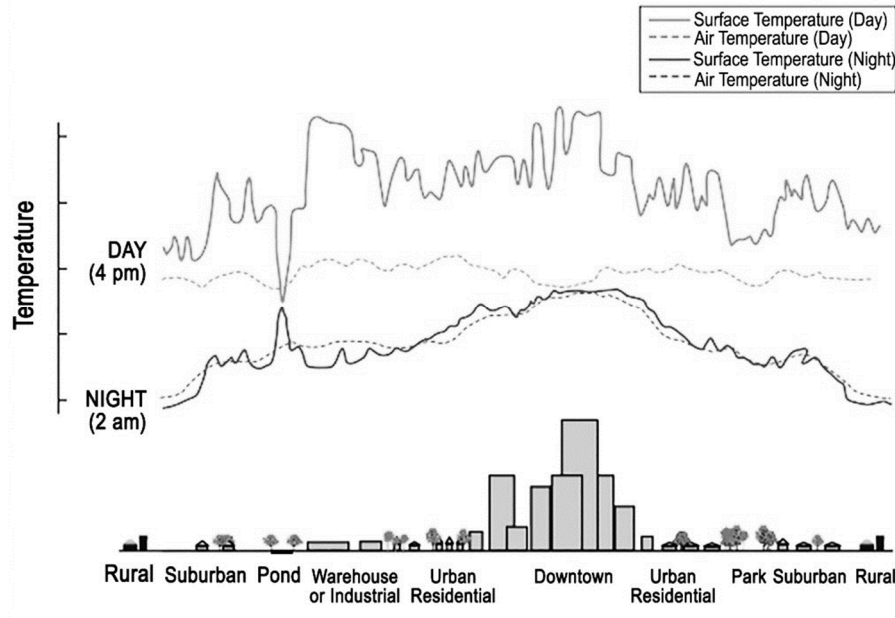


IMPACT OF URBAN HEAT ISLANDS

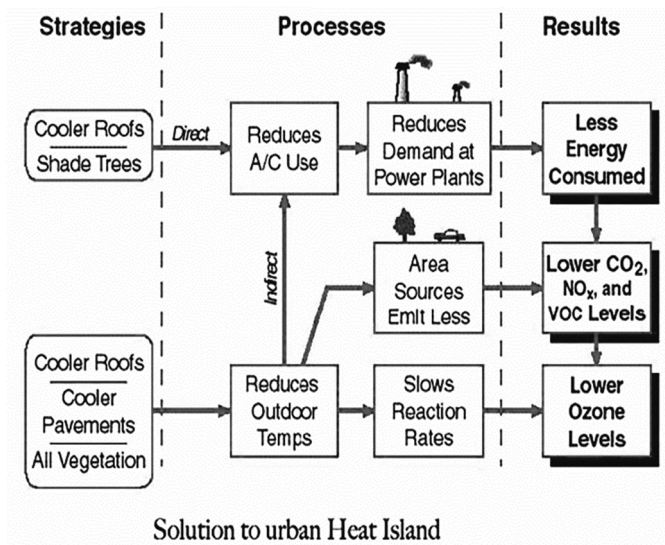
- **On local climate**
 - Higher Temperatures.
 - Increase in precipitation downstream wind direction.
 - Increasing plant growing seasons in sub-urban areas. Ex, some studies have found that growing areas located around 6.2 miles outside of city limits are extended by an average of 15 days.

- **On Biodiversity:** Migration of animals towards cities (Cold blooded animals). Thermal pollution of neighboring water bodies.

On Human Health: Urban inhabitants also suffer during heat waves because the urban heat island prevents nighttime temperatures from decreasing as they do in rural areas. Extreme temperatures lead to heat cramps, heatstroke, and heat exhaustion. Heatstroke may cause respiratory distress syndrome, impaired mobility, or decreased awareness.



SOLUTION



12. ASSESSMENT OF CLIMATE CHANGE OVER INDIAN REGION

- Published by Ministry of Earth Sciences.
- It is India's first-ever national forecast on the impact of global warming on the subcontinent in the coming century.
- These projections, based on a climate forecasting model developed at the Indian Institute of Tropical Meteorology (IITM), Pune, will be part of the next report of the Intergovernmental Panel on Climate Change (IPCC), expected to be ready in 2022.

- This is a significant step for climate science and policy in India because existing projections are put in the context of historical trends in land and ocean temperatures, monsoon rainfall, floods, droughts and Himalayan warming and glacier loss.

TEMPERATURE

- In a worst-case scenario, **average surface air temperatures over India could rise by up to 4.4°C** by the end of the century as compared to the period between 1976 and 2005.
- Radiative forcing or climate forcing is the difference between sunlight energy absorbed by the Earth (including its atmosphere) and the energy that it radiates back into space.
- Under an intermediate scenario of RCP 4.5, the country's average temperature could rise by up to 2.4°C.
- The rise in temperatures will be even more pronounced in the Hindu Kush-Himalayan region where the average could reach 5.2°C.
- The region is already highly vulnerable to climate-related variability in temperatures, rainfall and snowfall.
- The **incidences of heat waves over the country could also increase by three to four times**. Their duration of occurrence might also increase which was already witnessed by the country in 2019.
- Between 1900 and 2018, the average temperatures of India rose by 0.7°C.
- **This rise in temperatures has been largely attributed to global warming due to GHG emissions and land use and land cover changes.**
- However, **it has also been slightly reduced by the rising aerosol emissions in the atmosphere** that have an overall cooling characteristic. The latest global climate change assessments indicate a rise in worldwide average surface air temperatures by 5°C by the end of the century if human activities keep emitting GHGs at the current rate.
- The global average temperature in the last century has gone up by 1.1°C, according to the latest estimates by the IPCC. Even if the Nationally Determined Contributions (NDCs) declared by countries under the Paris Agreement 2015 are met, the global average temperature could rise by around 3°C, which could be disastrous.

RAINFALL

- Another significant highlight of the assessment is the projected variability in the rainfall, **especially during the monsoon season which brings 70% of the rainfall received by India** and is one of the primary drivers of its rural agrarian economy.
- **Monsoon rainfall could change by an average of 14% by 2100** that could go as high as 22.5%. It is not mentioned if this change will be an increase or a decrease but still represents variability.
- Overall **rainfall during the monsoon season has decreased by 6%** between 1950 and 2015.
- In the past few decades, there has been an increased frequency of dry spells during the monsoon season that has increased by 27% between 1981-2011, as compared to 1951-1980.
- The intensity of wet spells has also increased over the country, with central India receiving 75% more extreme rainfall events between 1950 and 2015.

- For example: Monsoon seasons of 2018 and 2019 where dry spells were broken by extremely heavy rainfall spells, creating a flood and drought cycle in many regions in India.

13. CLIMATE-SMART AGRICULTURE

CSA is an approach to help people who manage agricultural systems respond effectively to climate change. It pursues triple objectives of (a) sustainably increasing productivity and incomes, (b) adapting to climate change (c) reducing greenhouse gas emissions.

This does not imply that every practice applied in every location should produce “triple wins.” Rather, CSA approach seeks to reduce trade-offs and promote synergies by taking these objectives into consideration to inform decisions from local to global scales and over short and long-time horizons, to derive locally acceptable solutions.

Majority of world’s poor live in rural areas and agriculture is their most important income source. Developing the potential to increase the productivity and incomes from smallholder crop, livestock, fish and forest production systems will be the key to achieving global food security over the next twenty years.

Climate change is expected to hit developing countries the hardest. Its effects include higher temperatures, changes in precipitation patterns, rising sea levels and more frequent extreme weather events. All these pose risks for agriculture, food and water supplies.

Resilience is therefore a predominant concern. Agriculture is a major source of greenhouse gas emissions. Mitigation can often be a significant co-benefit of actions to strengthen adaptation and enhance food security, and thus mitigation action compatible with national development priorities for agriculture is an important aspect of CSA.

CSA APPROACH

CSA is not a set of practices that can be universally applied, but rather an approach that involves different elements embedded in local contexts. CSA relates to actions both on-farm and beyond the farm, and incorporates technologies, policies, institutions and investment.

ELEMENTS OF CLIMATE SMART AGRICULTURE

- Management of farms, crops, livestock, aquaculture and capture fisheries to balance near-term food security and livelihoods needs with priorities for adaptation and mitigation.
- Ecosystem and landscape management to conserve ecosystem services that are important for food security, agricultural development, adaptation and mitigation.
- Services for farmers and land managers to enable better management of climate risks/impacts and mitigation actions.
- Changes in the wider food system including demand-side measures and value chain interventions that enhance the benefits of CSA.

ACTIONS TO IMPLEMENT A CSA APPROACH INCLUDE

1. **Expanding evidence base:** The evidence base is made up of the current and projected effects of climate change in a country, identifying key vulnerabilities in agricultural sector and for food security, agriculture and the identification of effective adaptation options. It includes estimates of potential reduction in greenhouse gas emissions (or increased carbon sequestration) generated by adaptation strategies, information on costs and barriers to the adoption of different practices, issues related to the

sustainability of production systems and the required policy and institutional responses to overcome them.

2. **Supporting enabling policy frameworks:** The approach supports development of relevant policies, plans, investments and coordination across processes and institutions responsible for agriculture, climate change, food security and land use.
3. **Strengthening national and local institutions:** Strong local institutions to empower, enable and motivate farmers are essential. Efforts also need to be made in building capacity of national policy makers to participate in international fora on climate change and agriculture and reinforce their engagement with local government authorities.
4. **Enhancing financing options:** Innovative financing mechanisms that link and blend climate and agricultural finance and investments from public and private sectors are key means of implementing CSA. New climate financing instruments such as the Green Climate Fund are currently under development and could be a way of spurring sustainable agricultural development. Strong and all-encompassing Nationally Appropriate Mitigation Actions (NAMAs) and National Adaptation Plans (NAPs) are key national policy instruments important in creating links to national and international sources of finance. National sector budgets and ODA will continue to be the main sources of funding; climate integration into sector planning and budgeting is therefore a prerequisite for successfully addressing climate change.
5. **Implementing practices at field level:** Farmers are primary custodians of knowledge about their environment, agro-ecosystems, crops, livestock, and local climatic patterns. Adapting to CSA must be related to local farmers' knowledge, requirements and priorities. Local projects and institutions support farmers to identify suitable climate-smart options that can be easily adopted and implemented. Ex. **Farmer Field Schools in Tanzania.**

SUSTAINABLE AGRICULTURE PRACTICES

Agricultural Systems that can be adopted by farmers:

1. Agroforestry.
2. Precision farming
3. Integrated pest management
4. System of Rice Intensification
5. Organic farming
6. Conservation Agriculture
7. Natural Farming
8. Integrated Farming Systems
9. Biodynamic Agriculture
10. Permaculture

Sustainable practices that can be adopted by farmers:

1. Crop Rotation
2. Rainwater Harvesting
3. Mulching
4. Vermicomposting
5. Contour Farming
6. Cover crops
7. Intercropping
8. Floating farming

RECOMMENDATIONS

- Scale-up could start with rainfed areas, as they are already practicing low-resource agriculture, have low productivity and stand to gain from the transition.
- Restructure government support to farmers by aligning incentives towards resource conservation and by rewarding outcomes such as total farm productivity or enhanced ecosystem services rather than just outputs such as yields.
- Support rigorous evidence generation through long-term comparative assessments of conventional, resource-intensive agriculture on the one hand and sustainable agriculture on the other.
- Take steps to broaden the perspectives of stakeholders across the agriculture ecosystem and make them more open to alternative approaches.
- Extend short-term transition support to individuals liable to be adversely impacted by a large-scale transition to sustainable agriculture.
- Make sustainable agriculture visible by integrating data and information collection on SAPs in the prevailing national and state-level agriculture data systems.

LAND DEGRADATION

- Land degradation is a process in which the value of the biophysical environment is affected by a combination of human-induced processes acting upon the land.
- It is viewed as any change or disturbance to the land perceived to be deleterious or undesirable.
- Natural hazards are excluded as a cause; however human activities can indirectly affect phenomena such as floods and bush fires.
- Land degradation has severe consequences for agricultural productivity, the environment, and its effects on food security.
- It is estimated that up to 40% of the world's agricultural land is seriously degraded.

IMPACT OF LAND DEGRADATION

- **A temporary or permanent decline in productive capacity of the land:** This can be seen through a loss of biomass, a loss of actual productivity or in potential productivity, or a loss or change in vegetative cover and soil nutrients.
- **Loss of biodiversity:** A loss of range of species or ecosystem complexity as a decline in the environmental quality.
- **Shifting ecological risk:** increased vulnerability of the environment or people to destruction or crisis. This is measured through a base line in the form of pre-existing risk of crisis or destruction.

CAUSES OF LAND DEGRADATION

Land clearance, such as clearcutting and deforestation	Agricultural depletion of soil nutrients through poor farming practices
Livestock including overgrazing and over drafting	Urban sprawl and commercial development Vehicle off-roading
Invasive Species	Quarrying of stone, sand, ore and minerals
Soil degradation, Soil contamination, Soil acidification, Soil erosion	Exposure of naked soil after harvesting by heavy equipment

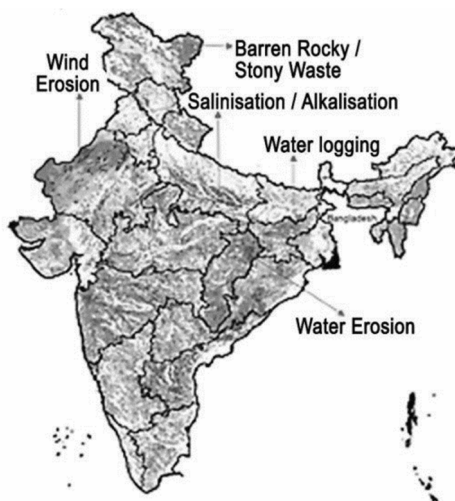
Significant land degradation from seawater inundation, particularly in river deltas and on low-lying islands, is a potential hazard that was identified in a 2007 IPCC report	Increase in field size due to economies of scale, reducing shelter for wildlife.
	Loss of soil carbon
Dumping of non-biodegradable trash, such as plastics	Monoculture, destabilizing the local ecosystem
Inappropriate irrigation and over drafting	

SENSITIVITY AND RESILIENCE

- Sensitivity and resilience are measures of the vulnerability of a landscape to degradation. These two factors combine to explain the degree of vulnerability.
- Sensitivity is the degree to which a land system undergoes change due to natural forces, human intervention or a combination of both. Resilience is the ability of a landscape to absorb change, without significantly altering the relationship between the relative importance and numbers of individuals and species that compose the community. It also refers to the ability of the region to return to its original state after being changed in some way.
- Resilience of a landscape can be increased or decreased through human interaction based upon different methods of land-use management. Land that is degraded becomes less resilient than undegraded land, which can lead to even further degradation through shocks to the landscape.

ABOUT LAND DEGRADATION NEUTRALITY (LDN)

It has been defined as "A state whereby the amount and quality of land resources, necessary to support ecosystem functions and services and enhance food security, remains stable or increases within specified temporal and spatial scales and ecosystems"



DIRECT CAUSES OF LAND DEGRADATION

- ✓ Deforestation of unsuitable land
- ✓ Overcutting of vegetation
- ✓ Agriculture related causes
 - Shifting cultivation without adequate fallow periods/Improper crop rotations

- Extension of cultivation onto lands of longer potential and/or high natural hazards
- Unbalanced fertilizer use
- Problems arising from planning and management of canal irrigation
- ✓ **Non-adoption of soil-conservation management practices**
- ✓ **Over pumping of groundwater**

LDN TARGET SEETING PROGRAM	INDIAN ACTIONS
<ul style="list-style-type: none"> • UNCCD is assisting countries that are interested in establishing national land degradation neutrality (LDN) targets, such as defining national baselines, targets, and associated strategies to attain LDN. • Creation of an LDN fund to invest in bankable land rehabilitation and sustainable land management projects around the world, such as sustainable agriculture, sustainable livestock management, and agroforestry, among other things. • UNCCD's Global Land Outlook emphasizes fundamental importance of land quality to human well-being, examines current trends in land conversion, degradation, and loss, analyses driving forces, and examines the implications. 	<ul style="list-style-type: none"> • National Action Plan (NAP) to combat desertification was launched in 2001 for 20 years • Desertification and Land Degradation Atlas (2016) of entire country was prepared by ISRO and 19 other partners using Indian remote sensing satellites data in GIS environment. • Schemes like Integrated Watershed Development Program, Per Drop More Crop, National Afforestation Program, National Green Mission, etc. have components to tackle Land degradation.

BONN CHALLENGE

- It is a global effort to bring 150 million hectares of world's deforested and degraded land into restoration by 2020 & 350 million hectares by 2030.
- At UNFCCC COP 2015 in Paris, India joined voluntary Bonn Challenge pledge to bring into restoration 13 million hectares of degraded and deforested land by the year 2020, and additional 8 million hectares by 2030. India's pledge is one of the largest in Asia.

14. UNCBD

COP15 to UN Convention on Biological Diversity (CBD) was held virtually in Kunming, China. COP 15's major goal was to create and accept a post-2020 "Global Biodiversity Framework" to replace and update the Strategic Plan for Biodiversity (SPB) 2011-2020 and Aichi Biodiversity Targets.

For the next ten years, the framework will comprise a set of global goals, targets, and indicators that will guide biodiversity and ecosystem conservation, protection, restoration, and sustainable management. The first draft of the GBF was released in July 2021, containing 21 targets for 2030 and 4 Goals to achieve humanity "living in harmony with nature," vision by 2050.

Kunming – Montreal agreement-

- This agreement has been achieved under Convention on Biological Diversity (CBD).

- It seeks to respond to the Global Assessment Report of Biodiversity and Ecosystem Services issued by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) in 2019 which provides ample evidence that, despite ongoing efforts, biodiversity is deteriorating worldwide at rates unprecedented in human history: An average of around 25% of species in assessed animal and plant groups are threatened, suggesting that around 1 million species already face extinction.
- In total there are 23 targets and 4 goals.
- It sets out targets for 2030:
 - on protection for degraded areas,
 - resource mobilisation for conservation,
 - compensation for countries that preserve biodiversity,
 - halting human activity linked to species extinction,
 - reducing by half the spread of invasive alien species (introduced plants and animals that affect endemic biodiversity),
 - cutting pollution to non-harmful levels and
 - minimising climate change impact and ocean acidification.

Key facts:

- Agreement calls upon members to adopt biodiversity-supporting methods such as agroecology and sustainable intensification.
- It also talks about turning cities into hosts of biodiversity, by expanding urban green and blue spaces. Urban planning should also be biodiversity-inclusive, enhancing native biodiversity, ecological connectivity and integrity, and improving human health and well-being and connection to nature.
- Four GBF goals for 2050 deal with
 - Maintaining ecosystem integrity and health to halt extinctions,
 - Measuring and valuing ecosystem services provided by biodiversity,
 - Sharing monetary and non-monetary gains from genetic resources and digital sequencing of genetic resources with indigenous people and local communities,
 - Raising resources for all countries to close a biodiversity finance gap of an estimated \$700 billion.
- GBF envisages that there will be access to justice and information related to biodiversity for indigenous peoples and local communities, respecting their cultures and rights over lands, territories, resources, and traditional knowledge.

Monitoring and implementation:

- Member nations need to submit a revised and updated national biodiversity strategy and action plan in the conference to be held in 2024.
- Further, the parties to the CBD should submit national reports in 2026 and 2029 to help prepare global reviews.
- High level discussions on the progress reviews should be held in 2024 and 2026.

Funding arrangements:

- By 2030, the GBF hopes to see at least \$200 billion raised per year from all sources — domestic, international, public and private — towards implementation of national action plans.
- In terms of international funding, developing countries should get at least \$20 billion a year by 2025 and at least \$30 billion by 2030 through contributions from developed countries.

HIGHLIGHTING FEATURES OF THE COP

- **Kunming Declaration:** Called for comprehensive action in all areas of global economy to reflect biodiversity concerns. More than a hundred countries, including India, have pledged to
 - Work together to design and implement a viable post-2020 global biodiversity framework.
 - Reverse the current biodiversity loss.
 - Ensure that biodiversity is on the mend by 2030.
- China established **Kunming Biodiversity Fund** with a budget of USD 230 million to fund programs that safeguard biodiversity in underdeveloped nations.
- Praised many countries' efforts and commitments to safeguard **30% of their land and sea regions by 2030 (30 by 30 objective)**, which is crucial for reversing a major cause of environmental degradation.
- Emphasized private sector participation.
- Global Environment Facility, UNDP, and UNEP have pledged to expedite financial and technical assistance to developing countries to help them implement Global Environment Facility.

CONSIDERATIONS FOR POST-2020 GLOBAL BIODIVERSITY FRAMEWORK

The framework has four long-term goals for 2050 related to the 2050 Vision for Biodiversity.

- **Goal 1:** Integrity of all ecosystems is enhanced, with an increase of at least 15% in the area, connectivity and integrity of natural ecosystems, supporting healthy and resilient populations of all species, rate of extinctions has been reduced at least tenfold, and risk of species extinctions is reduced by half and genetic diversity of wild and domesticated species is safeguarded, with at least 90% of genetic diversity within all species maintained.
- **Goal 2:** Nature's contributions to people are valued, maintained or enhanced through conservation and sustainable use supporting the global development agenda for the benefit of all.
- **Goal 3:** Benefits from utilisation of genetic resources are shared fairly and equitably, with a substantial increase in both monetary and non-monetary benefits shared including for conservation and sustainable use of biodiversity.
- **Goal 4:** Gap between available financial and other means of implementation, and those necessary to achieve the 2050 Vision.
- **Adoption of the 30 by 30 Goals**
 - In absence of quality targets, places of low conservation value will be protected.
 - Might jeopardize indigenous peoples' and local communities' rights in biodiverse areas.
 - Challenges in international cooperation for cross-border land/ocean protection.
- 50% greater reduction in the rate of introduction of invasive alien species and controls or eradication of such species to reduce their impacts.
- **Benefit-sharing systems** do not currently include commercial benefits of digital sequence information (DSI). Countries with genetic resources but not enough capacity to use them desire benefit-sharing mechanisms to include DSI, but countries with biotech research are against it. Data derived from sequencing and analysing genetic material is referred to as DSI.

- Reducing nutrients lost to environment by at least half, and pesticides by at least 2/3rd and eliminating discharge of plastic waste.
- Nature-based contributions to global climate change mitigation efforts of at least 10 Gigatons CO₂ equivalents per year, and that all mitigation and adaptation efforts avoid negative impacts on biodiversity.
- Redirecting, repurposing, reforming or eliminating incentives harmful for biodiversity, in a just and equitable way.
- **Current funding channels are insufficient** to meet the anticipated annual cost of \$700 billion required to prevent biodiversity loss.
- While the scientific conclusion that more than a million species are threatened with extinction has horrified the globe, the **draft framework fails to define a goal or objective for ending extinctions** caused directly by human activities.
- **Lack of easy-to-use tools for tracking common goals and keeping track of progress:** Despite an increase in policies and measures to support biodiversity, this has resulted in a worsening of causes of biodiversity loss and a fall in biodiversity between 2011 and 2020.
- Because biodiversity loss, climate change, land degradation and desertification, ocean degradation, and pollution share many underlying drivers of change, there is a **need for integrated efforts**.
- Redirecting agricultural, forestry, and fishing subsidies in ways that threaten biodiversity will have a **negative impact on small-scale farmers**, fishers, and other small-scale producers in developing countries.
- It may lead to carbon emitters using tree-planting and other carbon offsets in developing countries to avoid their obligations to reduce emissions while expropriating indigenous peoples' and local residents' forest usage rights.

WAY FORWARD

- IPBES should be involved in the consultations for Global Biodiversity Framework as the IPCC is involved in the global climate negotiations by the UNFCCC.
- Increasing financing for biodiversity conservation.
- Strengthening partnerships with other important global agreements like Paris Agreement, Land Degradation Neutrality Goal, SDGs, and other global goals to maximise co-benefits.
- Focus should be on Access and Benefit sharing by ensuring traditional knowledge is respected and not misappropriated, business interests do not get priority over local interests and benefits shared justly.
- There has been limited progress on achieving the AICHI Biodiversity goals, focused attention should be on ensuring implementation.

15. BIODIVERSITY FINANCING

*China announced creation of **Kunming Biodiversity Fund** at 15th Conference of Parties of UN Convention of Biodiversity with a contribution of about \$230 billion.*

However, according to estimate \$700 billion financing annually is needed to halt the decline of biodiversity. Removing all agricultural, fisheries, and forestry subsidies that are harmful to nature would account for more than USD 500 billion. Still, an additional USD 200 billion would be needed.

ISSUES WITH BIODIVERSITY FINANCING

1. There seems to be a trend towards providing environment finance as loans and debts, many of them to some of the poorest countries, which already highly indebted.
2. Some finance is inaccurately reported as climate finance, which inflates the numbers.
3. Counting private and non-grant finance as climate finance.
4. Counting finance that is not climate relevant as climate finance.
5. Applying non-transparent and inconsistent methodologies to count mobilised private finance, resulting in overstating finance volumes.
6. Shortfalls in the quality and composition of finance from what is suggested by the accords.
7. Spending on biodiversity is far less than that for climate change.
8. Relative dearth of financial resources in low- and middle-income countries.
9. More than half of all climate funds take the form of loans while 86% of biodiversity funding comes from public sources.
10. Public & Private investors know that in financing projects such as solar energy plants or batteries R&D, they will earn some return on investment. However, protecting a watershed or a wetland is more of a public service, hence needs to be funded by governments.

CONTOURS OF IDEAL BIODIVERSITY & CLIMATE FINANCING

1. Financing for biodiversity should be given out as grants and not loans.
2. Financing should be provided for research and development of local biodiversity in the Least Developed Countries.
3. Funding should be pooled and managed through international organisations.
4. Rules for access to need to be transparent and fair to all applicants.

TOPICS TO BE COVERED

1. *Himalayas*
2. *Mangroves*
3. *Coastal Vulnerability Index*
4. *Multilevel Farming*
5. *Marine Protected Areas in Antarctic*
6. *BBNJ negotiations*
7. *Western Ghats*
8. *WETLANDS*
9. *Coral Bleaching*
10. *Cheetahs Reintroduction*
11. *Human-Wildlife conflict*
12. *Invasive Alien Species*
13. *LIFE - Lifestyle for Environment*
14. *Gross Environment Product*

1. HIMALAYAS

Climate change is the main factor behind accelerated glacier retreat observed in the Himalayas. Himalayas have largest concentration of glaciers outside polar region (hence called **third pole**) and hold vast stores of fresh water. Continued climate change is predicted to lead to major changes in freshwater flows, with dramatic impacts on biodiversity, people and their livelihoods.

A GLOBAL HOTSPOT

The Himalayas is one of the world's most sensitive hotspots to global climate change, with impacts manifesting at a particularly rapid rate. A situation that is predicted to intensify in coming years, with dire and far-reaching impacts on food, water and energy security, as well as biodiversity and species loss. Not just in the Himalayas, but throughout Asia.

WATER TOWERS OF ASIA

The Himalayan glaciers are the water towers of Asia, and the source of many of the world's great rivers: The Yangtze, the Ganges, the Indus and the Mekong. Over a billion people depend directly on the Himalayas for their survival, with over 500 million people in South Asia, and another 450 million in China completely reliant on the health of this fragile mountain landscape.

Climate change in the Himalayas poses a serious threat to the source of these great rivers with dire and far-reaching impacts on biodiversity, food, water and energy security. Vulnerable nations must therefore move rapidly to build resilience to these impacts and adapt to the changing climate.

HABITAT LOSS

- Conversion of forest to agriculture land and development purposes
- Exploitation of forests for timber, fodder & fuelwood.
- Wood-charcoal production
- Intensive grazing as many rural people depends on cattle for their livelihoods but do not have sufficient land holdings. Thus, forcing herders to leave their herds for grazing in forests which causes significant damage to natural ecosystems.
- Lack of effectiveness of compensatory afforestation efforts: The species cultivated in compensatory afforestation efforts are on many occasions non-native and invasive in nature, there is not enough upkeep of seedlings resulting in deaths of many of the plants cultivated. Also, there is often non-availability of suitable land for regenerating forests.

SPECIES LOSS

- Poaching is a major threat to wildlife in the region, especially endangered species like tigers, elephants and rhinos, which have a high commercial value on the black market.
- Increased human-wildlife conflict leads to killing of wild animals.
- Retaliation against tigers and snow leopards for killing livestock, and against elephants and rhinoceros for raiding crops, is prevalent and continues to intensify as humans and wildlife compete for land and other resources.

LOSS OF GLACIERS

- Himalayas are third pole because it is home to largest permanently snow-covered regions outside Polar Regions. These glaciers feed many perennial rivers upon which lives and water needs of billions depend.
- However, due to climate change there has been melting and thinning of glaciers. Black carbon deposits on glaciers have accentuated the pace at which glaciers store heat and hence their melting.

INFRASTRUCTURE AND DEVELOPMENT

- Extensive development of hydroelectricity power projects and dams in the region which is expected to further increase in future.
- These dams are created without due environmental impact assessment leading to submergence of arable lands and biodiversity hotspots. Valley habitats which are richest in biodiversity are worst hit.
- Dams lead to displacement of villages and disruption of social life.
- Even run of river projects causes multiple environmental damages such as creation of tunnels for such projects leads to massive explosions and drilling in the mountains which increases the risks of landslides etc.
- Additional support infrastructure such as approach roads to dams, grid electricity connection and building residence of people employed in such projects also leads to diversion of forests. They do not require EIA. Despite causing extensive damage.
- Dams and projects on rivers affect the natural flow in the river affecting aquatic biodiversity.

CAUSES OF HIGHER MASS MOVEMENT IN HIMALAYAS

- Steep slope with high relative relief
- Seismicity
- Groundwater flows accentuating landslips

- Cloudbursts and intense rainfall events
- Nature of the rocks (soft sedimentary, foliated metamorphic or fractured igneous)
- Toe under-cutting by torrents and floods.

Anthropogenic factors accentuating mass movement:

- Loss of forest cover
- Extension of agriculture into steep slopes
- Open cast mining without environmental control
- Road built without regard for geological factors
- Other forms of poorly planned development.

WAY FORWARD

- Enacting a **Comprehensive National Himalaya Policy**.
- **Comprehensive Cumulative Environmental Impact Assessment of projects:** Clearances to hydro-electric projects are given in isolation. Not considering that what the cumulative impact of spree of hydro-electric projects on Himalayas is short-sighted.
- **Moving away from shifting agricultural practices** especially in Manipur, Nagaland etc.
- **Developing eco-tourism, agro-processing industries and organic farming** in the region to build livelihood of people.
- **Ensuring native Himalayan species are cultivated in compensatory afforestation** with proper upkeep. Such as Deodar etc.
- **Creation of a separate ministry** to look after issues of Himalayan States comprehensively.
- A **'Green Bonus'** should be given to Himalayan states which suffer from developmental challenges but contribute very highly to ecological security of India.
- **Research on effect of climate change** and other issues of Himalayas.
- **High solar irradiation potential in Himalayan region;** this potential should be harnessed by developing solar energy parks in the region.
- Coordination and dialogue with countries in region to develop a comprehensive inter-government platform to maintain pristine nature of Himalayas.

2. MANGROVES

More than 35% of world's mangroves are already gone. The figure is as high as 50% in countries like India, Philippines and Vietnam, while in Americas they are being cleared at a rate faster than tropical rainforests.

Status of Forest report states that India's mangrove cover rose by 54 sq. km. in 2019 compared to 2017.

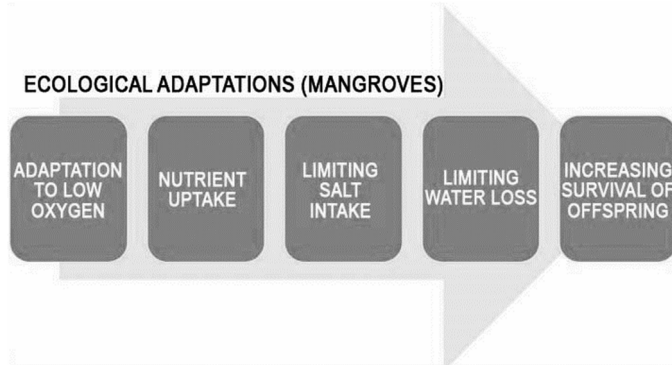
WHAT ARE MANGROVES?

Mangroves are salt-tolerant plants, also called halophytes that are adapted to harsh coastal conditions of tropical and subtropical intertidal regions of the world receiving rainfall between 1,000 to 3,000 mm and temperature ranging between 26-35 C.

