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of

ENVIRONMENT & GEOGRAPHY

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CONTENTS

1 Air Pollution

Context:

Both the indoor and outdoor air pollution is increasing and in the past few years' government have started many steps for controlling air pollution, but implementation is poor. The media coverage continues to focus largely on Delhi but the situation is worse in other states too. According to Greenpeace India report 2018, Uttar Pradesh is India's most polluted state.

What are the causes of Air pollution?

- Fuel wood and biomass burning
- Industrial chimney wastes
- Thermal power stations
- Vehicle emission and traffic congestion
- Large scale crop residue burning in agriculture fields
- Poor Governance
- Access to technology
- Unplanned Urbanization
- Continentality

North South divides in air pollution

- With higher population density, and much larger number of vehicles on road, the amount of pollutants emitted in Northern India is much more than in the south.
- The stark temperature difference between winters and summers not only changes wind patterns, it also raises energy consumption, both fossil fuel and biomass, in North India. Biomass burning, a significant contributor of PM2.5 emissions, spikes in North India during winters because of the intense cold.
- With Himalayas on the north acting as a barrier and limited availability of large water bodies acting as sinks, the dispersion of pollutants is limited in the Northern part of the country, particularly the Indo Gangetic Plain. In contrast, coastal regions in the south have fresh winds coming in and polluted air blown out to the sea, which controls pollutant levels significantly.
- Educational levels being lower in the north probably account for lower environmental awareness, which leads to callous attitude towards environmental issues.

Steps taken to curb Air Pollution

Reducing the deaths and ill health from air pollution is one of the targets of sustainable development goal. The Government has taken a series of steps to address issues related to air & vehicular pollution, industrial pollution etc. in cities, towns and metropolises. The major steps being taken by the Government to control pollution inter alia include the following:

- Notification of National Ambient Air Quality Standards;
- Formulation of environmental regulations / statutes;
- Setting up of monitoring network for assessment of ambient air quality;
- Introduction of cleaner / alternate fuels like gaseous fuel (CNG, LPG etc.), ethanol blend etc.;
- Promotion of cleaner production processes;

- Launching of National Air Quality index by the Prime Minister in April, 2015;
- Decision taken to leapfrog directly from BS-IV to BS-VI fuel standards by 1st April, 2020;
- Taxing polluting vehicles and incentivizing hybrid and electric vehicles;
- Notification of Construction and Demolition Waste Management Rules;
- Ban on burning of leaves, biomass, and municipal solid waste;
- Promotion of public transport network of metro, buses, e-rickshaws and promotion of car pooling, Pollution Under Control, lane discipline, vehicle maintenance;
- Revision of existing environmental standards and formulation of new standards for prevention and control of pollution from industries;
- Planting more trees especially species like Pinus, Juniparus etc.;
- Reduction of use of fossil fuels with replacement by renewable and cleaner energy sources;
- Raising awareness about ozone pollution and adequate precautions that need to be taken by people.

Issues in Implementation

- Corruption
- Weak governance as implementation is poor
- Lack of coordination between Centre and State
- Poor access to pollution information
- Increasing the culture of consumerism
- Not adopting the measures like reuse, recycle and reduce in order to contain waste generation
- There is currently **no air pollution monitoring stations in rural India.**
- Cleaning up the air we breathe will help prevent NCDs, particularly among women and vulnerable groups such as children, those already ill and the elderly.
- Public participation is critical in reducing air pollution. Our choices for electricity and transportation could play a major role in managing pollution levels in many parts of the country.

2 Carbon Tax and Feasibility in India

Context:

India has the world's third largest endowment of coal, which can help double our per capita electricity usage at a relatively low cost. But increased emission of carbon dioxide has posed a great danger to the humanity. Will it be feasible to pose carbon tax in India without affecting the manufacturing sector?

The Benefit of Carbon Tax:

- Carbon tax offers social and economic benefits.
- It is a tax that increases revenue without significantly altering the economy while simultaneously promoting objectives of climate change policy.

- The carbon tax is the most practical method to reduce the fossil fuel consumption.
- It checks the use of fossil fuel.
- It helps India to reach the committed INDC of 33% by 2030.
- This will benefited to protect the environment and ensure good quality of air in cities especially cities like Delhi and Kanpur.
- A carbon tax is a step towards helping India meets their voluntary target to reduce the amount of carbon dioxide released per unit of gross domestic product by 25% from 2005 levels by 2020.
- The clean energy tax will help to finance a National Clean Energy Fund (NCEF). Industry bodies have not favored the levy and fear that the resultant higher price of coal could trigger inflation.
- The carbon tax charges a fee based on the carbon emission. So, to reduce the fee, users try to use less of the fossil fuel.
- The alternative energy such as solar, hydro and wind energy are costlier than the fossil fuel energy. The carbon tax on fossil fuel makes the alternative energy competitive to the fossil fuel. It results in more use of alternative and clean energy. Perhaps, that will help India to promote the flagship programs like International solar Alliance, start up India and Make in India by reducing use of non renewable fossil fuels.
- All the money raised by the tax can help subsidize environmental programs and clean energy, instead of investing more amounts on importing the energy bill from outside the country.
- It can make the correct and more use of fund availability for the programs like afforestation and ISA.
- Carbon tax will increase cost of transport. People will start use of public transport and cycle.
- It makes the people pay for social cost due to negative externalities in form of global warming which affect almost all. This acts as per polluter pay principle.

Disadvantage of Carbon Tax:

- The first and most prominent disadvantage of the carbon tax is the inflation. Today, most of the energy demand is met by the fossil fuel. The carbon tax will make it costly which would have a trickle-down effect on overall inflation.
- Carbon taxes can be a regressive tax, in that they may directly or indirectly affect low-income groups disproportionately. The regressive impact of carbon taxes could be addressed by using tax revenues to favour low-income groups.
- Production may shift to countries with no or lower carbon taxes (so called 'pollution havens').
- The cost of administrating the tax may be quite expensive reducing its efficiency. Higher taxes may encourage firms to hide carbon emissions.

3 Demand for Renewable Energy

Context:

As we already know that India's energy mix is heavily skewed in favor of conventional sources of energy, more particularly coal and big hydro plants, there is growing clamor for increasing share of renewable energy. Renewable sources of energy mainly include –Solar, wind, small Hydro, Waste to energy, Bio energy. These have numerous advantage

over conventional. All Conventional resources use a scarce resource which is expected to exhaust in near future. Even hydro power falls in this category as water is a scarce resource and we have seen that countries are having hard time securing their future water needs. A renewable source on the other hand, uses resources which are abundant from nature. Wind and Solar resources won't exhaust even if fully exploited. Other renewable sources such as waste to energy, bio energy aims to turn waste into resources.

Why needed?

- Fossil fuels are non-renewable and require finite resources, which are dwindling because of high cost and environmentally damaging retrieval techniques. So, the need for cheap and obtainable resources is greatly needed. An efficient and more feasible alternative option is renewable energy.
- Climate is changing and fossil fuel emissions are contributing greatly to that change. By contrast, solar energy panels and wind turbines generate zero emissions in their generation of electricity. Generating electricity from renewable energy rather than fossil fuels offers significant public health benefits.
- Compared with fossil fuel technologies, which are typically mechanized and capital intensive, the renewable energy industry is more labor-intensive. This means that, on average, more jobs are created for each unit of electricity generated from renewable sources than from fossil fuels.

Challenges of Adopting Renewable Energy

- There are serious hurdles in the progress of renewable energy in India; the most important is the financial barrier as the initial cost of setting up renewable energy source is very high.
- The limited availability of evacuation infrastructure and grid interconnections is one of the biggest obstacles to harnessing renewable energy potential.
- Economically viable wind and small hydropower potential remains untapped because of lack of adequate grid evacuation capacity and approach roads.
- India currently offers a wide variety of incentives, including feed-in tariffs; generation-based incentives; Renewable Purchase Obligations (RPOs); central, state, and regional capital subsidies; accelerated depreciation; and tax incentives. The lack of coordination between incentives and state programs makes it difficult to adopt an economics-based least-cost development approach to tapping the country's renewable energy potential.
- Lacks manufacturing base for solar components and systems.
- Heavy dependence on imported solar cells and modules, mainly from China.
- The cost plus approach to tariff setting along with the technology-specific focus has led to incentives that hinder the economic development of India's renewable energy resources.

Way ahead:

- To support growing renewable energy, the expansion of transmission infrastructure, for both intra and inter-state should be strengthened.
- It should be carefully assessed to ensure that domestic content requirement does not hinder the growth of solar capacity.
- Investment in R&D programs, as well as human resource development is necessary in addition to local content requirements.
- Initiatives to be taken for encouraging investment in the renewable energy sector.

- Nation-wide net metering so that homeowners can sell excess energy. This would incentivize installing solar rooftops.
- Strengthen the institutional structure to facilitate effective flow of central financial assistance.

4 India's Waste Management Crisis

Context:

- **Urbanization is increasing all over the planet. Increasing along with it is one of the more unpleasant by-products of urban living: municipal solid waste. It is rapidly becoming a social, environmental and economic catastrophe.**
- **In India, waste management is governed by various sub-ordinate legislations and the Ministry of Environment, Forest and Climate Change, Government of India (MoEF) in conjunct with State Pollution Control Boards of different states (SPCB) administer the gamut of waste management regulations. However still waste management crisis have been neglected in India, which may have deadly consequences.**
- **Recently National Green Tribunal pulled up the Delhi government and the East Delhi Municipal corporation over the Ghazipur landfill collapse that killed two people.**

The required reforms in governance sector are:

- To better utilize the services of rag pickers and waste dealers, legal identity and protective gear like boots and gloves should be provided. The rag pickers can be seen in action on top of the landfill. As soon as a truck unloads garbage, they jump into the heap and start segregating. Within minutes, all that is left is unsalable waste. They bleed every day and catch infection. It is time the government provided some space to the rag-pickers for the job they do. They cannot operate in somebody's backyard or adjacent to a drain forever.
- Waste management in developing countries must emphasize and be linked to the creation of jobs, poverty alleviation and community participation.
- National policies should promote efficiency in the use of resources, emphasizing waste prevention and the productive use of wastes.
- Soil degradation and decline in soil organic carbon and soil fertility are widespread. The use of recycled organic products can help to counter this and at the same time reduce accumulation of organics in the city. The rural-urban alliance should be promoted.
- Waste Managementshould be the integral part of Swachh Bharat Mission.

Other alternatives to landfills:

- Onsite treatment and utilisation will reduce need for transport.
- Waste minimization is a socially desirable goal.
- Subsidy on products generated from recycled materials will encourage socio-economic changes.
- Centers with technologies that use collected waste materials are needed.
- Wastes that have severe risks and excessive problems in disposal should be identified and those which cannot be neutralized may need to be restricted at the point of creation or entry.
- A database on wastes that are available can provide information to possible users of wastes.

- Segregation at source, collection, storage, treatment and scientific disposal of waste are insufficient. Considering the problem of waste storage, there should be replacement of neighbourhood storage depots with metal containers to maintain hygiene.
- To improve technical expertise stage-wise responsibilities for urban local bodies should be placed, such as preparing detailed project reports and using advanced information technology tools like geographic and management information systems. These would be irrelevant if the technical expertise of the urban local bodies is not enhanced.
- There can also be public-private partnership (PPP) for waste management projects.

Ministry of Housing & Urban Affairs has launched 'My Home-My Neighborhood' (Ghar Bi Saaf-Pados Bhi Saaf) campaign with the following six components:

- Segregation of waste at source
- Compostmaking from wet waste within the premises/ neighbourhood/area
- Recycling of dry waste
- Freeing the neighbourhood from open defecation and open urination
- Motivating the residents of neighbourhood against throwinggarbage in open spaces; and Adopting a nearby park or open place for collection and waste segregation.

Conclusion

Right to a healthy environment is a fundamental right under Article -21 of Indian Constitution. Though the Government plays a significant role in waste management (Art-48A), it should be also the responsibility of every citizen to improve the quality of the environment around him/her (Art-51(A)G). Compost pits should be constructed in every locality to process organic waste. Community participation has a direct bearing on efficient waste management in the country.

5 Polluters Pay Principle

Context:

World Culture Festival held by Sri Sri Ravi Shankar's Art of Living (AoL) in March 2016 had degraded the Yamuna floodplain in Delhi. This has raised the debate for applicability of Polluters Pay Principle.

Court Cases

- The polluter pays principle made an important impact in the famous Mehta Oleum Gas Leak case.in this judgement,the SC laid down the rule of absolute liability which essentially state that a person would be wholly responsible for any mishap caused by their "hazardous or inherently dangerous "enterprise,which in this case was a chlorine plant. Theapex court noted that the polluters' liability would depend on their ability to pay-thus using the principle to both clean up the environment damage and to punish the polluter.
- In other cases like Bichhri, the Court noted that the polluter would need to pay for cleaning up the damage as well as compensate those harmed by the pollution. Again in the Vellore citizen Case, the court highlighted that the polluter pays principle was implied in the constitutional provisions protecting the environment as well as in the various Acts concerning the environment.
- Under the Public Interest litigation route court in India have often also held the government liable for failing to curb the pollution and have directed them to pay for the costs of environmental damage.

- Ultimately, in the National Green Tribunal Act 2010,it was stated that the NGT would decide cases based on the polluter pays principle.

Some Problems with this Principle

- Environmental pollution is not always easy to narrow down to a single source which can be strictly punished. A great deal of pollution is from non-point sources, cumulative in nature and occurs over long time spans. Thus, identifying a perpetrator is both difficult and in some cases, technically unfeasible.
- There is no clarity on how exactly the damages should be calculated. This means that a polluter may be asked to pay for the actual costs of clean-up, the damage caused to the victims of environmental damage, a fine or a penalty based on their ability to pay, a general levy aimed at a clean-up of the problem as a whole, or all of the above.
- A large number of poor households, informal sector firms, and subsistence farmers cannot bear any additional charges for energy or for waste disposal.

Way Forward

We should reconsider the criteria's laid to decide the compensation amount. At least it should deter the polluters from spreading pollution. This principle needs a strict interpretation from our judiciary with immediate effect and we just can't afford any sort of delay in its proper implementation in developing country, like India.

6 Public Participation in Environment Management

Context:

- **Maintenance of the healthy environment is not only the responsibility of the state alone but also of every citizen with which a spirit of partnership is to be realized through the Environment Management of the country. Environment Impact Assessment process is an instrument in reconciling this conflict by implementing the concept of sustainable development as it ensures public participation in environmental decision making in India.**
- **What role does citizens play in environmental management? How to create awareness and motivate them towards that?**

Role of citizens

- Public participation found particular resonance in environmental law matters due to the complex and dynamic nature of environmental issues. Such issues are intrinsically political yet involve both public and private interests. Hence they require flexible and transparent decision making that accounts for the array of knowledge and values that exist within the relevant audience.
- An effective public participation programme does not happen by accident; it must be carefully planned. A proactive effort will lead to a more effective process and outcome than a reactive, minimalist approach to public involvement.
- Public involvement needs to begin before project planning and decision-making are too far along to be influenced. The decision to participate must be genuine. Otherwise, public participation becomes a procedural exercise rather than a substantive democratic process.

- Public involvement can be used to create a project that is more suitable to, and accepted by, the public. Suitability should depend on public opinions and needs (rather than the technical feasibility of the project).
- Excluding the public does not ensure expediency in any case. Alienated citizens tend to delay the implementation of the project though time consuming legal action if they feel that their rights are curbed through project implementation which starts right from the **'Chipko Andolan' in 1970's.**
- Social participation should be encouraged to increase their involvement in environmental and development problems, through joint awareness initiatives and improved interchange with other constituencies in society.
- Another way to involve people is through public agencies (e.g., creation of a steering committee) that facilitate broad cooperation between stakeholders and the efficiency of activities being undertaken.
- In a democratic country like India, the mechanism of public participation in decision making manifests the direct democracy of people. The Public participation bridges the gap between the heterogeneous groups of the society. It tries to maintain balance between the right to environment and right to development.

How?

Environmental education is one of the most effective tools for public involvement. It must be approached, however, as a continuous, lifelong process that involves learning about nature through scientific knowledge, arts, personal experience and imagination.

- The first, and perhaps most important, link in the chain of environment education is at the nursery school level. Some of the best places to realize and demonstrate this principle is with water environments, particularly since rivers or ponds, lakes or streams may be found everywhere.
- The next stage of education is at the primary- and secondary-school level, where the above motto should be broadened considerably. The best results, regardless of age, typically is gained when educational activities are conducted in direct contact with nature, thereby facilitating emotional links and the participation of schools in monitoring and research projects.
- The next appropriate stage of environmental education is at the high school and university level. All available forms of environmental education can be used to provide students with direct contact to environmental issues focusing on the use and protection of environmental resources and the development of environmental awareness.

Conclusion

- The provisions for public hearing should not be taken as a mere procedure but the strict monitoring of public hearing would bring positive result. The procedure of public hearing should not be confined to those projects, which are specified in the schedule to the main EIA notification, but it should be made mandatory for all those, which may have possibility of causing any effects on the environment.
- Wherever there is any threat to the people's right to environment, the government should assume the role of parens patriae to protect it. With the advent of National Green Tribunal the confidence is built up that people's right to participation would be taken care of. But the real need is to educate the people about their procedural rights of effective participation in environmental decision-making process.

7 E-Waste: Treasure or Threat?

Context:

Recently, International E-Waste Day has been observed on October 14 and it has been observed every year since 2018.

About

- Waste electronic and electrical equipment (WEEE), a Brussels-based non-profit gave some shocking statistics about the rising tide of e-waste.
- This year's WEEE will total about 57.4 million tonnes (MT). This will be greater than the weight of the Great Wall of China, Earth's heaviest artificial object.
- Last year's Global E-waste Monitor reported that 53.6 MT of WEEE were generated in 2019. That represented a 21 per cent jump in the five years since 2014 (with e-waste predicted to reach 74 MT by 2030).

E-Waste

- E-Waste is short for Electronic-Waste and the term is used to describe old, end-of-life or discarded electronic appliances. It includes their components, consumables, parts and spares.
- It is categorised into 21 types under two broad categories:
  - Information technology and communication equipment.
  - Consumer electrical and electronics.
- Laws to manage e-waste have been in place in India since 2011, mandating that only authorised dismantlers and recyclers collect e-waste. E-waste (Management) Rules, 2016 was enacted in 2017.
- India's first e-waste clinic for segregating, processing and disposal of waste from household and commercial units has been be set-up in Bhopal, Madhya Pradesh.

How it can be Treasure?

- E-waste consists of both hazardous and non-hazardous items including ferrous and non-ferrous metals like copper, aluminium, silver, gold, platinum, palladium, etc. Plastics, glass, wood and plywood, printed circuit boards, concrete, ceramics and rubber. These precious earth metals like copper, aluminium, silver, gold, platinum, palladium if extracted and reutilized could prove to be a treasure trove.

How it can be Threat?

- Out of the 44 Million tonnes (Mt) of e-waste, only 20 % of total global e-waste was collected and recycled sustainably, there is also environmental and health hazard as e-waste contains over 1,000 harmful substances, including lead, mercury, nickel, brominated flame retardants and polycyclic aromatic hydrocarbons (PAHs).Mercury for example damages the human brain and or coordination system.
- E-waste is particularly hazardous as the extraction and recycling of e-waste is largely manually done and the sector is majorly dependent on informal workforce especially in developing or middle income countries. More than 18 million children and adolescents are actively engaged in the informal industrial sector, of which waste processing is a sub-sector, exposing themselves to toxic e-waste risk.

E-waste Generation in India:

- Asia generated the greatest volume i.e. 24.9 million tonnes (Mt) of e-waste in 2019 with China and India being the two largest contributors ranking first and third globally. India alone generated 3 Mt of e-waste in 2019 and about 95 per cent of India's e-waste is recycled in the informal sector and in a crude manner.
- In 2018, the Ministry of Environment had told the tribunal that 95% of e-waste in India is recycled by the informal sector and scrap dealers unscientifically dispose of it by burning or dissolving it in acids.

E-Waste Management Rules, 2016

- The Ministry of Environment, Forest and Climate Change notified the E-Waste Management Rules, 2016 in supersession of the E-waste (Management & Handling) Rules, 2011.
- Over 21 products (Schedule-I) were included under the purview of the rule. It included Compact Fluorescent Lamp (CFL) and other mercury containing lamps, as well as other such equipment.
- For the first time, the rules brought the producers under Extended Producer Responsibility (EPR), along with targets. Producers have been made responsible for the collection of E-waste and for its exchange.
- Various producers can have a separate Producer Responsibility Organisation (PRO) and ensure collection of E-waste, as well as its disposal in an environmentally sound manner.
- Deposit Refund Scheme has been introduced as an additional economic instrument wherein the producer charges an additional amount as a deposit at the time of sale of the electrical and electronic equipment and returns it to the consumer along with interest when the end-of-life electrical and electronic equipment is returned.
- The role of State Governments has been also introduced to ensure safety, health and skill development of the workers involved in dismantling and recycling operations.
- A provision of penalty for violation of rules has also been introduced.
- Urban Local Bodies (Municipal Committee/Council/Corporation) have been assigned the duty to collect and channelize the orphan products to authorized dismantlers or recyclers.
- Allocation of proper space to existing and upcoming industrial units for e-waste dismantling and recycling.

Why it is difficult to manage e-waste in India?

- The producers/manufacturers do not have adequate information on their website regarding e waste management.
- Customer care representatives do not have inkling about any take back or recycling programme and even if they have set up collection centres, they are simply not enough for a geographically vast country like India.
- India being a vast country, setting up collection mechanism is a big challenge. If any of the brands try individually to reach out to all corners of the country, it will economically not be sustainable or feasible.
- Improper enforcement of the existing laws is another hurdle.

Government efforts in this regard

- NITI Aayog India's public policy think tank has put prominent emphasis on e-waste among 11 end-of-life products, recyclable materials, wastes that continue to pose considerable challenges.
- They have formed 11 committees to be led by the concerned line ministries and comprising officials from MoEFCC and NITI Aayog, domain experts, academics and industry representatives.

- Greens cape Eco Management is one such company that has been involved in NITI Aayog's Committee for E-Waste Management Rules and Regulation. They provide end of Life IT asset solutions ranging from collection and disposal to reintegration solutions including re-use, de-manufacturing, brand security and e-waste recycling.
- The organization actively pursues projects and initiatives that benefit the e-waste industry and the communities that serve the environment.
- As of now they're ongoing projects over 427 locations across India. Currently they have collaborated with partners in all parts of India, Singapore and Australia.

Conclusion

The current situation is very hopeful with policy intervention, brand accountability, general public awareness, and technological advance in recycling. However much is yet to be done to achieve desired results. Getting quantifying data on the depth and spread of effort to sustainably process e-waste is necessary to get the actual scenario and increase the scale of momentum.

8 Why is it difficult for India to get to net zero?

Context:

- **On his recent visit to India ahead of the U.N. Climate Change conference in Glasgow, U.S. Special Presidential Envoy for Climate John Kerry said he had not received any assurance that India was working to raise its ambition to cut carbon dioxide emission.**
- **The COP 26 UN Climate Change conference, to be hosted by the UK in partnership with Italy, will be held from 31 October to 12 November 2021 at the Scottish Event Campus (SEC) in Glasgow, UK.**

What is the target of Net-zero output?

- Net-zero emissions are a way of measuring the release of heat gas into the atmosphere by the absorption of greenhouse gases from the atmosphere.
- In zero-carbon combustion, the country will focus on reducing carbon emissions. But in Net-zero carbon the country will focus on bringing carbon emissions to zero.
- In the first phase, the country will focus on reducing human emissions such as burning mineral fuels, measuring factory emissions, etc.
- Gradually, however, net-zero releases can be extended to other remaining locations.
- Globally the idea of net-zero emissions by 2050 is gaining momentum. It is being advised by many countries as a solution to tackling climate change.
- To date 58 countries have announced targets for zero emissions. Together these countries make up more than half of the current GHG emissions worldwide.
- Over the next 30 years, they all aim to reduce emissions of carbon dioxide and other GHGs. There are requests from international forums that India also needs to accept the release of net-zero emissions.
- But there are other environmental factors that do not allow you to accept the objectives of the Net-zero release. They say it's not fair in developing countries.

Indian Climate actions

- India is expected to significantly exceed the Paris Agreement's commitment to reduce its GDP emissions by 33-35% below 2005 levels by 2030.
- **Emphasis on renewal:** India impresses the world with its leading renewable energy output and target of 450GW by 2030, linked to its leadership in the International Solar Alliance and the latest national hydrogen strategy.
- **Businesses:** Indian companies are also on the rise, with Tata team winning awards for sustainability, Mahindra is committed to net-zero by 2040, and Reliance by 2035.
- In addition to logical arguments about historical obligation, individual exclusion, and equality, India's national interests in climate action are now operating in more efficient ways than waiting for donor support to create prominence.

Why achieving net zero emissions are not easy for India?

- The country is trying to balance its growing energy needs with demands to slash emissions, which could make the goal of achieving carbon neutrality difficult.
- The International Energy Agency (IEA) forecasts that India's energy demands will grow more than any other country over the next 20 years. By 2030, it is expected to overtake the European Union as the third biggest energy consumer.
- Although renewable energy's share in India's energy mix is increasing, coal accounts for almost 70 per cent of the country's electricity generation, according to the IEA. It plays a major role in global warming and contributes to deadly air pollution.
- India is the world's third-biggest emitter of GHG.
- India's per capita CO2 emissions – at 1.8 tonnes per person in 2015 – are around a ninth of those in the USA and around a third of the global average of 4.8 tonnes per person.
- India must also meet the aspirations of 1.4 billion people for faster economic development. This will limit India's development potential.
- Meeting the nation's existing target of 450 gigawatts of renewables by 2030 is already a massive lift. Hitting net zero will require an even more dramatic acceleration.
- By 2050, India's total electricity demand would be about 5500 to 6000 terawatt-hours (TWh), roughly a factor of five on today's level.
- In developed countries, emissions have already peaked. Their decision is only about the path to net-zero. Emerging economies like India, instead, will go through a high-growth phase with rising energy demand and emissions. So, before a net-zero year can be targeted, India must discuss options for its peaking year
- Many argue that net zero is not equitable and fair as it does not differentiate between developing and developed countries in sharing the burden of mitigation.
- Some also criticise mid-century net zero as allowing uncontrolled emissions today while relying on uncertain technologies to offset emissions in the future.
- Many net zero pledges are premised upon trading and offsetting emissions, allowing the rich to continue emitting and buying their way out.

9 World Freed from Toxic Lead: UNEP

Context:

The World has achieved a landmark global success. It is formally announced by the United Nations Programme on Environment (UNEP) that not a single fuel outlet across the globe is now selling leaded automotive petrol anymore.