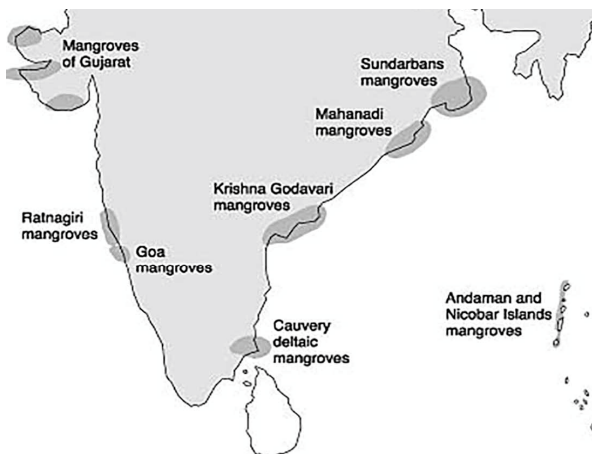
BENEFITS OF MANGROVES

- ✓ Act as a **Buffer Zone** between the land and sea.
- ✓ **Protect the land from erosion.**

- ✓ Act as **nature's shield against cyclones**, ecological disasters and as protector of shorelines.
- ✓ Breeding and nursery grounds for a variety of **marine animals**. Harbor a **variety of life forms** like invertebrates, fish, amphibians, reptiles, birds and even mammals like tigers.
- ✓ Good **source of timber, fuel and fodder**.
- ✓ Main source of **income generation** for shoreline communities like fisher folk.
- ✓ **Purify the water by absorbing impurities** and harmful heavy metals and help us to breathe a clean air by absorbing pollutants in the air.
- ✓ Potential source for **recreation and tourism**.



THREATS TO MANGROVE FORESTS



Location of Mangrooves in India

- **Indiscriminate clearing** due to growing human needs like land for agriculture, infrastructure and industries. Tourism, shrimp agriculture and salt farms are the new avenues for which mangrove forests are being cleared.
- **Overharvesting** to get firewood, construction wood, pulp, charcoal and animal fodder in no longer sustainable now and threatening the future of forests.
- **Dams and irrigation** restrict the riverine freshwater flow and hence increases the salinity of the water. If salinity becomes too high, the mangroves cannot survive. Further, high sediments brought by rivers also clog the mouths of mangroves.
- **Overfishing:** Global overfishing crisis has effects far beyond the directly overfished population. The ecological balance of food chains and mangrove fish communities can also be altered.
- **Destruction of coral reefs:** Coral reefs provide the first barrier against currents and strong waves. When they are destroyed, the stronger-than-normal waves and currents

reaching the coast can undermine the fine sediment in which the mangroves grow. This can prevent seedlings from taking root and wash away nutrients essential for mangrove ecosystems.

- **Pollution:** Fertilizers, pesticides, and other toxic man-made chemicals carried by river systems from sources upstream can kill animals living in mangrove forests, while oil pollution can smother mangrove roots and suffocate the trees.
- **Climate change:** Mangrove forests require stable sea levels for long-term survival. They are therefore extremely sensitive to current rising sea levels caused by global warming and climate change.

CLASSIFICATION OF CRZ

- CRZ-I areas are environmentally most critical
- CRZ-II: The developed land areas up to or close to the shoreline, within the existing municipal limits or in other existing legally designated urban areas.
- CRZ-III: Land areas that are relatively undisturbed (viz rural areas etc.) and those do not fall under CRZ-II.
- CRZ- IV: It constitutes the water area

According to the Global Forest Resources Assessment 2020 report, **the rate of forest loss has declined in the period of 1990-2020.**

- Released by UN Food and Agriculture Organisation (FAO).
- The FRA 2020 is based on the assessment of more than 60 forest-related variables in 236 countries and territories in the period of 1990–2020.

3. COASTAL VULNERABILITY INDEX

Recently, Indian Nationwide Centre for Ocean Info Companies (INCOIS) has conducted coastal vulnerability evaluation for total Indian coast to organize a Coastal Vulnerability Index (CVI).

ABOUT COASTAL VULNERABILITY INDEX (CVI)

- Coastal vulnerability evaluation has been conducted to deliver an Atlas comprising 156 maps on 1:1,00,000 scales to organize a Coastal Vulnerability Index (CVI).
- It makes use of the relative threat that will happen due to **sea-level rise**.
- Sea level rise scenarios are quantified primarily based on parameters like tidal vary, wave peak, coastal slope, coastal elevation, shoreline change fee, geomorphology, and historic fee of relative sea-level change.
- From this CVI, it may be delineated that
 - Gujarat's 124 coastal kms goes to get affected or 5.36%
 - Maharashtra 11 km or 1.22%
 - Karnataka & Goa 48 km or 9.54%
 - Kerala 15 km or 2.39%
 - Tamil Nadu 65 km or 6.38%
 - Andhra Pradesh 6 km or 0.55 %
 - Odisha 37 km or 7.51%
 - West Bengal 49 km or 2.56%
 - Lakshadweep Islands 1 km or 0.81%

- Andaman Islands 24 km or 0.96km
- Nicobar Islands 8 km or 0.97%.
- Thus, coastal areas of Gujarat will be most vulnerable to Climate Change induced future sea-level rise.
- Coastal vulnerability assessments will be helpful info for coastal catastrophe administration and constructing resilient coastal communities.

ABOUT MULTI-HAZARD VULNERABILITY MAPPING (MHVM)

- A coastal Multi-Hazard Vulnerability Mapping (MHVM) was additionally conducted utilizing parameters like sea stage change fee, shoreline change fee, high-resolution coastal elevation, excessive water stage from tide gauges and their return durations.
- These parameters had been synthesized to derive the composite hazard zones that may be inundated alongside the coastal low-lying areas attributable to excessive flooding occasions.
- This MHVM mapping was carried for complete mainland of India on a 1:25000 scale.

VULNERABILITY OF INDIAN COASTLINE

1. 26% of India's population live within 100 km from the shoreline.
2. Most of the coastal areas are low-lying and vulnerable to oceanographic disasters such as Tsunamis, Storm Surges, Sea-Level rise, tropical cyclones (13% of world's cyclones in the seas around India, leads to inundation of coastal areas).
3. Increased frequency and intensity of disasters due to climate change.

4. MULTILEVEL FARMING

Union Minister of Home Affairs launched the 'Green Sohra Afforestation Program' under which multi-level farming will be adopted for the afforestation of Cherrapunji region.

Sohra is the name of Cherrapunji region in Meghalaya. Cherrapunji region once used to receive rainfall all year round however due to deforestation this situation has changed.

- Under the program, Assam Rifles will lead efforts of afforestation in the region. 80% of land area will be planted with traditional and long lifespan trees while the remaining 20% will be used for animal feed, ornamental plants and nursery which will meet the needs of people and help reduce felling of long lifespan trees.

MULTI-LEVEL FARMING

- It is a farming system in which trees or crops of varying heights are grown together in a field at the same time. It is also known as multi-tier or multi-storied cropping system. It is a kind of intercropping farming system.
- This system is mostly used in orchards and plantation crops for maximum use of solar energy. Crops and plants of varying height, rooting pattern and duration are cultivated together.
- In this system, tallest components have foliage of strong light demand and shorter components with foliage requiring shade.
- ICAR has been pushing for Multi-Level Farming as it can lead to doubling of farmer income.

BENEFITS OF MULTI-LEVEL FARMING

- Higher income per unit area and more even distribution of income and employment throughout the year.
- Steady supply of farm and forest products all year round.
- Maximisation of land use: All growing space is used as crop fit together vertically, horizontally and underground.
- Reduces impacts of hazards like high intensity rainfall, soil erosion and landslides.
- Efficient use of soil moisture at different depths of soil and catch solar energy at different heights.
- Effective weed control
- Prevents water from evaporation
- Effective utilization of leaching materials
- Provide micro-climate conditions that benefit crops underneath.
- It allows forests to grow 30 times faster and after 3 years no maintenance is required.

5. MARINE PROTECTED AREAS IN ANTARCTIC

India has supported the proposal of European Union for creation of two marine protected areas (MPAs) in the Antarctic for protecting the Antarctic environment.

The two proposed Marine Protected areas are:

1. East Antarctic
2. Weddell Sea

ABOUT MARINE PROTECTED AREAS

A Marine Protected Area is a marine area that provides protection for all or part of the natural resources it contains. Within an MPA certain activities are limited, or entirely prohibited, to meet specific conservation, habitat protection, ecosystem monitoring or fisheries management objectives.

MPAs do not necessarily exclude fishing, research or other human activities.

Already two MPAs have been agreed by CCAMLR members:

1. South Orkney Islands (World's first international MPA)
2. Ross Sea

ABOUT COMMISSION FOR THE CONSERVATION OF ANTARCTIC MARINE LIVING RESOURCES (CCAMLR)

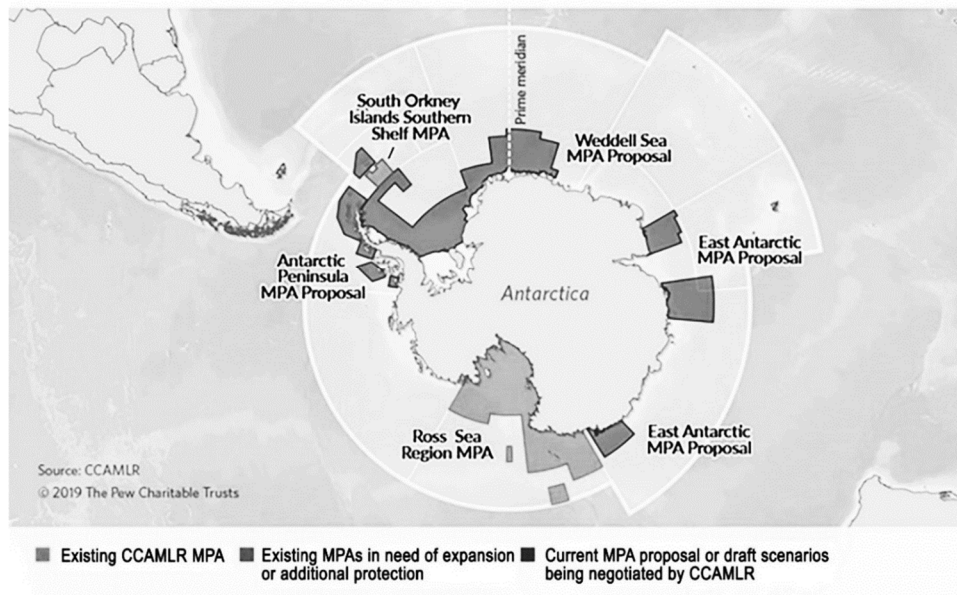
- The CCAMLR was established by international convention in 1982 with the objective of conserving Antarctic marine life. This was in response to increasing commercial interest in Antarctic krill resources, a keystone component of the Antarctic ecosystem and a history of over-exploitation of several other marine resources in the Southern Ocean.
- CCAMLR practices an ecosystem-based management approach. This does not exclude harvesting if such harvesting is carried out in a sustainable manner and takes account of the effects of fishing on other components of the ecosystem.
- Presently, the body has 26 members (25 countries and EU). India is a member of the organisation.
- CCAMLR is a key international instrument part of the Antarctic Treaty System that for 60 years has ensured peace, freedom of science and protection of the environment in

the Antarctic region. The system consists of the Antarctic Treaty and its Environmental Protocol, the Agreement on the Conservation of Albatrosses and Petrels and the Convention on the Conservation of Antarctic Seals in addition to CCAMLR.

- The CCAMLR Secretariat is in Hobart, Australia.

Southern Ocean Regions in Need of Protection

A network of MPAs would allow for conservation of distinct areas, each representing unique ecosystems



6. BBNJ NEGOTIATIONS

Since 2017, an Intergovernmental Conference convened by the United Nations General Assembly has been negotiating a new legally binding instrument under the United Nations Convention on the Law of the Sea (UNCLOS) on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction (BBNJ).

The United Nations General Assembly decided, in 2015, to develop an international legally binding instrument under UNCLOS on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction.

The “BBNJ Treaty”, also known as the “Treaty of the High Seas”, is an international legally binding agreement on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction, currently under negotiation at the United Nations.

This new instrument is developed within the framework of the UNCLOS.

It was agreed, following conclusion of the fifth round of treaty negotiations at the United Nations headquarters in New York, United States.

The legal framework would place 30 per cent of the world’s oceans into protected areas, put more money into marine conservation, and covers access to and use of marine genetic resources.

The BBNJ treaty addresses, among other things:

- the conservation and sustainable use of marine BBNJ;
- marine genetic resources, including questions on benefit-sharing (MGR);
- Area Based Management Tools (ABMT), including marine protected areas;
- environmental impact assessments (EIA); and
- capacity-building and the transfer of marine technology (CB&TMT).

KEY FEATURES INCLUDE

1. An important negotiating point, and source of tension during the talks, was developing countries' access to benefits reaped from the commercialisation of resources (especially genetic resources) extracted from the ocean. The treaty has agreed to setup an access- and benefit-sharing committee to frame guidelines. It was also underlined that activities concerning marine genetic resources of areas on high seas should be in the interests of all States and for the benefit of humanity. They have to be carried out exclusively for peaceful purposes.
2. Activities concerning marine genetic resources of areas on high seas should be in the interests of all States and for the benefit of humanity. They have to be carried out exclusively for peaceful purposes.
3. Signatories will have to conduct environmental impact assessments before the exploitation of marine resources. Before carrying out a planned activity, the member will have to undertake processes of screening, scoping, carrying out an impact assessment of the marine environment likely to be affected, identifying prevention, and management of potential adverse effects, and information on the public consultation process, a description of follow-up actions, including an environmental management plan.
4. It stipulates that marine resources in areas beyond national jurisdiction that are held by indigenous people and local communities can only be accessed with their "free, prior and informed consent or approval and involvement". No State can claim its right over marine genetic resources of areas beyond national jurisdiction, the draft adds.
5. Members will have to provide the clearing-house mechanism (CHM), established as part of the treaty, with details like the objective of the research, geographical area of collection, names of sponsors, etc.
6. Provision of funding to help developing countries implement the treaty. A special fund will be established which will be fixed by the conference of parties, which will be formed as part of the pact. The conference of parties will also oversee the functioning of the treaty

MERITS

- It reflects accepted principles in international environmental law such as 'the polluter-pays', equity and equitable sharing of benefits, precaution, use of the best available science and scientific information, and prevention of transboundary harm.
- It also contains innovative ideas such as the recognition of rights of future generations, taking action now to protect future rights, regulation of collection and access to digital scientific information, and the establishment of a digital open-access platform.
- The treaty establishes a broad institutional framework, including a Conference of the Parties (COP); a Scientific and Technical Body—an expert body under the 'authority and guidance' of the COP—to provide scientific and technical advice to the COP.

REMAINING ISSUES

- Capacity building & technological transfer – many industrialized countries are not in favour of transferring the technology. For e.g. Many industrialised States opposed UNCLOS regime, mostly due to the requirements for mandatory transfer of technology and the monetary contributions.
- Resource regulation: It does not apply to non-living resources such as oil and gas in the international seabed and water column, which constitutes an important economic interest of states.
- Infringement on state's rights: The new treaty may infringe on states' freedom of the high seas and possible extended continental shelves. For example, establishing area-

based management tools such as marine protected areas (MPAs), which may restrict access to and utilization of areas on the high seas and the Areas, essentially impinge on the freedom of the high seas and states' rights in the Area.

7. WESTERN GHATS

Flash floods and back-to-back landslips in Kerala bring into focus, once again, the fragile ecosystem of the mountain chain that runs almost parallel to India's western coast.

WESTERN GHATS

- Western Ghats are a mountain range running nearly parallel to India's western coast. It stretches 1,600 kilometres from the mouth of Tapti River near Gujarat-Maharashtra border to Kanyakumari in Tamil Nadu, India's southernmost tip.
- It stretches over six States of Tamil Nadu, Karnataka, Kerala, Goa, Maharashtra and Gujarat.
- Ghats are second only to Eastern Himalaya as a treasure trove of biological diversity in the country.

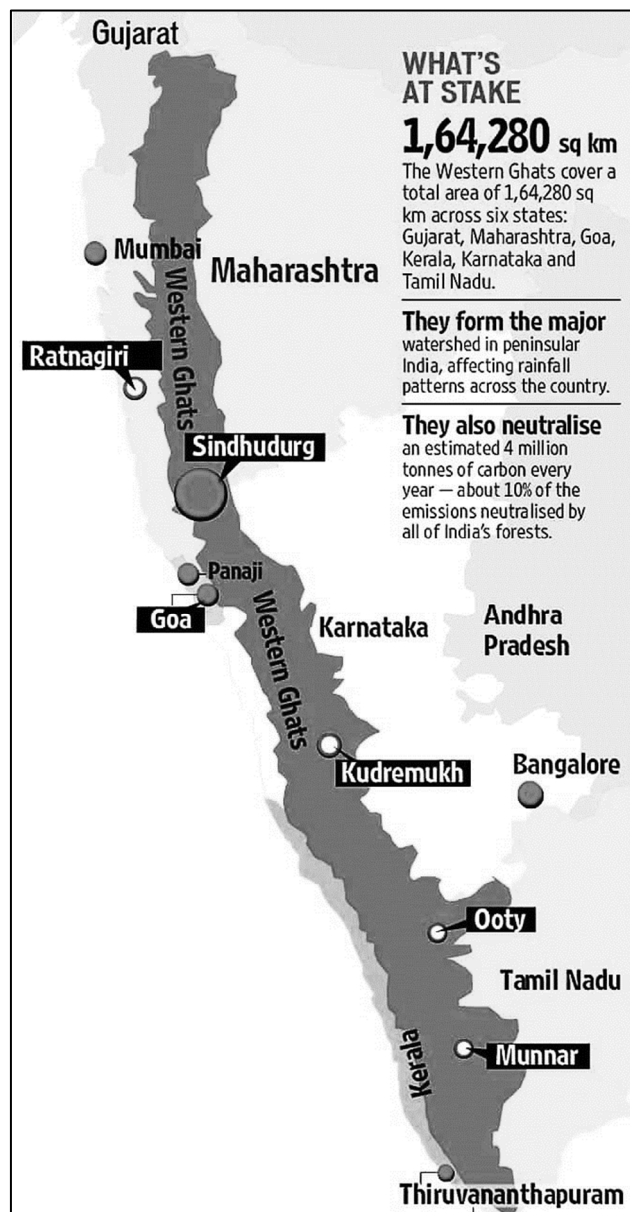
SIGNIFICANCE OF WESTERN GHATS

→ Biodiversity:

- Forests of Western Ghats include best representatives of non-equatorial tropical evergreen forests in world.
- At least 325 globally threatened (IUCN Red Data List) species occur in the Western Ghats.
- Western Ghats contain more than 30% of plant, fish, herpeto-fauna, bird & mammal species found in India.
- Include unique shola ecosystem which consists of montane grasslands interspersed with evergreen forest patches.

→ Ecological significance:

- The chain's forests, which are older than the Himalayas, influence the Indian monsoon weather pattern.
- It is recognised as one of the world's eight "hottest hotspots" of biological diversity.
- It was added to the world heritage list by the United Nations Educational, Scientific and Cultural Organisation (UNESCO).



→Hydrological significance:

- The Western Ghats perform important hydrological and watershed functions. Approximately 245 million people live in the peninsular Indian states that receive most of their water supply from rivers originating in the Western Ghats.

→Economic Significance:

- The Western Ghats are rich in iron, manganese and bauxite ores in parts of their ranges.
- It hosts several plantation crops and important source of timber. It also harbors several wild relatives of cultivated plants, including pepper, cardamom, mango, jackfruit and plantain.

THREATS

- **Illegal hunting:** Illegal local hunting driven by tradition or demand for wild meat is pervasive across the Western Ghats.
- **Human-wildlife conflicts:** Very high human population densities in several parts of the hotspot further exacerbate the intensity of conflict.
- **Extraction of fuelwood and fodder:**
 - The extraction of fuelwood and fodder constitutes a significant and pervasive consumptive use within the Western Ghats.
 - Human communities living within and adjacent to protected areas in the Western Ghats hotspot are frequently dependent on the extraction of non-timber forest products (NTFP) to meet a diversity of subsistence and commercial needs.
- **Plantations:** Over the years, plantations of cash crops have displaced extensive patches of natural forests throughout the Western Ghats and are frequently associated with encroachment of surrounding forest areas.

IMPORTANT COMMITTEES**→Madhav Gadgil committee:**

- The Western Ghats Ecology Expert Panel (WGEEP) report, popular as Gadgil report, had designated the entire hill range as an Ecologically Sensitive Area (ESA).
- It had classified the 142 taluks in the Western Ghats boundary into three Ecologically Sensitive Zones (ESZs).
- It recommended that “no new dams based on large-scale storage be permitted in the Ecologically Sensitive Zone 1”.
- It suggested that development activity needs to be decided through a participatory process involving the gram sabhas in these zones.
- It recommended the establishment of a Western Ghats Ecology Authority, as a statutory authority under the Ministry of Environment and Forests, with the powers under Section 3 of the Environment (Protection) Act, 1986.

→Kasturirangan report:

- 37% of the total area of the Western Ghats is ecologically sensitive.
- It distinguished between cultural and natural landscapes in the region. Cultural landscapes, which include human settlements, agricultural fields and plantations, covered 58.44% of the Western Ghats. Of the remaining area marked as natural landscape, about 90% was identified as ESA, where the panel called for a complete ban on mining, quarrying and sand mining.

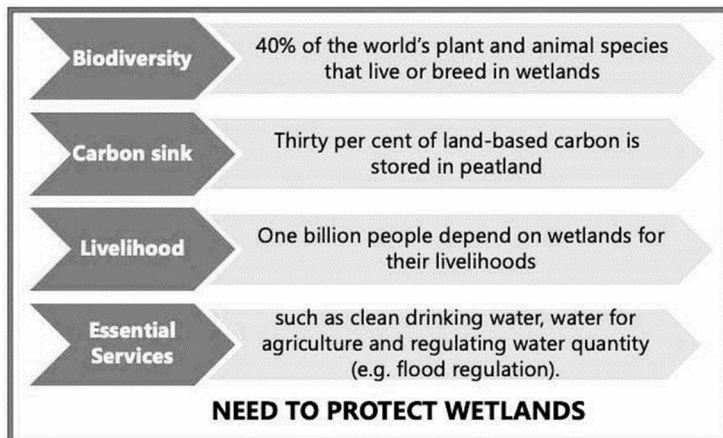
CONCLUSION

There is a need for exempting areas of very high susceptibility in the Western Ghats from any types of constructions while urging the government and the local communities to increase the vegetative cover as a first defence against the landslide vulnerability.

8. WETLANDS

Wetlands account for 4.7% of the total geographical area of India. **IPBES** (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services) has identified **wetlands as the most threatened ecosystem**.

The Ramsar Convention definition for wetlands includes marshes, floodplains, rivers and lakes, mangroves, coral reefs and other marine areas no deeper than 6 metres at low tide, as well as human-made wetlands such as waste-water treatment ponds and reservoirs.



Wetlands provide a wide range of important resources and ecosystem services such as food, water, fibre, groundwater recharge, water purification, flood moderation, erosion control and climate regulation. They are, in fact, are a major source of water and our main supply of freshwater comes from an array of wetlands which help soak rainfall and recharge groundwater.

THREATS TO WETLANDS

Urbanization	Wetlands near urban centers are under increasing developmental pressure for residential, industrial and commercial facilities. Urban wetlands are essential for preserving public water supplies.
Anthropogenic activities	Due to unplanned urban and agricultural development, industries, road construction, impoundment, resource extraction and dredge disposal, wetlands have been drained and transformed, causing substantial economic and ecological losses in the long term.
Agricultural activities	Following the Green Revolution of the 1970s, vast stretches of wetlands have been converted to paddy fields. Construction of many reservoirs, canals and dams to provide for irrigation significantly altered the hydrology of the associated wetlands.
Hydrologic activities	Construction of canals and diversion of streams and rivers to transport water to lower arid regions for irrigation has altered the drainage pattern and significantly degraded the wetlands of the region.

Deforestation	Removal of vegetation in the catchment leads to soil erosion and siltation
Pollution	Unrestricted dumping of sewage and toxic chemicals from industries has polluted many freshwater wetlands
Salinization	Over withdrawal of groundwater has led to salinization
Aquaculture	Demand for shrimps and fishes have provided economic incentives to convert wetlands and mangrove forests to develop pisciculture and aquaculture ponds.

WETLAND REGULATION

National Plan for Conservation of Aquatic Ecosystems

- The goal of NPCA is to develop and maintain a network of healthy wetlands which contribute to human well-being through their diverse ecosystem services, as well as sustain diversity
- NPCA is a single conservation program for both wetlands and lakes. It was formulated in 2015 by merging of the National Lake Conservation Plan and National Wetlands Conservation Program.
- NPCA seeks to promote better synergy and avoid overlap of administrative functions.

Ramsar Convention and Wise Use of Wetlands

- The Convention's mission is "the conservation and wise use of all wetlands through local and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world"
- Under the "three pillars" of the Convention, the Contracting Parties commit to:
 - Work towards the wise use of all their wetlands.
 - Designate suitable wetlands for the list of Wetlands of International Importance (the "Ramsar List") and ensure their effective management.
 - Cooperate internationally on transboundary wetlands, shared wetland systems and shared species.
 - At the centre of the Ramsar convention's philosophy is the "wise use" of wetlands. When they accede to the Convention, Contracting Parties commit to work towards the wise use of all the wetlands and water resources in their territory, through national plans, policies and legislation, management actions and public education.
- **Challenges faced in Wetland Conservation:** Wetland ecosystems are interconnected and interactive within a watershed. In India, unplanned urbanization and a growing population have taken their toll on wetlands. But apart from this, following challenges are being faced:
 - **Multiple Jurisdictions:** Wetlands are governed by several departments, including agriculture, fisheries, irrigation, revenue, tourism, water resources, and local governments. For example, the forest department has direct jurisdiction over all mangroves in the country.
 - Each department having its own developmental priorities, works against the interests of conservation of wetlands resulting in intended or unintended spill-over that further aggravates the problem.

- **Lack of a comprehensive wetland policy:** Combined with each department's own developmental priorities, works against the interests of wetlands protection, leading in accidental or intentional spillover that exacerbates the problem.
- Limited state government commitment for the programs.
- MAPs for NWCP implemented on annual cycles –limited adoption of integrated approaches
- Need for a strong institutional mechanism for implementation – only a few Wetland/Lake authorities in place.
- Weak uptake of regulatory framework.
- Encroachment of urban water bodies.
- Loopholes being exploited for conversion of wetlands.

WAY FORWARD

- Management of wetlands must be an integrated approach in terms of planning, execution and monitoring. Effective enforcement of rules.
- Protection of wetlands from being encroached.
- Comprehensive mapping and inventory of wetlands at the national, state and local level should be maintained by authorities.
- Effective tie-ups of trained academicians and professionals, including ecologists, hydrologists, economists, watershed management specialists, planners and decision makers must be linked with local expertise for overall management of wetlands.
- Spreading awareness by initiating educational programs about the importance of wetlands in local schools, colleges and among the public in the vicinity of the water bodies
- Constant monitoring of wetlands for their water quality would provide vital inputs to safeguard the wetlands from further deterioration.

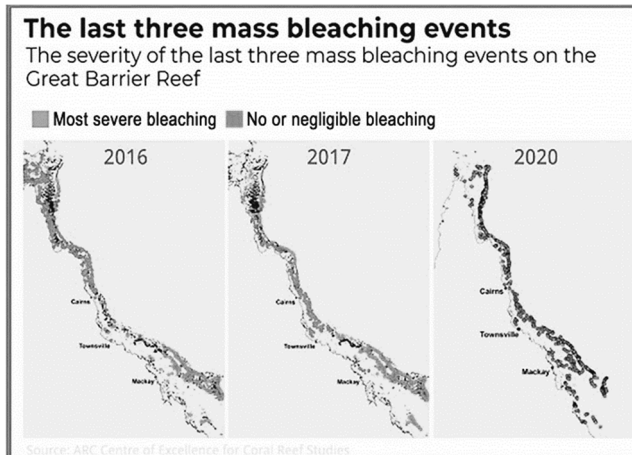
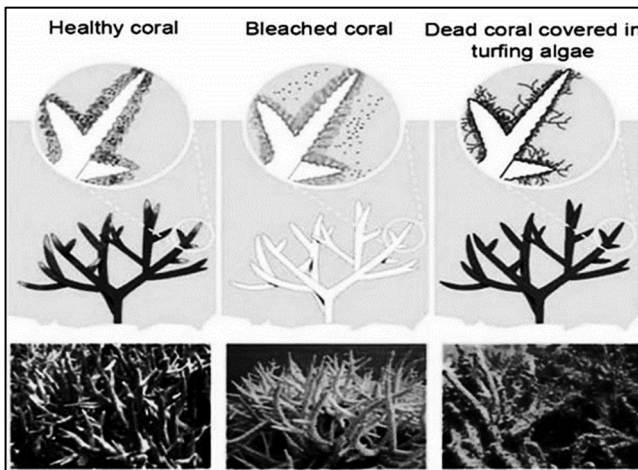
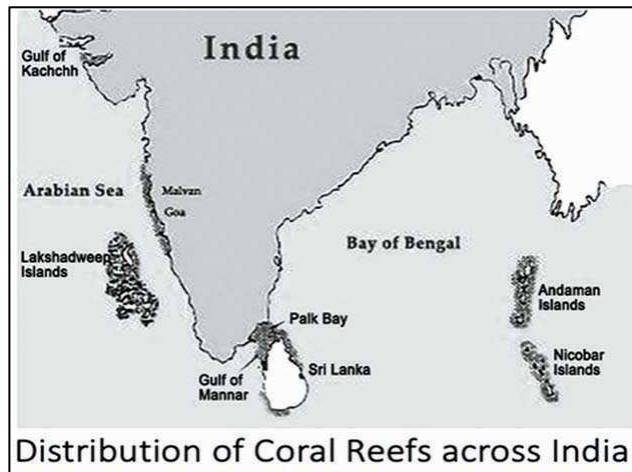
9. CORAL BLEACHING

Corals are invertebrate animals belonging to a large group of colourful and fascinating animals called Cnidaria. Each individual coral animal is called a polyp, and most live in groups of hundreds to thousands of genetically identical polyps that form a 'colony'. The colony is formed by a process called budding, which is where the original polyp literally grows copies of itself.

CONSERVING CORALS

Geographical Conditions

- ✓ **Sunlight:** They grow best in the brightly lighted water about 5 to 10 meters deep. The suspended particles interfere with feeding.
- ✓ **Temperature:** The reef building corals are found within the 21°C isotherm, Temperature below 18°C causes their death.
- ✓ **Salinity:** Most reef-building corals also require very saline (salty) water ranging from 32 to 42 parts per thousand.



CAUSES OF CORAL BLEACHING

- **Increase in seawater temperature**, particularly when associated with elevated levels of solar irradiance (e.g., ultraviolet radiation)
- **Change in seawater chemistry** (e.g., due to ocean acidification or pollution) Chemicals in sunscreens and other personal care products can accumulate in areas with significant marine tourism and recreational use by humans and can promote viral infections in hard corals that lead to bleaching.
- **Increment in levels of sediment in seawater**, or a coral's exposure to sodium cyanide (a chemical used in the capture of coral reef fish).

- **Mining and burning coal pollute the atmosphere** and causes global warming. Increased carbon pollution in our atmosphere traps heat, which causes the temperature to rise on Earth.
- **Deep water trawling**, which involves dragging fishing net along the sea bottom.

Status of Coral Reefs 2000-24 - International Coral Reef Initiative (Clive Wilkinson's Report): The reports predicted that almost all the reefs would soon be coming in the threatened stage. (NOAA Coral Reef Watch, 2017).

CONSERVING CORALS

- **Global alliances and organizations** are involved in preventing damage to healthy reefs and restoring damaged ones through assessment, conservation and restoration programs (that include- coral nurseries, marine protected areas and awareness campaigns) world-wide involving local communities.
- Global Coral Reef Monitoring Network, International Coral Reef Initiative (ICRI),
- National Oceanic and Atmospheric Administration (NOAA) – **In India, the coral reefs come under the ecologically sensitive areas** (Coastal Regulation Zone, CRZ-I) and Wildlife Protection Act.
- So, no new activities related to construction/ underwater blasting/ use of corals or sand from beaches are permitted. There is a National Committee on Wetlands, Mangroves and Coral Reefs, but it has no strict policies that stop harmful activities or pollution on the seaward side.
- Artificial coral regeneration techniques such as Active and Passive techniques. 3D Printing techniques can also be explored for reef restoration.

CONCLUSION

Immediate reductions in CO₂ emissions, overfishing, sedimentation and pollution, and promoting sustainable tourism and education are the only ways to save reefs from vanishing completely.

10. CHEETAHS REINTRODUCTION

*It could be many months before cheetahs from Namibia make it to India. An expert team of wildlife officials from Madhya Pradesh, the Indian Forestry department and Wildlife Institute of India that visited Namibia for a site visit last week is reportedly "satisfied," but a formal Memorandum of Understanding (MoU) regarding the transfer is yet to be signed. A press release from Namibia noted that a delegation from India had visited the **Cheetah Conservation Fund** and had held "bilateral and technical discussions" on introducing the animals.*

CHEETAH CONSERVATION FUND

- It is an international **non-profit organization headquartered in Namibia**, founded in 1990.
- Its mission is to be the internationally recognized center of excellence in the conservation of cheetah's and their ecosystems.
- CCF was the result of efforts of Dr. Laurie Marker who moved to Namibia to fight farmer-cheetah conflict in the region.

NEED FOR RE-INTRODUCTION

- Cheetah species has gotten extinct in the country.
- And the plan is to revive the Indian Population of Cheetah.

ORIGINAL GEOGRAPHICAL RANGE

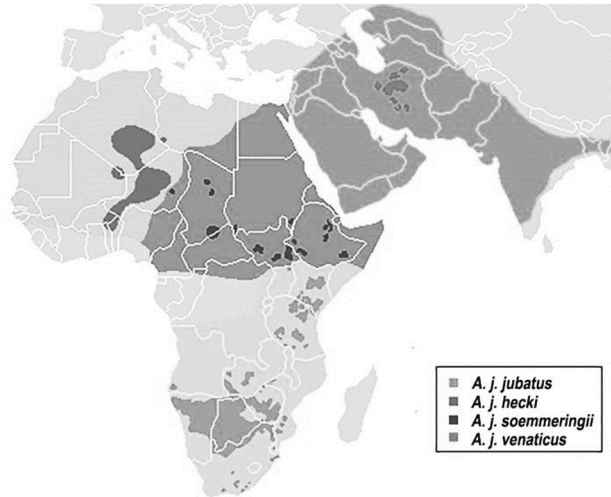


Fig: showing the range of Cheetah
(India clearly lies in this range)

CAUSES FOR EXTINCTION OF CHEETAHS IN INDIA

- **Hunting:** They were hunted into extinction during and after the Mughal Period, largely by Rajput and Maratha Indian royalty and later by British colonialists, until early 20th century when only several thousand remained.
- **Captive (help in hunting):** Trapping of large numbers of adult Indian cheetahs, who had already learned hunting skills from wild mothers, for assisting in royal hunts is said to be another major cause of the species rapid decline in India as they never bred in captivity with only one record of a litter ever.

WAYS TO REVIVE CHEETAH POPULATION

- **Biotechnology: Cloning**
 - India first proposed this method during last decade, but it did not work. In early 2000s, Indian scientists from Centre for Cellular and Molecular Biology (CCMB), Hyderabad, proposed a plan to clone Asiatic cheetahs obtained from Iran.
 - Indian scientists requested Iran to allow them to collect some live cells of the cheetah pair in Iran itself, which can then be made into living cell lines. They planned to use the nucleus from these cells to manually reproduce their own cheetahs, over a significantly long amount of time.
 - Iran refused to cooperate (would neither send any cheetahs to India nor would allow Indian scientists to collect their tissue samples)
 - It is said that Iran wanted an Asiatic lion in exchange for a cheetah and that India was not willing to export any of its lions.
- **Reintroducing live Cheetahs**
 - It was decided that African Cheetah would be introduced in protected areas in India. Reintroduction of the cheetah in India involves the re-establishment of a population of cheetahs into areas where they had previously existed
 - A part of the reintroduction process is the identification and restoration of their former grassland scrub forest habitats

ISSUES WITH REINTRODUCTION

- **Clash with lion conservation**

- As the habitat for Asiatic lion as well as the Cheetah is similar, many sites identified for Cheetah reintroduction clash with lion conservation. As there is only a single population of Lion in India in Gir and has become unsustainable due to rapid growth in their population and there is a need to relocate many lions from Gir.
- An expert panel formed by the government shortlisted several protected areas where cheetahs could be relocated. These were **Kuno-Palpur and Nauradehi Wildlife Sanctuary in Madhya Pradesh, Velavadar National Park in Gujarat and the Shahgarh bulge in Rajasthan.**
- **Kuno reintroduction plan ran into trouble:** The protected area had also been shortlisted for introduction of Asiatic Lions from heavily populated Gir in Gujarat. To not give lions to Kuno, Gujarat had put forward the argument that Kuno was being used for the introduction of African cheetah which might take several years to fully settle down and repopulate the area and hence reintroduction of lions should only be done after that.
- **Perpetual problems with India's wildlife**
 - As the import of the Cheetahs from Africa will be limited, the problems being faced by the wildlife in the country might undo the efforts.
 - It is advisable to resolve following issues first:
 - Human-wildlife conflict
 - Loss of habitat and loss of prey
 - Habitat fragmentation
 - Illegal trafficking
 - Advent of climate change
 - Growing human populations
 - With less available land for wildlife, species that require vast home range like the cheetah are placed in competition with other animals and humans, all fighting over less space.

11. HUMAN-WILDLIFE CONFLICT

Human wildlife conflict is increasingly being observed across the globe.

REASONS FOR ANIMAL-HUMAN CONFLICT

- **Human population explosion:** Many human settlements are springing up at edges of protected areas, and local people encroaching on forest grounds for farming and gathering food and fodder, putting further strain on forest's scarce natural resources.
- **Agricultural expansion and cultivation up to forest boundaries:** Increases availability of easily accessible food crops.
- **Lack of protected area:** Only around 10% of world's surface area is covered by protected zones. In India, 35% tiger ranges currently lie outside protected areas.
- **Rapid and unplanned urbanisation:** In modern times rapid urbanization and industrialisation have led to diversion of forest land to non-forest purposes, as a result, the wildlife habitat is shrinking.
- **Infrastructure development in forest areas like** electrification penetrating forest areas & increasing road density.
- **Destruction of natural animal corridors**
- **Increasing penetration of invasive alien species:** Due to proliferation of invasive alien species in forests, wildlife does not get to eat their traditional feed in search of which they get out of forest areas.

- Climate change is causing the threat of Human-Wildlife conflict to escalate. Wildlife attacks on livestock may intensify in some regions as climate change forces predators and livestock to increase their spatial overlap and interactions.

So, human-animal conflict is increasing across the globe, but we do not see these kinds of news from other countries:

- That is because in almost all developed nations these species are kept in control, so they don't destroy large crop areas.
- In developing countries, local people take matters into their own hands.
- Most countries follow "Boars eating crops, people eating boar": this is what allows farmers tolerate these otherwise problematic animals.
- India does not allow rural people to hunt animals, but neither does the government cull animals regularly despite their numbers shooting up.

WAY FORWARD

- Institutionally controlling the vermin population.
- Getting rid of the wildlife-territorial dichotomy of management.
- Forestalling the destruction of natural habitat.
- Developing forage and water bodies inside forests.
- Stalling the growth of invasive alien species in forests.
- Developing buffer zone around forests and according to legal protection to corridors which connect protected areas.
- Developing nature-based solutions to reduce Human-Animal Wildlife conflict. For ex use of Honeybees to control Elephants in Project Rehab.

It is our greed that has destroyed vast tracts of forests and thousands of elephants and other animals over the last few decades. The poor farmer who inadvertently kills one elephant to feed us while making enough money for him is much less responsible.

12. INVASIVE ALIEN SPECIES

A recent estimate reproduced from a global study on invasive species economics published in Nature journal, has put the cost of invasive alien species (IAS) on the Indian economy between at least USD 127.3 billion to USD 182.6 billion in the last 60 years.

Invasive alien species have devastating impacts on native biota, causing decline or even extinctions of native species, and negatively affecting ecosystems. Biological invasions are a major global challenge for the conservation of biodiversity, maintenance of ecosystem health and sustainable livelihoods.

Hence, invasive alien species, which can spread and sustain without human assistance outside their natural distribution, are causing environmental and economic damage worth trillions in India.

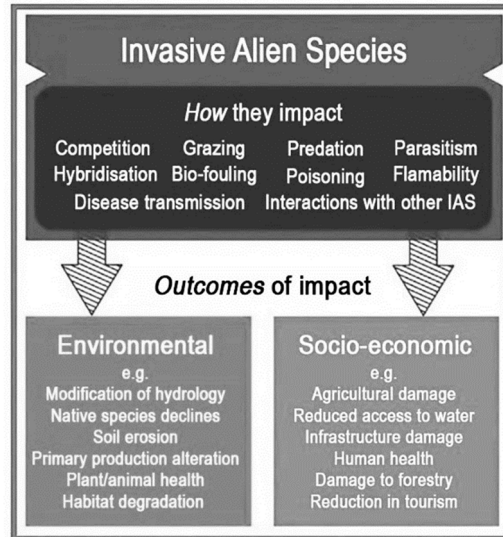
REASONS FOR SPREAD OF INVASIVE SPECIES

- **Absence of a dedicated biosecurity infrastructure:** National policy or legislation to regulate movements of IAPS and their management is lacking. This lack of overarching legal oversight and complete or partial failure in the enactment of the existing policies has accelerated the unregulated introduction and spread of IAPS in India.
- **Lack of coordination** and consensus persists between several agencies, even between those operating under the same ministry. For example, the National Biodiversity Authority has recognised 63 and 173 IAPS in India, respectively. While

there are certainly overlaps between these databases, this discrepancy highlights the absence of a standardised framework to designate alien species as invasive.

- **Roadblocks to tackle invasive alien plant species:**

- Lack of awareness, prevalent across public and government sectors, is the major hindrance for IAPS-specific policy formulation.



- Consumers prefer having alien ornamentals in their gardens or using abundant aliens for income generation purposes.
- No legal framework exists to hold any person or organisation accountable for unintended impacts caused by these species once they escape human control.
- IAPS with positive utilities are often promoted by non-governmental organisations for the welfare of marginalised people.
- For example, *Lantana camara*, one of the world's 100 worst invasive species, has been widely used for making handicrafts in different parts of the country.

Over-exploitation of these 'useful' IAPS has been portrayed (and encouraged) as a management measure in research and popular writings. Although this appears to be a promising strategy, scientific data to back it up is scarce, if not non-existent.

In contrast, the monetary incentives associated with this practice generate community dependence, develop new markets and induce novel invasion, thereby causing more harm than good.

Such a positive attitude begets more positivity leading to exploration of other invasive alien plant species for similar benefits. When these long-term effects on human livelihood, not to mention on other life forms, are recognised, the damage is already done, and the feedback loop of IAPS utilisation becomes a major hindrance for policy formulation and implementation.

13. LIFE - LIFESTYLE FOR ENVIRONMENT

At COP26 to UNFCCC held in Glasgow, UK, India shared the mantra of LIFE - Lifestyle for Environment - to combat climate change.

Goal 12 of SDG is to ensure sustainable consumption and production patterns focussing on waste management (both municipal and hazardous), food loss reduction, waste recycling and reuse, and sustainability in industries such as tourism. SDG 12 calls for a change in present lifestyle to one that is more sustainable.

As part of the United Nations Decade of Action for attainment of SDGs, **India has initiated several measures for promoting Resource Efficiency and Circular**

Economy, including for prevention and management of waste. Concepts of Extended Producer Responsibility (EPR) and Circular Economy are based on principles of reduce-reuse-recycle and are relevant for promoting sustainable consumption and production. NITI Aayog has constituted Committees for development of circular economy (CE) action plans for distinct categories of wastes.

MoEFCC is the Nodal Ministry for Circular Economy Action Plan for Tyre and Rubber and has notified on 'Guidelines on the Extended Producer Responsibility (EPR) for Plastic Packaging' under Plastic Waste Management Rules, 2016.

MoEFCC launched the Green Good Deeds (GGDs) movement as a social movement with the aim to bring about mass environmental awareness in the society at all levels. GGDs are simple, practical steps that every individual may perform in day-to-day life to adopt an environment-friendly lifestyle. A compilation of such deeds has also been published under the title 'Green Deeds & Habits for Sustainable Environment.' Promotion of GGDs among school and college students has been taken up under National Green Corps (NGC) **"Eco-club" program**. Cleanliness drives, plantation drives, awareness on waste management, minimizing use of single-use plastic, eco-friendly celebration of festivals, etc. are some of the activities undertaken by Eco-club students.

COMPONENTS OF LIFE

- **From dispose economy to circular economy:** In a linear/dispose economy we mine raw materials that we process into a product that is thrown away after use. In a circular economy, we close the cycles of all these raw materials. It aims to increase the lifecycle of goods through reuse, recycling and repairs.
- **3Ps - Pro Planet People:** People and planet are interconnected. Life as we know today cannot exist if either are destroyed. The aim is to encourage people to lead the lifestyle having a smaller carbon footprint, leading to a more sustainable use of the environment.
- **Eliminating/ Reducing throw away culture:** Under throwaway culture, economy is strongly influenced by consumerism. It features overconsumption and a preference for short-lived products, which maximise profit, rather than creating durable goods that don't need constant replacing.
- **One World:** Climate change is a global phenomenon. No individual country could solve this problem alone. Thus, there is need for international cooperation and coordination to better tackle the challenge.

MAKE SUSTAINABLE FOOD CHOICES

- Production, processing, packaging, and transportation of food is highly dependent on the use of fossil fuels and chemical fertilizers. These can harm our health and the health of the environment.
- A food system that provides healthy, sustainable choices, minimizes environmental impacts, and serves as a model for the broader public health community.
- Farmers can make their food more sustainable by limiting pesticide use and treating their animals humanely and responsibly. Consumers can select food produced close to home and reduce the impact of our food system on the environment by lessening the distance food travels from farm to table.

USE ALTERNATIVE TRANSPORTATION

- Pollutants released by vehicles increase air pollution levels and have been linked to adverse health effects, including premature mortality, cardiac symptoms, exacerbation of asthma symptoms, and diminished lung function.

- To minimize the damaging impact of our current transportation choices, try adopting more sustainable methods of travel.

MAKE GREEN UPDATES AT HOME

- Sustainably resourced and reclaimed materials
- Low flow sinks and toilets
- Energy-efficient appliances, lighting, and heating and cooling systems
- Smart home systems such as thermostats that can be controlled via apps
- Air-tight insulation to reduce energy leaks
- Water filtration systems
- Double-pane windows and doors that transmit little to no heat
- Solar panels
- Non-toxic paint, carpeting, and furniture with lower levels of volatile organic compounds (low-VOC).

DRIVERS OF LIFESTYLE OF A PERSON/ SOCIETY

- **Values:** They are the underpinning of way of life choices as individuals will consume to satisfy esteem loaded goals. Values can be at the individual or more extensive social or moral levels.
- **Income level:** This is one of the strongest lifestyle indicators and drivers of consumption. Also, there is compounded social pressure to maintain lifestyle levels once adopted.
- **Ability:** People's abilities are influenced by many things e.g., age, geography, climatic conditions, which in turn affect lifestyle decisions.
- **Awareness:** Awareness of consumption impacts, at the individual and collective levels, can shape choices. Awareness can have a multiplier effect.
- **Knowledge:** The availability (or the lack) of knowledge and information on products, services, and alternative options can often encourage or hinder lifestyles choices.
- **Social norms and peers:** Our lifestyles are heavily influenced by those around us: family background, social circles, colleague expectations, professional decorum and social practices
- **Media** with its far reach into our lives is one of strongest influences on values, social norms and lifestyles, spreading and accelerating the social norms of consumerism.
- **Market prices:** Market prices determine who can afford market options. When more sustainable products or services are priced higher than less sustainable alternatives, sustainable option is less competitive.
- **Technology:** Characteristics such as complexity, resource efficiency, indigenouslyness, and affordability influence the uptake and use of technologies.
- **Policies and institutional frameworks:** These 2 have a powerful influence on all stakeholders and lifestyle directions. Hard (e.g., penalties and subsidies) and soft (e.g., nudging and voluntary standards) policy instruments can shift the entire consumption architecture.

STRATEGIES FOR IMPLEMENTING LIFE

- **REDuse framework: Refuse, Effuse and Diffuse (REDuse) framework**, supports bottom-up approaches, encourages programs and actions that directly empower individuals and households in their daily lives (Indirectly communities), enabling them to understand, create and choose more sustainable lifestyle options.

- **Attitude-Facilitator-Infrastructure (AFI) framework** is a top-down approach to support government policy, business models, institutional arrangements, and actions that set the conditions necessary for sustainable lifestyles to thrive.
 - Attitude – pro-sustainability value orientation
 - Facilitators/ Access – institutional arrangements and enablers
 - Sustainability infrastructure – the hardware and systems of provision.

14. GROSS ENVIRONMENT PRODUCT

Uttarakhand government recently announced it will initiate valuation of its natural resources in the form of 'Gross Environment Product' (GEP), said to be along the lines of Gross Domestic Product (GDP).

There is a general agreement among the policy makers that the economic concepts of GDP, GNP or per capita income do not reflect the correct state of economic development of a state or country as these concepts do not reflect on the status of environment of the state/country impacted by economic growth.

Humans derive so much from resources and processes that are supplied by ecosystem, collectively termed as "Ecosystem Services". They include all the tangible and non-tangible assets or products which human get from nature like food, recreation, clean water, air and processes such as decomposition.

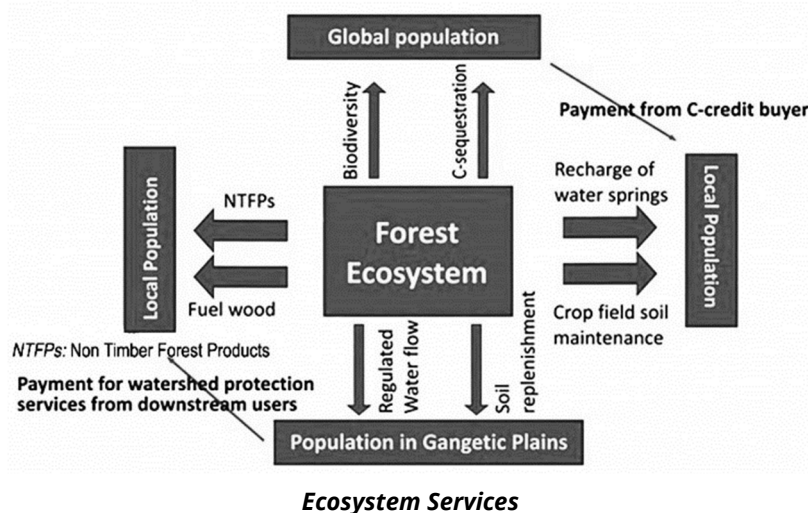
GROSS ENVIRONMENT PRODUCT

Ecosystem products and services are essentials for human survival and development. Gross Ecosystem Product (GEP) aims to specific indicators to measure the total economic value of all ecosystem products and services.

GEP is the total value of final ecosystem goods and services supplied to human well-being in a region annually and can be measured in terms of biophysical value and monetary value. Ecosystems that can be measured include natural ecosystems such as forests, grassland, wetland, desert, freshwater and ocean, and artificial systems that are based on natural processes like farmland, pastures, aquaculture farms and urban green land, etc.

GEP summarizes the value of ecosystem services in a single monetary metric. For instance, total value of forest ecosystem services flowing from Uttarakhand is about \$2.4 billion / year. At the Indian Himalayan-level, it is Rs 94,300 crore / year.

In some cases, the GEP could be more than the GDP. E.g., GEP was greater than GDP in Qinghai (China) in 2000 and was three-fourths as large as GDP in 2015.



BENEFITS OF INTEGRATING GEP IN ACCOUNTING

- It is a better way to measure the status of ecosystem and can help us gauge our progress towards sustainable development.
- It can be utilized as an indicator to assess the performance of officials.
- It can be used as a rationale for compensation purposes. For example: Finance Commissions Horizontal revenue sharing.
- It will help us in our assessment of state of stress created by anthropogenic factors on eco-system and natural systems.

PROBLEMS WITH IMPLEMENTATION OF GEP

- **Policy Failure:** Lack of recognition of ecosystem services in economic decision making, development planning and resource allocation. Value of ecosystem services is either ignored or poorly understood.
- **Market Failure:** Inadequate or missing market for many ecosystems service.
- **Institutional Failure:** Insufficient compensation for ecosystem services.
- **Knowledge gaps**
 - Challenges to provide economic value of ecosystem services, regulating and supporting services
 - Lack of baseline data

So, we can easily comprehend how GEP tries to balance economy and ecology. If Uttarakhand can pull off a scientific and rational mechanism to calculate the GEP, that would lead to radical changes in our policy domain. However, there is a need for real-time data to better understand GEP. It is based on this data that a future for the GEP could be determined.

TOPICS TO BE COVERED

1. *Water Stress in India*
2. *Ground Water Contamination*
3. *Inter-linking of Rivers*
4. *Multipurpose Dams*
5. *Draft National Water Policy*
6. *Jal Shakti Abhiyaan: Catch the Rain*
7. *Jal Jeevan Mission*
8. *Watershed Development*

1. WATER STRESS IN INDIA

According to Niti Aayog's Composite Water Index Report, India is experiencing a very significant water challenge.

- Approximately, 820 million people of India living in twelve river basins have per capita water availability close to or lower than 1000 m³, the official threshold for water scarcity as per the Falkenmark Index.
- About three-fourth of the households in the country do not have drinking water at their premise. About 82% of rural households in India do not have individual piped water supply.
- With nearly 70% of water sources being contaminated, India is placed at 120th amongst 122 countries in the water quality index.
- Average per capita water availability, which is already low enough for India to be categorized as water stressed, is expected to reduce further to 1341 m³ by 2025 and 1140 m³ by 2050, close to the official water scarcity threshold.
- Estimates suggest ~INR 20,00,000 crores in investments are required to bridge the expected water supply gap by 2030.
- Almost around 2 lakh people die in India due to lack of access to drinking water. 21 Indian Cities are set to reach ground zero.
- By 2030, India's water demand is projected to be twice the available supply, implying severe water scarcity and a ~6% loss in the country's GDP.
- Water is a state subject and its optimal utilization and management lies predominantly within the domain of the States.

STRUCTURAL CHALLENGES IN WATER MANAGEMENT

- **Limited water availability:** India has 4% of world's freshwater resources. While, we have 17% of world's population & 17% of world's livestock population.
- **Monsoon dependence:** Much of India's precipitation is concentrated in the months of June, July, August & September (Monsoon months). This means that during the other months water needs must be fulfilled by storing water that comes down in monsoons season.

There is a need to deepen our understanding of water resources and usage and put in place interventions that make our water use efficient and sustainable.

OTHER CHALLENGES IN WATER MANAGEMENT

1) Climate change is expected to increase the complexity around water due to changing patterns, intensity of precipitation, changes in discharge of rivers.

2) Crisis of water

a. Falling Groundwater levels: Groundwater accounts for 90% of India's irrigation needs. Average depth at which groundwater is available has fallen from 7.5 metres in 1998 to 9.2 metres in 2018. In Punjab, groundwater level has fallen by more than 10 metres in this period, while in Madhya Pradesh this level has fallen by 5 meters.

b. Water quality concerns

c. High unmet need for water: If the current pattern of demand continues, about half of the national demand for water will remain unmet by 2030.

3) In-efficient water usage:

a. Water guzzling agriculture sector: Agriculture sector consumes most water in India. Water use efficiency is very low in India, with most farmers still practicing flood irrigation and planting water guzzling crops such as sugarcane and rice even in water stressed areas of Maharashtra and Punjab respectively. This unsustainable cropping trend has led to deepening of water crisis due to following reasons:

- Incentives such as free-power or subsidized power which makes it very cheap to exploit groundwater resources endlessly.
- Minimum support prices give assurance of income to farmers. MSPs are skewed towards Rice, Wheat and Sugarcane in India.
- Open-ended procurement of these water intensive crops by state agencies.

b. India's industrial water footprint is one of the highest in the world.

c. Wastage of water in activities such as vehicle washing, flushing etc. in urban areas.

d. Cities lose a lot of water in the piping and supply leakages.

e. Export of virtual water: Despite water scarcity, India has turned into a virtual water exporter as India exports water-intensive crops such as rice, sugar etc.

4) Supply side interventions no longer working:

a. Country is running out of sites for further construction of large dams. Also, water stored in dams fails to reach farmers.

b. Water tables and groundwater quality are falling in many areas.

5) Water governance: Water resource management is fragmented and inadequate. Water issue fall in the State list of the constitution. States often lack effective capacity and focus on water issues, especially poorer states. Also, at the Central level, water issues are broken between Central Water Commission and Central Ground Water Board, this stops in treating water issues in an integrated manner.

6) Water user fees: Some states currently have fixed user charges for water (for ex. UP, Maharashtra, Haryana and Uttar Pradesh), but they are too nominal and inadequate compared to the expenditure incurred in providing the service. The water user fees are not revised regularly. Farmers not willing to pay the fee leads to steady deterioration of public irrigation infrastructure and impacts the quality of services.










ISSUES WITH WATER SCARCITY

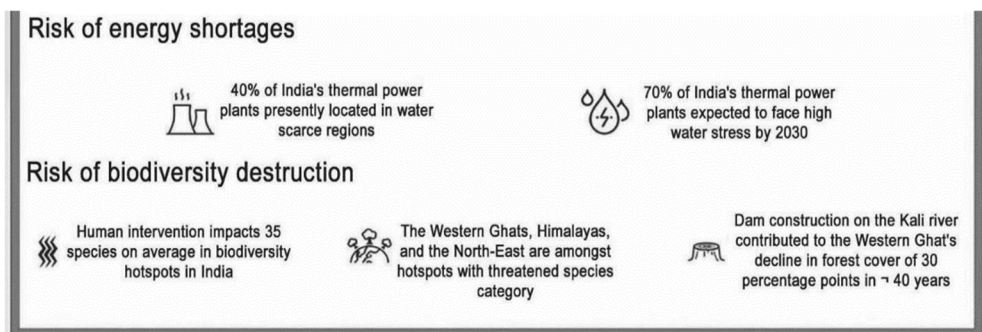
- **Social & political risks:** Depleting access to clean water impacts food security and health and can cause social unrest and political instability.

- **Threats to urbanization:** Urban hubs are likely to witness severe water shortages in the future, which could risk urban growth in India and reduce quality of life for urban citizens.
- **Risk to sustainable industrial activity:** Water shortages can hamper industrial operations and other economic activity. As the water crisis worsens, production capacity utilization and new investments may both decline, threatening livelihoods of millions. Commodity prices could rise steeply due to production shortages.
- **Energy shortage:** 70% of India's thermal power plants are likely to face high water stress by 2030, India's energy mainstay.
- **Environmental risk:** The rich biodiversity of India faces a serious threat from activities undertaken for creating additional water sources. Climate change, temperature rise, human engineering of hydrological flows by dam construction and river diversion is already proving catastrophic for biodiversity.
- **Desertification risk:** ~30% of Indian land is impacted by desertification and land degradation, and this outcome is strongly linked to poor water management.
- As per the National Commission for Integrated Water Resource Development, the water requirement by 2050 in high use scenario is likely to be 1,180 BCM, whereas the present-day availability is 695 BCM.

SUGGESTIONS FOR SUSTAINABLE WATER FUTURE

- **Water Pricing**
 - Effective pricing for water and power with subsidized water supply for basic water needs of drinking and household needs. (Jal Jeevan Mission)
 - Setting up water meters at all levels across the distribution network.
 - Independent regulatory authority should be established to determine water user fees in a rational and depoliticized fashion.
- **Promoting use of wastewater**
 - High priority for recycle and reuse of water. For ex. Wastewater usage can be increased in Thermal power plants and industrial establishments and for irrigation. This will reduce India's industrial water footprint.
 - In urban areas, for all non-potable uses such as flushing, fire protection, vehicle washing, landscaping, horticulture etc. wastewater should be used.

Risk to food security		
 About 74% area under wheat cultivation and 65% area under rice cultivation faces extreme levels of water scarcity	 Expected water demand-supply gap of up to 570 BCM by 2030 in agriculture sector	 Virtual water export adds to the problem-export of ~ 37 lac tonnes of Basmati rice alone costed India 10 trillion litres of water in 2014-15
Risk of exceeding the carrying capacity of urban hubs		
 5 of the world's largest cities under water stress present in India; Delhi ranks second on the list	 No Indian city able to provide 24x7 water supply to its entire urban population	 Expected water demand-supply gap of ~ 50 BCM for domestic sector by 2030, as future demand doubles present use
Risk to sustainable industrial activity		
 Industries expected to draw 3x water compared to their actual consumption by 2030	 Shutdowns possible as states prioritize irrigation and households needs, and fail to provide water to industries	 Water-intensive industries such as Food & Beverages, Textiles, and Paper & Paper products likely to be worst affected



- **Increasing water use efficiency in Agriculture**

- For Agriculture: Greater marketing support for water-efficient crops in water-constrained areas along with crop diversification. Dis-incentivising the cultivation of water-intensive crops in states like Maharashtra, Punjab and Haryana. Shifting these crops to water-rich eastern and north-eastern regions.
- Focus on upkeep and maintenance of canal networks and lining them to reduce groundwater seepage. Also, solar power plants can be overlain canals to reduce evaporation along with generation of electricity. Use of SCADA systems and closed conveyance pipelines to supply water.
- A general shift from price support to cash transfer to let the actual crop prices to be determined by market forces. Use of technologies such as laser leveling, drip and micro irrigation systems etc. Promotion of organic farming, agroecology based farming systems and mulching etc. to preserve soil moisture.
- Focus on water issues in program like Jal Shakti Abhiyan, MGNREGA etc.

- **Employing nature-based solutions for sustainable water**

- Rejuvenation of catchment areas needs to be incentivized through compensation for eco-system services, especially to vulnerable communities in the upstream, mountainous regions.
- Thrust on local rainwater harvesting to catch the rains where it falls when it falls.
- Demarcation, notification, protection and revival of traditional local water bodies in both rural and urban areas.
- Restoration of rivers with wet meadows (where they can meander)
- Infrastructure solutions such as rain gardens and bio-swales
- Wetlands constructed for bioremediation, urban parks, permeable pavements, sustainable natural drainage systems, green roofs and green walls.

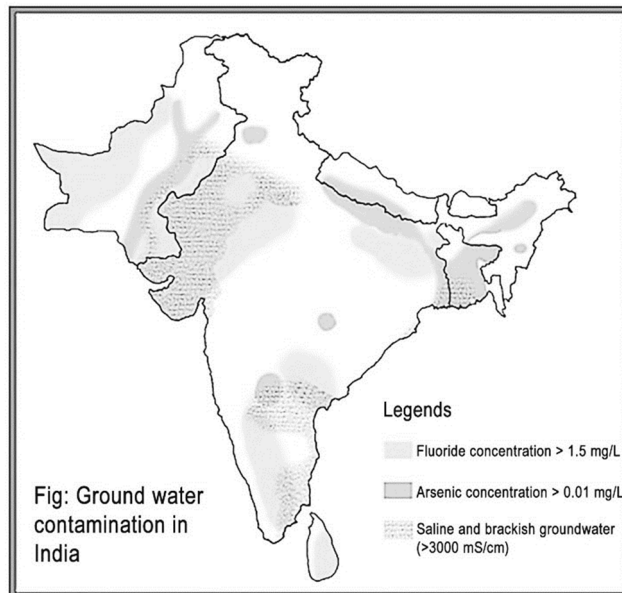
- **Water governance reforms**

- Need to break down the silos into which issues related to water is divided. A National Water Commission as advised by Mihir Shah Committee should be formed.
- Bringing water from State list to concurrent list to develop a common national vision, greater attention and resources for water issues.
- Creation and empowerment of water user association and panchayats in taking up water issues and regulation. This will raise people's awareness and participation in the management of water.
- More investment and private sector involvement is necessary for sustainable water scenario.

2. GROUNDWATER CONTAMINATION

Discharge of toxic elements from industries and landfills and diffused sources of pollution like fertilizers and pesticides over the years has resulted in high levels of contamination of groundwater.

Leachate contamination, Nitrate contamination, the presence of fluoride, iron, arsenic and heavy metals have also touched worrying levels.



The chemical quality of groundwater (GW) is monitored once a year by the Central Ground Water Board (CGWB) through a network of about 15,000 observations well.

A recent study has found over 30 micrograms per litre (mcg/l) of the Uranium in parts of north-western, southern and south-eastern India. The World Health Organization (WHO) prescribes '30 mcg/l' as an upper limit.

In South Asia, arsenic contamination in groundwater in the Ganga- Brahmaputra fluvial plains in India. In West Bengal, Jharkhand, Bihar, Uttar Pradesh in the flood plains of the Ganga, Assam and Manipur in the flood plains of the Brahmaputra and Imphal rivers and Rajnandgaon village in Chhattisgarh state have been reported to be affected by arsenic contamination in groundwater.

Landfill leachate is formed when rainwater infiltrates and percolates through the degrading waste, while landfill gas is a microbial degradation by product under anaerobic conditions. Its composition can vary widely depending on the age of the landfill and the type of waste that it contains. It usually contains both dissolved and suspended materials.