Analysis

- It is a huge milestone for global health and the environment that we have achieved.
- It is going to prevent more than 1.2 million premature deaths annually from heart disease, strokes and cancer and in monetary terms this milestone is to save $2.4 trillion annually (global economy).
- It has offered us the opportunity for restoring ecosystems, especially in urbanised regions that are affected the most.
- It is expected to support the realization of various Sustainable Development Goals, including:
  - good health and well-being (SDG3)
  - affordable and clean energy (SDG7)
  - industry, innovation and infrastructure (SDG9)
  - sustainable cities and communities (SDG11)
  - climate action (SDG13)
  - life on land (SDG15)

Understanding the Issue in-depth:

- Soon after the discovery of anti-knock and octane-boosting properties of **Tetraethyl Lead (TEL),** it was widely brought into use across all the countries. It being a neurotoxin has caused a great deal of harm since then.

What is an Octane Number?

- Octane number is a universally accepted standard that measures the fuel's ability to withstand compression in an internal combustion engine without detonating (Engine Knocking).
- A higher-octane number indicates that the fuel can withstand the compression in the internal combustion before getting detonated.
- Octane rating has nothing to do with the power output of the fuel but simply indicates gasoline's capability against the engine's compression.
- Petrol with a higher octane rating can be used in higher-compression engines, to yield higher power. This higher power comes from the fuel's higher compression and not from the fuel (Gasoline).

What is Tetraethyl Lead (TEL)?

- To solve the problem of knocking of the engine, various efforts had been made and, in the year, 1921 **Tetraethyl Lead (TEL)** (Anti-knocking agent) had been found its use as a highly inexpensive and effective additive that allowed the engine compression to be raised without the issue of engine knock. It is sometimes also called **organic lead**.

Why Tetraethyl Lead (TEL) has caused so many problems?

- Since 19th century TEL has been recognised as a dangerous substance that could result in lead poisoning**.**
- The combustion of leaded petrol causes the lead to be released into the atmosphere and it not only causes damage to the environment but also to the people who have been exposed to it. Over time, lead has the tendency of getting accumulated in the tissues and various organs.

Toxicity:

- There is a high rate of absorption for Tetraethyl lead by the skin, the lungs, and the gastrointestinal tract. It is later converted to triethyl lead, and the research has suggested that in this form it is more toxic.
- It gets accumulated in the brain, liver, kidneys, bones and other major organs in the body. It can result in heart disease, stroke and cancer. It also affects the development of the human brain, especially at a young age.
- Long term effects of TEL include encephalopathy, dementia and poor verbal memory.

Octane Numbers of Fuels in India:

- The minimum octane rating for fuels as prescribed (**Bharat IV emission standards)** is 91 Octane.
- Premium fuels like Extra-Premium, Speed and Power also have the same octane rating of 91, but they have extra additives that prevent sludge formation inside the engine.

Fuel with higher-Octane rating than 91

- 93 Octane from Indian Oil and
- Speed 97 from Bharat Petroleum.
- Lately, India has also started production of XP100- a 100 octane petrol from Indian Oil.

Campaign against leaded petrol:

- Since 1922, TEL was used as a petrol additive to enhance engine performance but by the 1970s, its catastrophic effects on public health and the environment became evident.
- Leaded petrol/gasoline was phased out in the developed world by 2000.
- Despite warnings from public health authorities, the use of TEL continued to be in use for decades. By 2002, almost all low-income, middle-income countries, and some Organisation for Economic Co-operation and Development (OECD) members continued using leaded petrol. Leaded petrol was used mainly in the African subcontinent and in other low-income countries.
- The UN Environment Programme (UNEP) started its campaign to end the use of lead in petrol in 2002 through the Global Partnership for Clean Fuels and Vehicles (PCFV).
- The **Partnership for Clean Fuels and Vehicles (PCFV)** was set up in 2002 at the World Summit on Sustainable Development to eliminate leaded petrol globally.
- The Partnership for Clean Fuels and Vehicles (PCFV) is the leading global public-private initiative promoting cleaner fuels and vehicles in developing countries and countries in transition.
- The PCFV Secretariat is located at the United Nations Environment Programme headquarters in Nairobi, Kenya.

Efforts by India:

- The process of eliminating lead in the petrol had started as early as 1994, which got completed in 2000.
- Unleaded petrol was introduced across India in the year 1995.
- The introduction of unleaded petrol was mandated in April 2000 for the entire country.

- **India has moved towards other anti-knocking additives which are relatively less toxic.**
- After the lead phase out, Indian refineries took voluntary steps to not use MMT **(Methylcyclopentadienyl manganese tricarbonyl) and Methyl tertiary butyl ether** (MTBE).

Curbing on other emission sources:

- TEL is the largest source of lead pollution, but other sources require urgent action too– such as lead in paints, leaded batteries, and lead in household items.
- Backyard smelting and unauthorised reprocessing of lead-acid batteries is also a point of concern. The draft for **Battery Waste Management Rules, 2020** is working towards making the recycling process a more responsible one, by functionalizing the idea of **"Extended Producer Responsibility".**

10 India's northeastern states desertifying most rapidly

Context:

The Indian Space Research Organization (ISRO) released the Desertification and Land Degradation Atlas of India, which shows a worrisome picture of land degradation in India's north-east.

Background

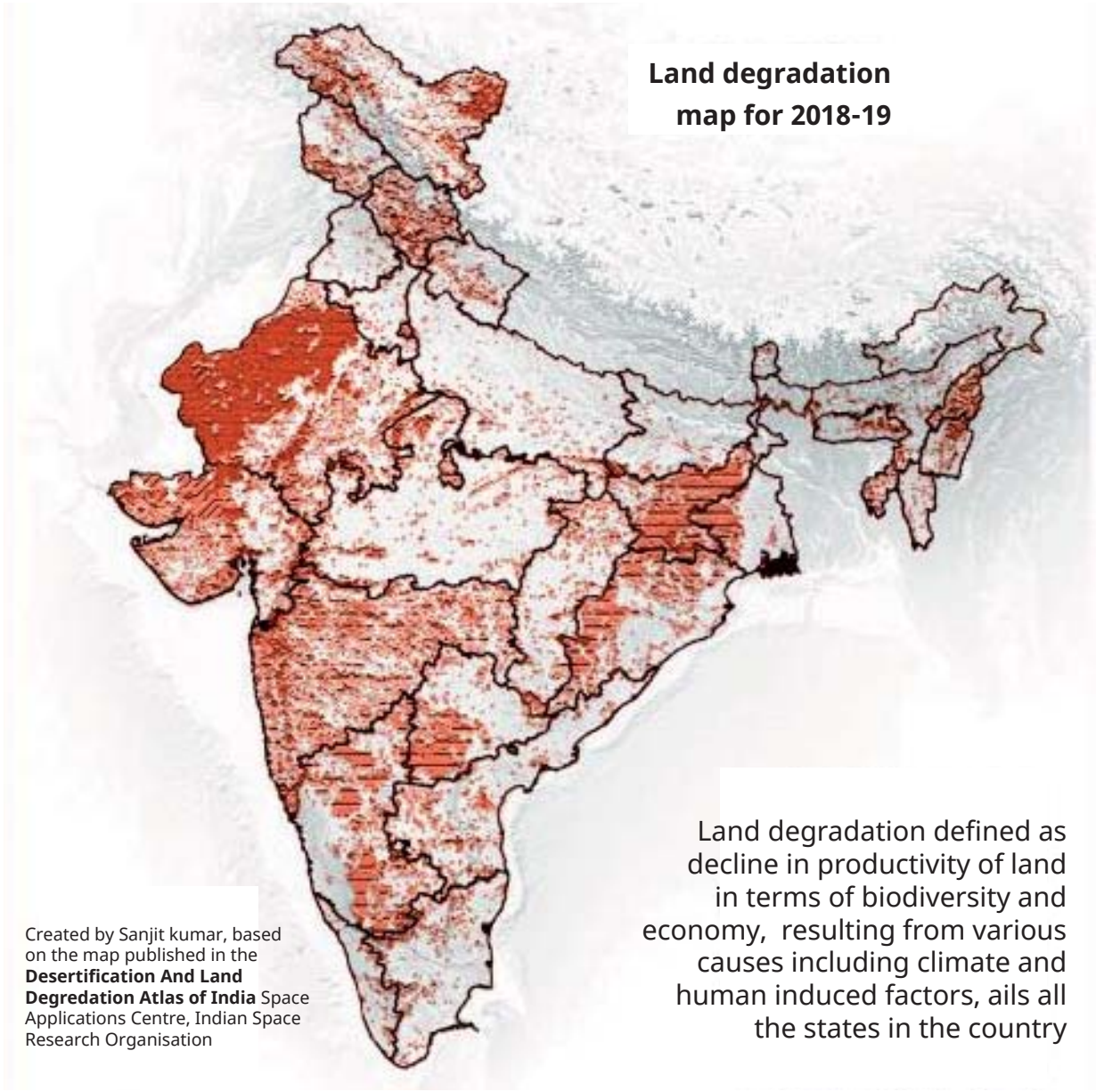
- With close to 30 per cent of its geographical area already affected, land degradation is definitely among India's most pressing environmental problems.
- In the last 15 years, almost all Indian states have recorded an increase in degraded land, with the most rapid increase being noted in the biodiversity-rich northeastern states.
- The scientists at ISRO compared the data collected between 2003 and 2005 with that gathered in 2018-19.
- Currently, 97.85 million hectares (mha) of land has already been degraded.
- Of this, 3.32 mha has been added in the 15 years between 2003-05 and 2018-19.
- **Silver lining:** Rajasthan, the most degraded state, along with Uttar Pradesh and Telangana, have seen a reduction in their degraded land in the last 15 years.
- Rajasthan, which accounts for almost 22 per cent of the degraded land in the country, reclaimed almost 388,000 ha, an area roughly 2.6 times the size of Delhi.
- Uttar Pradesh (285,665 ha) and Telangana (19,974 ha) together reclaimed degraded land twice the size of Delhi during the period.

Forestland degradation

- India has a little over 71 mha of forestland, according to the India State of Forest Report 2019, released by the Union Ministry of Environment, Forest and Climate Change.
- Of this, 30 per cent or a little more than 21 mha of forestland is degraded.

Losing land

Almost 30% of India land area is under desertification

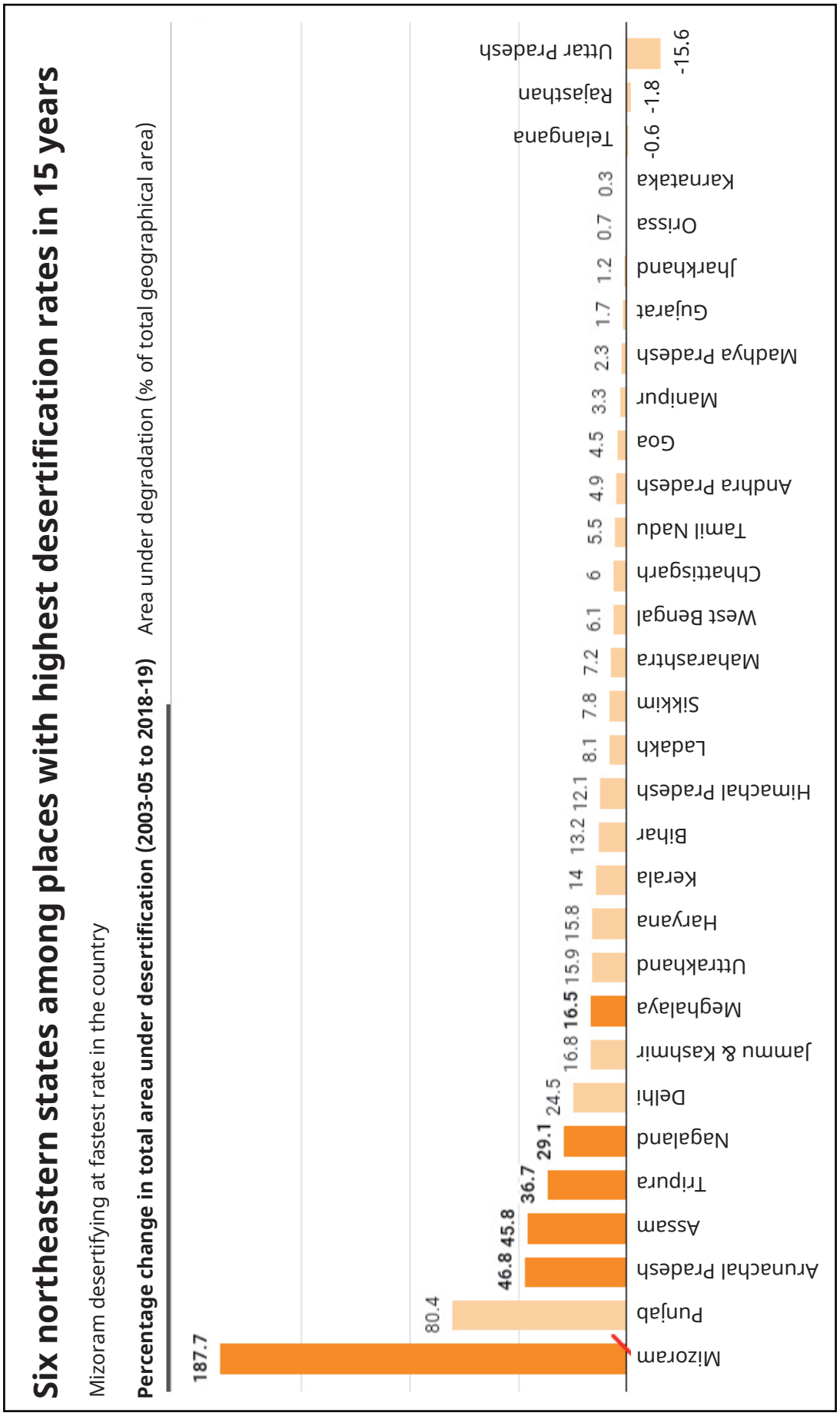


Created by Sanjit kumar, based on the map published in the **Desertification And Land Degredation Atlas of India** Space Applications Centre, Indian Space Research Organisation

Land degradation defined as decline in productivity of land in terms of biodiversity and economy, resulting from various causes including climate and human induced factors, ails all the states in the country

Key-findings of the Report-cum-Atlas

- Six states in northeastern India were among the top 10 places in the country with the highest rates of desertification between 2003 and 2018, according to a recent report.
- These are Mizoram, Arunachal Pradesh, Assam, Tripura, Nagaland and Meghalaya.
- Punjab, Delhi, Jammu and Kashmir and Uttarakhand in northern India also witnessed some of the highest rates of desertification.