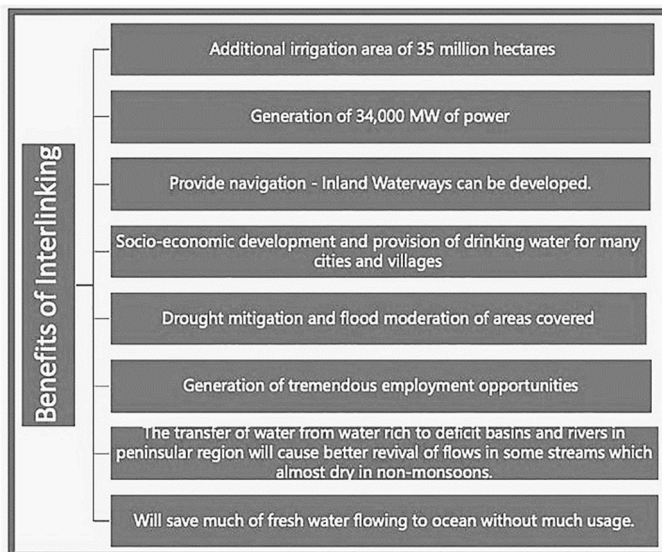
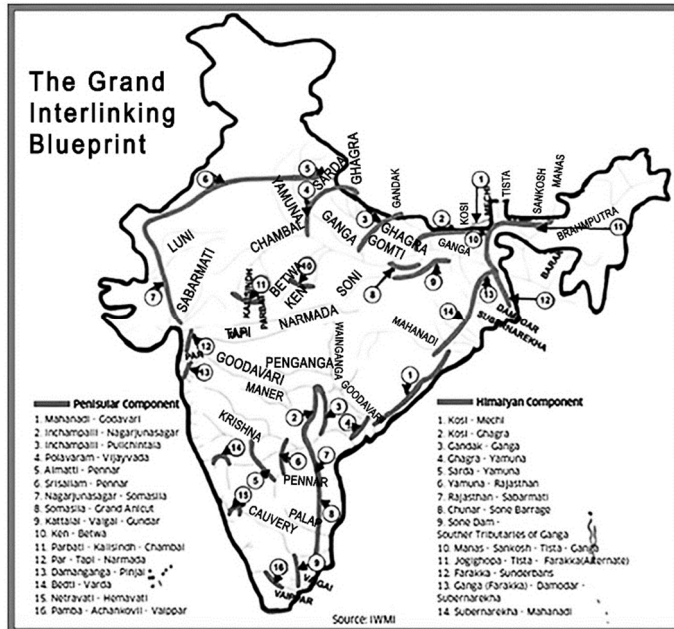
EFFECTS OF GROUNDWATER CONTAMINATION

- **Arsenicosis** stands for arsenic poisoning, which occurs due to accumulation of large amounts of arsenic in the body. It leads to adverse health effects through inhibition of essential enzymes, which ultimately leads to death from multi-system organ failure. Arsenic increases the risk of numerous illnesses. It leads to skin damage including keratosis and skin cancer, internal cancers such as that of the lung and bladder and diseases of the vascular system.
- **Uranium toxicity** can affect various organs and bones; however, kidney is most adversely affected. Also, radioactivity of uranium is also a major concern.
- The contamination of groundwater in the area around the landfill site due to leachate from the garbage is a serious threat to the residents and the environment. Health

conditions can range from sweating, bleeding stomach disorders, to blood disorders, birth defects, even cancer, medical literature tells us.

3. INTER-LINKING OF RIVERS

Interlinking of rivers is necessary to overcome anomaly of uneven temporal and spatial distribution of rainfall in the country. It is also necessary to remove the regional imbalances in the country.



Currently, Himalayan Rivers has perennial flow with often serious flooding during monsoon months. While the Peninsular Rivers have flows during the monsoon months and have very low or run dry during other times of the year. This anomaly has been visualised to be solved by Interlinking of Rivers.

CURRENT PROGRAM

The program for interlinking of major rivers comprises 30 links to share available waters equitably between different basins and states. The current program has two components: The National Perspective Plan for Inter-Linking of rivers

- Himalayan Component: 14 Links

- Peninsular Component: 16 links

CHALLENGES TO RIVER INTERLINKING PROGRAM

- **Interstate challenges:** Lack of consensus on implementation of project among the co-basin states
- **International Relations:** International Issues involved such as concerns of neighboring countries such Resettlement and rehabilitation of the project affected people
- **Financial Burden:** High project funding cost. It is estimated that the project will involve
- **Infrastructural challenges**
 - Construction of big dams. Ex.
 - Arresting flow of fresh water can harm mangroves.
 - Resettlement of large population.
- **Environmental Challenges**
 - Low flow of fresh water to Bay of Bengal can reduce freshwater layer over Bay of Bengal. This can have regressive impact over monsoons.
 - Regime change of rivers and consequential changes in physical and chemical composition of sediment, river morphology and shape of delta.
 - Submergence of land leading to deforestation and soil erosion.
 - Adverse impact on coastal ecosystems and deltas on East Coast of India.
 - Dams result in diversion of forest areas, increased methane emissions from reservoirs, reservoir induced seismicity.
 - Adverse effect on groundwater recharge and diversion of forest areas for dam building.
 - Increased saline ground water intrusion
 - Risk for delicate wetland and estuarine ecology which is not only aquatic habitats and fisheries.
 - There can be waterlogging and desertification.
- The water surplus in most river basins of India is during the same period of monsoons. After the monsoon season even the so-called water surplus states such as Punjab, UP, Uttarakhand face water deficits. Hence, during this period there will be no surplus left to transfer to peninsular states.
- The river interlinking will involve pumping the water from Himalayan rivers to the peninsular India which will involve increase of height of water by 1000 m. This will involve huge cost for pumping.

WAY FORWARD

1. In interlinking proposals, a provision of the minimum lean season flow should be safeguarded to maintain the ecology and the river regime
2. Cumulative impact assessment for the entire project should be done and not on component-by-component basis.
3. Rehabilitation and Resettlement should be done prior to undertaking the projects.
4. First projects should be identified which has least opposition. Ken Betwa Linkage is the first Inter-linkage proposal to be taken up; it should be completed as lighthouse of the project.
5. Despite the project, it will not be able to solve all water issues in the country. Hence, the focus should be on reforming the water governance (as per Mihir Shah Committee

Report), focus on water use efficiency, participatory water governance and reforms in water usage in agricultural sector

6. Water availability will be the main developmental concern. All possible steps should be taken to solve this after consensus building.

4. MULTIPURPOSE DAMS

Hydroelectricity is the electricity produced from generators driven by turbines that convert the potential energy of falling or fast-flowing water into mechanical energy. In the early 21st century, hydroelectric power was the most widely utilized form of renewable energy; in 2019 it accounted for more than 18 percent of the world's total power generation capacity.

BENEFITS OF HYDROPOWER PROJECTS

1) Renewable

- It is considered renewable because it uses earth's natural water flow to generate electricity. Due to natural water cycle, water is recycled back to Earth and will never run out of supply.
- Amount of hydroelectricity produced can vary because of drought and lower water levels, but this is seasonal.

2) Clean and safe

- Unlike fossil fuels, biomass and nuclear power, hydroelectric power is a clean and green alternative source of energy. Since hydroelectric dams do not use fuel, they do not release any greenhouse gases or toxins into the environment.

3) Flexible

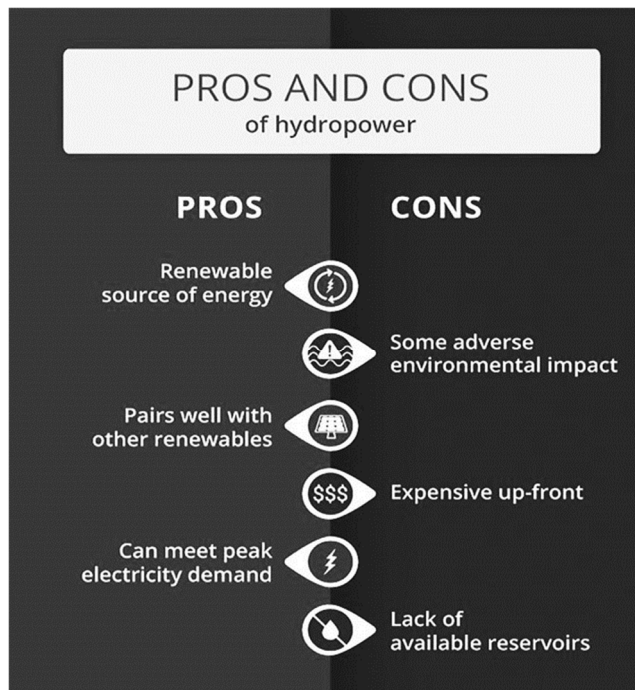
- It is a flexible source of electricity as hydro plants can be scaled up and down quickly to meet the changing energy demands.
- Compared to gas turbines or steam plants the start-up time taken by hydro turbines is very less.
- Hydropower units also serve as backup for non-hydro generators.
- **Pump-storage hydropower plants can act as battery to store renewable energy** and release this energy when renewable production is low. For ex. During nighttime.

4) Cost-competitive energy source

- Despite expensive upfront building costs, hydroelectric power is a cost-competitive source of energy.
- Hydropower plants require low cost of maintenance and operation. Since they have few parts, the plants need minimal replacements.
- Also, dams are typically designed for long-term use and are therefore capable of producing hydroelectric power up to an average lifetime of 50 – 100 years.

5) Additional benefits

- Provide water for irrigation if the command area is developed.
- Ground-water recharge in the area.
- Assured source of drinking water.
- The pond created is good source for fisheries and serves many ecological functions such as saving biodiversity. For ex. Pong Dam and Harike Dam have been recognized as Ramsar sites.
- Tourist and water & adventure sports developments.
- Flood moderation



CONCERNS WITH HYDROPOWER PROJECTS

1) Failure risks

- As dams hold back large volumes of water, a sub-standard construction, natural disasters or sabotage, and the extreme influx of water can be catastrophic to downriver settlements and infrastructure. For ex. There is concern over the safety of Mullaperiyar Dam between Kerala and Tamil Nadu.
- These failures not only affect the supply of power but also affect the flora, fauna and other forms of life.
- Risk of reservoir induced seismicity. For ex. Koyna

2) Methane emissions

- Hydroelectric dams contribute more to global warming than previously estimated by the anaerobic oxidation of plant material in inundated material which leads to substantial methane emissions.

3) May lead to local droughts

- One of the main downsides of setting up hydroelectric power plants is the occurrence of local droughts.
- The overall cost of energy is calculated depending on the availability of water and a drought could potentially affect this, causing people not to acquire the power they need.

4) Ecosystem damage and loss of wetlands

- Big reservoirs cause submersion of extensive areas upstream of the dams, sometimes destroying lowland and riverine valley forests, marshland and grasslands rich in biodiversity.
- They affect the natural hydrological cycle and threaten the surrounding aquatic ecosystems both upstream and downstream.
- Since turbine gates are often opened intermittently, interruptions of natural water flow can have a great impact on the river ecosystem and the environment.
- Fish in the river is affected by the draining of the water from the dam as well as the fish that is in the dam.

- Animals such as birds, cranes and other aquatic birds, and some plant species thrive in marshy habitats. However, because of the hydroelectric power plant construction, these habitats will be destroyed.

5) Displacement of large population

- People are forced to relocate to facilitate the construction of the dams needed to generate hydroelectricity often without comprehensive resettlement and rehabilitation.
- Local populations living downstream can become vulnerable to flooding due to the possible strong water currents that might be released from the dams.
- The World Commission on Dams estimated in 2000 that dams had physically displaced 40-80 million people worldwide.

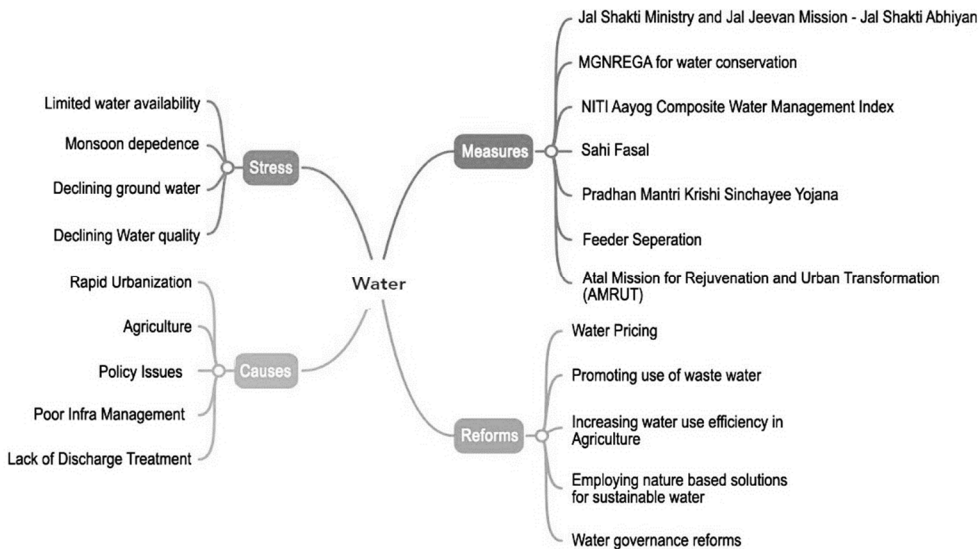
6) Other concerns

- Substantial time and cost overruns.
- Lack of completion of command area leads to suboptimal realization of irrigation potential.
- Often in some areas, there is problem of water logging and soil salinity, leading to degradation of good agricultural lands.
- Construction of large number of dams has reduced the amount of sediments reaching the delta regions particularly in Eastern India. This has led to increasing risk of submergence of these coastal areas.
- Construction of dams involves use of lots of explosives and drilling which increases the risks of landslides particularly in Himalayan region.

5. DRAFT NATIONAL WATER POLICY

Committee set up by government of India to formulate national water Policy has submitted its draft to the ministry of Jal Shakti.

According to recent predictions, approximately half of the country's water demand will remain unmet by 2030 if current trends continue. Water tables are dropping, and water quality is decreasing, necessitating a major shift in water management strategy.



The water cycle no longer operates within an invariant range of prediction, as seen by changing precipitation patterns and intensity, as well as river discharge rates. This necessitates a greater focus on water management's agility, resilience, and flexibility to respond appropriately to the future's increased uncertainty and unpredictability.

ISSUES IN WATER POLICY 2012

• Water Governance

- The strategy proposes fundamental changes to the way water is managed, which is plagued by three types of challenges:
 - That is, the distinction between irrigation and drinking water, surface and groundwater, and water and wastewater.
- Because of over-extraction of groundwater, rivers are drying up, reducing the base-flows required for rivers to have water following the monsoon.
- Dealing with drinking water and irrigation in silos has resulted in aquifers offering reliable sources of drinking water drying up because the same aquifers are also utilised for irrigation, which consumes far more water.
- Water quality suffers when water and wastewater are separated during planning.

• Demand Management:

- The policy recognises that increasing water supply indefinitely has limits and argues for a shift to demand management.
- Irrigation:
 - Rice, wheat, and sugarcane use most of India's water, which is consumed by irrigation.
 - The basic water needs of millions of people cannot be addressed unless this pattern of water demand is drastically altered.

• Groundwater:

- Sustainable and equitable groundwater management is a top concern for the NWP.
- The key is community-based groundwater management. Stakeholders selected as custodians of their aquifers would be able to adopt guidelines for effective groundwater management if they were given information about aquifer boundaries, water storage capacities, and flows in a user-friendly way.

• River:

- Historically, rivers have been viewed as primarily an economic resource. Despite the economic value of rivers, the NWP prioritises river protection and rehabilitation.
- NWP lays forth a plan for drafting a River Rights Act, which would protect rivers' rights to flow, meander, and reach the sea.

• Water Quality

- It is the most critical neglected issue in India today.
- It is proposed that a water quality department be included in every water ministry, both at the federal and state levels.

RECOMMENDATIONS

- **Crop Diversification:** Single most critical step in alleviating India's water crisis, according to demand side options.
 - Diversifying public procurement activities to include Nutri-cereals, pulses, and oilseeds is suggested in the policy.
 - The Integrated Child Development Services, the mid-day meal scheme, and the public distribution system are the primary outlets for these procured crops.
 - Given the higher nutritional composition of these crops, establishing this link would also assist address the crisis of starvation and diabetes.
 - Farmers should be encouraged to diversify their cropping patterns, resulting in significant water savings.

- **Reduce-Recycle-Reuse**
 - This has been recommended as the basic motto of integrated urban water supply and wastewater management, with sewage treatment and eco-restoration of urban river sections achieved as far as practicable through decentralised wastewater management. Use of cleaned and treated wastewater for all non-potable purposes, such as flushing, firefighting, and vehicle washing.
- **Supply Side recommendations:**
 - The policy recommends utilizing water stored in large dams that are still not reaching farmers and explains how irrigated areas could be greatly expanded at a low cost by deploying pressurised closed conveyance pipelines, combined with Supervisory Control and Data Acquisition (SCADA) systems and pressurised micro-irrigation.
 - The NWP lays a strong emphasis on water supply via "nature-based solutions" such as catchment area rejuvenation, which will be rewarded with ecosystem services compensation.
- **Rain gardens and bio-swales** restored rivers with wet meadows, **bio-remediation wetlands**, urban parks, permeable pavements, green roofs, and other specially curated "**blue-green infrastructure**" are proposed for urban areas.
- **Water Quality:**
 - The policy encourages the use of cutting-edge sewage treatment technology that are low-cost, low-energy, and environmentally friendly.
 - The widespread use of reverse osmosis has resulted in significant water waste and harmed water quality.
 - If the total dissolved solids count in water is less than 500 mg/L, the guideline states that RO units should be avoided.
 - It proposes forming an emerging water pollutants task team to better understand and address the problems they are anticipated to pose.
- Re-vegetation of catchments, management of groundwater extraction, river-bed pumping, and sand and boulder mining are all steps in the process of restoring river flows.

6. JAL SHAKTI ABHIYAAN: CATCH THE RAIN

- Ministry of Jal Shakti is taking up this national campaign 'Jal Shakti Abhiyan: Catch the Rain) focusing on saving and conserving rainwater from March to end of November 2022 in the pre-monsoon and monsoon periods, covering both urban and rural areas.
- National Water Mission is the implementing agency for this program.
- Aims to nudge states and stakeholders to create appropriate Rainwater Harvesting Structures suitable to climatic conditions and sub-soil strata before monsoon.
- To facilitate these activities, states have been requested to open '**Rain Centers**' in each district, in collectorates/municipalities or GPs.
- Efforts should be made so that all building in the district has rooftop rainwater harvesting systems and maximum quantity of rainwater in any compound should be impounded. This will improve in improving soil moisture and raising ground water table. In urban areas, it will reduce water gushing onto roads, damaging them and prevent urban flooding.

COMPONENTS

1. Intensive rainwater harvesting and water conservation:

- a. Rooftop water harvesting structures (WHS) on buildings and water harvesting pits in compounds.
- b. Maintenance of existing Roof WHS & creation new check dams/ponds.
- c. Renovation of traditional WHS
- d. Removal of encroachment of tanks/lakes and in their catchment areas.
- e. Desilting of tanks, reuse and recharge of borewells
- f. Watershed development
- g. Rejuvenation of small rivers and rivulets
- h. Revival of wetlands and protection of flood banks, springshed development, protection of water catchment areas.

2. **Setting up of Jal Shakti Kendras (JSK):** will be established at each district headquarter. JSK will be knowledge centres for disseminating information related to water conservation techniques and will provide technical guidance to people.

3. Enumeration, Inventory and GIS Mapping of all water bodies.

4. Intensive afforestation

5. Awareness Generation

CHALLENGES WITH JSA

- **Lack of scientific approach and planning:** JSA has failed to incorporate scientific water management principles and planning. For instance, JSA treats district as planning unit rather than treating the entire hydrological unit i.e., river basin as a planning unit.
- **Lack of integrated approach to surface and groundwater:** Surface water and ground water cannot be seen in a compartmentalized manner. However, JSA has failed to set up autonomous and knowledge intensive River-basin organizations which can provide integrated information about the surface and ground water within a hydrological unit. There is no data on the basin-wise rainfall, analysis of the surface run-off and mapping of aquifers.
- **Neglects urban areas:** Predominantly focuses on rural areas and neglects urban areas. JSA fails to incorporate water management strategies in the urban areas which may include sewage treatment, checking pollution of water bodies, rainwater harvesting in large residential buildings etc.
- **Quality of Structures:** Presently, JSA is implemented in convergence with government schemes and programs such as MGNREGA. However, concerns have been raised with respect to poor allocation of finances to MGNREGA. Most farm ponds built under JSA may be of poor quality and may collapse in future due to heavy rains, trespassing by farm vehicles, animals etc.

WAY FORWARD

- JSA must be seen as an opportunity to address present water crisis in India and hence various flaws highlighted above must be addressed at the earliest.
- Presently, there is no parameter to measure outcome of this mission-mode campaign. Thus, government must develop a comprehensive parameter which can compare and monitor the long-term water level data prior to and post the implementation of JSA. Such a parameter would enable us to monitor the effectiveness of the JSA on a continuous basis and undertake course correction, if needed.

- Secondly, as the agriculture sector consumes around 80% of the water, efforts must be stepped up to dissuade the farmers from cultivating water-intensive crops such as Paddy, sugarcane etc.
- JSA has failed to incorporate the lessons learnt from our previous failures of the water management strategies. These lessons need to be incorporated to ensure the effectiveness and success of JSA.

7. JAL JEEVAN MISSION

Assured availability of potable water is vital for human development. India has about 17% of the world population but only 4% of the world's freshwater. At present, only 18.33% of rural households have tap water

connection. Lack of access to quality drinking water leads to health, development and socio-economic challenges especially for women who must toil hard to get the water.

Jal Jeevan Mission has been launched as a flagship scheme with a focused attention to provide 55 lpcd safe potable tap water connections to the rural areas of the country by 2024. It focusses on integrated demand and supply side management of water at the local level.

The scheme has a bottom-up approach with Gram Panchayat or Paani Samiti to plan, implement, manage, operate and maintain its in- village water supply infrastructure including water quality surveillance.

CHALLENGES

However, considering the experience of drinking water programs following aspects needs attention.

1. Scheme covers only rural areas. Focus on urban water needs especially in water stressed districts is needed.
2. Effective coordination among states and centre.
3. Extra focus is required on areas where water quality issues.
4. Lack of management skills and requirement of training of members of Paani Samiti, local governments are needed.
5. Convergence through programs such as District Mineral Fund, MGNREGA, Swachh Bharat Abhiyaan, CSR, PPP models etc. should be explored.
6. Training of rural youth to monitor quality of water and technologies such as sensor-based delivery monitoring systems should be explored.
7. User fees should be charged for proper upkeep and maintenance of infrastructure.

Effective provision of drinking water will result in improved health outcomes especially for women and children, rural employment and enhance productivity of people. The program if pursued will improve quality of life and bring ease of living to people in the rural areas.

8. WATERSHED DEVELOPMENT

The guidelines for watershed development component of Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) have been updated recently. The new guidelines have a new focus area on Springshed Development as part of Watershed Development.

ABOUT WATERSHED

- Watershed is a geo-hydrological unit draining to a common point by a system of drains.

- Watershed development refers to the conservation, regeneration and the judicious use of all the natural resources particularly land, water, vegetation and animals and human development within the watershed.
- Watershed is an intricate, dynamic and natural functional unit established by physical relationships and social communication and actions. Thus, watershed as a unit enables planners and implementing agency to consider all inputs, processes and expected outputs systematically which are essential for a holistic development approach.

IMPORTANCE OF WATERSHED DEVELOPMENT

- Large area dependent of rains: Dryland area accounts for 51% of net sown area, 40% of total food production.
- Soil quality is poor, irrigation not available, only one crop is sown that is dependent on monsoons.
- Dryland areas are poorly endowed with natural resources.
- Agriculture yields in dryland areas is low as compared to irrigated lands. Crop failures leading to distress among the farming sector is often seen here.
- Average size of land holdings is small and often do not have monetary resources to invest in inputs to increase productivity of agriculture.
- Poor socio-economic status: These areas have high incidence of poverty, malnutrition, low level of education, poor access to public goods and land degradation.
- Prone to disasters: Dryland areas are prone to droughts, which reduces their resilience. Climate change is expected to increase the vagaries of this region.
- Thus, rainfed agriculture assumes critical importance from the broader perspective of economy, ecology and equity.

STEPS FOR WATERSHED DEVELOPMENT

Watershed development programs have been taken up by government:

- Integrated Watershed Management Program (IWMP)
- Participatory Watershed Development Program launched in 1994.
- Constitution of National Rainfed Area Authority as an expert body to make agriculture economically viable in rainfed areas.

WORKS TO BE TAKEN UNDER WATERSHED DEVELOPMENT

- Effective management of runoff (Field bunding, contour bunding/trenching, land levelling etc.)
- Focus on improving soil & moisture conservation activities such as ridge area treatment, drainage line treatment, rainwater harvesting (check dams, bunds, farm ponds etc), in-situ moisture conservation (mulching).
- Capacity building
- Afforestation
- Horticulture, pasture development for cattle.
- Livelihood activities for asset less persons
- Promotion of MSMEs etc.
- Participatory structures of water management and irrigation management at village level.

CHANGE IN ORIENTATION IN WDC-PMKSY 2.0

1. Shift from mechanical/engineering treatments to more agriculture engineering measures: Implies focus on trees, cropping systems, soil moisture conservation & soil organic matter.
2. Effective use of rainwater by focus on water productivity: Measures to enhance water percolation for storage of rainfall in the soil profile for longer periods, supplementing of moisture deficit in crops with water harvesting by constructing structures like bunds, trenches, farm ponds, diversion weirs, embankments, percolation tanks, check dams etc.
3. Crop systems diversification for risk management; enhancing productivity by adopting water use efficient crops and opting for crop alignment with water availability to provide irrigation at critical stages of crop growth.
4. Risk management plans for adaptation and mitigation of adverse impacts of climate change,
5. Setting up and nurturing of community groups for creation of assets, promote responsible ownership and management.
6. Focus on decentralisation, flexibility, community empowerment and greater role of village level institutions
7. Rejuvenation of springs by taking appropriate activities in watershed development projects.

BENEFITS OF WATERSHED DEVELOPMENT

1. **Economic benefits:**

- a. Security agriculture production and income in the face of climate change and drought risks.
- b. Diversification of crop systems and animal husbandry.
- c. Efficient water harvesting and retention of rainwater in soil.
- d. Improving access to water resources on equitable basis.
- e. Optimal, integrated, sustainable and efficient use of natural resources.
- f. Recognising stake of non-land holding members
- g. Promoting alternative livelihood opportunities, Secondary agriculture, value addition etc.
- h. Access to credit and market linkages, promotion of FPOs & MSMES & SHGs.

2. **Ecological Restoration:**

- a. Ridge to valley approach would result in soil and water conservation improving soil organic carbon.
- b. Increase in green cover and higher moisture in soil. Forests on upper reaches
- c. Sustained community action of natural resources (Soil, groundwater etc) by building of community organisations like User Groups
- d. Supporting user groups with regulatory norms institutionalised through panchayats.
- e. Promotion of simple and accessible technologies based on local knowledge.
- f. Water budget-based crop planning, crop alignment and diversification in favour of less water consuming crops.
- g. Systems of monitoring health of natural resources such as soil, groundwater etc.
- h. Members of user groups and panchayats to be trained to maintain and monitor all natural resources.

3. Socio-economic benefits:

- a. Landless, poor and women to find a place in watershed committee. They would be active members of FPO, SHGs, User Groups etc.
- b. Investment to improve conditions of poorer sections, SC/ST community and women.
- c. Access to community assets will improve condition marginal and landless
- d. Alternative livelihood opportunities to help landless people.

SPRINGSHED DEVELOPMENT

ABOUT SPRINGSHED

- In the mountain regions, groundwater naturally discharges in the form of springs, which occur where a water bearing layer (perched aquifer) intersects with a hill slope and groundwater seeps.
- Springshed is the unit of land where rain falls (recharge area) and then emerges at discharge points of the spring. It is the natural unit for revival and management of springs.

NEED FOR FOCUS ON SPRINGSHED DEVELOPMENT

1. Traditionally only dryland regions have been treated as rainfed. This results in exclusion of other categories of rainfed regions like high rainfall regions, mountainous tracts and cold deserts.
2. Himalayan, North-East, Western Ghats and Eastern Ghats and other hilly areas of states have benefitting from perennial water sources fed by springs. These springsheds have suffered ecological degradation leading to drying up of almost 50% of estimated 4-5 million springs.
3. Especially important source of water for tribal and other vulnerable communities.
4. Reasons for drying of springsheds development:
 - a. Indiscreet use of springsheds.
 - b. Abuse of upper reaches
 - c. Adverse impact on aquifer zones and corresponding recharge zones that feed these springs
 - d. Erratic rainfall pattern
 - e. Seismic activity
 - f. Ecological degradation
 - g. Lack of relevant data for springshed.

INTERVENTIONS FOR SPRINGSHED DEVELOPMENT

- **Needs assessment:** Identifying needs and willingness of community is the first step in the springshed management projects. Participatory resource assessment be involving local especially females can be undertaken.
- **Spring inventory:** It is the mapping and collation of basic information on a set of springs of interest in a geographical area.
- **Data monitoring:** GIS Mapping and database of springs. Use of satellites can also be undertaken.
- Community mobilisation, livelihood creation and capacity building
- Hydrogeological assessments and recharge interventions
- Funding sources and convergence: A whole of government approach can be undertaken with funding to be used from various schemes for rural development such as MGNREGA, FC XV grants etc.

- Identification of springs within the area of watershed.
- Identification & delineation of catchment area along the spring
- Identification of aquifer zone contributing towards perennial flow in spring
- **Springshed recharge works:**
 - Recharge area should be free from waste disposal and defecation.
 - No application of chemicals (fertilisers, pesticides) in the recharge area or near the spring. Need to replace these with eco-friendly methods like composting and integrated pest management.
 - No cutting of trees in the demarcated 'protection and recharge area'.
 - Management should catalyse community action.
 - Community contribution for springshed works.
 - All castes and groups of different socio-economic status should participate, women's participation should be encouraged.
 - Springshed management should integrate formal and people's knowledge.

5 CHAPTER ENVIRONMENTAL CHALLENGES

TOPICS TO BE COVERED

1. Environment Impact Assessment
2. Micro-Plastics
3. Regulations on Extended Producers' Responsibility
4. Single Use Plastic
5. Plastic Waste Management Amendment Rules, 2021
6. E-WASTE
7. Kigali Amendment to Montreal Protocol
8. Ganga Pollution
9. Bioremediation
10. Biomedical-Waste
11. Air Pollution
12. SMOG
13. Bio-digesters

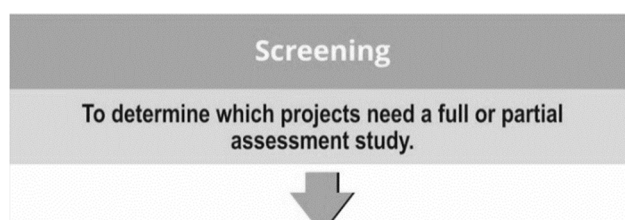
1. ENVIRONMENT IMPACT ASSESSMENT

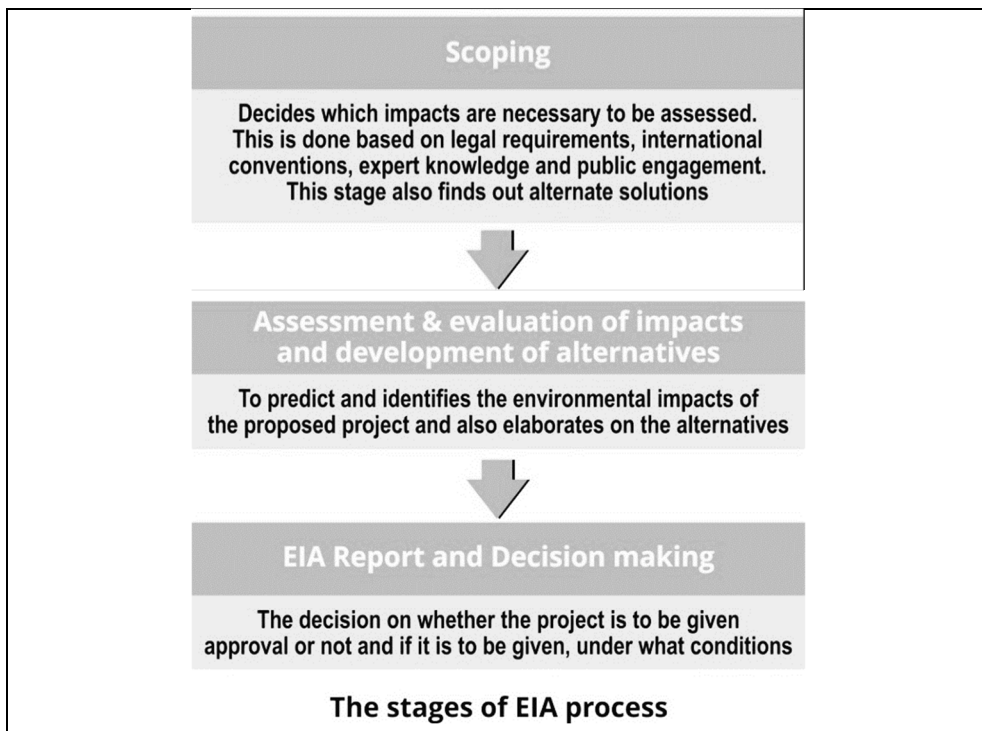
Environmentalists have slammed a plan by the MOEFCC to "rank" and "incentivize" States based on how soon they can issue environmental permits to proposed infrastructure projects, claiming it violates basic environmental principles. According to centre the ranking criteria was not intended to accelerate the speed with which clearances were accorded but to **encourage the SEIAA to take quicker decisions** on approving or rejecting a project and adhere to timelines already specified by the provisions of the Act.

ENVIRONMENT IMPACT ASSESSMENT

- It is a **planning tool to integrate the environmental concerns into developmental process right at the initial stage of planning** and suggest necessary mitigation measures.
- EIA essentially refers to the assessment of environmental impacts likely to arise from a project.
- **Section 3 of the Environment (Protection) Act 1986 (EPA)** gives power to the Central Government to take all measures that it deems necessary or expedient for the purpose of protecting and improving the quality of the environment and preventing and controlling abating environmental pollution. Mandate for EIA has been under this section.

STAGES OF EIA





ISSUES WITH EIA PROCESS

- **Conflict of Interest:** EIA is funded by the same agency which is implementing the project and hence the primary concern of that agency is to obtain clearance.
- **Discretion in the hands of state government:** The problem is that categorising the projects is in the hands of state level committees and these committees are formed by the state governments.
- **EIA reports are plagiarised and often spread misinformation:**
 - Many a times EIA reports are plagiarised. EIA reports of one project is copied and pasted into other defeating the whole purpose. There is also a lack of scientific approach in the way report is prepared.
 - Moreover, since there is no process for punishing the agencies tabling such dishonest EIA reports, there is no deterrence for such acts.
- **Poor quality of EIA professionals:** The individuals involved in the process lack knowledge in the field of environment and ecology.
- **Issues related to public hearing:**
 - Lack of awareness among local people about EIA process.
 - Notification issues due to publication of EIA process in the local newspaper and not in every panchayat. Most of the times local people are unaware of the Public hearing meetings.
 - Unavailability of EIA in local languages affects the capacity of most of the rural people to participate in the process.
 - The issues raised by people in public hearings remains unanswered and they do not know what happens to the issues, nor do they know if the issues raised are reflected in public hearing reports that is presented to Ministry of Environment and forests
- **Lack of larger outlook while conducting EIA:** EIA remains focused on very small aspect of the projects and do not assess the overall impact on ecology.

CRITICISM OF EIA RATING SYSTEM

- Could lead to negligence on behalf of state EIA authorities.
- The system will guarantee that SEIAA's goal is to complete projects in quickest period feasible overlooking environmental concerns.
- Because seasonal variations have an influence on a given area's biodiversity profile, penalising SEIAAs for obtaining extra information more than once may lead to them awarding clearances with insufficient data.
- Generates artificial rivalry between states, which might lead to firms moving in areas that provide speedier environmental clearance.
- The pressures of speed, efficiency, and incentivizing environmental governance may tilt it in favour of business.

DRAFT ENVIRONMENT IMPACT ASSESSMENT RULE 2020

1. **Ex post facto environmental clearance:** This rule allows any industry working in violation of the Environment (Protection) Act to apply for clearance.
2. **Reduction of public consultation:** Generally, the interested stakeholders are given a period of 30 days to raise any concerns regarding the preliminary report of the assessment. The draft EIA 2020 seeks to reduce this period to a mere 20 days.
3. **Reducing the Number of Compliance Reports:** The Compliance Report contains all the norms and regulations which are being followed by industries on a regular basis. It is an essential aspect of EIA since it helps the concerned authorities to put a system of checks and balance. However, as per the draft EIA 2020, this period has been increased to one year, granting unwarranted freedom to industrial units to grossly violate the environmental norms and cover it up with ease.
4. **Empowering the central govt. to declare certain projects as 'strategic':** Once a particular project has been labelled/categorised as 'strategic' by the central government, information regarding it shall be removed from the public domain. Any information regarding environmental violations thus remain a privy to the government.
5. **Exclusion of projects:** Clause 26 of the Draft EIA Notification 2020 excludes a long list of projects from the purview of EIA. Further, Clause 14 of the said Notification excludes a number of projects from public consultation. Further, public consultation has also been exempted for the projects falling under Category B2.

MoEF&CC has published the draft Environment Impact Assessment (EIA) Notification 2020, with the intention of replacing the existing EIA Notification, 2006.

ISSUES PERTAINING TO DRAFT EIA NOTIFICATION 2020

1. **Post-Facto Approval:** It means that the clearances for projects can be awarded even if they have started construction or have been running phase without securing environmental clearances.
 - This also means that any environmental damage caused by the project is likely to be waived off as the violations get legitimised. As the only remedy would be to impose a fine or punishment; but that would not reverse the detrimental consequences on the environment.
 - Post facto approval is the derogation of the fundamental principles of environmental jurisprudence and violation of the "precautionary principle," which is a principle of environmental sustainability.
 - In 2017, post-facto clearance given to projects in Tamil Nadu was struck down by the Madras high court.

2. **Public Consultation Process:** The draft notification provides for a reduction of the time from 30 days to 20 days for the public to submit their responses during a public hearing for any application seeking environmental clearance.
 - The danger is that if adequate time is not given for the preparation of views, comments and suggestions to those who would be affected by the project, then such public hearings would not be meaningful.
 - Unless a public hearing is meaningful, the whole EIA process would lack transparency and credibility.
 - Further, the reduction of time would particularly pose a problem in those areas where information is not easily accessible or areas in which people are not that aware of the process itself.
3. **Compliance Report Issue:** The 2006 notification required that the project proponent submit a report every six months, showing that they are carrying out their activities as per the terms on which permission has been given.
 - However, the new draft requires the promoter to submit a report only once every year.
 - During this period, certain irreversible environmental, social or health consequences of the project could go unnoticed because of the extended reporting time.
 - For example, if a mining project is being carried out at someplace which can be potentially hazardous to the nearby population and can contaminate the air, and water nearby, a half-yearly compliance report would better help in addressing these concerns.
4. **Bypassing EIA Process:** Through the draft notification, the central government gets the power to categorise projects as “strategic.”
 - Once a project is considered as strategic, the draft notification states that no information related to such projects shall be placed in the public domain.
 - Violations can only be reported suo-motu by the project proponent, or by a government authority, appraisal committee, or regulatory authority. This is against the principles of natural justice.
 - Further, the draft notification states that the new construction projects up to 1,50,000 square meters (instead of the existing 20,000 square meters) do not need “detailed scrutiny” by the Expert Committee, nor do they need EIA studies and public consultation.

WAY FORWARD

1. Independent EIA Authority

- Which will be responsible for conducting/regulating EIAs.
- There is a need for Sector wide EIAs.
- It is vital that the EIA be prepared without the involvement of the project proponent.

2. Applicability:

- Without exception, all projects that are expected to have a substantial impact on ecosystems must go through the environmental clearance process.
- No industrial developmental activity should be permitted in ecologically sensitive areas.

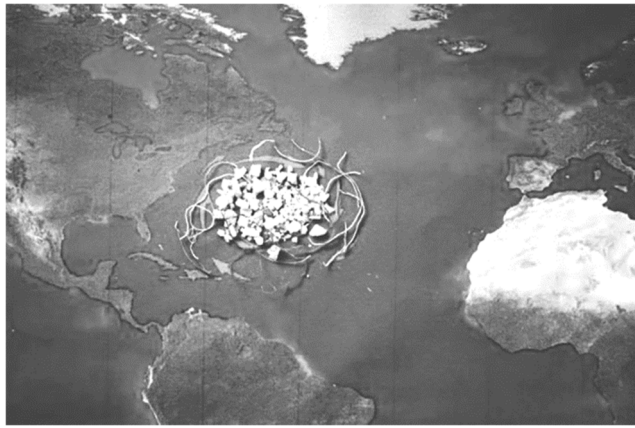
3. Public hearing:

- All previously exempt categories of projects with environmental consequences should be subject to public hearings.

- The focus of EIA should change from natural resource consumption and exploitation to natural resource conservation.
- 4. **Grant of clearance:** The notification should state explicitly that the provision for site clearance does not mean that the effect Assessment agency will provide full environmental clearance.
- 5. **Composition of expert committees:** The present executive committees should be replaced by expert people from various stakeholder groups, who are reputed in environmental and other relevant fields.
- 6. **Monitoring, compliance and institutional arrangements:**
 - The EIA notification should include an automatic withdrawal of clearance if the requirements of clearance are not met, as well as more severe penalties for noncompliance. Currently, EIA notification is limited to the point at which environmental clearance is granted.
 - The composition of the NGT needs to be changed to include more judicial persons from the field of environment.
 - Citizen should be able to access the authority for redressal of all violation of the EIA notification as well as issues relating to non-compliance.
- 7. **Capacity building:**
 - NGOs, civil society groups and local communities need to build their capacities to use the EIA notification towards better decision making on projects.
 - Dissemination of all information related to projects from notification to clearance to local communities and the public.

2. MICRO-PLASTICS

- Microplastics are very small pieces of plastic that pollute the environment.
- Microplastics are not a specific kind of plastic, but rather any type of plastic fragment that is less than 5 mm in length.
- **Micro Plastics are of two kinds:**
 - **Primary microplastics** are any plastic fragments or particles that are already 5.0 mm in size or less before entering the environment. These include microfibers from clothing, microbeads, and plastic pellets (also known as nurdles).
 - **Secondary microplastics** are microplastics that are created from the degradation of larger plastic products once they enter the environment through natural weathering processes.
 - Such sources of secondary microplastics include water and soda bottles, fishing nets, and plastic bags. Both types are recognized to persist in the environment at high levels, particularly in aquatic and marine ecosystems
 - **Troubles with Microplastics:**
- Owing to their small size, microplastics can be ingested by organisms across all trophic levels, enabling transfer of harmful toxic substances. Therefore, determining where microplastics accumulate and their availability for incorporation into the food chain is fundamental to understanding threats to globally important deep-seafloor ecosystems.



IMPACT OF BIO-PLASTICS

- The lack of research on microplastics is a result of their difficulty in identifying.
- They are invisible to the naked eye, hence specialized tools like spectrophotometers are required to identify them.
- It is also little understood how microplastics affect ecologically rich places like mangroves, coral reefs, and kelp beds.
- **Widened reach:** Even the most isolated locations have recently been found to have microplastics, including Mount Everest, Arctic snow, Icelandic glaciers, the French Pyrenees, and the Mariana Trench.
- **Persistent:** The existing plastic degradation mechanisms such as photodegradation (using sunlight) and biological degradation (using microbes) are ineffective as they only breakdown the microplastics rather than degrading them completely.
- **Bio-Integration:** Microplastics can become embedded in animals' tissue through ingestion or respiration.

GOVERNMENT AND GLOBAL INITIATIVES

- India has announced its commitment to eliminate single-use plastic by 2022 at Confederation of Indian Industry's Sustainability Summit in New Delhi.
- Project REPLAN (stands for REducing PLastic in Nature) launched by Khadi and Village Industries Commission (KVIC) aims to reduce consumption of plastic bags by providing a more sustainable alternative.
- The Group of 20 (G20) environment ministers, agreed to adopt a new implementation framework for actions to tackle the issue of marine plastic waste on a global scale.
- Plastic Waste Management Rules, 2016 state that every local body has to be responsible for setting up infrastructure for segregation, collection, processing, and disposal of plastic waste.
- Plastic Waste Management (Amendment) Rules 2018 introduced the concept of Extended Producer Responsibility (EPR).

3. REGULATIONS ON EXTENDED PRODUCERS' RESPONSIBILITY

MOEFCC Ministry published draft regulations on Extended Producer Responsibility (EPR).

ABOUT EXTENDED PRODUCERS' RESPONSIBILITY (EPR)

- It is a policy approach under which producers are given a significant responsibility – financial and/or physical – for the treatment or disposal of post-consumer products.
- Assigning such responsibility could in principle provide incentives to prevent wastes at the source, promote product design for the environment and support the achievement of public recycling and materials management goals.
- In essence, EPR requires the manufacturer of a product, or the party that introduces the product into the community, to take **responsibility for its life cycle**.
- For example: An FMCG company should not only account for the costs of making, packing and distributing a packet of chips, **but also for the collection and recycling/reuse of the packet**.

BENEFITS OF EXTENDED PRODUCER RESPONSIBILITY

EPR leads to:

- Integration of environmental costs
- Improved waste management
- Reduction of disposal
- Reduction of burden on municipalities
- Design of environmentally sound products

ACHIEVEMENTS OF THE DRAFT EPR POLICY

- Brand owners and e-commerce players have been brought under the ambit of EPR.
- EPR is now applicable to both pre-consumer and post-consumer plastic packaging waste.
- Producers and brand owners (PIBO) have finally been assigned targets for collection of plastic waste that they put out in the market.
- Provisions and targets for collection, re-use (by brand owners), recycling (by PBOs) and use of recycled plastic (by PIBOs) have been laid out.
- Bi-annual plastic characterisation studies.

ISSUES WITH THE EPR GUIDELINES

- **Lack of Accountability for Petrochemical Corporations, the Original Manufacturers of Plastic:** An inordinate focus on the end-of-life impacts of plastic often leads us to forget that plastic has a range of environmental and climate impacts across its life cycle, starting from its extraction from fossil fuels.
- **Incomplete Definitions under the Draft Regulations:** The term “plastic packaging” itself is not defined under the Draft. Key descriptors that have been used in Regulation, such as “rigid packaging”, “flexible packaging” and “fresh plastic packaging” have not been defined. It is unclear whether the meaning of “plastic packaging” is limited to the terms “carry bags” and “plastic sheets”.
- **Surplus Trading Mechanism Allows Evasion of Liability:** It also allows PIBOs to meet their target obligations for the year by purchasing EPR surplus certificates from other PIBOs.
- **Weak Compliance and Enforcement Mechanisms:** The EPR obligations envisaged in the Draft Regulations are largely based on self-reporting of the quantities of packaging waste that would be collected and processed.
- **Vague and Limited Constitution of EPR Supervisory Committee:** There is no clarity regarding the constitution of the Committee headed by the CPCB Chairman that is tasked with monitoring the implementation of the EPR Regulations.

- **Inadequate and Harmful End-of-Life Disposal Mechanisms:** With respect to end-of-life plastic disposal, the following mechanisms are proposed: (i) waste-to-energy, (ii) waste-to-oil, (iii) cement kilns for co-processing, and (iv) road construction.
- Waste-to-Energy (“WtE”) plants are known to cause intense, long-lasting, highly toxic and widespread air pollution. WtE incinerators release highly dangerous chemicals, furans and dioxins, which are triggering agents for cancer, and also produce hazardous bottom ash.

4. SINGLE USE PLASTIC

- In 4th **United Nations Environment Assembly**, 2019, India had piloted a resolution on addressing single-use plastic products pollution, recognizing the urgent need for the global community to focus on this very important issue.
- Recently, GoI notified Plastic Waste Management Amendment Rules, 2021, **prohibiting identified single-use plastic items by 2022.**

Single-use plastics are goods that are made primarily **from fossil fuel-based chemicals (petrochemicals) and are meant to be disposed of right after use**—often, in mere minutes. Single-use plastics are most used for packaging and service-ware, such as bottles, wrappers, straws, and bags. Pollution due to single use plastic items has become an important environmental challenge confronting all countries.

India imposed a nationwide ban on plastic bags, cups and straws on Oct. 2nd, 2019 in its most sweeping measure yet to stamp out single-use plastics from cities and villages that rank among the world's most polluted. In this background let us understand various aspects of the single use plastics issue.

CONSEQUENCES OF USING SINGLE USE PLASTIC

- **Non-renewable:** Only 1-13% of the plastic items are recyclable, the rest ends up either buried in the land or water bodies, eventually reaching the oceans, leading to polluting of water bodies and killing of marine life.
- **Pollution:** One of the biggest threats about plastic bags is that they threaten the environment. Plastic bags pollute the land and water, since they are lightweight, plastic materials can travel long distances by wind and water.
- **Energy intensive:** Production of plastic material are very energy intensive. They require a lot of water for their production. Thus, using plastic bags is not advisable.
- **Threat to aquatic life:** Being non-recyclable, plastic bags end up in the oceans. While they reach, they break up into tiny little pieces and are consumed by wildlife. Thereby leading to health issues or even death. Many animals also get entangled or trapped in plastic bags.
- **Harmful to human health:** Toxic chemicals from plastic bags can damage the blood and tissues. Frequent exposures can lead to cancers, birth defects, impaired immunity, hormone changes, endocrine disruption and other serious ailments.

Hence, with climate and environment becoming a rising global concern, plastic pollution and plastic waste management have become the point of worry.

Segregation of waste at sources: plastics, organic, metals, paper, etc.	Effective collection of the segregated waste, transport and safe storage	Cost-effective recycling of materials (Including plastics)	Less landfilling and dumping in the environment
Waste management system design to reduce landfilling and illegal dumping			

PLASTIC WASTE MANAGEMENT RULES AMENDMENT, 2021

- **Prohibition:** The manufacture, import, stocking, distribution, sale and use of following single-use plastic, including polystyrene and expanded polystyrene, commodities shall be prohibited with effect from the 1st of July 2022.
- **Compostable plastic:** The provisions will not apply to commodities made of compostable plastic.
- **Timeline:** The government has given industry ten years from the date of notification to comply with any future bans on plastic commodities other than those included in this notification.
- **Thickness of plastic bags:** The allowable thickness of plastic bags will be increased from 50 mm to 75 microns on September 30, 2021, and to 120 microns on December 31, 2022.
- **Monitoring agency:** The Central Pollution Control Board, along with state pollution bodies, will monitor the ban, identify violations, and impose penalties already prescribed under the Environmental Protection Act, 1986.
- **Extended Producer Responsibility (EPR):** According to the Plastic Waste Management Rules, 2016, the plastic packaging waste that is not covered under the phase out of identified single-use plastic items must be collected and managed in an environmentally sustainable manner through the Extended Producer Responsibility (EPR) of the Producer, Importer, and Brand Owner (PIBO).

CHALLENGES TO PHASE OUT SINGLE-USE PLASTIC

- **Effective waste collection:** India lacks systems for effective waste separation, collection, and recycling.
- **National Policy for recycling plastics:** There is no policy in place for recycling plastics. There are also difficulties in establishing a recycling plant due to environmental concerns voiced by various state Pollution Control Boards.
- **Attitudinal change:** Changing one's behavior to avoid using single-use plastic is difficult.

INDIA'S INITIATIVES

- India has received international praise for its **"Beat Plastic Pollution"** resolution, which was announced on World Environment Day last year and committed to eliminate single-use plastic by 2022.
- India piloted a resolution on combating pollution caused by single-use plastic products at the **fourth United Nations Environment Assembly in 2019.**

DEALING WITH PLASTIC WASTE

Status of domestically generated plastic waste in India

	Plastic waste generation 25,940 tonnes/day (TPD)	Plastic waste collection 15,564 TPD (60% of total)	Uncollected plastic waste 10,376 TPD (40% of total)
	➤ Thickness of polythene bags to be increased from 50 microns to 120 microns from September 30, 2021 		
What's a single-use plastic item? Plastic commodity intended to be used once before being disposed of or recycled	Single-use plastic items to be banned from January 1, 2022 Earbuds with plastic sticks, plastic sticks for balloons, plastic flags, candy sticks, ice-cream sticks and polystyrene (thermocool) for decoration		
Single-use plastic items to be banned from July 1, 2022 Plates, cups, glasses, cutlery such as forks, spoons, knives, straw, trays, wrapping/packing films around sweet boxes; invitation cards; and cigarette packets, plastic/PVC banners less than 100 micron and stirrers			
(Ban will not be applicable on items, including carry bags, that are made of compostable plastic material)			



Circular Economy and reduction of Plastic Use

WAY FORWARD

- **Effective waste management:** India lacks a well-organized system for managing plastic trash, resulting in widespread littering. To strengthen processing, there is a need to invest extensively in increasing waste source segregation and supporting end-to-end waste segregation.
- **Sustainable products:** The government should put money into fostering the formation of businesses that supply sustainable products as an alternative to non-recyclable ones.
- Need for a new **international legally binding agreement** that addresses the entire life cycle of plastics, from extraction of raw materials to legacy plastic pollution.
- **Chemical recycling and upcycling of polymers:** Hitherto management of plastic waste was focused on mechanical recycling of plastic waste. However, strategies have been developed for chemical recycling of plastics into its constituent monomers and subsequently restructured into new polymers used for new plastic production. This will lead to circularity of the plastic ecosystem.
- **Promoting use of waste plastics:** Waste plastics are useful as a structural material and can be utilised as a binder for laying roads, making of blocks, table-tops etc. For example, **Plastone** is a structural material developed which is synthetic granite.
- **Promoting biodegradable bioplastics:** Bioplastics are a broad category of materials encompassing bio-based plastics that can be both biodegradable and non-biodegradable. They are manufactured from diverse sources such as crops and crop waste, wood pulp, fungi etc. with the help of algae or microbes. Examples of biodegradable bioplastics are polylactic acid (PLA) or polyhydroxyalkanoates (PHAs).

Ways to reduce the use of Single Use Plastic

Reduce usage of SUP

- Target the most problematic single-use plastics through assessment
- Identify and engage key stakeholder groups (retailers, consumers, industry representatives, local government, manufacturers, civil society, environmental groups, tourism associations - to ensure broad buy-in).
- Raise public awareness about the harm caused

Encourage Alternatives

- Provide economic incentives to encourage alternatives
- Reduce or abolish taxes on the import of materials used to make alternatives.
- Provide incentives to industry by introducing tax rebates or other conditions to support its transition.
- Use revenues collected from taxes or levies on single-use plastics to maximize the public good.

5. PLASTIC WASTE MANAGEMENT AMENDMENT RULES, 2021

MOEFCC notified Plastic Waste Management Amendment Rules, 2021, **prohibiting identified single-use plastic items by 2022.**

- Pollution due to single use plastic items has become an important environmental challenge confronting all countries.
- In the **4th United Nations Environment Assembly** held in 2019, India had piloted a resolution on addressing single-use plastic products pollution, recognizing the urgent need for the global community to focus on this very important issue.

SALIENT FEATURES

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6. E-WASTE

Electronic waste (e-waste), that is, waste arising from end-of-life electronic products such as computers and mobile phones, is one of the fastest growing waste streams in the world today.

Used electronics which are destined for refurbishment, reuse, resale, salvage recycling through material recovery, or disposal are also considered e-waste. Informal processing of e-waste in developing countries can lead to adverse human health effects and environmental pollution.

CURRENT STATUS

- Annual global production of e-waste is estimated to surpass 50 million tons in 2020.
- India is among the top five e-waste producing countries in the world with estimated annual production of 2 million tons.
- Like some of the other developing countries, **e-waste management in India is dominated by the informal sector** with estimates of more than 90 per cent of the waste being processed in this sector.

- E-waste contains several precious metals, rare earth metals, ferrous and non-ferrous metals, plastic, wood and glass.
- Unscientific practices in the processing of e-waste are associated with several environmental and health externalities.

IMPORTANCE OF E-WASTE AND ITS SOUND MANAGEMENT

- All e-waste is **valuable as it is highly rich in metals** such as copper, iron, tin, nickel, lead, zinc, silver, gold, and palladium. Printed Circuit Boards (PCBs) contain rare and precious metals such as ruthenium, rhodium, palladium, osmium, iridium and platinum – which are together referred to as the Platinum Group Metals (PGM).
- E-waste, if handled and disposed of in an inefficient manner can **lead to extremely damaging impact on human health and the environment**.
- This is mainly because **e-waste comprises hazardous constituents** such as lead, cadmium, chromium, brominated flame retardants or polychlorinated biphenyls (PCBs) that contaminate soil, water and food.

THE PROBLEM OF E-WASTE MANAGEMENT

- **Primarily conducted by informal sector:**
 - Unfortunately, the collection and recycling of e-waste is predominantly being done by the informal or unorganized labour through highly environmentally degradative ways, which cause serious health hazards.
- **High rate of collection but low recovery:**
 - The rate of e-waste collection is very high in India owing to its valuable content.
 - But since most of the e-waste recycling is done by the informal sector in India, wherein recovery of valuable materials ranges between 10–20% only.
- **Exposure of vulnerable section to toxic elements:**
 - The informal sector comprises of unskilled workers, sometimes even children who live near dumps or landfills of untreated e-waste and work in dangerous working conditions without any protection or safety gear.
- **Environmental degradation:**
 - **Non-environmentally sound practices** – such as burning cables to recover copper and unwanted materials in open air – caused environmental pollution and severe health hazards to the operators.
 - Practices like disposal of unsalvageable materials in fields and riverbanks have led to **leaching of heavy metals/chemicals** into land and water.
 - Some of the e-waste is extremely complex in constitution and hence **difficult to recycle**, while the other does not even have environmentally sound recycling technologies.

CHALLENGES IN E-WASTE MANAGEMENT

- **Lack of infrastructure:**
 - Huge Gap between e-waste that is being collected and recycled by authorized dismantlers/recyclers and total quantum of e-waste being generated.
 - Existing recycling facilities face issues from lack of suitable environmentally sound technologies to lack of steady supply of raw materials.
 - Due to lack of awareness among consumers about hazardous impact of inappropriate e-waste recycling, sell their electronic waste to informal recyclers as it is easier and faster.

- Thus, registered recycling units are deprived of a regular supply of e-waste which is crucial for their sustenance. Currently, authorized e-waste recycling facilities in India capture only small amount of the total e-waste generated and the rest makes its way into informal recycling.
- **High cost of setting up recycling facilities:**
 - Advanced recycling technology is expensive and makes large investments risky, especially when sourcing of e-waste is a challenge.
 - Most of the formal recycling companies in India limit their role to only pre-processing of e-waste, wherein the crushed e-waste with precious metals is exported to smelting refineries outside India. An end-to-end solution for e-waste recycling is still not available in India.

NEW AND FUTURE INITIATIVES

Since the implementation of the erstwhile **E-waste (Management and Handling) Rules, 2011** ('Rules 2011') and the more recent **E-waste (Management) Rules, 2016** ('Rules 2016') there has been a growing change in perception of e-waste in the waste recycling market in India.

Electrical and electronic waste with its rich content of valuable metals is increasingly being seen as a harvest point for **urban mining**. Recognizing the potential of the formal e-waste recycling sector in alleviating the environmental issues caused by unscientific methods of handling and disposal of e-waste, **Gol has taken the following new initiatives:**

Extended Producer Responsibility: The linchpin of Rules 2016 is the provision on extended producer responsibility (EPR). Based on the 'polluter pays' principle, it brings in producers who have the wherewithal to collect the end-of-life products placed in the market in the past and, thereby, effectively serves to channelise the electrical and electronic product from cradle-to-grave. The collection targets were revised in 2018. So far, 1151 producers of electrical and electronic equipment in the country have been given EPR authorisation by the Central Pollution Control Board (CPCB).

Boosting the formal e-waste recycling industry: The Amendment to the E-waste (Management) Rules, 2016 was made with the objective of channelizing e-waste generated in the country towards authorised dismantlers and recyclers to formalise the e-waste recycling sector.

Developing an online mass balance system: The government is currently in the process of developing an online mass balance system to monitor the e-waste flow in India. This would enable automated data management, transparency, reduce administrative burden of authorities, shift from traditional paper-based systems to electronic recording, and better enforcement of EPR provisions of Rules 2016.

Conducting a national inventory of E-waste: All State Pollution Control Boards/ Pollution Control Committees have been mandated to develop inventories of e-waste in their respective states/union territories.

Facilitating Producer Responsibility Organisations: The e-waste rules provide producers with the option of using Producer Responsibility Organisations (PROs) to implement EPR.

Some of the future initiatives are listed as follows:

1. Addressing the informal sector

- Bridging the gap between formal and informal sectors.
- Improving the working conditions and minimising the work related to toxic exposure at the e-waste collection, processing, recovery and disposal sites.

2. Access to environmentally sound technologies

- Cost-effective technologies for recycling e-waste such as Li-ion batteries, printed circuit boards, etc.
- R&D on innovative technologies for
- Processing e-waste and effective metal extraction methodologies.

3. Development of sustainable e-waste business models and implementation of pilot projects for different innovations

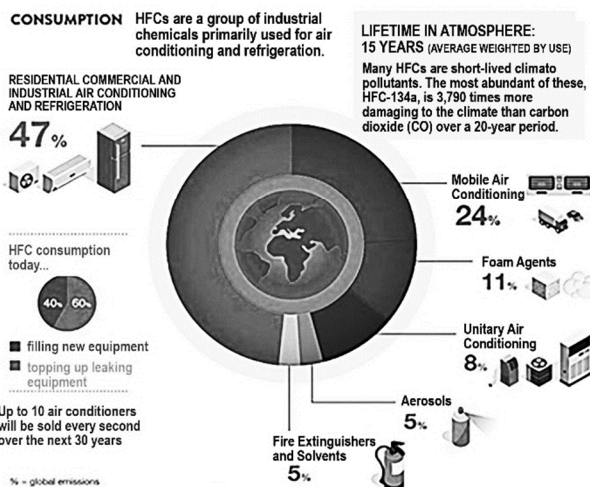
MEASURES TO MANAGE E WASTE

- **Formal collection of e waste** by designated organizations, producers, and/or the government via retailers, municipal collection points, and/or pick-up services.
- **Recycling e-waste:** Recycling e-waste enables us to recover various valuable metals and other materials from electronics, saving natural resources (energy), reducing pollution, conserving landfill space, and creating jobs.
- The value of raw materials in the global e-waste generated in 2019 is equal to approximately \$57 billion USD.
- **E-waste Legislation:** Governments around the world are developing national e-waste policies and legislation that lay out plans or courses of action and indicate, in a non-binding manner, what can be achieved by a society, institution, or company.
 - India passed the first law on e-waste management in 2011
- **E-waste data:** Understanding the quantities and flows of e-waste provides a basis for monitoring, controlling, and ultimately preventing illegal transportation, dumping, and improper treatment of e-waste.
- **Create awareness:** on the environmental benefits of recycling among consumers.
- Ministry of Electronics and Information Technology has initiated an e-waste awareness program under Digital India about the hazards of e-waste recycling by the unorganised sector and educate about alternate methods of disposing their e-waste.

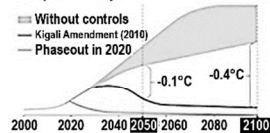
7. KIGALI AMENDMENT TO MONTREAL PROTOCOL

HYDROFLUOROCARBONS (HFCs)

HFCs are powerful man-made greenhouse gases that are rapidly building up in the atmosphere.

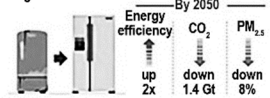


AVOIDING FUTURE EMISSIONS
HFC emissions will quickly grow without action. Under the Kigali Amendment, countries have committed to reduce the production and use of these gases by 85% by 2050. This would avoid up to 0.1°C of warming by 2050 and up to 0.4°C by 2100.



ADDED BENEFITS OF ENERGY EFFICIENCY

Almost 80% of the climate impact from cooling comes from the electricity generated to power the equipment. Improving air conditioning efficiency could cut CO₂ and air pollutant emissions from power generation and as much as double the climate benefit of the Kigali Amendment.



- India recently approved the ratification of the Kigali Amendment to the **Montreal Protocol on Substances that deplete the ozone layer for phase down of Hydrofluorocarbons (HFCs)**. This was adopted by the Parties to the Montreal Protocol in October 2016.

- India's ratification follows a similar move by China and the United States earlier this year and will be the 123rd ratification of the important treaty amendment.

Hydrofluorocarbons (HFCs) are a group of industrial chemicals primarily used for cooling and refrigeration. HFCs were developed to replace stratospheric ozone-depleting substances that are currently being phased out under the Montreal Protocol on Substances that Deplete the Ozone Layer.

PRIMARY HFC SOURCES

HFCs are entirely man-made. They are primarily produced for use in refrigeration, air-conditioning, insulating foams and aerosol propellants, with minor uses as solvents and for fire protection. Most HFCs are contained within equipment, so emissions are the result of wear, faulty maintenance, or leakage at the end of a product's lifetime.

HFCs have only been commercialized since the early 1990s, and their abundance in the atmosphere is currently small. They are, however, among the fastest growing greenhouse gases, largely because of increasing demand for refrigeration and air-conditioning, particularly in developing countries. Emissions of these gases are growing at a rate of 10-15% per year, which will cause a doubling every five to seven years.

SOLUTIONS

HFCs can be most effectively controlled through a phase down of their production and consumption.

In addition to the direct climate benefits from HFC mitigation, a global HFC phase down could also provide indirect benefits through improvements in the energy efficiency of the refrigerators, air conditioners, and other products and equipment that use these chemicals. These efficiency gains could also lead to reduced emissions of CO₂ and other air pollutants.

HYDROFLUOROCARBONS (HFCs) - 56% emissions reduction potential by 2050 (upon execution of policies under the Kigali Amendment)

COOLING AND REFRIGERATION	<ul style="list-style-type: none"> • Replace high-global warming potential hydrofluorocarbons with low- or zero-global warming potential alternatives, combined with improvements in lifecycle energy efficiency • Improve insulation materials and building designs to avoid the use of or reduce the need for air-conditioners
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KIGALI AMENDMENT

- **Origin:** Kigali Amendment enables phase-out of hydrofluorocarbons, a set of chemicals notorious for their capacity to warm the planet.
- **Aim:** It is estimated that a **complete phase-out of HFCs by 2050** would prevent about 0.5°C rise in global temperatures by the end of this century.
- **Binding:** It is a **legally binding agreement** between the signatories, with non-compliance penalties in place to guarantee that it is carried out.
- **Impact:** The **UNEP estimates** that, with Kigali Amendment, the avoided emissions **could touch 420 billion tons of carbon dioxide** equivalents by the end of the century.
- **Common but Differentiated Responsibilities and Respective Capabilities:** The principle of Common but Differentiated Responsibilities and Respective Capabilities is upheld in the Kigali Agreement.
- **Different timelines:** Under the Kigali amendment, **the United States, China and India are in separate group of countries, with different time schedules** to phase out their HFCs and replace them with climate-friendly alternatives.