Six northeastern states among places with highest desertification rates in 15 years
Mizoram desertifying at fastest rate in the country
Percentage change in total area under desertification (2003-05 to 2018-19)
Area under degradation (% of total geographical area)
187.7
80.4
46.8
45.8
36.7
29.1
24.5
16.8
16.5
15.9
15.8
14
13.2
12.1
8.1
7.8
7.2
6.1
6
5.5
4.9
4.5
3.3
2.3
1.7
1.2
0.7
0.3
-0.6
-1.8
-15.6
Mizoram
Punjab
Arunachal Pradesh
Assam
Tripura
Nagaland
Delhi
Jammu & Kashmir
Meghalaya
Uttrakhand
Haryana
Kerala
Bihar
Himachal Pradesh
Ladakh
Sikkim
Maharashtra
West Bengal
Chhattisgarh
Tamil Nadu
Andhra Pradesh
Goa
Manipur
Madhya Pradesh
Gujarat
Jharkhand
Orissa
Karnataka
Telangana
Rajasthan
Uttar Pradesh

The most vulnerable areas

■ Mizoram desertifying fastest

- Mizoram has been desertifying at the fastest rate in the country.
- Land degradation and desertification increased 2.8 times in the state in the 15-year period studied.
- A total of 0.18 million hectares (mha) underwent degradation/desertification in those years — an increase of over 188 per cent.

■ Rapid degradation in Arunachal, Nagaland

- **Arunachal Pradesh:** In Arunachal Pradesh, 2.4 per cent of the area or 0.2 mha underwent degradation / desertification in 2018-19. Between 2003-05 and 2018-19, degradation / desertication increased 46 per cent in the state.
- **Nagaland:** Over half the 200,683 ha geographical area of the state was found to be degraded / desertified in 2018-19, whereas, the share of degraded land was 38.74 per cent in 2003-05.

- Land in India's northeast is **naturally acidic** because of the heavy rainfall it receives every year but climate change induced high frequency of heavy rainfall events will further exacerbate the acidification.
- This acidification decreases the quality of soil and reduces their productivity significantly.

Understanding Land degradation & Desertification

- Land degradation is defined as decline in productivity of land in terms of biodiversity and economy, resulting from various causes, including climate and human dominance, leading to loss of ecosystem.
- Desertification is a type of land degradation in which a relatively dry region becomes increasingly arid, typically losing its water bodies as well as vegetation and wildlife.

As a signatory to the **United Nations Convention to Combat Desertification**, India is committed to reducing its land degradation and desertification. In fact, India's goal is to achieve land degradation neutral status by 2030 whereby increases in land degradation would be offset by gains in land reclamation.

Main causes of land degradation and desertification

- Deforestation and loss of green cover
- Human settlements and water erosion
- Water logging
- Vegetation degradation (96 per cent) is the major reason for forest degradation.
- **Vegetation degradation** is referred to as reduction in the biomass and / or decline in the vegetative ground cover, as a result of deforestation and / or overgrazing.
- A lot of erosion happens because the top soil remains exposed and got washed away easily with rains.
- The US, after a major dust storm event in the 1930s, brought a legislation that says the top soil of any land should not remain exposed.

It is surprising that 66 per cent of the farmland in the country remains rainfed, according to the **Pocket Book of Agricultural Statistics 2020**, released by the **Union Agriculture and Farmers' Welfare** in May 2021.

Why land degradation is a concern?

- **Carbon:** Land degradation reduces the soil's ability to absorb carbon.
- **Worsened climate change:** Land degradation and climate changefuel each other.
- **Threat to food security:** Degraded land in the country is either rainfed farmland, responsible for the food security of the country, or forest land that offers the best defence against climate change.
- **Economic loss**: Lost productivity can weigh heavily on the economy.

11 Wildfires: Good servant bad disaster

Context:

At least eight people have been killed in wildfires that have ripped through southern Turkey, ravaging coastal resorts and forcing tourists to flee.

Background

- Forest fire is a major cause of injury and loss to forests, with the population increase, the frequency and subsequent damage due to forest fire is increasing day by day.
- Major forest fires recently witnessed were- Australia Bush Fire, Uttarakhand forest fire, Russian wildfires etc.
- Climate change, anthropogenic activities are seen as major cause of wildfires with increased frequency in recent past.

Analysis

■ Types of Forest Fire

- **Surface fires**: Surface fire is the most common forest fires that burn undergrowth and dead material along the floor of the forest. It is the type of fire that burns surface litter, other loose debris of the forest floor and small vegetation.
- **Underground fires**: The fires of low intensity, consuming the organic matter beneath and the surface litter of forest floor are sub-grouped as underground fire. In most of the dense forests a thick mantle of organic matter is found on top of the mineral soil. This fire spreads in by consuming such material.
- **Ground fires**: There is no clear distinction between underground and ground fires. The smoldering underground fire sometime changes into ground fire. This fire burns root and other material on or beneath the surface i.e. burns the herbaceous growth on forest floor together with the layer of organic matter in various stages of decay.
- **Crown fires**: Crown fire is the most unpredictable fires that burn the top of trees and spread rapidly by wind. In most of the cases these fires are invariably ignited by surface fires. Since it is over the heads of ground force it is uncontrollable until it again drops to the ground, and since it is usually fast moving, it poses grave danger to the fire fighters becoming trapped and burned.

■ Causes of Forest fire

- More than ninety five percent forest fires are caused either by negligence or unknowingly by the human being. The rest of the fires are caused by natural reasons i.e. lightning, extreme rise in the temperature etc., which are very rare.

Natural Cause	Anthropogenic Cause	
	Deliberate	**Accidental**
Lighting	Shifting Cultivation	Collection of Non Timber Forest Produce
Friction of rolling stones	To flush growth of tendu leaves	Burning farm residues
Rubbing of dry bamboo clumps	To have good growth of grass and fodder	Driving away wild animals
Volcanic explosion	To settle score with forest department or personal rivalry	Throwing burning bidi/ cigarettes
	To clear path by villagers	Camp fires by picnickers
	To encroach upon the forest land	Sparks from vehicle —exhaust
	For concealing illicit felling	Sparks from transformers
	Tribal traditions/ customs	Uncontrolled prescribed burning
		Resin tapping
		Making charcoal in forests
		Extracting wine in forest
		Sparks from cooking near the forest
		Heating coal tar for road construction in forest

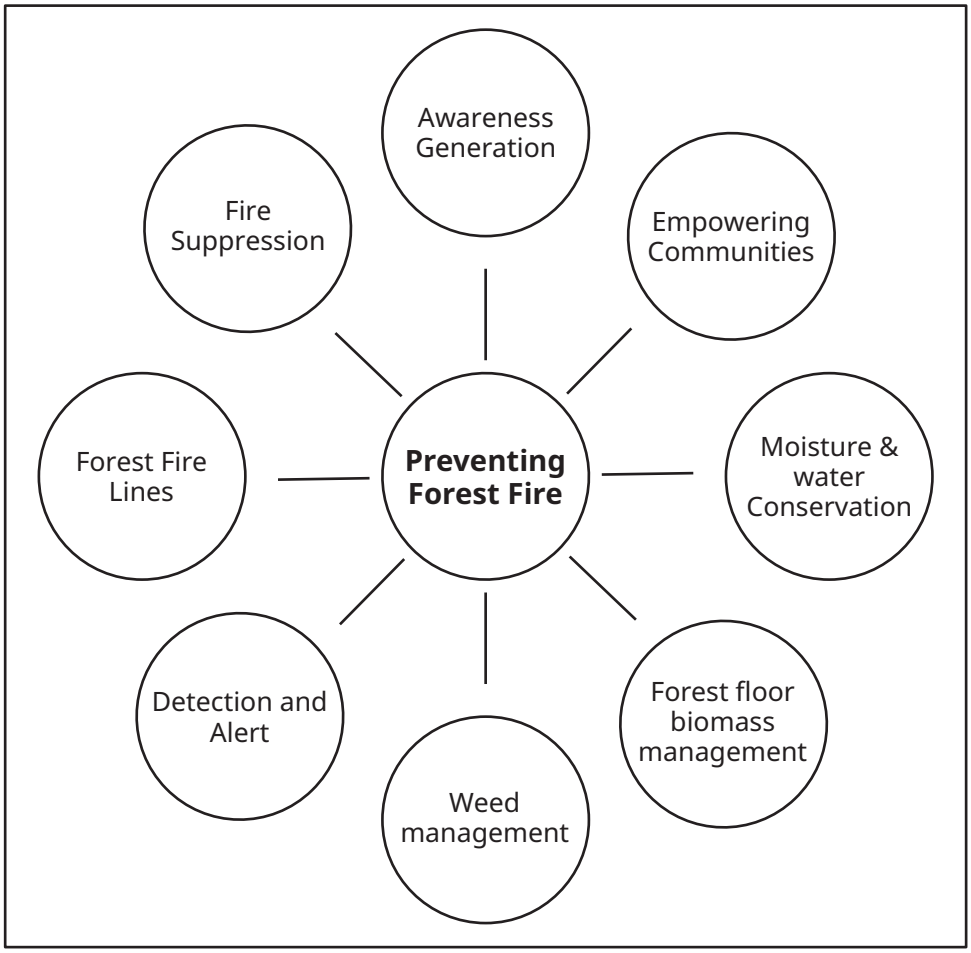
Damage caused by Forest Fire

- **Loss of valuable timber resources**
  - Forest fires cause indispensable loss to timber and deteriorate its quality. Valuable timber species like teak, sal, chir, deodar, sheesam, rosewood etc. are adversely affected by fire
- **Impact of forest fire on eco- system**
  - The most damaging impact of forest fire on ecosystem is very evident in the Himalayas, where hills existing between the heights of 1000 to 1800 meters are dominated by pine forests and seem to be more fire prone.
  - The uncontrolled fires in such areas help in spreading pine forest at the cost of indigenous oak forest, which is very serious threat to the ecological balance in the Himalayan region.
- **Degradation of water catchments areas resulting into loss of water**
  - After forest fire, soil moisture is decreased and litter decomposition becomes almost negligible, which creates a possibility of forest fire in future.

- **Loss of wildlife habitat and depletion of wildlife**
  - Forests are the habitat of many wild animals, when fire becomes uncontrolled, the problem of survival of animals and their habitat arises.
  - The forest fires in Sankhuwasabha and Ilam in Nepal claimed red pandas, leopards as well as monkeys, deer, bear and other species.
- **Global warming**
  - The immediate effect of vegetation burning is the production and release of gases including carbon dioxide, carbon monoxide, methane, non-methane hydrocarbons, nitric oxide, methyl chloride and various other gases, which are released and returned to the atmosphere.
- **Soil erosion**
  - The scientific studies indicate that erosion of the soil from the forest land depends on many factors i.e. the soil porosity, its mineral composition, the texture, the gradient of the land and length etc.
  - All these factors decide the ease with which the individual soil particles are detached.

National Action Plan on Forest Fires, 2018

- One of the main objectives of the action plan is to reduce the incidences of fires by informing, enabling and empowering forest fringe communities and incentivizing them to work in tandem with the State Forest Departments (SFDs).
- The plan also aims to reduce the vulnerability of forests against fire hazards across the diverse forest ecosystems in the country, enhancing the capabilities of institutions in fighting fires, and accelerating the recovery after a fire incidence.



Conclusion

- It is critical to monitor and understand such fires using satellite data so that we can successfully manage them in a warmer world.
- Understanding both the immediate and long-term effects of fire requires long-term global datasets that follow fires from their detection and that accurately map the scale of the burned area.

12 Human-Wildlife Conflict

Context:

The report, titled, "A future for all - the need for human-wildlife coexistence", by the World Wide Fund for Nature (WWF) and the UN Environment Programme (UNEP) has stated that conflict between humans and animals is one of the main threats to the long-term survival of some of the world's most iconic species.

Background

- Around the world, human wildlife conflict (HWC) challenges people and wildlife, leading to a decrease in people's tolerance for conservation efforts and contributing to multiple factors that drive species to extinction
- HWC is a significant threat to conservation, livelihoods, and myriad other concerns and should be addressed at a scale equal to its importance.
- By allocating adequate resources and forming wide-ranging partnerships, we can move towards long-term coexistence that benefits both people and wildlife.