- **India's plan:** India will complete its phase-down of HFCs in four steps from 2032 onwards with a cumulative reduction of 10 per cent in 2032, 20 per cent in 2037, 30 per cent in 2042 and 80 per cent in 2047.

MONTREAL PROTOCOL

- Montreal Protocol is not a climate agreement. Instead, it aims to protect the planet against ozone-depleting chemicals like chlorofluorocarbons, or CFCs, which were previously employed in the air-conditioning and refrigerant industries. Because of the extensive use of CFCs, a hole in the ozone layer of the atmosphere developed, allowing some damaging radiation to reach the ground.
- **The Montreal Protocol resulted in CFCs being replaced with HFCs, which do not deplete the ozone layer.** They were eventually discovered, however, to be extraordinarily powerful in generating global warming. As a result, the HFCs solved one problem while also contributing significantly to another. These, however, could not be eliminated under the Montreal Protocol's initial terms, which were solely intended to phase out ozone-depleting compounds. **The Kigali Amendment enabled the Montreal Protocol to mandate the elimination of HFCs as well.**

8. GANGA POLLUTION

Rapidly increasing population, rising standards of living and exponential growth of industrialization and urbanisation have exposed water resources, in general, and rivers to various forms of degradation. The mighty Ganga is no exception. The deterioration in the water quality impacts the people immediately. Ganga, in some stretches, particularly during lean seasons has become unfit even for bathing. The threat of global climate change, the effect of glacial melt on Ganga flow and the impacts of infrastructural projects in the upper reaches of the river, raise issues that need a comprehensive response.

Sources of pollution of Ganga River: In the Ganga basin approximately 12,000 million liters per day (mld) sewage is generated, for which presently there is a treatment capacity of only around 4,000 mld. Approximately 3000 mld of sewage is discharged into the main stem of the river Ganga from the Class I & II towns located along the banks, against which treatment capacity of about 1000 mld has been created till date. The contribution of industrial pollution, volume-wise, is about 20 per cent but due to its toxic and non-biodegradable nature, this has much greater significance. The industrial pockets in the catchments of Ramganga and Kali rivers and in Kanpur city are significant sources of industrial pollution. The major contributors are tanneries in Kanpur, distilleries, paper mills and sugar mills in the Kosi, Ramganga and Kali River catchments.

ISSUES FACED IN CLEANING GANGA RIVER

- **Inadequate Sewage treatment:** As opposed to around Four thousand MLD treatment capacity available, Ganga basin produces around twelve thousand MLD sewage.
- **Pollution from Agriculture:** The cumulative use of pesticides has doubled in the last one decade and most of it runs off in our rivers.
- **Disruption of e Flow:** Many interruptions in the flow of the river lead to the reduction in the flow which results in reduced velocity and siltation. This also increases the pollutant concentration. The decrease in flow has led to an increase in groundwater extraction for various uses.
- **Challenges of Swachh Bharat:** About 180 mld sludge would be generated in five Ganga basin states when they become ODF and if proper faecal sludge management is not in place, it would invariably pollute the Ganga.

- **Escalating costs due to delays** in setting up of STPs. An IIT report predicted the cost of treating sewerage to be about 1 paisa per liter at 2010 price levels.
 - NMCG could not utilize any amount out of the Clean Ganga Fund and the entire amount was lying in banks due to non-finalization of action plan.
- **Lack of coordination:** The cleaning of the Ganga requires seamless coordination between the agencies responsible for carrying out different tasks. Jal Shakti ministry signed MOUS with 10 ministries for better implementation of Namami Gange. However, till date no detail is available as to how these ministries are functioning for better convergence.

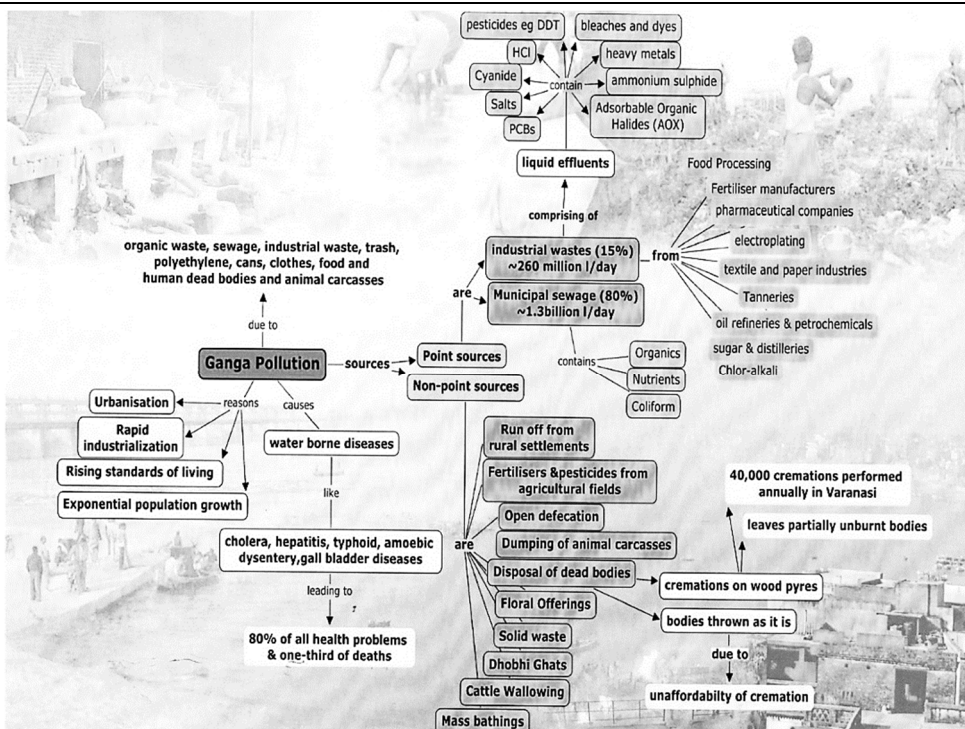
NATIONAL MISSION FOR CLEAN GANGA (NMCG)

It has a five-tier structure at national, state and district level to take measures for prevention, control and abatement of environmental pollution in river Ganga and to ensure continuous adequate flow of water to rejuvenate the river Ganga as below.

1. National Ganga Council under chairmanship of Prime Minister of India.
2. Empowered Task Force (ETF) on river Ganga under chairmanship of Hon'ble Union Minister of Jal Shakti (Department of Water Resources, River Development and Ganga Rejuvenation).
3. National Mission for Clean Ganga (NMCG).
4. State Ganga Committees and
5. District Ganga Committees in every specified district abutting river Ganga and its tributaries in the states.

NMCG has a two-tier management structure and comprises of Governing Council and Executive Committee. Both are headed by Director General, NMCG. Thus, the newly created structure attempts to bring all stakeholders on one platform to take a holistic approach towards the task of Ganga cleaning and rejuvenation.

The Director General (DG) of NMCG is an Additional Secretary in Government of India. For effective implementation of the projects under the overall supervision of NMCG, the State Level Program Management Groups (SPMGs) are, also headed by senior officers of the concerned States.

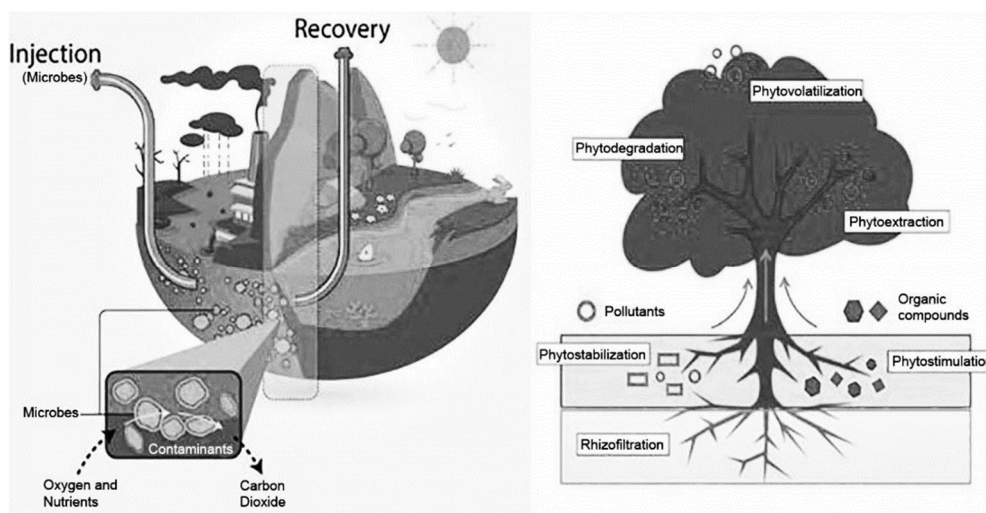


WAY FORWARD

- **Multi-dimensional approach:** Many of the separated approaches like river-linking, riverfront development projects, access to toilets, making villages open defecation free, piped water supply in rural areas, need to integrate long-term ecological and sustainability goals.
- **Organic agriculture:** Agriculture along the entire riverbed should be organic.
- **Liquid Waste Management:**
 - Decentralization of STPs: at the colony level.
 - Reuse treated wastewater for irrigation and empty into natural drains. For all upcoming cities, smart cities and for those, whose master plans are not in place, earmark land for STPs.
- Develop and restore local storages (ponds, lakes, wetlands) as permanent solutions to both floods and droughts. Only 10 per cent of water received during monsoon rainfall is harvested. Restoration of ponds, lakes and wetlands should be an integral part of river restoration and conservation strategy
- **Restoring lower order streams** and smaller tributaries in the Ganga Basin.

9. BIOREMEDIATION

- It is the cleaning of polluted sites through naturally occurring or introduced microorganisms for breaking down environmental pollutants.
- It deals with the use of living microorganisms such as bacteria and fungi to remove contaminants, pollutants and toxins from soil and water. It can be used to clean up environmental problems like an oil spill or contaminated groundwater.
- Bioremediation process involves oxidation-reduction reactions where either an electron acceptor (commonly oxygen) is added to stimulate oxidation of a reduced pollutant (ex. hydrocarbons) or an electron donor (commonly an organic substrate) is added to reduce oxidized pollutants (nitrate, perchlorate, oxidized metals, chlorinated solvents, explosives and propellants).

**Factors for effective microbial bioremediation**

- **Microbial population:** Suitable kinds of microorganisms that can biodegrade all types of contaminants.
- **Oxygen:** Oxygen should be enough to support aerobic biodegradation.
- **Water:** Soil moisture should be from 50-70% of the water holding capacity of the soil (if bioremediation of contaminated soil is taken as an example).

- **Nutrients:** Nitrogen, phosphorus, sulphur, and other nutrients to support good microbial growth.
- **Temperature:** Appropriate temperatures for microbial growth, something between 0-40°C.
- **pH:** Best range of pH should be around 6.5 to 7.5 to ensure good microbial growth and timely biodegradation.

ADVANTAGES OF BIOREMEDIATION

- **Natural Process:** Microbes degrade the contaminant, increase in numbers and release harmless products such as carbon dioxide, water, and cell biomass.
- **Complete destruction:** It is useful for the complete destruction of a wide variety of contaminants.
- **On-site treatment:** This removes the need to transport huge quantities of waste off-site and thus reduce potential harm to human health and the environment that can arise during transportation.
- **Cost-effective:** It is less expensive compared to other methods used for the removal of hazardous waste.

LIMITATION & CHALLENGES WITH BIOREMEDIATION

- **Only for biodegradable:** Bioremediation is limited to those compounds that are biodegradable.
- This method is susceptible to rapid and complete degradation. Products of biodegradation may be more persistent or toxic than the parent compound.
- **Specificity:** Biological processes are highly specific. Factors required for success include presence of metabolically capable microbial populations, suitable environmental growth conditions and appropriate levels of nutrients and contaminants.
- **Technological advancement:** Research is needed to develop and engineer bioremediation technologies that are suitable for sites with complex mixtures of contaminants that are not evenly distributed in environment.
- **Time Taking Process:** Bioremediation takes a longer time to compare to other treatment options, such as excavation and removal of contaminants from site.
- **Regulatory Uncertainty:** We are not certain to say that remediation is 100% completed, as there is no accepted definition of clean. Due to this, the performance evaluation of bioremediation is difficult, and there is no acceptable endpoint for bioremediation treatments.

NEED FOR BIOREMEDIATION

- Global environment is now facing a highly critical situation due to rapid urbanization and industrialization as well as increasing population in limited natural resources. Population growth reflects the drastic changes in the lifestyle of the people that created anthropogenic stress on the environment.
- The world is investing billions of dollars in cleaning up polluted groundwater and soils, yet this large investment may not be producing the benefits that citizens expect. Recent studies have revealed that there are several limitations of the clean-up technologies which have been employed to decontaminate the natural surroundings.
- The main concern is the high cost of the various technologies being employed. Because of the limitations, alternative clean-up technologies, like bioremediation, specifically, in situ bioremediation, have emerged.

With advances in biotechnology, bioremediation has become one of the most rapidly developing fields of environmental restoration, utilizing microorganisms to reduce the concentration and toxicity of various chemical pollutants, such as petroleum hydrocarbons, polycyclic aromatic hydrocarbons, polychlorinated biphenyls, phthalate esters, nitroaromatic compounds, industrial solvents, pesticides, and metals.

PHYTOREMEDIATION

- Phytoremediation technologies use living plants to clean up soil, air, and water contaminated with hazardous contaminants.
- It is defined as "**use of green plants and associated microorganisms, along with proper soil amendments and agronomic techniques to contain, remove or render toxic environmental contaminants harmless**".
- Although attractive for its cost, phytoremediation has not been demonstrated to redress any significant environmental challenge to the extent that contaminated space has been reclaimed.

ADVANTAGES

- the cost of the phytoremediation is lower than that of traditional processes both in situ and ex situ
- the possibility of the recovery and re-use of valuable metals (by companies specializing in "Phyto mining")
- Preserves topsoil, maintaining the fertility of the soil.
- Increase soil health, yield, and plant phytochemicals.
- The use of plants also reduces erosion and metal leaching in the soil.

LIMITATIONS

- Phytoremediation is limited to the surface area and depth occupied by the roots.
- with plant-based systems of remediation, it is not possible to completely prevent the leaching of contaminants into the groundwater (without the complete removal of the contaminated ground, which does not resolve the problem of contamination)
- the survival of the plants is affected by the toxicity of the contaminated land and the general condition of the soil
- bioaccumulation of contaminants, especially metals, into the plants can effect consumer products like food and cosmetics, and requires the safe disposal of the affected plant material
- When taking up heavy metals, sometimes the metal is bound to the soil organic matter, which makes it unavailable for the plant to extract.

10. BIOMEDICAL-WASTE

NGT has recently directed various authorities to ensure compliance from the biomedical waste management facilities in the country.

KEY POINTS

Central Level: The Central Pollution Control Board (CPCB) to ensure strict compliance of biomedical waste management rules and scientific disposal of the waste.

State Level: The Chief Secretaries of all the States/UTs to oversee compliance and ensure that authorisation is secured by every health care facility in their respective jurisdiction and there is adherence to the norms.

District Level: The District Magistrates in accordance with the District Environmental Plans.

Groundwater Contamination: While permitting deep burials, it may be ensured that groundwater contamination does not take place.

Segregation: Ensure that hazardous bio-medical waste is not mixed with the general waste.

Frequent Violation of Rules: The direction came because of regular fines being imposed on various healthcare facilities and biomedical waste treatment facilities

Earlier Observation: The segregation of Covid--19 biomedical waste from general garbage is a must to avoid further contamination adversely affecting public health.

BIO-MEDICAL WASTE MANAGEMENT RULES, 2016

Definition: Biomedical waste is defined as human and animal anatomical waste, treatment apparatus like needles, syringes and other materials used in health care facilities in the process of treatment and research.

Objective: The objective of the rules is to properly manage the per day bio-medical waste from Healthcare Facilities (HCFs) across the country.

Ambit: The ambit of the rules has been expanded to include vaccination camps, blood donation camps, surgical camps or any other healthcare activity.

Phase Out: Chlorinated plastic bags, gloves and blood bags have been phased out within two years starting from March 2016.

Pre-treatment: Pre-treatment of the laboratory waste, microbiological waste, blood samples and blood bags through disinfection or sterilisation on-site in the manner prescribed by the World Health Organization (WHO) or by the National AIDS Control Organisation (NACO).

Categorisation: Bio-medical waste has been classified into 4 categories instead of the earlier 10 categories to improve the segregation of waste at source.

Stringent Standards for Pollutants: The rules prescribe more stringent standards for incinerators to reduce the emission of pollutants in the environment.

Role of State Government: The State Government provides the land for setting up common bio-medical waste treatment and disposal facilities.

CONCERNS

Pandemic: The pandemic has presented a challenge in terms of capacity to scientifically dispose of generated waste and a challenge for civic authorities in charge of its collection and disposal.

Poor Compliance: States are not following the CPCB guidelines on Covid-19 related waste.

In some states, improper segregation of waste has been reported from Covid-19 facilities and quarantine homes.

Non-Segregation: The non--segregation of waste results in the incineration of contaminated plastics producing toxic gases and adding to air pollution.

Increase in Waste: The rise in residential biomedical waste and its collection without adhering to safety protocols could also trigger a surge in caseload.

Health of Workers Associated: Without proper scientific management of such waste, it can potentially affect patients and can affect the concerned workers and professionals.

Discarded masks and gloves risk the lives of thousands of sanitation workers who work often without any protection or training to handle such hazardous material.

SUGGESTIONS

Proper Segregation: Left-over food, disposable plates, glasses, used masks, tissues, toiletries, etc. used by Covid-19 patients should be put in yellow-coloured bags, while used gloves should be put in red bags and sent for sterilisation and recycling at the CBWTFs.

Where waste is not going to incinerators, deep burial systems should be properly maintained as per protocols taking all due precautions to prevent harm to the environment. A deep burial system involves burying biomedical waste in 2-meter-deep ditches and covering them with a layer of lime and soil.

Awareness Campaign: Initiatives like conducting an appropriate program on Doordarshan, All India Radio and other media platforms to create mass awareness about the correct disposal of biomedical waste.

Creating Infrastructure: The government should set up recycling plants across the country (as envisaged under the Smart cities project) under the Public-Private Partnership (PPP) Model.

Coherency in Rules: The Centre should form a national protocol combining the Biomedical Waste Management Rules, 2016 with the guidelines on Extended Producer Responsibility (EPR) for producers of plastic.

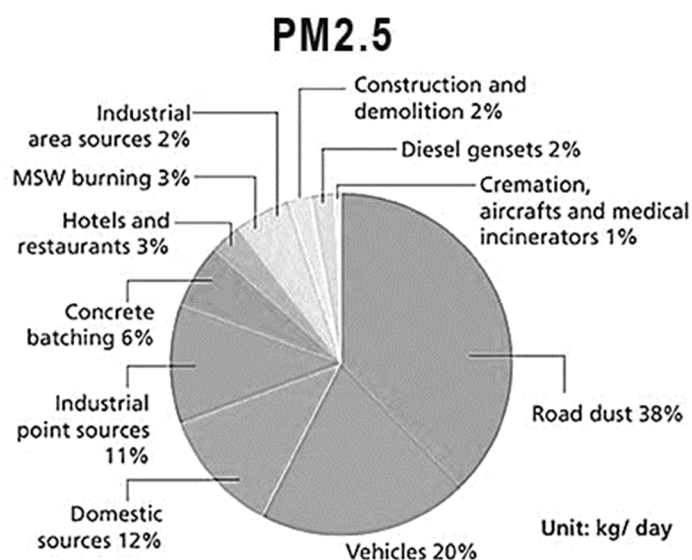
Innovation: Incentivise start-ups and Small and Medium Enterprises (SMEs) offering solutions for waste segregation and treatment.

Monitoring: There should be constant and regular monitoring by the central and state PCBs, Health Departments in the states/UTs and by the high-level task team at Central level with further coordination by CPCB.

11. AIR POLLUTION

In 2019, air pollution led to about 18 percent of all deaths in the country.

In the same year, it resulted in an economic loss of approximately 1.4 percent of GDP.



SOURCES OF AIR POLLUTION

The various sources of air pollution are classified into seven major sectors, which include transportation, industries, agriculture, power, waste treatment, biomass burning, residential, construction, and demolition waste.

VEHICULAR/TRANSPORT EMISSIONS

- The transportation sector is the main contributor of air pollutants in almost every city, but this phenomenon is worse in urban cities.
- Road dust is a major contributor to PM emissions.
- Carbon monoxide (CO), NOX, and NMVOCs are the major pollutants (>80%) from vehicular emissions.

INDUSTRIAL PROCESSES

- Over the last few decades, India has witnessed large-scale industrialisation. This has degraded the air quality in most urban cities.
- Some industries are 'critical' industries that include iron and steel, sugar, paper, cement, fertiliser, copper, and aluminium. The major pollutants comprise SPM, SOX, NOX, and CO2 emissions.

AGRICULTURE

- Agricultural activities produce emissions, which have the potential to pollute the environment.
- Ammonia (NH3) and nitrous oxide (N2O) are the key pollutants released from agricultural activities.
- The other agricultural emissions include methane emissions from enteric fermentation processes, nitrogen excretions from animal manure, such as CH4, N2O, and NH3, methane emissions from wetlands, and nitrogen emissions from agricultural soils (N2O, NOX, and NH3) due to the addition of fertilisers and other residues to the soil.

POWER PLANTS

- The contribution of power plants to air emissions in India is both immense and worrisome.
- Thermal power plants are the main sources of SO2 and TSP emissions, thereby contributing significantly to the emission inventories.

WASTE TREATMENT AND BIOMASS BURNING

In India, about 80% of municipal solid waste (MSW) is still discarded into open dumping yards and landfills, which leads to various GHG emissions apart from the issues of foul odour and poor water quality at nearby localities.

DOMESTIC SECTOR

- Households are identified as a major contributor of air pollution in India.
- Domestic energy is powered by fuels, such as cooking gas, kerosene, wood, crop wastes or cow dung cakes

CONSTRUCTION AND DEMOLITION WASTE

Major source of air pollution in India is waste, which is an outcome of construction and demolition activities.

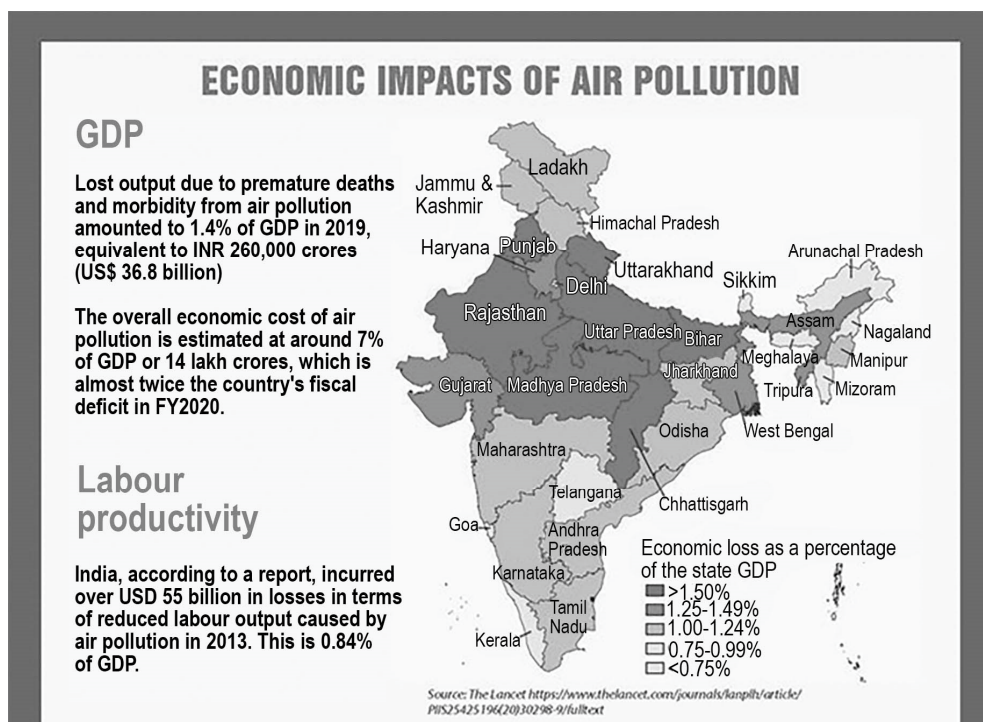
IMPACTS OF AIR POLLUTION

- **Human Health:** According to a study by Centre for Science and Environment (CSE), India's life expectancy has decreased by 2.6 years because of severe diseases induced by air pollution.

- **Economy:** Economic cost of air pollution to Indian economy is estimated to be more than US\$150 billion per year, owing to pollution-related death, disease, and welfare.
- **Climate Change:** including global warming, acid rain, depletion of ozone layer etc.
- **Wildlife:** Toxic chemicals present in the air can force wildlife species to move to new place and change their habitat.

STEPS TAKEN BY GOVERNMENT

- **National Clean Air Program:** This program aims to reduce the levels of air pollution at both regional and urban scales. Target is for reduction of 20-30% of PM 2.5 and PM10 concentration by 2024 by stringent implementation of mitigation measures, augmenting and evolving effective a proficient air quality monitoring networks and augmenting public awareness.
- **Clean Air India Initiative:** to curb air pollution in Indian cities by promoting partnerships between Indian start-ups and build a network of entrepreneurs working on business solutions for cleaner air. Under it, an 'INDUS impact' project aims to halt the burning of paddy stubble by promoting businesses that "up cycle" it by using paddy straw as feedstock to make materials that would find use in construction and packaging.
- **Notification of National Ambient Air Quality Standards,** National Air Quality Index and sector-specific emission & effluent standards for industries to reduce emission of PM 10, SO2 and oxide of nitrogen.
- **Promotion of fuel standards-** Leapfrogging from BS-I to BS-VI fuel and ban on pet coke and furnace oil.
- **Subsidy to cooking fuel** under Pradhan Mantri Ujjwala Yojana (PMUY) to curb indoor pollution.
- **Encouraging Alternatives:** Promotion of public transport and network of metro, e-rickshaws, promotion of car-pooling etc.

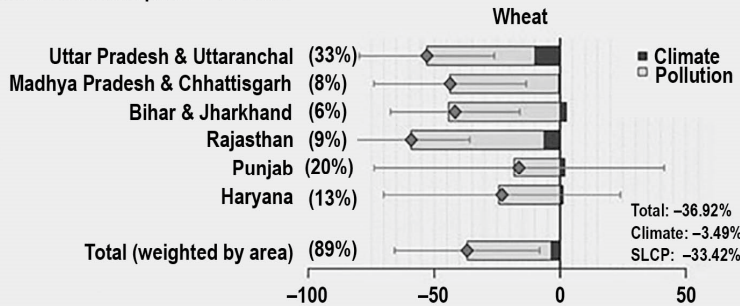


Crop yields and food security

Up to 90 percent of the decrease in potential food production seems to be linked to air pollution, while changes linked to global warming and precipitation levels accounted for the remaining 10%.

India, which produced a record wheat harvest of 100 million tonnes in 2018-19, could have produced 40 million tonnes more if air quality was as clean as it was 50 years ago.

In India, air pollution is cutting yields of wheat and rice crops in half, according to a study from 2014. Researchers mostly attribute this to ground level ozone (O₃), a short-lived pollutant that exists in the atmosphere for weeks.



Source: Down To Earth <https://www.downtoearth.org.in/news/air-pollution-damages-crops-more-than-climate-change-47299>

KEY POLICIES AND INSTITUTIONS FOR MONITORING AND PROMOTING AIR QUALITY

Policy/Institution	Mandate	Year
Central Pollution Control Board	Indias Central Pollution Control Board sets national ambient a quality standards and is responsible for both testing a quality and assisting governments in planning to meet such standards.	1974
Air (Prevention and Control of Pollution) Act of 1981	Provide for the prevention control and abatement of air pollution through boards established under the Act the Central Pollution Control Board.	1981
Environment Pollution Prevention and Control) Authority	The EPCA was constituted with the objective of protecting and improving the quality of the erwonment and preventing and controlling environmental polution in the National Capital Region under the previors of the Emmend Protection Act 1904.	1998-2020
National Ambient Air Quality Standards (NAAQS)	Outlines the standards for ambient air quality.	2009
National Air Quality Index (AQI)	Disseminates information regarding air quality in an area through an understandable form for the general public and the measurement is usually based on 8 pollutants: PM10 PM2.5, NO SO, CO.O., NH, and Pb	2014
National Clean Air Programme	The programme was launched to reach a tentative national target of 20%-30% reduction in PM2.5 and PM10 concentrations by 2024.	2019

Commission for
Air Quality
Management

The permanent Commission envisages a multi-sectoral participatory, multi-state dynamic body with a statutory status.

2020

<https://timesofindia.indiatimes.com/business/india-business/pollution-cuts-solar-yield-by-25/articleshow/58370530.cms>

DELHI POLLUTION

WHY DOES AIR POLLUTION RISE IN OCTOBER EACH YEAR?

October marks the withdrawal of monsoons in Northwest India. Once monsoon withdraws the predominant direction of winds changes to north westerly. According to a peer reviewed study conducted by scientists at the National Physical Laboratory, 72 per cent of Delhi's wind in winters comes from the northwest, while the remaining 28 per cent comes from the Indo-Gangetic plains.

Reduction in Temperatures As temperature dips, the inversion height — which is the layer beyond which pollutants cannot disperse into the upper layer of the atmosphere — is lowered. The concentration of pollutants in the air increases when this happens.

Reduction in wind speed during winters High-speed winds are very effective at dispersing pollutants, but winters bring a dip in wind speed over all as compared to in summers. The combination of these meteorological factors makes the region prone to pollution. When factors such as farm fires and dust storms are added to the already high base pollution levels in the city, air quality dips further.

What roles do farm fires play in Delhi's air pollution?

- Farm fires have been an easy way to get rid of paddy stubble quickly and at low cost for several years. With the use of combine harvesters, the practice became more common as the harvester leaves behind tall stalks, which must be removed before replanting. But the practice gained widespread acceptance starting 2009, when the governments of Punjab and Haryana passed laws delaying the sowing of paddy.
- The aim of passing this law was to conserve groundwater as the new sowing cycle would coincide with monsoons and less water would be extracted.
- This, however, left very little time for farmers to harvest paddy, clear fields and sow wheat for the next cycle. The paddy straw and stalks have high silica content and are not used to feed livestock.
- The easiest, but the least productive, way to get rid of it is to set it on fire.

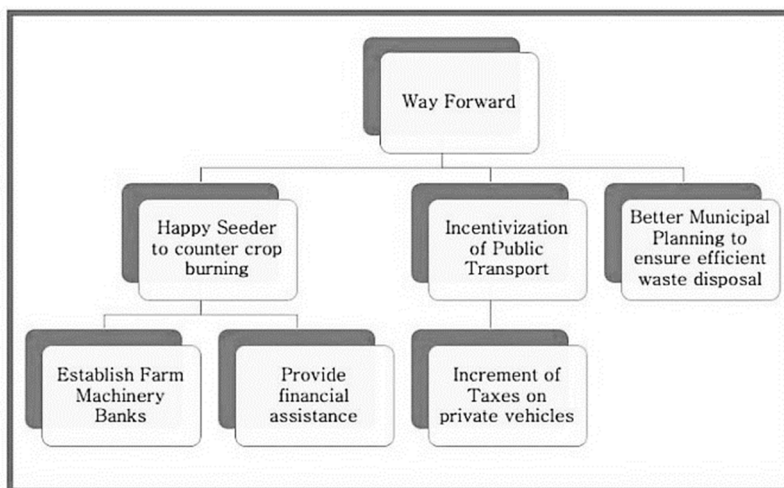
STEPS TAKEN TO COUNTER DELHI'S AIR POLLUTION

- Notification of *graded response action plan* for Delhi identifying source wise actions for various levels of air pollution, etc.
- Leapfrogging from BS-IV to BS-VI standards for vehicles by 1st April 2020.
- Notification of National Ambient Air Quality Standards and sector-specific emission and effluent standards for industries.
- Setting up of monitoring network for assessment of ambient air quality.
- Introduction of cleaner gaseous fuels like CNG, LPG etc. and ethanol blending.
- Launching of National Air Quality Index (AQI).
- Banning of burning of biomass.
- Promotion of public transport network.
- Issuance of directions under Air (Prevention and Control of Pollution) Act, 1981.

- Installation of on-line continuous (24x7) monitoring devices by 17 highly polluting industrial sectors.
- Regulating the bursting of pollution-emitting crackers.
- Smog towers to tackle pollution problem

Benefits of Happy Seeder

- **Pollution Reduction:** Happy Seeder removes the need to burn rice stubble before planting wheat, therefore reducing air pollution.
- **Soil Conservation:** Direct sowing also reduces soil disturbance, enabling it to retain more nutrients and organic content.
- **Water Conservation:** Possibility of sowing wheat in the residual moisture i.e., saving of one irrigation.
- **Better Rabi Yields:** Possibility of sowing wheat crop just after rice harvesting i.e., option for long duration wheat and rice varieties.
- Crop residue as much helps in moisture and temperature conservation.



12. SMOG

Photochemical smog occurs in summer season and hence is also known as summer smog. It is mainly caused by the reaction of sunlight with the nitrogen oxides and other pollutants present in the atmosphere. This reaction results into the formation of secondary pollutants such as ground level ozone. The primary pollutants in photochemical smog are mainly nitrogen oxides such as nitric oxide (NO) and nitrogen dioxide (NO₂) and some other volatile organic compounds. The secondary pollutants are peroxyacyl nitrates (PANs), tropospheric ozone and aldehydes.

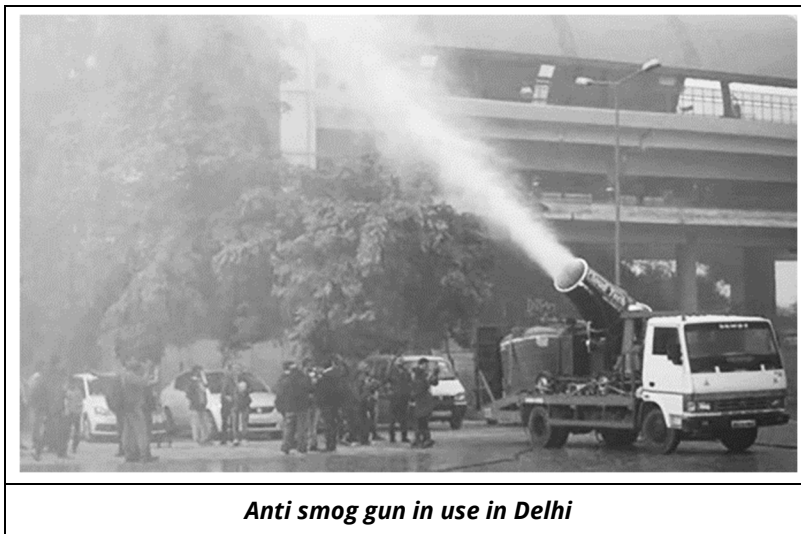
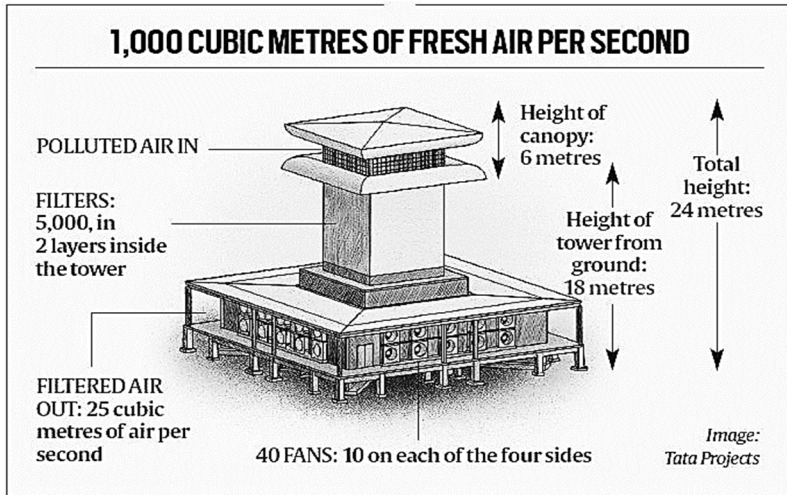
SMOG TOWERS

- A smog tower is a large vertical structure designed as large-scale air purifier to reduce air pollution particles. It is fitted with exhaust fans that will help in sucking polluted air.
- The device will be able to take in air from all 360-degree angles and generate 1,300,000 cubic meters of clean air per hour. (The mammoth purifier will have 48 fans to keep the flow of clean air going)
- The air will be purified by using the highly effective H14 grade highly effective particulate arrestance (HEPA) filter which can clean up to 99.99 per cent of the

particulate matter present in the air in conjunction with a pre-filter and activated carbon.

ANTI-SMOG GUNS

- In India water cannons have been used recently in an attempt to wash out particles.
- The anti-smog gun is a cannon shaped device that sprays atomised water droplets in the air. The gun is attached to a water tank built on a movable vehicle, which can be taken to various parts of the city.



SMOG: CAUSES, IMPACTS AND LONG-TERM SOLUTIONS

SMOG		
Causes	Effects	Solutions
<ul style="list-style-type: none"> • Overpopulation • Fossil fuels • Private cars 	<ul style="list-style-type: none"> • Pulmonary health issues • Lung damage • Lung cancer 	<ul style="list-style-type: none"> • Avoid the use of cars • Home office • Buy from organic food stores
<ul style="list-style-type: none"> • Long transportation distances • Industrial processes 	<ul style="list-style-type: none"> • Long-term health issues • Allergies 	<ul style="list-style-type: none"> • Buy local food • Buy energy-efficient devices
<ul style="list-style-type: none"> • Excessive consumption 	<ul style="list-style-type: none"> • Asthma 	<ul style="list-style-type: none"> • Support green energies

- | | | |
|---|---|--|
| <ul style="list-style-type: none"> • Excessive waste production • Fireworks | <ul style="list-style-type: none"> • Lower life expectancy • Irritation of eyes • Breathing issues • Lower quality of life • Birth defects • Accidents due to bad visibility • Effect on flora and fauna | <ul style="list-style-type: none"> • Reduce waste production • Reduce consumption levels • Reuse and recycle • Protect yourself against smog |
|---|---|--|

13. BIO-DIGESTERS

Bio-decomposer namely Pusa Decomposer developed by Indian Council of Agricultural Research (ICAR) has been used by the States of Punjab, Haryana, Uttar Pradesh and NCT of Delhi to total of 978,713 acres (3,91,485 ha) equivalent to about 2.4 million tonnes of straw management in this year.

Human waste disposal in innocuous form is an ever-growing problem leading to aesthetic nuisance, threat of organic pollution & several infectious diseases in epidemic proportions due to contamination of ground water and drinking water resources in highly populated and developing countries, like India. Less than 30% of Indians have access to the toilets. In rural areas about 10% of houses have toilets and rest of the people go to open defecation. Population in the cities although have better access to the toilets but only to the tune of ~70%. Untreated waste is responsible for several diseases like, dysentery, diarrhoea, amoebiasis, viral hepatitis, cholera, typhoid etc. taking the life of lakhs of children annually.

Bio decomposers degrade and converts the human waste into usable water and gasses in an eco-friendly manner. The generated gas can be utilized for energy/ cooking and water for irrigation purposes.

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.

BIOMASS AS ENERGY

Biomass has always been an important energy source for the country considering the benefits it offers. It is renewable, widely available, carbon-neutral and has the potential to provide significant employment in the rural areas. Biomass is also capable of providing firm energy. About 32% of the total primary energy use in the country is still derived from biomass and more than 70% of the country's population depends upon it for its energy needs. Ministry of New and Renewable Energy has realised the potential and role of biomass energy in the Indian context and hence has initiated several programs for promotion of efficient technologies for its use in various sectors of the economy to ensure derivation of maximum benefits. For efficient utilization of biomass, bagasse-based cogeneration in sugar mills and biomass power generation have been taken up under biomass power and cogeneration program.

Biomass power & cogeneration program is implemented with the main objective of promoting technologies for optimum use of country's biomass resources for grid power generation. Biomass materials used for power generation include bagasse, rice

husk, straw, cotton stalk, coconut shells, soya husk, de-oiled cakes, coffee waste, jute wastes, groundnut shells, saw dust etc.

POTENTIAL

As per a recent study sponsored by MNRE, the current availability of biomass in India is estimated at about 750 million metric tons per year. The Study indicated estimated surplus biomass availability at about 230 million metric tons per annum covering agricultural residues corresponding to a potential of about **28 GW**. This apart, about 14 GW additional power could be generated through bagasse-based cogeneration in the country's 550 Sugar mills, if these sugar mills were to adopt technically and economically optimal levels of cogeneration for extracting power from the bagasse produced by them.

TECHNOLOGY

Combustion

The thermo chemical processes for conversion of biomass to useful products involve combustion, gasification or pyrolysis. The most used route is combustion. The advantage is that the technology used is like that of a thermal plant based on coal, except for the boiler. The cycle used is the conventional rankine cycle with biomass being burnt in high-pressure boiler to generate steam and operating a turbine with the generated steam. The exhaust of the steam turbine can either be fully condensed to produce power or used partly or fully for another useful heating activity. The latter mode is called cogeneration. In India, cogeneration route finds application in industries.

Cogeneration in Sugar and Mills

Sugar industry has been traditionally practicing cogeneration by using bagasse as a fuel. With the advancement in the technology for generation and utilization of steam at high temperature and pressure, sugar industry can produce electricity and steam for their own requirements. It can also produce significant surplus electricity for sale to the grid using same quantity of bagasse. For example, if steam generation temperature/pressure is raised from 400°C/33 bar to 485°C/66 bar, more than 80 KWh of additional electricity can be produced for each ton of cane crushed. The sale of surplus power generated through optimum cogeneration would help a sugar mill to improve its viability, apart from adding to the power generation capacity of the country.

Deployment

Ministry has been implementing biomass power/co-generation program since mid-nineties. Over 800 biomass power and bagasse/non-bagasse cogeneration projects aggregating to 10170 MW capacity have been installed in the country for feeding power to the grid. States which have taken leadership position in implementation of bagasse cogeneration projects are Maharashtra, Karnataka, Uttar Pradesh, Tamil Nadu and Andhra Pradesh. The leading States for biomass power projects are Chhattisgarh, Madhya Pradesh, Gujarat, Rajasthan and Tamil Nadu.

SALIENT FEATURES

- No bad smell in toilets from the tanks
- Faecal matter in the tank not visible
- No infestation of cockroaches & flies
- No clogging of digester
- Effluent is free from off odour and solid waste

- Reduction in pathogens by 99%
- Reduction in organic matter by 90%
- No maintenance required
- No requirement of adding bacteria/ enzyme
- No need of removal of solid waste
- Use of phenyl is permitted upto 84 ppm

AVAILABLE MODELS

- **Microbial inoculum (cold-active)**
 - Isolated, screened, selected and enriched through acclimatization and bio-augmentation
 - Can withstand freezing and thawing
 - Ability to inactivate the intestinal pathogens
- **High altitude model**
 - Material: Metal/FRP of cylindrical shape
 - Works at low temperature as well as high temperature
- **Glacier model**
 - Material: Metal/FRP of cylindrical shape
 - Provided with insulation and heating arrangement with solar system
- **Plain area model**
 - Material: Material: FRP/MS
 - Suitable for existing/independent toilet
 - Also available with top mounted toilets
 - Can be installed for single house / apartment / society / community
- **Island model**
 - Material: FRP
 - Design involves longer path for treatment
 - Suitable for high water usages and areas with high water table
- **Biotank model**
 - Low cost, simple design for onsite construction
 - Material: Brick / RCC structure/ FRP
 - REED BED SYSTEM (optional) improves effluent quality & can also be used to treat kitchen and bathroom wastewater
 - Final effluent safe and can be used for recycling or irrigation
 - Can be installed for single house/ apartment/society / community

BIOGAS

Biogas is produced when bio-degradable organic materials/wastes such as cattle-dung, biomass from farms, gardens, kitchens, industry, poultry droppings, night soil and municipals wastes are subjected to a scientific process, called Anaerobic Digestion (A.D.) in a Biogas Plants. Biogas Plant designs depend upon several factors and the feed stock to be processed is of paramount importance. Biogas is the mixture of gases (primarily methane (CH₄) and Carbon di-oxide (CO₂) and traces of Hydrogen Sulfide (H₂S), Moisture) produced by the decomposition/breakdown of bio-degradable organic matter in the absence of oxygen from raw materials such as agricultural waste,

cattle dung, poultry droppings, municipal waste, plant material, sewage, green waste or food/kitchen waste. Biogas has a calorific value of about 5000 kcal per m³.

The digested slurry produced from Biogas Plants as a by-product is a better source of nutrient enriched organic manure for use in Agriculture. It not only helps in improving the crop yield but also maintain soil health.

There is ample potential of setting up biogas plants considering the livestock population of 512.06 million, which includes about 300 million (299.98 million) total population of bovines (comprising of cattle, buffalo, mithun and yak). The livestock sector contributes about significantly to India's GDP and will continue to increase. The dissemination of biogas technology is a boon for Indian farmers with its direct and collateral benefits.

Biogas contains about 55-65 % of methane, 35- 44 % of carbon dioxide and traces of other gases, such as Hydrogen Sulphide, Nitrogen and Ammonia. Biogas, in its raw form, which is without any purification, can be used as clean cooking fuel like LPG, lighting, motive power and generation of electricity. It can be used in diesel engines to substitute diesel up to 80% and up to 100% replacement of diesel by using 100% Biogas Engines. Further, Biogas can be purified and upgraded up to 98% purity of methane content to make it suitable to be used as a green and clean fuel for transportation or filling in cylinders at high pressure of 250 bar or so and called as Compressed Biogas (CBG).

Initially, Biogas Plants were developed for digesting cattle dung. However, over a period, technology has been developed for the bio-methanation of various types of biomass materials and organic wastes. Biogas plant designs are now available from 0.5 M³ to 1000 M³ unit size or more and multiples of that can be installed for achieving higher Biogas Plant sizes, depending upon availability of the raw material such as for family/ household, small farmers, dairy farmers and for community, institutional and industrial/ commercial applications. The unit size of industrial and municipal wastes-based biogas plants may go up to 15000 M³ to 20000 M³ biogas production per day.

TOPICS TO BE COVERED

1. Green Hydrogen Policy
2. Bio-CNG
3. Fame Scheme
4. Coal Bed Methane
5. Electricity
6. Hydro-electric power
7. Thermal Electricity
8. Geothermal Energy
9. Wind Energy
10. Solar Energy
11. Nuclear power plants (NPP)

1. GREEN HYDROGEN POLICY

Hydrogen and ammonia are expected to replace fossil fuels in the future. Primary criteria for India's ecologically sustainable energy security are production of these fuels using renewable energy. Indian government is taking several steps to make transition from fossil fuels and fossil fuel based feedstocks to green hydrogen & green ammonia easier.

'Green Hydrogen' policy announced by government incentivises producers. According to International Renewable Energy Agency (IRENA), hydrogen will make up 12% of the energy mix by 2050. The agency in its 'World Energy Transitions Outlook' Report also suggested that about 66% of this hydrogen used must come from water instead of natural gas. 'Green hydrogen' is seen as a driving source to power our industries and light our homes with the 'zero emission' of carbon dioxide.

HYDROGEN AS AN ENERGY-RICH SOURCE

- Hydrogen is the most abundant element on the planet, but it is not found in pure form naturally which is required to be used as fuel.
- Has an energy density almost three times that of diesel?
- Has potential to be the key renewable energy alternative in supporting infrastructure sectors.
- Green Hydrogen can function as an energy storage option, which would be essential to meet intermittencies (of renewable energy).

HYDROGEN ECONOMY AND INDIA

- Because of its ideal geographic circumstances and abundance of natural ingredients, India has a tremendous advantage in green hydrogen generation.
- The administration has pushed for the expansion of gas pipeline infrastructure as well as modifications to the electrical grid, including the implementation of smart grids. To efficiently incorporate renewable energy into the current energy mix.

- Producing green hydrogen in India can become cost competitive with the addition of capacity to renewable power production, storage, and transmission, ensuring not just energy security but also progressive self-sufficiency.

GREEN HYDROGEN/ GREEN AMMONIA POLICY

Ministry of Power has notified Green Hydrogen and Green Ammonia policy to promote domestic production capacity of Green Hydrogen and Green Ammonia.

The Union Budget for 2021-22 has announced a **National Hydrogen Energy Mission (NHM)** that will draw up a road map for using hydrogen as an energy source.

INCENTIVES FOR PRODUCTION OF GREEN HYDROGEN





- Any new renewable energy facilities built to produce power for green hydrogen generation before July 2025 will receive **25 years of free power transmission** under the new policy. This means that a green hydrogen producer can procure solar power cheaply from Rajasthan to a green hydrogen plant in anywhere without having to pay **any inter-state transmission fees**.
- The move is likely going to make it more economical for key users of hydrogen and ammonia such as the oil refining, fertiliser and steel sectors to produce green hydrogen for their own use. These sectors currently use grey hydrogen or grey ammonia produced using natural gas or naphtha.
- Government plans to **create a single gateway for all green hydrogen production clearances**, as well as a **mechanism for producers to bank any excess renewable energy** created with discoms for up to 30 days and use it as needed.
- **Requirement of time bound clearances** for these projects would spur investment while grid connectivity on priority will ease operational processes.
- Energy plants set up to produce green hydrogen/ammonia would be **given connectivity to the grid on a priority basis**.
- **Power distribution companies may also procure renewable energy to supply green hydrogen producers** but will be required to do so **at a concessional rate** which will only include the cost of procurement, wheeling charges and a small margin as determined by the state commission.
- Such procurement would also **count towards a state's Renewable Purchase Obligation (RPO)** under which it is required to procure a certain proportion of its requirements from renewable energy sources.
- **Export promotion: Port authorities will also provide land** at applicable charges to green hydrogen and green ammonia producers **to set up bunkers near ports for storage prior to export**. Germany and Japan could be key markets for green hydrogen produced in India.

TYPES OF HYDROGEN

Production techniques of this '**Energy-Carrier**' vary depending upon its applications — designated with different colours such as **black hydrogen, brown hydrogen, blue hydrogen, green hydrogen** etc.

- Black hydrogen is produced by use of fossil fuel.
- Pink hydrogen is produced through electrolysis but using energy from nuclear power sources.
- Brown hydrogen is produced using coal where the emissions are released to the air.
- Grey hydrogen is produced from natural gas where the associated emissions are released to the air.

- Blue hydrogen is produced from natural gas, where the emissions are captured using carbon capture and storage.
- Green hydrogen is a zero-carbon fuel made by electrolysis using renewable power from wind and **solar energy** to split water into hydrogen and oxygen. This 'Green hydrogen' can be used for the generation of power from natural sources — wind or solar systems — and will be a major step forward in achieving the target of 'net zero' emission. Currently, less than 1% of hydrogen produced is green hydrogen.

Color	GREY HYDROGEN	BLUE HYDROGEN	TURQUOISE HYDROGEN	GREEN HYDROGEN
Process	SMR or gasification	SMR or gasification with carbon capture (85-95%)	Pyrolysis	Electrolysis
Source	Methane or coal 	Methane or coal 	Methane 	Renewable electricity 

Note : SMR = steam methane reforming
* Turquoise hydrogen is an emerging decarbonisation option.

BENEFITS OF GREEN HYDROGEN FOR INDIA

- **High Energy demand:** India is the world's fourth largest energy consuming country (behind China, the USA and European Union). According to the IEA's forecast, India will overtake European Union to become world's third energy consumer by the year 2030.
- **Transition to Clean Energy:** Green hydrogen can drive India's transition to clean energy, combat climate change. Under Paris Climate Agreement, India pledged to reduce the emission intensity of its economy by 33-35% from 2005 levels by 2030.
- **Reduction in Import dependency** on fossil fuels.
- **Indigenization of Technology:** Localisation of electrolyser production and development of green hydrogen projects can create a new green technologies market in India.

CHALLENGES IN THE DEVELOPMENT OF GREEN HYDROGEN

- **Technology:** It is a rich source of energy, but the challenge is to compress or liquify it. It needs to be kept at a stable minus 253°C (far below the temperature of (-) 163°C at which Liquefied Natural Gas (LNG) is stored; making its 'prior to use cost' extremely high.
- **Prohibitive Costs:** The 'production cost' of 'Green hydrogen' has been a prime obstacle. Research conducted by the International Renewable Energy Agency (IRENA) indicates that, the cost of its production is about \$1.5 per kg by 2030 (for countries with eternal sunshine and huge unoccupied area) if several conservative measures are implemented.
- **Manufacturing and deployment of electrolyzers will have to increase** at an unprecedented rate by 2050 from the current capacity of 0.3 gigawatts to almost 5,000 gigawatts.
- For transportation fuel cells, hydrogen must be cost-competitive with conventional fuels and technologies on a per-mile basis.
- Fuel cells which convert hydrogen fuel to usable energy for cars, are still expensive. The hydrogen station infrastructure needed to refuel hydrogen fuel cell cars is still widely underdeveloped.

WAY FORWARD

- Commercial use of hydrogen as a fuel and in industries necessitates
 - A massive investment in R&D and infrastructure for hydrogen production

- Investment in storage and transportation infrastructure and demand development.
- Incentives for investment in this sector.
- Mainstreaming other uses of hydrogen such as fuel cells, HCNG etc.

CONCLUSION

- Even oil-producing nations such as Saudi Arabia is prioritising plans to manufacture Green Hydrogen by utilising 'idle-land-banks' for solar and wind energy generation. It is working to establish a mega \$5 billion 'Green hydrogen' manufacturing unit covering a land-size as large as that of Belgium, in the northern-western part of the country. It is high time to catch up with the rest of the world by going in for clean energy, decarbonising the economy and adopting 'Green hydrogen' as an environment-friendly and safe fuel for the next generations.
- The world is presently experimenting the dawning of hydrogen energy in all sectors that includes energy production, storage, and distribution; electricity, heat, and cooling for buildings and households; the industry; transportation; and the fabrication of feedstock. Energy efficiency and sustainability are two important factors driving the transition from the present fossil fuel-based economy to a circular economy, that is, a renewable circular sustainable fuel utilization cycle that will characterize the highly efficient engineering and the energy technological choices of the 21st century.

2. BIO-CNG

Prime Minister inaugurated India's largest bio-CNG plant in Indore. When it reaches full capacity, the plant is expected to process 550 tonnes of organic solid municipal waste per day to produce 17,000 kg of bio-CNG and one hundred tonnes of organic compost.

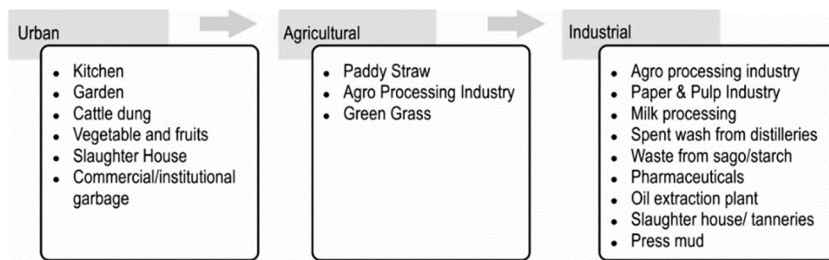
OVERVIEW OF INDIA'S ENERGY SECTOR

- India is among the fastest growing economy in the world and its energy consumption is slated to increase rapidly.
- According to the Ministry of Petroleum and Natural Gas estimates, India has a total reserve of 763 million Metric Ton (MMT) of crude oil and 1,488 billion Cubic Meter (BCM) of natural gas.
- The country currently imports nearly 77% of its crude oil requirements and about 50% of natural gas requirement, leading the Government of India to set a target of reducing this import by at least 10% by 2022.
- Further, it has set a target of increasing the contribution of gas in India's energy mix from existing 6.5% (global average is 23.5%) to 15% by 2022.

ABOUT BIO-CNG

- CNG stands for 'compressed natural gas.' **Bio-CNG is a renewable fuel obtained by purifying biogas** – in contrast to CNG, a non-renewable source of energy.
- Biogas is produced when microbes break down organic matter like food, crop residue, wastewater, etc.
- Waste / Bio-mass sources like agricultural residue, cattle dung, sugarcane press mud, municipal solid waste and sewage treatment plant waste, etc. produce biogas through the **process of anaerobic decomposition**. The biogas is purified to remove hydrogen sulphide (H₂S), carbon dioxide (CO₂), water vapor and compressed as Compressed Biogas (CBG), which has methane (CH₄) content of more than 90%.
- **CBG has calorific value and other properties like CNG** and hence can be utilized as green renewable automotive fuel. Thus, it can replace CNG in automotive, industrial and commercial areas, given the abundance biomass availability within the country.

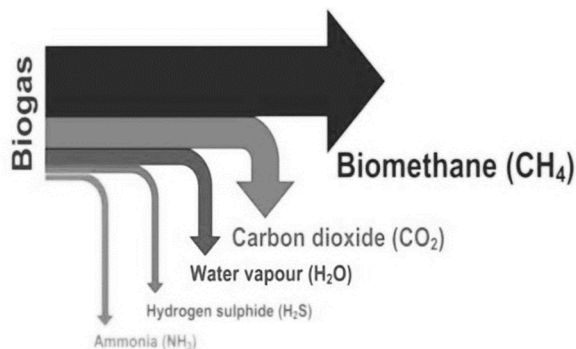
SOURCES OF BIO-CNG



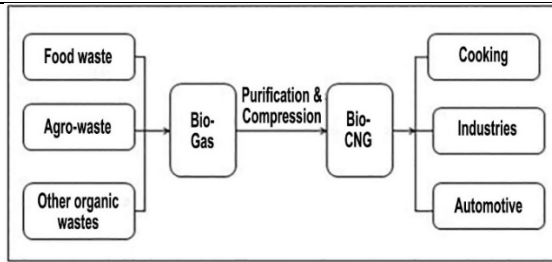
Municipal solid waste comprises organic and inorganic wastes including recyclables which could be sorted out and reused as raw materials. The organic fraction of municipal solid waste can be converted into useful product like organic manure or Methane gas etc. which could be used for cooking, heating and production of energy.

- Bio-degradable (organic matter) (30-55% of weight)
- Inert matter (40-55% of weight)
- Recyclable matter (5-15% of weight)

BIOGAS TO BIO-CNG



- Biogas consists mainly of **methane (CH₄, 55-65%)** and **carbon dioxide (CO₂, 35-45%)** and the calorific value of biogas is ~19500 KJ/Kg. Methane is a valuable form of gas, as it is an efficient energy carrier with a wide range of uses. The amount of CO₂ that is produced corresponds to the amount of CO₂ captured when the biomass was created, making biogas **carbon neutral**.
- Aside from methane and CO₂, biogas also contains trace components like **water vapor, hydrogen sulphide (H₂S), siloxanes, hydrocarbons, ammonia, oxygen, carbon monoxide, and nitrogen**. The proportion of these trace components depends on the source of the biomass. **Presence of water vapor, H₂S, and CO₂ make biogas very corrosive and unsuitable to be used as fuel.** If this biogas is used as fuel in automobiles, it can cause erosion of the metal parts, which in turn increases the maintenance cost of the vehicles. Thus, there is a need to upgrade biogas to tackle this issue.
- **Biogas upgrading or purification** is the process by which contaminants in the raw biogas stream are absorbed or scrubbed, leaving more methane per unit volume of gas. This final product is called **biomethane**.
- The most widely used technologies for biogas upgrading are **water scrubbing, Pressure Swing Adsorption, membrane, and chemical scrubbing**.
- Of these technologies, water scrubbing, and Pressure Swing Adsorption are most appropriate on a small scale due to low cost and easy maintenance.
- Biomethane can also be compressed and bottled into cylinders, and it is called **Bio-Compressed Natural Gas (Bio-CNG) or simply Compressed Biogas (CBG)**.



Flow diagram of Bio-CNG

ABOUT BIO-CNG

- Bio-CNG contains about 92-98 % of methane and only 2-8 % carbon dioxide.
- Calorific value of Bio-CNG is about 52,000 kilojoules per kg, which is 167 % higher than that of biogas.
- High methane content and calorific value combined with the low quantity of moisture, hydrogen sulphide and impurities make Bio-CNG an **ideal fuel for automobiles and power generation**.
- The low emission levels of Bio-CNG make it a more **environment-friendly fuel than biogas**.
- Compressed biogas is exactly like the commercially available natural gas in its composition and energy potential.

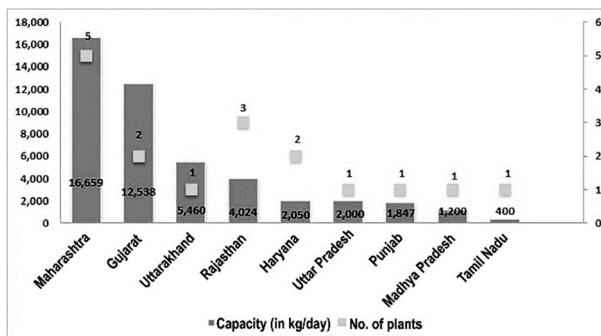
POTENTIAL USES OF BIO-CNG

- **Replace CNG in automotive, industrial and commercial uses in the coming years.**
- **High potential in India:** The potential for compressed biogas production in India is estimated at about **sixty-two million tons per annum due to abundance of biomass**.
- Help **bring down dependency on crude oil imports**.
- **Efficient municipal solid waste management** and in tackling the problem of **polluted urban air due to farm stubble-burning and carbon emissions**.
- Produces **enriched organic manure** which can be **used as fertiliser**.
- **Used in blast furnaces** as it has high calorific value.

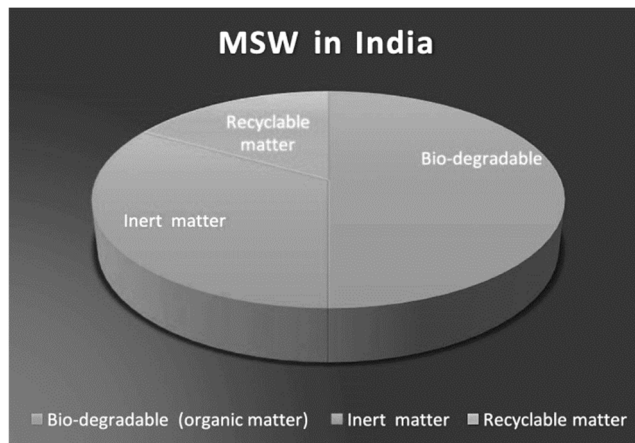
STATUS OF BIO-CNG IN INDIA

In India, Bio-CNG is estimated to replace two-thirds of India’s Natural gas imports, which is currently at 429 billion cubic feet.

Presently, there are 17 Bio-CNG plants operational in India, with a combined capacity of 46,178 kg per day. These plants are spread over nine states, of which Maharashtra leads in terms of the largest capacity as well as the highest number of plants.



State-wise installed Bio-CNG capacity



WASTE TO ENERGY: TECHNOLOGICAL OPTIONS

- **Sanitary Landfills:** Method of controlled disposal of municipal solid waste (refuse) on land.
- **Bio-Methanation:** A process by which organic material is microbiologically converted under anaerobic conditions to biogas.
- **Pyrolysis / Gasification:** Process of thermal conversion of organic matter using a catalyst in the absence of oxygen.
- **Combustion/ Incineration:** Process that involves combustion of substances contained in waste materials.

BENEFITS OF COMPRESSED BIOGAS

- Import reduction of natural gas and crude.
- Utilization of agricultural residue, cattle dung and MSW to produce CBG and thus to achieve reduction in emissions and pollution.
- A boost towards fulfilment of National commitments in achieving climate change goals.
- Providing a buffer against energy security concerns and crude/gas price fluctuations.
- Contribution towards Swachh Bharat Mission through responsible waste management
- Lowering pollution and carbon emission.
- Providing additional source of revenue to the farmers, rural employment and amelioration of the rural economy.

WAY FORWARD

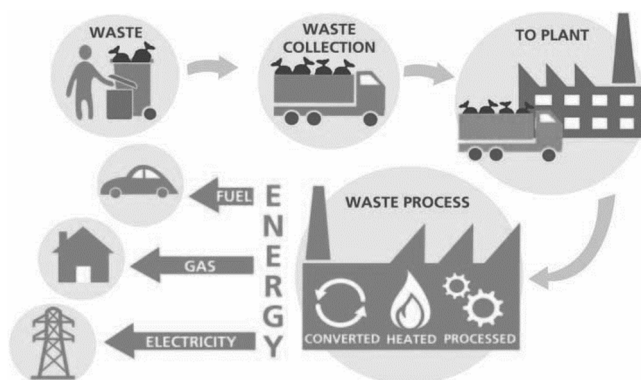
Policy Support

1. **National Policy on Biofuels 2018** emphasizes on promotion of advanced Biofuels including CBG.
2. **Galvanizing Organic Bio-Agro Resources Dhan (GOBAR-DHAN)** scheme to convert cattle dung and solid waste in farms to Bio-CNG (CBG) and compost. GOBAR-DHAN scheme proposes to cover 700 projects across the country in 2018-19.
3. **Central Financial Assistance (CFA) for Bio-CNG** has been notified by Ministry of New and Renewable Energy. Financial assistance under the program is available for **Biogas generation, Bio CNG generation, Power generation from MSW, Biomass Gasifier** etc.

4. **SATAT Initiative:** An initiative of Ministry of Petroleum and Natural Gas that promotes entrepreneurs to set up Compressed Biogas plants, produce and supply CBG to Oil Marketing Companies for sale as automotive and industrial fuels.

CHALLENGES IN PRODUCTION OF BIO-CNG

- **Expensive:** Capital cost for installing a Bio-CNG is expensive. E.g., to produce 400 kg/day of Bio-CNG requires a capital investment of Rs. 1.65 crores while 5000 kg/day requires Rs.16 crores.
- Preliminary processes like collection, transportation, and segregation may also limit the adaptation.
- **Can be installed only where waste generation is abundant.** It is challenging to assure waste sources to produce Bio-CNG and it will not be consistent.
- Production process **requires skilled technicians.**
- **No specific standards** existing in India for installation, operation, and maintenance of these plants.