Analysis

■ Key-highlights of the Report

- The report features contributions from 155 experts from 40 organisations based in 27 countries.
- Globally, conflict-related killing affects more than 75% of the world's wild cat species.
- Besides, many other terrestrial and marine carnivore species such as polar bears and Mediterranean monk seals as well as large herbivores such as elephants are affected.
- Global wildlife populations have fallen an average of 68 per cent since 1970.
- India will be most-affected by human-wildlife conflict. This was because it had the world's second-largest human population as well as large populations of tigers, Asian elephants, one-horned rhinos, Asiatic lions and other species.

Data on human-elephant conflict

- In India, data from the **Union Ministry of Environment, Forest and Climate Change** indicates that over 500 elephants were killed between 2014-2015 and 2018-2019, mostly due to human-elephant conflict.
- During the same period, 2,361 people were killed as a result of conflict with elephants.

Example

- The report gave the example of **Sonitpur district in Assam**. Here, destruction of forests had forced elephants to raid crops, in turn causing deaths of both, elephants and humans.
- In response, WWF India had developed the **'Sonitpur Model'** during 2003-2004 by which community members were connected with the state forest department.
- They were given training on how to work with them to drive elephants away from crop fields safely.
- WWF India had also developed a low-cost, single strand, non-lethal electric fence to ease the guarding of crops from elephants.

What drives Human-Wildlife Conflict?

- HWC results from a variety of ecological and anthropogenic drivers that exert pressures on landscapes where humans and wildlife share space.
- **Ecological drivers** include seasonal changes, natural calamities, and animals' life cycles, as well as the movement patterns of animals.
- **Anthropogenic drivers,** such as habitat loss, changes in land use, livestock management, expansion of agricultural practices, climate change, resource extraction, infrastructure development, and urbanisation.
- Each negative impact emerges from a complex web of interactions between drivers, making it extremely difficult, if not impossible, to view the effect of one driver in isolation.
- For instance, if forests are cleared for settlements or agriculture, or roads are cut into previously inaccessible areas, habitat loss and fragmentation result, forcing wildlife and people into closer proximity to each other.

Timeline of milestones in development of HWC management

1987	The International Bear Association and the IUCN Bear Specialist Group start to focus on HWC.
1990-05	IUCN African elephant specialist group gave recommendations on human-elephant conflict management.
2004	IUCN World Parks Congress, South Africa, recognises the need to address growing challenges of HWC.
2008	Pathways Conference disusses the need to better integrate the human dimension into HWC management.
2009	Human-wildlife conflict collaboration, later renamed CPeace, launches capacity bulding programme on conflict transformation.
2010-15	Scientist and conservation practitioners recognise HWC as including conflicts among different groups of people regarding wildlife.
2016	IUCN SSC Human-Wildlife Conflict Task Force is set up to support professionals working on HWC.

The IUCN SSC Human-Wildlife Conflict Task Force

- The IUCN SSC Human-Wildlife Conflict Task Force (HWCTF) is a global advisory group and think tank.
- It aims to support professionals working on HWC by providing interdisciplinary guidance, resources, and capacity building.
- The IUCN established the HWCTF to foster connection between policymakers, scientists, and communities and to assimilate knowledge and capacity for HWC management across IUCN members and the wider conservation community.

The Six Elements of Hwc Management

- **Understanding the conflict**: Researching all aspects of the conflict profile to understand the context for conflict in any given situation (hotspot mapping, community attitudes, spatial and temporal characteristics, etc.)
- **Mitigation**: Reducing the impacts of HWC after it occurs (compensation, insurance, alternative livelihoods, etc.)
- **Response**: Addressing an ongoing HWC incident (response teams, reporting mechanisms, standard operating procedures, etc.)
- **Prevention**: Stopping or preventing HWC before it occurs (fences, early detection tools, safe working environments, etc.)
- **Policy**: Enabling HWC management through protocols, principles, provisions, and measures stipulated in legislation and undertaken by authorities (international and national law, national and local HWC management plans, spatial plans, etc.)
- **Monitoring**: Measuring the performance and effectiveness of HWC management interventions over time (data collection, information sharing, adaptive management, etc.)

Conclusion

The means to prevent and reduce HWC have changed relatively little over time, but the socio-cultural, economic, and physical geographies of landscapes where conflict plays out have been radically transformed by ever growing human enterprises. Considering where we are in the wider landscape of moving towards human-wildlife coexistence, global community can come together and collaborate to implement and scale up integrated and holistic approaches to HWC management, and if new policies are able to strike an appropriate balance between mechanisms that deter negative human behaviour towards wildlife and those that promote and enable tolerance, then humans and wildlife may be able to share space more harmoniously for a long time to come.

13 Plastic waste management rules on beating Plastic Pollution

Context:

The central government introduced the Plastic Waste Management Amendment Rules which recognizes the severity of pollution caused by plastic labels for daily use.

How big is this plastic issue?

- Plastic is a synthetic polymer made of gasoline with structures suitable for various uses, including packaging, construction and construction, household and sports equipment, automobiles, electronics and agriculture. Plastic is cheap, lightweight, strong and soft.
- More than 300 million tons of plastic are produced annually, half of which are used to design consumer goods, such as shopping bags, cups and straw.
- Only 9% of recycled plastic waste. About 12% burned, while 79% accumulated in landfills.
- According to the International Union for Conservation of Nature (IUCN), at least eight million tons of plastic end up in the oceans every year.

Global Waste Plant Problem:

- Pollution due to the use of plastic materials has become an important environmental challenge facing all countries.
- Only nine percent of the plastic trash produced between 1950 and 2015 was reused worldwide, according to a study by researchers at the University of California, Santa Barbara, and others.
- 3 million tons of Indian waste was recovered in 2018-19.
- This translates to about 9,200 tons per day (TPD). The total amount of municipal waste is 55-65 million tons; plastic waste is about 5-6 percent of the solid waste generated in the country.

Recent steps by India

- Currently, the **Plastic Waste Management Regulations, 2016**, prohibit the manufacture, importation, storage, distribution, sale and use of handling bags and plastic sheets of less than 50 microns in the country.
- The Prime Minister of India was also awarded the "world champion" award by the **United Nations Environment Program (UNEP)** in 2018 for promising to eradicate all once-used plastic by 2022.
- India has pledged to take steps to reduce land pollution caused by Single Use Plastics.
- India has generated 34 lakh tonnes of plastic waste in 2019-20, of which only 60% has been recycled.
- 6 of the top 100 global producers of polymers which produces large quantity of plastic waste are based in India.
- 22 states in India have announced ban on single use plastic but, it had little impact on outcomes.

Plastic Waste Management Amendment Regulations, 2021:

- The Department of Environment has introduced the **Plastic Waste Management Amendment Regulations, 2021.**

- These laws prohibit certain types of plastic items that are used and have 'low use and high waste disposal capacity' by 2022.
- The permissible size of plastic bags, currently 50 microns, will be increased to 75 microns from September 30, 2021, and to 120 microns from December 31, 2022.
- High-strength plastic bags are easily treated as waste and have high recycling performance.
- At the policy level, the concept of Extended Product Responsibility (EPR), already mentioned under the 2016 Regulations, should be promoted.
- EPR is a policy in which producers are given significant, financial and / or physical responsibility for the treatment or disposal of post-consumer products.
- The **Central Pollution Control Board**, together with state pollution agencies, will monitor the ban, identify violations, and impose fines already imposed under the Environmental Protection Act, 1986.

Problems with plastic waste management

- In terms of policy- India's environmental policies vary, deliberately good but bad in terms of results.
- With regard to government spending in the absence of a strong will from national governments to replace municipal contracts.
- Regarding recycling- due to lack of partition, most plastic waste cannot be recycled.
- Cold regulation - This has led to a ban on the movement of plastic waste to other provinces with recycling.

Steps So far

- **GloLitter Partnerships Project:** Launched by the International Maritime Organization (IMO) and the Food and Agriculture Organization of the United Nations (FAO) as well as the first subsidy from the Norwegian Government.
  - **Purpose:** To prevent and reduce marine plastic waste from shipping and fisheries.
- **World Environment Day**, 2018 is held in India, world leaders promise "Beat Beat Pollution" and end its use completely.
- **Specifically, in India:** The Plastic Waste Management Regulations, 2016 states that every local organization must be responsible for establishing infrastructure for sorting, collecting, processing and disposing of plastic waste.
- **Plastic Waste Management Regulations (Amendments):** The 2018 Regulations introduce the concept of Extra Manufacturer Responsibility (EPR).
- **Prohibit Single Use Plastics** with the aim of liberating India of once-used plastics by 2022.

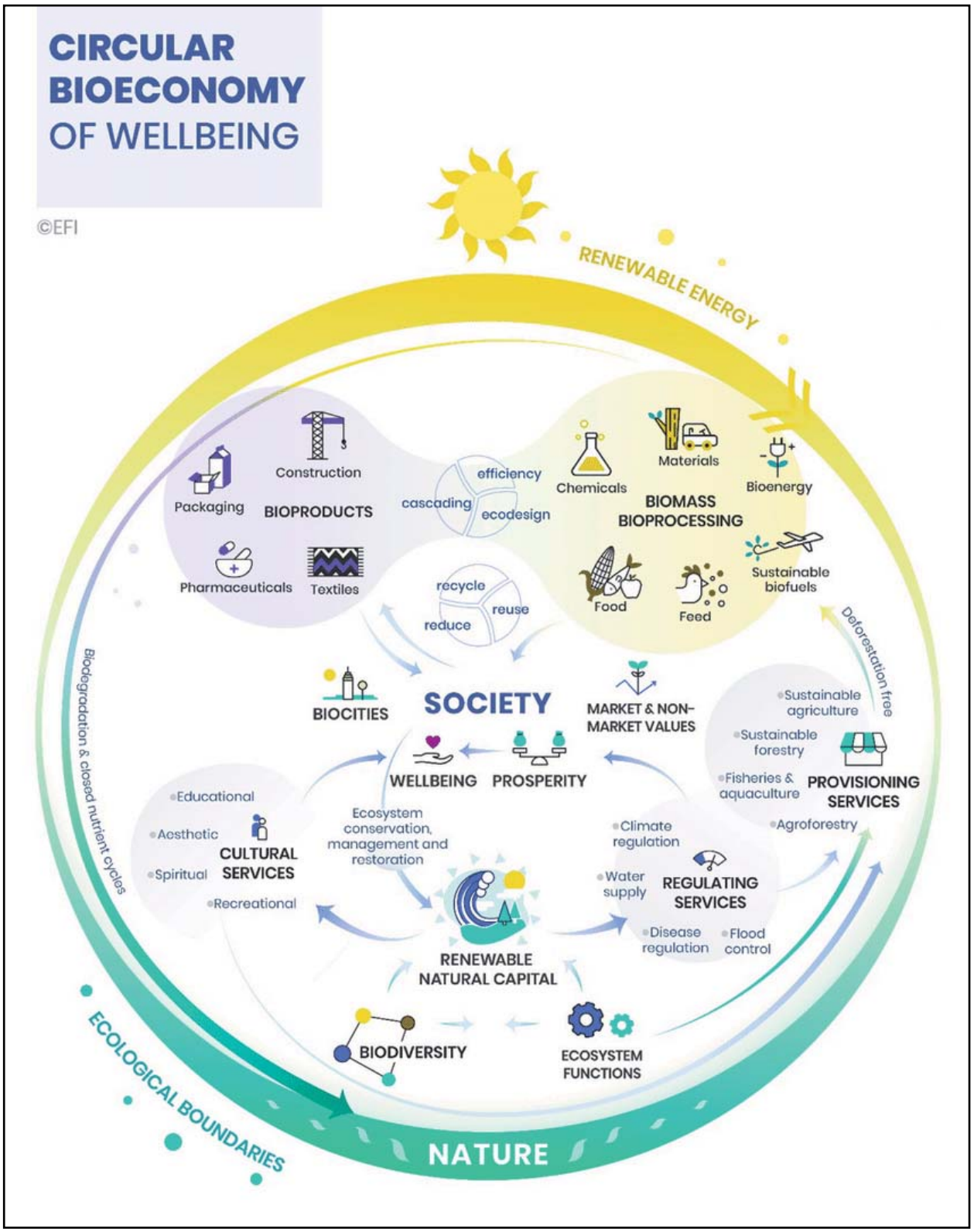
14 Circular Bioeconomy

Context:

The current economic system has failed to value nature. Thus, a new economic model is needed: a "circular bioeconomy".

What is Circular Bioeconomy?

- A circular economy is an industrial system that is restorative or regenerative by intention and design.
- It replaces the end-of-life concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals and aims for the elimination of waste through the superior design of materials, products, systems and business models.



Components of Circular Bio economy

- The CBE mainly relies on biomass carbon (i.e., any biodegradable organic sources) as a building block, while social, economic and environmental components are the key drivers.

The grim situation

- Over 70% of population is affected by rising inequalities.
- A third of the world's land is severely degraded.
- We are losing forests at an alarming rate (one football field of forests every six seconds in 2019).
- Up to 1 million species are threatened with extinction.
- Over half of the world's GDP ($44 trillion) is threatened by such nature loss.