3. FAME SCHEME

The union government has modified India's ambitious scheme to promote electric mobility and allotted the electric three-wheelers and electric buses component of the Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (Fame) scheme to state run Energy Efficiency Services Ltd (EESL).

In this context, let us understand the need for Electric vehicles, steps taken by the government to incentivise the manufacturing and sale of electric vehicles and challenges being faced by the sector.

WHAT IS FAME?

Faster Adoption and Manufacturing of Electric (Hybrid) Vehicles in India is a scheme under **National Electric Mobility Mission Plan (NEMMP)**

Target of NEMMP - 2020

- **6-7 million** Hybrid & Electric Vehicle sale by 2020
- **9500 million** litres of estimated cumulative fuel saving
- **2 million** tonnes reduction in pollution & green house gas emissions
- **65,000** Direct & **3,00,000** Indirect jobs



NEED TO SWITCH TO ELECTRIC VEHICLE

- **More Energy Efficiency:** Battery-run vehicles have an efficiency of nearly 85% compared to 20% of gasoline-run engines.
- **Crude Oil Imports:** Nearly 80% of India's oil requirement comes from its crude oil imports.

INDIA A POWER SURPLUS COUNTRY

- **Reforms in Coal Mining:**
 - India has recently liberalized its coal sector by privatizing mining and allowing FDI in Coal mining.
 - Besides India has ended its captive mining regime accelerating the commercial mining of coal in India
- Thrust on renewable power generation in India means that many electric vehicles can be powered by solar and wind energy.
- Higher power demand from the electric vehicles can easily be met by domestic power industry, which currently suffers from overcapacity.

Safe and Clean Urban Mobility: Pollution from Internal Combustion engines can be tackled which degrades quality of life in urban areas. India is home to some of the most polluted cities in the world.

Head Start: Many developed countries are moving away from Internal Combustion based engines. India also needs to plan its transition to electric vehicles and ready its large domestic auto industry for this transition in timely fashion.

FASTER ADOPTION AND MANUFACTURING OF ELECTRIC VEHICLES IN INDIA – FAME - II

- **Based on the experience gained in the Phase-I of FAME India Scheme, it has been observed that enough charging infrastructure is required to achieve expected outcome of the plan,** which is being addressed presently in Phase-II of FAME Scheme.
- Department of Heavy Industry notified Phase-II of the Scheme in March 2019 with an outlay of Rs. 10,000 Crore for a period of 3 years commencing from 1st April 2019.
- The **main objective of the scheme is to encourage Faster Adoption of Electric and Hybrid Vehicle by way of offering upfront incentive** on purchase of Electric vehicles and by way of establishing a necessary charging Infrastructure for electric vehicles.
- The scheme will help in addressing the issue of environmental pollution and fuel security. Emphasis is on electrification of the public transportation that includes shared transport.
- The scheme proposes for establishment of charging infrastructure, whereby about 2700 charging stations so that there will be availability of at least one charging station in a grid of 3 km x 3 km. Establishment of Charging stations are also proposed on major highways connecting major city clusters.

THE CHANGES WHICH HAVE BEEN BROUGHT IN THE RECENT NOTIFICATION

- Capped incentives for electric two-wheelers at **40% of the cost of vehicle, up from 20% earlier.**
- **Increased the demand incentive for electric two-wheelers to ₹15,000 per KWh from an earlier uniform subsidy of ₹10,000 per KWh** for all EVs, including plug-in hybrids and strong hybrids except buses.

IMPACT OF THE RECENT CHANGES

- India has a unique mobility pattern which is quite distinct from other countries. The vehicle fleet in India is dominated by two-wheelers which account for almost 80% of vehicles, while premium four-wheelers (costing more than 10 lakhs) account for only 2%. Hence, incentives must be designed keeping in mind the unique aspect of vehicle fleet in India.
- The increase in the demand incentive for the electric two wheelers is expected to increase their demand and hence provide fillip to electric mobility in India.

LIMITATIONS OF LI-ION BATTERIES

The complete fleet of EVs currently is run on Lithium Batteries (LiBs) which poses a major challenge for switch to EVs

- LiBs are expensive.
- They are not suitable for long-distance travel.
- The LiBs used in EVs are about 500 Kgs and makes up for bulk of the weight of the cars.
- LiBs use lithium, cobalt, nickel and manganese which are in short supply in the world restricted to Bolivia, Chile.
- Mining for these minerals degrades local environment.
- Charging lithium batteries will demand very high investments in power generation which might not be met from the renewable sources in near future. Using conventional power to charge batteries is again polluting.

OTHER CHALLENGES

- Charging infrastructure
- Battery recycling. For this government has proposed battery swapping stations.
- Possible Job losses: Besides EVs have lesser number of moving parts (about 20 compared to 2000 in gasoline vehicles) in them as compared to gasoline vehicles. This is because of constant torque generated at all speeds. As a result, the **transmission system, gearbox, clutch etc** are not needed. This results in loss of jobs in the MSME sector in India which produces many of these auto parts.
- Safety of batteries as some of these batteries are found to have issues of catching fire.

WAY FORWARD

- However, India needs auto industry's active participation to ease electric mobility transition.
- The auto and battery industries could collaborate to enhance customer awareness, promote domestic manufacturing, promote new business models, conduct R&D for EVs and components and must consider new business models to promote EVs.
- Government should focus on a phased manufacturing plan to promote EVs, provide fiscal and non-fiscal incentives for phased manufacturing of EVs and batteries.
- Transformation to EVs will create enormous economic, social and environmental benefits for the citizens of India.

4. COAL BED METHANE

- India has *the fifth-largest coal reserves in the world*, and CBM has been looked at as a *clean alternative fuel with significant prospects*.
- India's CBM resources are estimated at around *92 trillion cubic feet (TCF), or 2,600 billion cubic meters (BCM)*.

- The country's coal and CBM reserves are *found in 12 states of India*, with the Gondwana sediments of eastern India holding the bulk.
- Damodar Koel valley and Son valley are prospective areas for CBM development.

WHAT IS COALBED METHANE (CBM)?

It is an unconventional form of natural gas found in coal deposits or coal seams.

CMB is formed during the process of coalification, the transformation of plant material into coal.

USES OF COAL BED METHANE

1. In Power generation.
2. As Compressed natural gas (CNG) auto fuel.
3. As feedstock for fertilizers.
4. Industrial uses such as in cement production, rolling mills, steel plants, and for methanol production.

CHALLENGES AND CONCERNS

1. Methane is a *greenhouse gas* emitted through CBM extraction. *Global methane emissions from coal mines are projected to account for approximately 8 percent of total global methane emissions.*
2. Disturbance of lands drilled and its effect on wildlife habitats results in *ecosystem damage.*
3. CBM production behavior is complex and difficult to predict in the early stages of recovery.
4. Another concern is the effect *water discharges from CBM development could potentially have on downstream water sources.*
5. *Disposal of the highly salinized water that must be removed to release the methane creates a challenge*, as its introduction into freshwater ecosystems could have adverse effects.

OTHER CLEAN COAL USES BEING PROPOSED

1. Coal usage with carbon capture and storage technology.
2. **Coal gasification:** This involves use of chemical process to transform coal into natural gas or other chemicals which are environmentally less degrading. This is especially useful in India context, where India has surplus coal capacity and is deficient in other fossil fuels such as crude oil and natural gas. Thus, coal seam can be used to transformed into natural gas which is a much cleaner fuel.
3. Using coal washing and coal grading techniques to reduce tar.
4. Promoting sustainable rehabilitation and promotion of renewable energy at mine sites after end of their life to salvage the mine site.
5. Employing local people in coal mining industry, giving royalty for local development, Corporate Social Responsibility.

5. ELECTRICITY

- Principal source of energy in the world.

ADVANTAGES

- **Inexhaustibility:** There are many sources of electricity generation and hence they will replace each other. Currently, for India Thermal > Hydro > Nuclear power generation. In Japan where hydroelectric power plants were the important.

- **Cleanliness:** Electricity is much cleaner compared to other sources like coal and oil. It is an invisible source of energy i.e., usage of electricity leaves no mark. However, a lot of pollution is done while producing electricity.
- **Easy to use:** It is highly adaptable. Current flow and voltage can be monitored to suite the requirements. Ideal for use in highly complex industries: precision is very important
- **Convenient to Transport:** Unlike coal or oil, it does not require physical transport, loading and unloading, electricity can be transferred efficiently over long-distance grids. Thus, it has an advantage of reaching difficult and uneconomic areas over coal and oil.
- **Industrial importance:** Indispensable in Information communication, internet and electronic equipment. It has led to decentralisation of manufacturing sector. Earlier access to energy was one of the main considerations for industries to locate. However, since electricity can be easily transported and easy to use, manufacturing industries have decentralized. For ex. Electric arc technology-based steel mills located in NCR region, Automobile industry using manufacturing robots located near NCR, Chennai & Pune etc.

DISADVANTAGES

- **Electricity can only be transported** at relatively short distances as compared to coal and oil and only over the grids, if grid is not there it cannot be transported.
- **Electricity cannot be stored:** It must be used instantaneously. This creates a lot of problems as there is no reserve to fall back to as in the case of coal and oil.
- In industrial areas demands are high when production is going on while in city demand peaks during the day. So, the production must be varied accordingly. This is achieved by running big power plants in full capacity and keeping others on partial capacity so that their production can be altered to meet the variation.

6. HYDRO-ELECTRIC POWER

- Independent source of energy
- Produced from Multipurpose river projects which requires pondage and run of the river projects, these projects do not require pondage.
- **Waterpower:** Running water from river streams, glaciers have been a source of motive power since ancient times and have been the earliest industrial locations even though they are in remote and often in relatively sparse mountainous areas.
- Three important inventions which allowed waterpower to be used to generate electricity and has enhanced its importance as a source of power which was earlier overshadowed by use of fossil fuels.
 1. Development of hydro turbine
 2. Dynamo
 3. Cement: big dams

FACTORS AFFECTING DEVELOPMENT OF HEP

1. **Head of water:** Potential energy or gradient of water flow is necessary for hydropower generation. Thus, naturally occurring sites close to waterfalls and rapids are preferred. Examples: Alps, Scandinavia, Rocky Mountains. Rivers with massive discharge flow but low gradients are also viable for example Volta River in Ghana. Many countries possess **fall line** (At which mountain streams fall to coastal plains, all along the eastern side of Appalachian). There are also artificial dams.

- 2. Large volume of water:** Power generation is proportional to volume of water. Ex: Nile, Indus and Zaire.
- 3. Regular and reliable supply of water:** To ensure continuity and avoid fluctuation of power production. Thus, perennial rivers are preferred. Ex: long draughts in monsoon in Savana and Mediterranean lands decrease discharge in temperate latitudes, its freezing of water. Rainfall should be well distributed throughout the year therefore it is important to build dams to store water and hence river flow can be regulated.
- 4. Presence of lakes during river:** Very useful in seasonal rainfall areas. This obviates the need of reservoir. Allows flood water can be stored easily. In the glaciated areas: Corries and ribbon lakes (Swiss and Britain)
- 5. Space for reservoir:** Suitable location for lake creation (for ex. the destruction to human, agriculture). Gorges have natural advantages: deep, steep slopes, large capacity and usually do not have any other use like agriculture.
- 6. Large market:** Since electricity cannot be stored or transported to large distances, hence there should be a ready market for their production. Availability of alternative fuels should be considered. Multipurpose schemes: power forms the minor component and irrigation and other uses are primary. Here HEP may form the basis of industrial development.
- 7. Heavy capital outlay:** This is due costs of land acquisition and compensation, dam erection, power plant and transmission & round the year maintenance. Since the initial costs are so high, therefore these projects are usually undertaken by government especially the multipurpose projects.

7. THERMAL ELECTRICITY

Thermal electricity is produced by burning other fuels like coal, petroleum and natural gas in thermal generators or specially designed furnaces.

FACTORS AFFECTING LOCATION OF THERMAL POWER

- **Fuel supply:** Many thermal power plants are located near coal fields, oil & natural gas fields or at importing points. Nearness to fuel can greatly reduce the transportation cost of raw materials such as coal.
- **Water supply:** It is required for cooling purposes because much heat is produced and needed to be released and hence nearness to the river lake, estuary or coastal site is preferred.
- **Market:** There are several advantages of nearness to the market. It reduces transmission cost of the generated current. Also, allows the plant to work at full capacity.
- **Economic and political stability:** Many of thermal power plants are privately owned in general. Hence, profitability and economic viability is important. Also, stable political and policy environment is required.

WORLD THERMAL ELECTRICITY GENERATION

- Shows a very similar pattern to the distribution of densely populated industrial areas.
- **Favored areas for Thermal Power Plants (TPP) are:**
 - Major coal fields of the world. (Lignite and even peat are used)
 - Chief oil and natural gas fields where these are near markets.
 - Major oil importing and refining ports.
 - Major industrial regions.
 - Highly urbanized region where there is large demands.

COMPARISON OF HEP AND THERMAL ELECTRICITY GENERATION

- **Effect on environment:** HEP is completely clean source while TPP generates a lot of pollution.
- **Effect on local environment and area:** TPP do little change to the area, while HEP tend to change the surroundings by flooding in an otherwise scenic and biologically diverse areas, especially if there is a plan to attract a large amount of industries dependent on HEP. There is a growing opposition of HEP.
- **Conservation of resources:** TPP use fossil fuels, while HEP uses freely flowing water.
- **Economics of development and operation:**
 - Initial cost of power generation in TPP is lower.
 - TPP is a standard plug and play model. But each HEP plant is carefully designed and meticulously planned to suit local geology, population and market.
 - Maintenance cost TPP is higher than HEP. Because of tremendous heat output of the TPP. In HEP, de-silting and weeding out must be done regularly.
 - Fuel cost of TPP, while HEP is free.
 - Transmission cost HEP > TPP
 - Labour cost TPP >> HEP
 - Output
 - TPP < HEP
 - Output easily controlled in HEP than in TPP
- **Value in the National economy**
 - Value of the HEP is not limited to the power as they are part of the larger **Multipurpose projects**. But TPP are solely for power and serve no other purpose.
 - HPP and TPP most times complement each other with most countries building both. Developed countries like USA have constructed a national grid, to which all the power generating units are connected.
 - TPP's constantly run on full or stable capacity and HEPs (which can be easily and immediately regulated) are altered to meet the changing demands.
- **Future development:**
 - TPP more preferred because they are cheaper to construct and take less time to install. Private. companies usually take the lead unlike HEPs which are very expensive and hence mostly executed by the government and most often they must take loans and foreign support.
 - HEP bring along many other associated problems:
 - Diseases. Ex. mosquitoes.
 - Siltation of dam → greater eroding power for the river downstream

8. GEOTHERMAL ENERGY

It is heat derived within the sub-surface of the earth. Water and/or steam carry the geothermal energy to the Earth's surface.

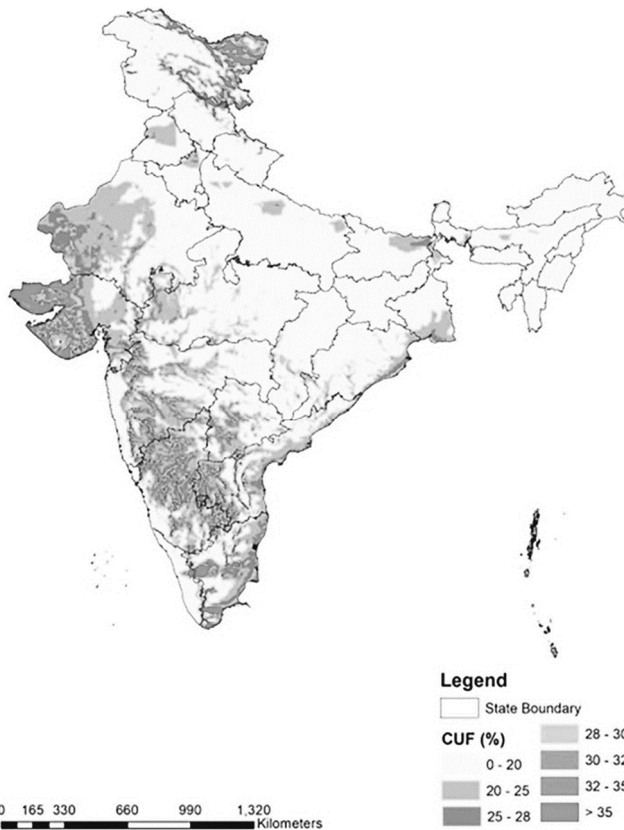
ADVANTAGES	CHALLENGES
Renewable and sustainable	High upfront costs for construction and installation

Not dependent on weather conditions	Connection costs to the local electricity grid may be quite high
Stable energy supply	It cannot be installed where the geothermal gradient is low.
Not dependent on weather conditions	
Low unit price for energy	
Large future expansion prospects	
Creation of local jobs	
Independence from other countries	
No dependence on fossil fuels hence unaffected by their price fluctuations	

9. WIND ENERGY

WIND POWER POTENTIAL

- Viable wind power potential across globe is 72TW, which is four times more than current world's total energy demand.
- India's wind power potential at 120 meters height is estimated to be 695 GW. Current, installed wind power in India is 38 GW.
- Wind power capacity in India can be further enhanced with increase in hub heights, with more turbines going up to 150 m.



STRENGTHS OF WIND ENERGY

1. Wind power constitutes a significant share of India's renewable energy capacity. (46%)
2. India's wind energy sector is mature. India has the world's fourth largest wind capacity.
3. Large degree of indigenization of wind power industry. All wind turbines are made in India and more than 80% of components are made domestically.
4. Water smart electricity: Wind energy is the least water consuming source of electricity. Water requirement is negligible after commissioning as against other forms of electricity generation.
5. Technological advancement: Wind Turbine technology has evolved with focus on greater energy capture and improved capacity utilization. Turbines with larger rotor diameter and higher hub heights are being developed.

SHORTCOMINGS

1. **Land focused wind power policy:** India wind power capacity is entirely land based. There is a need to develop offshore wind power capacities.
2. The earliest wind power projects were established at sites with highest wind power capacity. Thus, India's best wind power sites are not being adequately harnessed for wind power generation.

WAY FORWARD

- Exploring manufacturing and deployment of wind turbines with higher hub heights of 150m and larger turbine size.
- Harnessing offshore wind power potential.
- Supporting and developing domestic manufacturing capacity for efficient and state of art wind turbines.
- Repopulating older and legacy wind power sites with modern turbines at 120 m and above heights and larger turbine capacity.

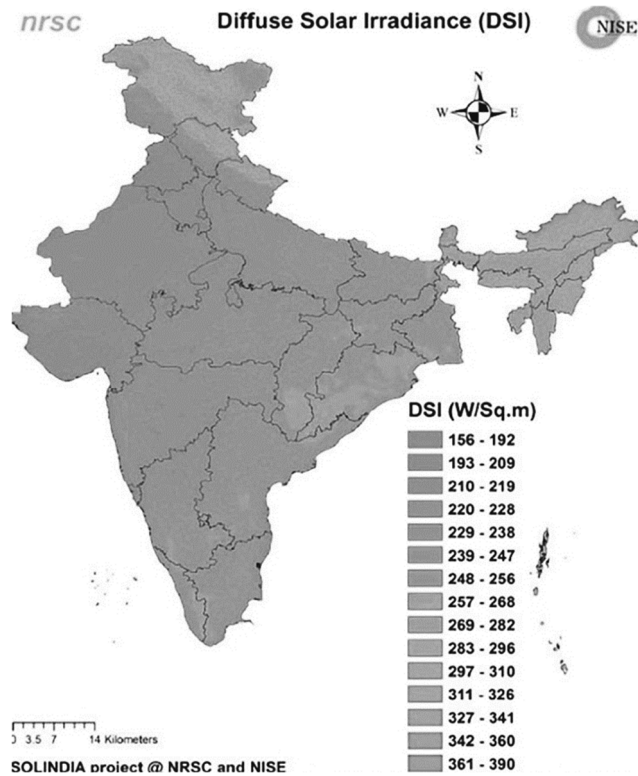
Advantages	Disadvantages
New and Renewable resource	Fluctuating wind speeds alter the production projections.
No greenhouse gas emissions	Threats to avian fauna.
Cheapest among all renewable resource	Create noise pollution
	Land use competition (Agriculture, Housing)
	Often built on remote locations.

10. SOLAR ENERGY

Solar Energy Generation Potential in India

REGIONAL VARIATION IN SOLAR DSI ACROSS INDIA

1. Himalayan region has very high potential of developing solar energy.



DEFECTS IN SOLAR PV MODULES

Defects come in Solar PV modules which lead to lower efficiency of conversion of solar energy to electricity. Some common defects in Solar PV modules are:

1. Due diligence should be exercised while selecting and procuring modules.
2. Degradation of PV modules in hot climates as compared to cooler climates. This is particularly important for India,
3. Micro-cracks caused due to transport and installation phases.
4. Solar power plants should be developed in cold and sunny areas of Himalayas. This region has very low degradation rates of solar PV modules & high-performance ratios. This region is also endowed with highest irradiance in India and easy availability of large stretches of land.

WAY FORWARD

1. Developing solar power plants in regions with high Diffused Solar Irradiance. For ex. Ladakh, Northeast, Odisha etc. and other similar areas for expansion of solar power generation. Grids should be constructed for evacuation of power from this region.
2. Developing solar power plants in wasteland areas.
3. Using better quality and higher efficiency silicon PV modules in solar power plants. For ex. Perovskite solar cells etc.
4. Promoting non-power usages of solar energy such as solar water.
5. Promotion of solar power plants over canals.

Advantages	Disadvantages
New and Renewable resource	Fluctuating wind speeds alter the production projections.

No GHG emissions, water pollution.	Threats to avian fauna.
Cheapest among all renewable resource	Create noise pollution
Very easy to install and get started	Land use competition (Agriculture, Housing)
	Often built on remote locations.

HOW TO MANAGE INDIA'S SOLAR PV WASTE PROBLEM?

What is PV waste?

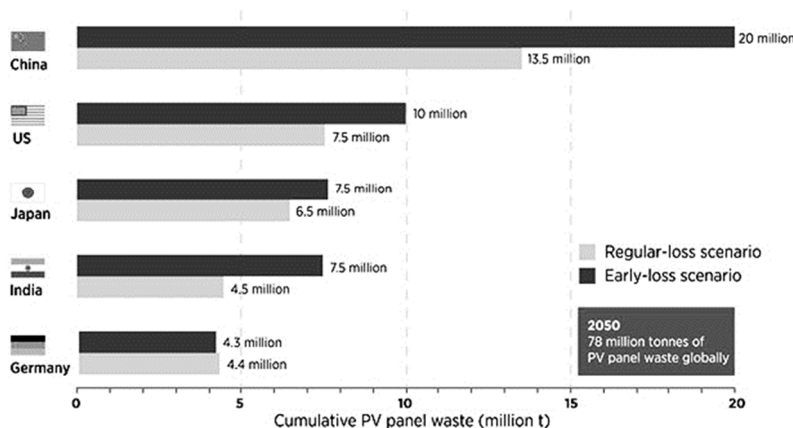
- It is the **electronic waste (e-waste) generated by discarded solar panels and Photo-voltaic (PV) devices.**
- Photovoltaic (PV) devices contain semiconducting materials that convert sunlight into electrical energy.
- A single PV device is known as a cell, and these cells are connected together in chains to form larger units known as modules or panels.
- Although up to 90% of the components are recyclable, many PV modules contain heavy metals such as **cadmium, copper, lead, antimony or selenium**, and when they are taken out of service or broken, they may be classified as hazardous waste.

While photovoltaics generate only about 3 percent of global electricity, they consume 40 percent of the world's tellurium, 15 percent of the world's silver, a substantial chunk of semiconductor-grade quartz and lesser amounts of indium, zinc, tin and gallium. A report, prepared jointly by the International Renewable Energy Agency (IRENA) and the International Energy Agency Photovoltaic Power Systems Programme (IEA-PVPS) highlights that recycling or repurposing solar PV panels at the end of their roughly 30-year lifetime can unlock an estimated stock of 78 million tonnes of raw materials and other valuable components globally by 2050. If fully injected back into the economy, the value of the recovered material could exceed USD 15 billion by 2050.

Present status of Solar PV waste in India

- According to a report prepared by the National Solar Energy Federation of India, India could generate over 34,600 tonnes of cumulative solar waste in India by 2030.

Cumulative waste volumes of PV panels by 2050, by country



- India currently considers solar waste a part of electronic waste and does not account for it separately. Moreover, there is no commercial raw material recovery facility for solar e-waste operational in India.
- A committee had been constituted under the chairmanship of the Ministry's Secretary to propose an action plan to evolve a "circular economy" in solar panel, through reuse/recycling of waste generated.

CHALLENGES IN INDIA

- **Informal handling** - Only about 20% of the waste is recovered in general; the rest is treated informally. As a result, the waste often accumulates at landfills, which pollute the surroundings. Incinerating the encapsulant also releases sulphur dioxide, hydrogen fluoride, and hydrogen cyanide into the atmosphere.
- **No segregation** - PV waste is clubbed with e-waste in India generally.
- **High cost of recycling** - Recycling a solar panel cost between \$20 and \$30, according to the National Renewable Energy Laboratory; sending it to a landfill costs \$1-2.
- **Lack of incentives** - The market to repurpose or reuse recycled PV waste is minuscule in India due to a lack of suitable incentives and schemes in which businesses can invest.

WHAT CAN WE DO ABOUT THEM?

- **Promote recycling** - According to a 2021 report, approximately 50% of the total materials can be recovered. The domestic development of PV waste recycling technologies must be promoted through appropriate infrastructure facilities and adequate funding. New business models, incentives or issues of green certificates to be provided to encourage the recycling industry to participate more.
- **Environmental disposal and recycling** of solar waste could be part of the power purchase agreement SECI / DISCOMS / government signs with project developers.
- **Dedicated Policy formulation** - India should formulate and implement provisions specific to PV waste treatment within the ambit of the e-waste guidelines. EPR for the manufacturer and developers to take responsibility for end-of-life the solar panel.
- **Ban on Landfills:** Solar panel waste is harmful to the environment as it contains toxic metals and minerals that may seep in the ground.
- **Central insurance or a regulatory body** should be set up to protect against financial losses incurred in waste collection and treatment.
- **Research and Development:** Innovation in design may have an impact on the type of waste they generate; technology advancements will be significant in reducing the impact of renewable energy waste. New panels, for example, use less silicon and produce less waste during the manufacturing process.
- **Awareness drives** - Pan India sensitisation drives and awareness programmes on PV waste management will be beneficial.

Global best practices -

- **Europe** - EU imposes responsibility for the disposal of waste on the manufacturers or distributors who introduce or install such equipment for the first time.
- **UK** - PV producers will need to register and submit data related to products used for the residential solar market (B2C) and non-residential market.
- **Australia** - announced a \$2 million grant as part of the National Product Stewardship Investment Fund to develop and implement an industry-led product stewardship scheme for PV systems.

11. NUCLEAR POWER PLANTS (NPP)

FACTORS MAKING NPP ATTRACTIVE

- Initially they started because of rising oil prices
- Strategic purposes: Hope of developing nuclear weapons from waste of power plants.
- Green power
- High operational cost, but very low operational cost once nuclear fuel is secured.
- India is short on uranium, hence dependence on imports to feed its nuclear power plants. Currently, India has 7480 MW. India has signed many pacts with uranium exporting nations to secure uranium fuel supplies. These deals have been facilitated by India-US civil nuclear deal and a special waiver from Nuclear Supplier's Group.
- India plans to double its nuclear power plant capacity in the coming decades.
- India has one of the world's largest reserves of monazite sands located on the coasts of Kerala and Tamil Nadu, which are a rich source of Thorium. This thorium can be exploited to produce nuclear power.
- Currently, technology for producing nuclear power from Thorium has not matured. India is constructing a 500 MW Fast Breeder Reactor based in Kalpakkam, Tamil Nadu. This reactor will pave way for Thorium fuel-based reactors in future. Thorium based nuclear power plants can make India energy secure for thousands of years.

FACTOR WHICH INFLUENCES NPP

- **Environmental degradation**, radioactive waste disposal
- **Nuclear accidents**: Fukushima Daiichi, Chernobyl: massive cleaning costs. Then also remains polluted
- **Long incubation period**, serving time 30-40 years, and then must be decommissioned which involves large capital.
- **Suitable safe sites**: Difficult in densely populated areas.

NUCLEAR PLANT	THERMAL PLANT	HYDRO PLANT
Located in isolated areas away from population.	Located where water and coal and transportation facilities are adequate.	Located where large reservoirs or dams can be created like in hilly areas.
Initial cost is highest as cost of reactor construction is very high.	Initial cost is lower than hydro and nuclear.	Initial cost high due to large dam construction.
Cost of running is low as very less amount of fuel is required.	Running cost is higher than nuclear and hydro due to amount of coal required.	Practically nil as no fuel is required.
Uranium is fuel source along with platinum rods. So enough is available.	Coal is source of power. So limited quantity is available.	Water is source of power which is not a dependable quantity.
Cost of fuel transportation is minimum due to small quantity required.	Cost of fuel transportation is maximum due to large demand for coal.	No cost for fuel transportation.

Better friend of environment than steam power plant.	Least environment friendly.	Most environment friendly.
More efficient than steam power.	25% overall efficiency.	Around 85% efficient.
Maintenance cost is the highest as highly skilled workers are required.	Maintenance cost is very high.	Maintenance cost is quite low.
Less standby losses.	Maximum standby losses as boiler keep running even though turbine is not.	No standby losses.



GSF FOUNDATION - COURSE STRUCTURE

1. WHAT IS GSI - FOUNDATION COURSE ?

GSI Foundation Course – will start from basics and cover the entire length, breadth and depth of the UPSC Prelims and Mains syllabus in an integrated manner.

FOUNDATION CLASSES

≈ 800 HRS

To cover the UPSC prelims and UPSC Mains syllabus from

Basics to Advanced

STUDY MATERIAL

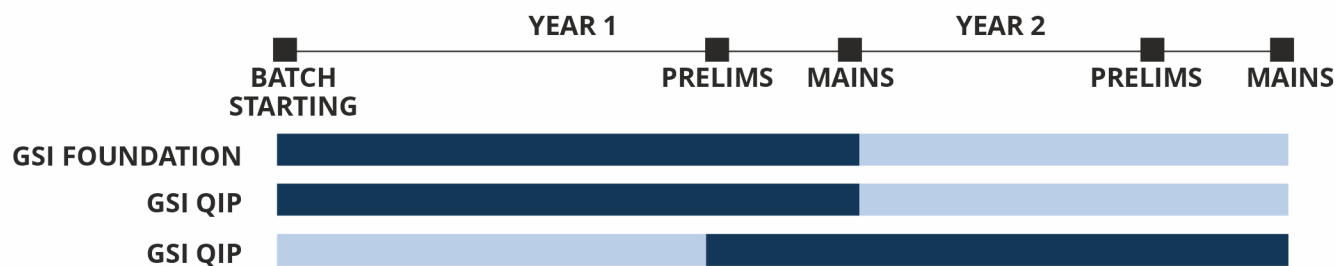
UPSC Exam Centric material will be given at the **time of admission.**

- IAS COMPASS - Foundation Study Material (12 books)
- **FOCUS (Monthly) Current Affairs Magazine**

CLASS TESTS

For effective Absorption & Revision of class teaching After every Teaching module

As a student of GSI Foundation Course, you also get **2 years complimentary subscription to Rau's GSI - Quality Improvement Program (QIP).**



2. WHAT IS GSI - QUALITY IMPROVEMENT PROGRAM ?

GSI QIP – is knowledge and skills enhancement program. Its focus is on improving the quality of your content and its application in Prelims and Mains. It'll cover current affairs, give you lots of test taking practice through Prelims and Mains Test Series and a final Revision for the Prelims and Mains right before the respective exams.

KNOWLEDGE ENHANCEMENT & REVISION CLASSES ≈ 250+ HRS

Current Affairs,
Prelims Revision & Practice,
Mains Revision & Answer Writing,
Essay Revision & Practice

STUDY MATERIAL

In Digital Format

- Focus (Monthly)
- Class Notes (PDFs/PPTs)
- **COMPASS** – Current Affairs Compilations

INTEGRATED PRELIMS & MAINS TEST SERIES

Prelims = 59 Tests
GS Mains = 25 tests
Essay = 5 tests
UPSC PYQ Discussions

Both the courses are taught and delivered by different teams of teachers who work in sync to help you **SUCCEED IN THE EXAM.**

NEW DELHI CAMPUS: ORN CAMPUS

11B, Bada Bazaar Marg, Old Rajinder Nagar,
(Close to Karol Bagh metro station)
New Delhi – 110060
Tel: 011 – 4078 6050, 98101 84722,
94037 05170, 88269 39973

NEW DELHI CAMPUS: CP CAMPUS

309, Kanchenjunga Building, 18 Barakhamba Road,
Connaught Place, (Near Barakhamba Road metro station)
New Delhi - 110001
Tel: 011 – 23318135/36, 4151 2737

BENGALURU CAMPUS

2nd Floor, AKS Plaza, 10 Industrial Layout,
Jyoti Niwas College (JNC) Road,
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