15 Harnessing the Power of India's Forests for Climate Change Mitigation

Context:

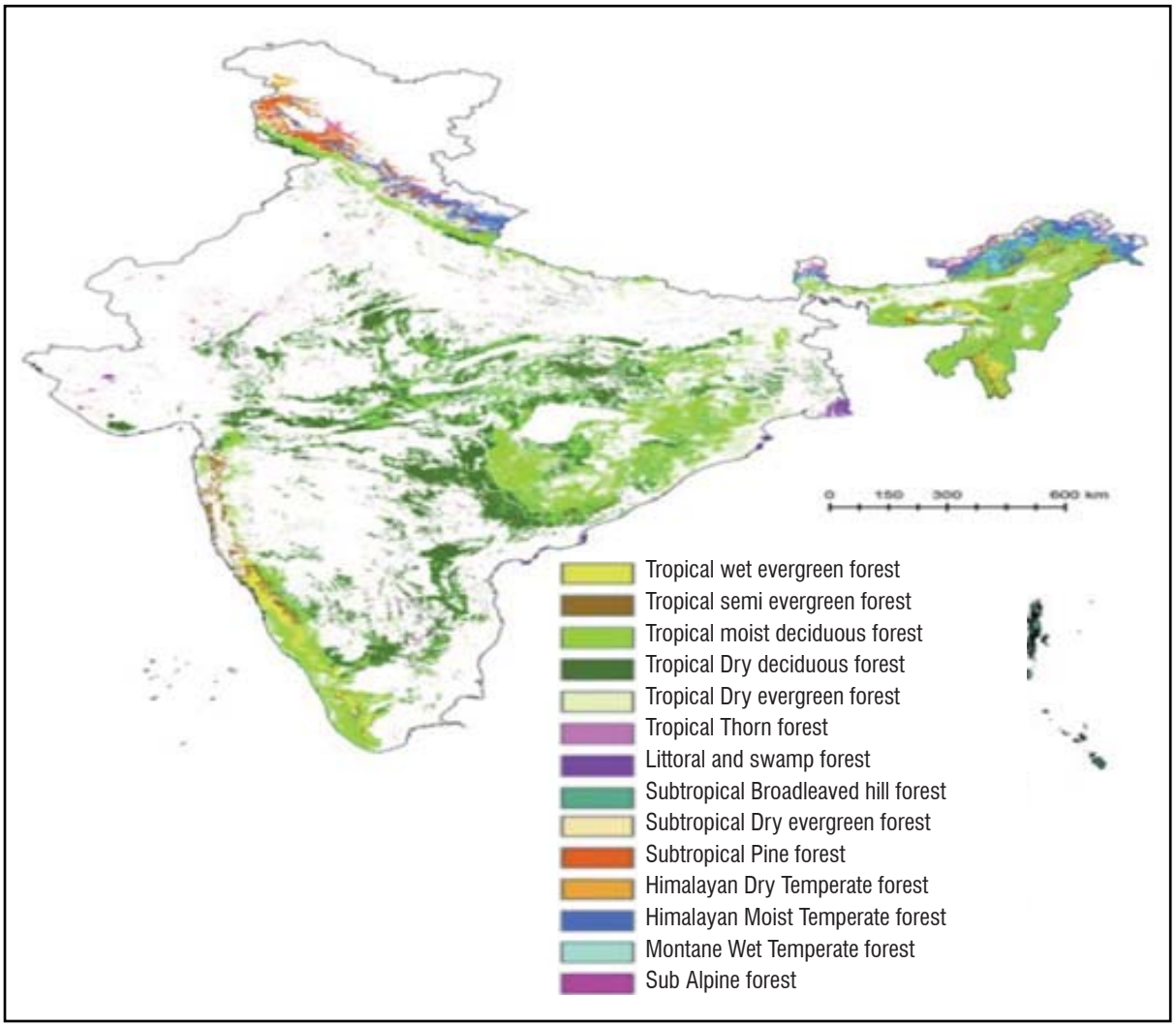
- **Forests help mitigate the impacts of climate change, provide economic benefits for the country, and meet specific facets of India's sustainable development goals.**
- **It is essential, therefore, to revisit India's forest governance and evaluate the country's efforts at forest restoration and conservation.**

What is the state of India's Forests?

- India is now ranked 3rd in the world for annual net gain in terms of forest area.
- The biennial **India State of Forest Report-2019** released by the Union Ministry for Environment, Forest and Climate Change reports that India has achieved an increase of 24.56 percent in its total forest and tree cover.
- The government has claimed that India's green cover has increased by 15,000 km2in the last four years.

Definitions

- **Forest and tree cover:** The total area of tree patches in areas both less than and more than 1 ha is then known as "forest and tree cover".
- **Tree cover:** "Tree cover" is also separately defined as "all tree patches less than 1 ha outside the recorded forest area".
- **Trees outside forests:** Further, "trees outside forests" refers to trees outside recorded forest area, regardless of the area of the tree-patch.
- **Growing stock:** The other term, "growing stock", is the volume of trees in an area of forest above a certain thickness at breast height and measured in cubic meters. The 'growing stock' is the basis for calculating the amount of biomass and carbon stock in forests.



Classification Scheme

The forest cover is broadly classified in 4 classes, namely very dense forest, moderately dense forest, open forest and mangrove. These classes are defined is below.

Very dense Forest	All Lands with tree cover (Including mangrove cover) of canopy density of 70% and above	
Mod Dense forest	All lands with tree cover (Including mangrove cover) of canopy density between 40% and 70% above	
Open forest	All lands with tree cover (Including mangrove cover) of canopy density between 10% and 40%	
Scurb	All forest lands with poor tree growth mainly of small or stunted trees having canopy density less than 10 percent	
Non Forest	Any area not included in the above classes	

Assessing the power of Indian forests

- **Supporting economy and livelihood:** India's forest ecosystems support the economy and livelihood of approximately 300 million tribal and local people in forest villages.
- **Habitat, food and energy supplier:** Covering 80.73 mha or 24.56 percent of the geographical area of the country, forests are home to 80 percent of the terrestrial biodiversity, provide 40 percent of energy needs, and 30 percent of the fodder supply.
- **Natural stabilising agent for climate:** Besides driving sustainable growth, forests act as a natural stabilising agent for the climate as they regulate carbon cycle significantly.
- **Carbon sequestration:** Carbon sequestration through photosynthesis is considered one of the most potent and inexpensive methods for climate change mitigation.
- Forests are the only unique, safe and inexpensive carbon capture and storage technology that is naturally available at scale with the potential to neutralise global CO2 concentrations.

Role of forests in climate change

- Forests have four major roles in climate change:
  - they currently contribute about one-sixth of global carbon emissions when cleared, overused or degraded
  - they react sensitively to a changing climate
  - when managed sustainably, they produce woodfuels as a benign alternative to fossil fuels
  - they have the potential to absorb about one-tenth of global carbon emissions projected for the first half of this century into their biomass, soils and products and store them - in principle in perpetuity.

Mapping deforestation

- Unfortunately, due to the over-dependence on forests of large populations and the unsustainable exploitation of their resources, India has witnessed rapid deforestation in the last decades, leading to the degradation of over 30 percent of its land and a loss of 1.6 mha of forest cover.
- According to government data, in the last 30 years, 14,000 km^2 of forests were cleared to accommodate 23,716 development and industrial projects across India.
- Besides rapid land conversion, the harvest of an estimated 850 Mt of fodder, 100 Mt of fuel wood, and 15 Mt of timber annually beyond the sustainable limits have led to the degeneration of India's forests.
- At the same time, however, India is seeing a massive deterioration in the health of its forests, with the growing stock (GS) decreasing significantly by 586.387 million cubic meters (M cum) or 12.26 percent.
- The reduction in GS, despite increasing forest cover, is an indicator of forest degradation.
- Within the forests recorded officially by government authorities, 94.96 percent are prone to crop injuries, 39.94 percent has inadequate regeneration, and 5.05 percent has no regeneration.
- Forest degradation undermines the ability of forests to act as carbon sinks.

Impact of deforestation

- **Reducing productivity of ecosystem**
- **Increase in carbon emissions**
- **Economic loss:** According to a study by **TERI (The Energy and Resource Institute**), the degradation of India's forests is depriving the country of 1.4 percent of its GDP annually.

What initiatives are taken by India?

- At the UN Framework Convention on Climate Change (UNFCCC) Conference of Parties (COP, 2015), India, under the **Bonn Challenge** committed to the goal of restoring 13 million hectares (mha) of degraded and deforested land by 2020 and an additional 8 mha by 2030.
- Moreover, in its pledge to reduce the emission intensity of its GDP by 33-35 percent by 2030 (from 2005 levels) through mitigation efforts across various sectors, India envisions to create an additional carbon sink of 2.5-3.0 billion tonnes (Bt) of CO2eq through additional forest and tree cover by 2030.
- The Indian government is pursuing afforestation and reforestation through policies and programmes such as:
  - the **National Mission on Green India**
  - the **National Afforestation Programme**
  - compensatory afforestation
  - plantation drives across States

International treaties to protect forests

- **United Nations Forum on Forests (UNFF):** UNFF was established in 2000. In May 2006 it adopted four objectives:
  - Reverse the loss of forest cover worldwide through sustainable forest management;
  - Enhance forest-based economic, social and environmental benefits;
  - Increase significantly the area of sustainably managed forests; and
  - Reverse the decline in official development assistance for sustainable forest management and mobilise significantly increased new and additional financial resources from all sources for the implementation of sustainable forest management.
- **Convention on Biological Diversity:** Since deforestation is one of the main causes of species loss, in 1998 the Conference of the Parties to the Convention on Biological Diversity endorsed a work programme for forest biological diversity. 2002 saw the adoption of an expanded programme of work on forest biological diversity.
- **UNCCD:** The United Nations Convention to Combat Desertification (UNCCD), entered into force in 1996. It has helped bring about a situation in which most countries have now established clear rules for combating desertification.
- **REDD+:** REDD (Reducing Emissions from Deforestation and Forest Degradation) is based on the idea of financially rewarding a country's government and its population when they can demonstrate that they have avoided deforestation. **REDD+** marked a further extension of this approach.
- As well as forest protection, this approach now also includes other measures that support the role of the forest as a carbon sink, such as improved forest management and targeted reforestation.
- **Bonn Challenge:** In 2011, the world's largest forest and landscape restoration initiative was launched in Bonn. The "Bonn Challenge" aims to restore 150 million hectares of degraded and deforested land by 2020, and 350 million hectares by 2030. It is estimated that by reforesting this land it will be possible to absorb around one gigaton of carbon dioxide.
- **2030 Agenda for Sustainable Development:** In 2015, the international community adopted the 2030 Agenda for Sustainable Development.
  - **Goal 15** includes forest protection. Specifically, it aims to halt deforestation worldwide by 2020 and ensure that all forests are managed sustainably.
  - **Goal 6** also underlines the importance of forests for water supply.
  - **Goal 13:** Although forests are not mentioned explicitly in this context they also play a major role in Goal 13, which deals with climate change.

A Roadmap for Forest Regeneration

- **Redefining 'forests':** An important element of a sound roadmap for forest regeneration is a redefinition of what is considered a 'forest'. The focus should shift to the measurement of the relative density of a 'thriving forest' or an 'ecosystem'.
- **Updating forestry policies:** The National Forest Policy of 1952 and 1988, as well as existing forest regulations, have become ineffective in protecting and conserving forest resources. A new forest policy, therefore, is vital in order to provide an overarching framework and direction for the management and regulation of forests; such new policy would consider current changes in forests due to pressing issues such as climate change and pollution.

National Forest Policy

- The first National Forest Policy in independent India came into effect in 1952.
- Thereafter, in 1988, a new version of the NFP came into being. The latest version has been in the offing for nearly four years now but a final version is yet to be made public.
- Nearly three and a half years ago, in June 2016, the Environment Ministry had unveiled a draft NFP but when it came under fire for not being enough to protect the then-existing forest regulations, the ministry had backtracked on it, calling it just a "study".
- Subsequently, in 2018, the central government officially unveiled the draft of the NFP.
- The draft was then revised in 2019 as well but since then there has been no news about the final version of the NFP.

- **Effective institutional and monitoring mechanism:** A successful forest programme will depend on creating strict institutional mechanisms for the effective utilisation and monitoring of funds.
- **Empowering local communities:** For a forest landscape as diverse and densely populated as India's, the agency of local communities in operational decision-making and forest governance is essential. The participation of local communities must work synonymously with the coordination of impartial and credible processes to operationalise sustainable use and conservation strategies.

16 'The New Green Revolution: A Just Transition to Climate-Smart Crops'

Context:

The agriculture sector's massive greenhouse gas emissions pose a threat to India's green transition. There is an urgent need for a transition to climate-smart crops.

Background

- During British Raj, India faced drastic feminine. After independence, the country was determined to become self-sufficient in producing food grains and not to depend on other countries for food sufficiency.
- However, India had been importing wheat from the **US under Public Law 480 (PL480)** since 1954.

- The situation mutually benefitted India and the US until the India-Pakistan war in the summer of 1965, and the subsequent condemnation of US actions in Vietnam by India, which led to an immediate threat of withdrawal of the PL480 programme by the US.
- By this time, India's urban labouring class had become dependent on PL480 wheat supplied to them through the ration shop system.

- In order to become self-sufficient, India launched Green Revolution in **1965** under the leadership of the **Lal Bahadur Shastri** and with the help of **S. Swaminathan.**
- S. Swaminathan played a vital role in introducing high-yielding varieties of wheat in India to increase agriculture production in India.
  - He is also known as the father of green revolution in India.
  - He is an Indian geneticist; under his guidance and supervision, high-yielding varieties of wheat and rice were grown in the fields of Indian states.
- In India, the green revolution continued from 1965 to 1977.
- It mainly increased the food crops production in the state of Punjab, Haryana and Western UP and enabled India to change its status from a food deficient country to one of the leading agricultural nations in the world.
- However, today the sector faces enormous environmental issues, which needs to be addressed at the earliest.

Analysis

■ Contribution of Agriculture Sector

- The agriculture sector is an integral part of India's growth story.
- **Economic benefit:** It employs 58 percent of the population and contributes 18 percent of the country's GDP.
- In the first quarter of 2020, agriculture was the only sector that showed some growth (3.4 percent) when the economy contracted overall by a massive 23.4 percent.
- **Food security:** It is responsible for both food and nutritional security and is key to efforts towards alleviating poverty and reducing inequality.
- **Contribution to GHG:** At the same time, agriculture contributes 16 percent of the total greenhouse gas emissions in the country, second only to the energy sector.

■ Why agriculture is becoming a 'concern'?

- **Expanding population, increasing burden on land:** To feed an expanding population, the annual world food production will need to increase by 60 percent over the next three decade.
- **Climate Change, adding difficulty level:** Climate change will undermine agricultural production systems and food systems, especially in agricultural communities in developing countries where poverty, hunger and malnutrition are the most prevalent.
- **Contribution to GHG:** The agricultural sector itself, which include crop and livestock production, forestry, fisheries and aquaculture, is also a major contributor to global greenhouse gas emissions.

How does the sector contribute to GHG?

- Most farm-related emissions come in the form of **methane (CH4)** and **nitrous oxide (N2O).**

- **Cattle belching (CH4)** and the addition of **natural or synthetic fertilizers** and **wastes to soils (N2O)** represent the largest sources, making up 65 percent of agricultural emissions globally.
- Smaller sources include manure management, rice cultivation, field burning of crop residues, and fuel use on farms.
- At the farm level, the relative size of different sources will vary widely depending on the type of products grown, farming practices employed, and natural factors such as weather, topography, and hydrology.

Important International Reports

- In September 2020, the **United Nations Environment Programme (UNEP)** released a report that says that the food production line of the world accounts for about a quarter (21 to 37 percent) of GHG emitted every year due to human activities.
  - The food production line involves everything from growing and harvesting crops to processing, transporting, marketing, consumption and disposal of food and related items
  - It sustains around 7.8 billion people.
- This means, food system is as polluting as sectors like electricity and heat production (which accounts for 25 percent of GHGs) and industry (21 percent), and are more polluting than transportation (14 percent) and buildings and energy use (16 percent).

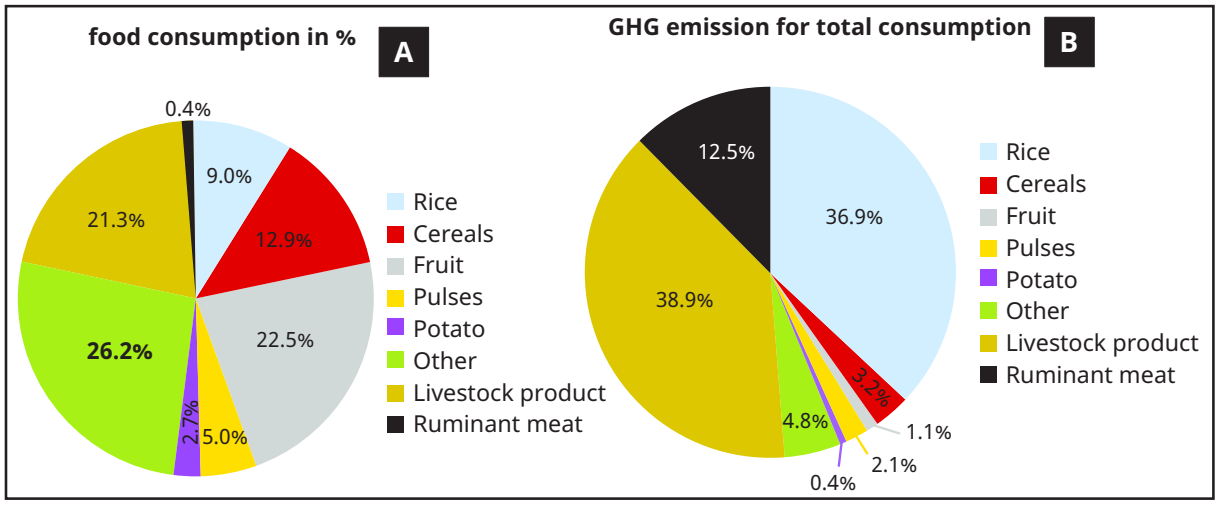
How rice (specifically) adds to GHG emissions?

- Rice is the staple food for more than 65 percent of the Indian population and contributes 40 percent of total food grain production in India.
- It occupies a central role in Indian agriculture as it provides food and livelihood security to a large proportion of the rural population.
- In 2018-19, India produced 116.42 million tonnes of rice, second in the world only to China.
- However, rice cultivation is a considerable threat to sustainable agriculture as it is a significant source of GHG emissions (e.g., methane and nitrite oxide).
- Rice is a **significant sequester of carbon dioxide** from the atmosphere.
- Furthermore, emission of **methane (or CH4)** from flooded paddy fields, combined with the burning of rice residues such as husks and straws, further add to GHG emissions.
- In 2017, India produced 112.78 million tonnes of rice, which led to large emissions as summarised in the following table.

Emission Content of Rice Cultivation in India

Rice Cultivation	Value 2017	Unit
Implied emission factor for CH4	10.556	g CH4/m2
Emissions (CH4)	4622.3668	gigagrams
Emissions (CO2eq)	97069.7036	gigagrams

- While rice formed only **9 percent** of total consumption in Indian diets, it contributed **9 percent** to the total GHG emissions in Indian diets.



Why Indian farmers are fascinated with rice?

- **Handsome incentives:** Indian farmers are incentivised to produce rice because of an assured demand at a remunerative price.
- **Assured demand:** The assured demand for rice had been a motivator towards its production. On the other hand, the lack of such demand for millets and pulses has forced a decline in their production over the years. Thus, income support and demand are crucial facilitators for production of any desirable climate-smart crop.
- **Subsidised inputs:** It is also the availability of subsidised inputs for one set of food grains over the other that further promotes the production of the former.

Is climate-smart agriculture, the future?

- To step up and face the many challenges in agriculture, the solution lies in climate-smart agriculture (CSA).
- CSA is defined by its desired outcomes—agricultural systems that are resilient, productive, and have low emissions.
- **Parameters:** CSA broadly works on three parameters. These are:
  - sustainably increasing agricultural productivity and farmers' incomes
  - adapting to climate change
  - reducing greenhouse gas emissions (GHG)

Climate-Smart Agriculture (CSA)

- The **Food and Agricultural Organisation (FAO)** defines Climate-Smart Agriculture (CSA) as an approach that helps guide actions needed to transform and reorient agricultural systems to effectively support development and ensure **food security** in a changing climate.
- It takes into consideration the diversity of social, economic and environmental contexts, including agro-ecological zones.
- Implementation requires identification of climate-resilient technologies and practices for management of water, energy, land, crops, livestock, etc at the farm level.
- It also considers the links between agricultural production and livelihoods.
- Testing and applying different practices are important to expand the evidence base and determine what is suitable in each context.

Can't organic farming take the lead?

- Organic agriculture is defined by the method of production (no use of synthetic pesticides or fertilisers).
- However, many of the practices used in organic agriculture are climate smart.
- Organic agriculture enhances natural nutrient cycling and builds soil organic matter, which can also support resilience to climate change and sequester carbon in soils.
- But to get more desired results, climate-smart agriculture can be more effective and successful.

What needs to be done?

- The agriculture sectors need to overcome three intertwined challenges:
  - sustainably increase agricultural productivity to meet global demand
  - adapt to the impacts of climate change
  - contribute to reducing the accumulation of greenhouse gases in the atmosphere
- **Focus on agriculture for inclusive growth:** If India is aiming to transition to a green economy and achieve its Sustainable Development Goals (SDGs), it will have to pay greater attention to the agricultural sector. Agriculture can yet prove to be a catalyst for India to achieve a standard of inclusive, green growth.
- **Incentivization towards climate-smart crops:** While it is clear that the unsustainable incentivization towards production of rice was due to the procurement system and that the procurement system is largely unequal in its reach, it is nevertheless, a powerful tool to drive the transition towards climate-smart crops.
- **Shifting to climate-smart crops:** Phasing out procurement of rice and in its stead, creating assured procurement (demand pull) for pulses and millets, at remunerative prices (income support) with subsidised inputs (shadow prices) will ensure a shift to the production of these climate-smart crops, which will aid in India's green transition.
- **Enabling environment:** However, in the long run, switching to a more robust alternative for sustainable agriculture will require building an enabling environment with better income support for the farmers.
- **Focus on food and nutritional security:** The government could then supply the nutritious, climate-smart food-grains to its citizens utilising its PDS and mid-day meal scheme, thereby ensuring food and nutritional security.

The Four Attributes of 'Transition'

- There are four pillars that will enable a shift to climate-smart agriculture

Attributes	Mechanisms	Impacts
Sustainable Practises	Shadow Prices of Inputs	Incentivises production of climate-suitable crops.
Income Stability	Income Support	Support against seasonal changes worsened by climate crisis. Balanced flow of revenue to farmers.
Market Signalling Infrastructure	Production as per demand	Restrains over-production of certain goods, ensures price and inventory maintained.

Accessible Enabling Environment	Feasible Storage & Processing Facilities	Cost of cultivation goes down.
	Better Market Access	Easier to sell food-grains.

Eco-friendly approaches for farming system

- **The Zero Budget Natural Farming (ZBNF)**: The concept introduced in Andhra Pradesh in 2015 is a low-input, climate-resilient type of farming that encourages farmers to use low-cost locally sourced inputs. It eliminates the use of chemical fertilisers and pesticides.
- **Organic farming:** It is a production system, which avoids or largely excludes the use of synthetically compounded fertilizers, pesticides, growth regulators, and livestock feed additives. To the maximum extent feasible, organic farming system rely upon crop rotations, crop residues, animal manures, lagumes, green manures, off-farm organic wastes, mechanical cultivation, mineral-bearing rocks, and aspects of biological pest control to maintain soil productivity and tilth, to supply plant nutrients, and to control insects, weeds, and other pests.
- **Regenerative Agriculture:** In regenerative agriculture bunds on nature's own inherent capacity to cope with pests, enhance soil fertility, and increase productivity.
- **Permaculture:** Permaculture is concerned with designing ecological human habitats and food production systems, and follows specific guidelines and principles in the design of these systems.
- Other important approaches include:
  - zero tillage
  - raised bed planting
  - direct seeded rice
  - crop residue management
  - cropping diversification (horticulture, bee keeping, mushroom cultivation, etc)
- Besides, site-specific nutrient management, laser levelling, micro-irrigation, seed/fodder banks can also be adopted.

Recent Government measures to mitigate risks of climate change on agriculture

Foreseeing the future risks of climate change, the Government of India is implementing:

- **National Mission of Sustainable Agriculture (NMSA),** one of the eight missions under the **National Action Plan on Climate Change (NAPCC).**
- Parallelly, the **Pradhan Mantri Krishi Sinchayee Yojana (PMKSY)** envisages "**Per Drop More Crop**", that is, promoting micro/drip irrigation to conserve water.
- There is also a push to cluster-based organic farming through the **Paramparagat Krishi Vikas Yojana** (PKVY).

The mission of these programmes is to extensively leverage adaptation of climate-smart practices and technologies in conjunction with the Indian Council of Agricultural Research (ICAR) and state government.

Wrapping Up

- Given the quantum of the agricultural sector's contribution to greenhouse gas emissions in India, any movement towards green growth must incorporate the principles of climate-smart agriculture. In turn, taking into account the contribution of rice cultivation to agriculture emissions, any such movement must also incorporate alternatives to improve rice cultivation.

- It is therefore important to initiate a new Green Revolution, wherein a just transition towards climate-smart agriculture will incorporate sustainable agriculture planning, provide market signalling and income support, and create an enabling environment through provisioning of processing and storage facilities and better market access.

17 Carbon Capture, Utilisation & Storage (CCUS)

Context:

- **After years of a declining investment pipeline, plans for more than 30 new integrated CCUS facilities have been announced since 2017.**
- **The vast majority are in the United States and Europe, but projects are also planned in Australia, China, Korea, the Middle East and New Zealand.**
- **If all these projects were to proceed, the amount of global CO2 capture capacity would more than triple, to around 130 Mt per year.**

What is Carbon Capture and Storage (CCS)?

- Carbon capture, utilisation and storage, or CCUS, is an important emissions reduction technology that can be applied across the energy system.
- It involves the **capture of carbon dioxide (CO2) emissions** from industrial processes, such as steel and cement production, or from the burning of fossil fuels in power generation.
- It is then **transported from where it was produced**, via ship or in a pipeline, and stored deep underground in geological formations.
- There are **three steps** to the CCS process:
  - **Capture:** the CO2 is separated from other gases produced in industrial processes, such as those at coal and natural-gas-fired power generation plants or steel or cement factories.
  - **Transport:** the CO2 is then compressed and transported via pipelines, road transport or ships to a site for storage.
  - **Storage:** finally, the CO2 is injected into rock formations deep underground for permanent storage.

How does it work?

- It encompasses methods and technologies to **remove CO2 from the flue gas** and from the atmosphere.
- It is followed by **recycling the CO2 for utilization** and determining safe and permanent storage options.
- It involves the **capture of CO2 from large point sources**, including power generation or industrial facilities that use either fossil fuels or biomass for fuel.

18 Marine heatwaves

Context:

- **Among the most severe consequences of climate change is the global rise in average temperatures, and the resultant heatwaves.**

- **Given the increase in the frequency and intensity of heatwaves, it is essential to prepare and implement hear action plans and to adopt a framework for adaptive action plans.**

Important Reports

- In its **Fifth Assessment Report (2013),** the **United Nations Intergovernmental Panel on Climate Change (IPCC)** revealed that between 1880 and 2012, the average global temperature rose by **0.85 percent**.
- The report also stated that a great deal of irreversible damage had already been triggered and most aspects of climate change will persist for centuries, even if emissions are controlled.
- A **2018 IPCC report** concluded that many of the adverse impacts of climate change would come at the 1.5°C mark, including:
  - extreme temperatures in most inhabited regions
  - a rise in mean sea level
  - heavy precipitation in many areas
  - the probability of drought and precipitation deficits in some areas

What are Heatwaves?

- A heatwave refers to surface temperatures being significantly higher than normal for several days at a time.
- The World Meteorological Organization defines heatwaves as **"five or more consecutive days during which the daily maximum temperature surpasses the average maximum temperature by 5°C (9°F) or more".**
- However, there is no universally accepted definition for heatwaves.
- Heatwaves are measured relative to the usual weather in an area and the normal temperatures for the season, and so definitional differences are reflective of global climatic variations and the geographically variable nature of heatwaves and their impact.

Different standards on heatwaves

Several countries have adopted their own standards on heatwaves:

- **India:** The India Meteorological Department requires that, to be classified as a heatwave, temperatures should reach:
  - at least 40°C in the plains
  - at least 30°C in the hilly regions
  - should reflect an increase of at least 5°C-6°C (or 9°F-10.8°F) above the normal temperature
- **United States:** The US National Weather Service defines a heatwave as a spell of "abnormally and uncomfortably hot and unusually humid weather" over two days or more.
- **Denmark:** In Denmark, a heatwave occurs when the mean of the highest recorded temperature measured over three consecutive days exceeds 28°C (82.4°F).
- **Australia:** In Adelaide, Australia, a heatwave is defined as five straight days with temperatures at or above 35°C (95°F), or three consecutive days at or over 40°C (104°F).

India and Heatwaves

- India routinely experiences hot summers but, in recent years, several parts of the country have seen abnormally high temperatures—**4°C-5°C (39.2°F-41°F) above normal**—over several days, being defined as heatwaves.
- India's northwest region typically experiences heatwaves between March to June, and in rare cases until July.

- Urban habitats are more prone to disasters than rural areas—cities have frequently been hit by floods and other calamities and bore the brunt of the COVID-19 pandemic worldwide.
- Similarly, cities are more vulnerable to heatwaves due to the 'heat island effect'. Urbanised areas experience higher temperatures due to their built density.

Aren't 'heat waves' and 'loo' same?

- Additionally, during the summer months, north and northwest India also experience the **'loo'—strong, hot, dry winds** that blow during the day and sometimes until late in the evening.
- On account of its extreme temperature, ranging between 45°C-50°C (115°F-120°F) and very low humidity, the 'loo' zaps the human body dry on exposure, leading to **fatal heatstroke.**
- However, the 'loo' is a normal weather phenomenon in northern India, and heatwaves are considered to occur above this condition *not* before it.

How 'urbanization' is contributing to the phenomenon?

- Buildings, roads and other infrastructure absorb and re-emit the sun's heat more than natural landscapes such as forests and water bodies.
- Urban areas, where such structures are highly concentrated and greenery is limited, become 'islands' of higher temperatures in comparison to outlying areas.

Is the phenomenon limited to India?

- Heatwaves are a global phenomenon; around the world, days are getting hotter more frequently. The proportion of the Earth's surface area that was subjected to scorching summers (significantly higher than the average temperatures) increased from 1 percent between 1951-80 to over 10 percent between 1981-2010.
- **United States:** In the US, for instance, the frequency of heatwaves has increased substantially, from an average of two per year during the 1960s to over six per year during the 2010s.
- **England:** In England, between 2015 and 2019, over 3,400 people lost their lives on account of extreme temperatures, with nearly 900 extra deaths (deaths above the normal numbers recorded each year) during the 2019 summer heatwaves.
- **Europe:** In 2003, a devastating heatwave during Europe's hottest summer since the sixteenth century killed about 30,000 people across the region.
- **Japan:** In 2018, Japan's weather agency warned of unprecedented levels of threat on account of extreme heat and declared the heatwave sweeping the country as a natural disaster.
- **Africa:** While Sub-Saharan Africa has been identified as a heatwave 'hotspot', regional governments have not reported such events, but the African continent is as vulnerable to the impacts of heatwaves as elsewhere.

What are health impacts of Heatwaves?

Heatwaves have several health impacts:

- Dehydration
- Heat cramps
- Heat exhaustion and/or heat stroke

19 Atlantic Meridional Overturning Circulation (AMOC)

Context:

According to scientists weakening of AMOC could have drastic consequences on global climate.

What is Atlantic Meridional Overturning Circulation (AMOC)?

- The Atlantic Meridional Overturning Circulation (AMOC) is a large system of ocean currents that carry warm water from the tropics northwards into the North Atlantic.
- AMOC ensures the oceans are continually mixed, and heat and energy are distributed around Earth.

How does the AMOC work?

- The AMOC is a large system of ocean currents**, like a conveyor belt**, driven by differences in temperature, salt content and the water's density.
- As warm water flows northwards it cools and some evaporation occurs, which increases the amount of salt. Low temperature and a high salt content make the water denser, and this dense water sinks deep into the ocean.
- The cold, dense water slowly spreads southwards, several kilometres below the surface. Eventually, it gets pulled back to the surface and warms in a process called "upwelling" and the circulation is complete.

Has the AMOC been changing?

- For thousands of years, AMOC has remained stable, **but since the past 15 years, it has been weakening** which could have dramatic consequences for Europe and other parts of the Atlantic rim.
- Indirect evidence (for example from sediments on the sea floor) shows that there have been some large, rapid changes in the AMOC in the past (for example around the end of the last ice age).

What will be the effect of climate change on the AMOC?

- Climate models suggest that the AMOC will weaken over the 21stCentury as greenhouse gases increase. This is because as the atmosphere warms, the surface ocean beneath it retains more of its heat.
- All these changes make the ocean water lighter and so reduce the sinking in the 'conveyor belt', leading to a weaker AMOC. So the AMOC is very likely to weaken, but it's considered very unlikely that large, rapid changes in the AMOC, as seen in past times, will happen in the 21st
- A weaker AMOC will bring less warm water northwards, and this will partly offset the warming effect of the greenhouse gases over Western Europe.

What is the role of Indian Ocean?

- As the Indian Ocean warms faster and faster, it generates additional precipitation. This draws more air from other parts of the world to the Indian Ocean, including the Atlantic.

- With so much precipitation in the Indian Ocean, there will be less precipitation in the Atlantic Ocean. Less precipitation will lead to higher salinity in the waters of the tropical portion of the Atlantic because there won't be as much rainwater to dilute it.
- This saltier water in the Atlantic, as it comes north via AMOC, will get cold much quicker than usual and sink faster.

20 Naming of Tropical Cyclones

Context:

- **The recent cyclones in Arabian Sea and Bay of Bengal were named as Tauktae and Yaas.**
- **These Cyclones are listed in India Meteorological Department (IMD) of future tropical cyclones that would emerge in the Bay of Bengal and the Arabian Sea.**

About the Cyclone List

- **The list of 169 cyclone names is released by IMD, which provides the names of the cyclones and have 13 suggestions from each of the 13 countries.**
- **Cyclones are named by the** regional specialised meteorological centres (RSMCs**) and** Tropical Cyclone Warning Centres (TCWCs) **in every ocean basin across the world.**
- **There are** six RSMCs in the world **that also includes the India Meteorological Department (IMD), and a total of five TCWCs.**
- **As an** RSMC, the IMD names **the cyclones which develop over** the north Indian Ocean, including the Bay of Bengal and Arabian Sea**, after following a standard procedure.**
- **The** IMD is also mandated to issue advisories to 12 other countries **in the region on the development of cyclones and storms.**

How the cyclones are named?

- In 2000, a group of nations which is called WMO/ESCAP (World Meteorological Organisation/ United Nations Economic and Social Commission for Asia and the Pacific), decided to start naming cyclones.
- The group is comprised of Bangladesh, India, the Maldives, Myanmar, Oman, Pakistan, Sri Lanka and Thailand, region.
- The WMO/ESCAP expanded to include five more countries in 2018 — Iran, Qatar, Saudi Arabia, United Arab Emirates and Yemen.
- Each country sent in suggestions and they were finalized to prepare a list by the WMO/ESCAP Panel on Tropical Cyclones (PTC).
- The list of 169 cyclone names is released by IMD, which provides the names of the cyclones and have 13 suggestions from each of the 13 countries.
- **Significance of naming:** It helps the scientific community, the media and disaster managers to create awareness of the development, for rapidly disseminating warnings to increased community preparedness and remove confusion where there are multiple cyclonic systems over a region.

What are the guidelines to adopt names of cyclones?

Some of the rules that countries need to follow:

- The proposed name should be neutral to (a) politics and political figures (b) religious believes, (c) cultures and (d) gender
- Name should be chosen in such a way that it does not hurt the sentiments of any group of population over the globe
- It should not be very rude and cruel in nature
- It should be short, easy to pronounce and should not be offensive to any member
- The maximum length of the name will be eight letters
- The proposed name should be provided with its pronunciation and voice over
- The names of tropical cyclones over the north Indian Ocean will not be repeated. Once used, it will cease to be used again. Thus, the name should be new.

Names of cyclones suggested by India

- The 13 names in the recent list that have been suggested by India include: Gati, Tej, Murasu, Aag, Vyom, Jhar (pronounced Jhor), Probaho, Neer, Prabhanjan, Ghurni, Ambud, Jaladhi and Vega.
- Some of the names picked by India were suggested by the general public.
- An IMD committee is formed to finalise the names before sending it to the PTC.

21 Discovery of India's First ever Lithium Reserves in Karnataka's Mandya

Context:

- **In a major development, India has discovered its maiden lithium deposits of 1,600 tonnes in the igneous rocks located in the Marlagalla-Allapatna region of Karnataka's Mandya district.**
- **Though the discovery is very small in size in the present, it marks an initial success for the nation's attempts to domestically mine the metal in India, which is in high demand for making electric vehicles (EV).**

What is Lithium?

- Lithium is a **metal** of utmost importance. It is everywhere today.
- Lithium is a key element for new technologies and finds its use in ceramics, glass, telecommunication and aerospace industries.
- The well-known uses of lithium are in lithium ion batteries, lubricating grease, high energy additives to rocket propellants, optical modulators for mobile phones and as a converter to tritium used as a raw material for thermonuclear reactions i.e. fusion.
- It's the juice that powers our smartphones, tablets, cameras, laptops and even cars. This element is the driver of the technology age. And it could dictate the future of civilization.

The survey was done on surface and limited subsurface in the pegmatites of Marlagalla - Allapatna area by Atomic Minerals Directorate for Exploration and Research (AMD), a constituent unit of Department of Atomic Energy.

Important facts

- The growing demand for Lithium in India is driven by the goal of Indian government to become one of the largest electric vehicle markets world over.
- NITI Ayog has set an ambitious target to increase the number of electric vehicles by 30 percent by 2030.

The projected market

- While electric cars in India remain a small segment, with an estimated 3,000 sold in 2018 compared with the 3.4 million fossil fuel-powered cars in the same year, the nation is forecast become the fourth-largest market for EVs by 2040, when the segment will comprise nearly a third of all vehicles sales.

- India's first Lithium plant has been set up at Gujarat in 2021, where Manikaran Power Limited will invest Rs 1000 crore to set up this refinery.
- The refinery will use Lithium ore to produce base battery material.

Karnataka's **Marlagalla-Allapatna area**, along the **Nagamangala Schist Belt**, is being seen as among the most promising geological domains for potential exploration for lithium and other rare metals.

- Bolivia is the leading producer with 2.10 crore tonnes lithium reserves, and Argentina has 1.70 crore tonnes of Lithium.
- Chile has around 8.6 Mn tonnes, Australia has 2.8 Mn tonnes, and even Portugal has around 60K tonnes of lithium deposits.

In 2020, India, signed an agreement with an Argentinian firm to jointly prospect lithium in the South American country that has the **third largest reserves of the metal in the world.**

What are the advantages of lithium for the renewable sector?

The element is promoted because it has a lot of potential in the renewable sector of the modern energy spectrum, some of its advantages include:

- **Lithium-ion batteries** can serve as a solution for varied power demands across the spectrum. It can range from vast energy storage to portable energy storage solutions. They can thus be used as large or small batteries.
- Lithium-ion battery has **high energy density**. This implies Li-ion batteries can last way longer between charges, while maintaining high current output. This makes it an ideal battery for most of our contemporary needs.
- Li-ion batteries are **low to minimum maintenance**, most other cells like Nickel-Cadmium (Ni-Cd) batteries have a huge cost of ownership and maintenance.
- Li-ion batteries come in all shapes and sizes, giving the users with many options to choose from according to their needs.

22 Ancient Bawadis and Water Management

Context:

With Chennai and Maharashtra water crisis, water management issues have again taken centre stage. NITI Aayog reiterated its strategy for water resources in "Strategy for new India@75" document which included adopting an integrated river basin management approach, and setting up of river basin organisations (RBOs) for major basins.

What is Water Management?

- Water resource management is the activity of planning, developing, distributing and managing the optimum use of water resources.
- According to a recent NITI Aayog report, 21 Indian cities including Delhi, Chennai, and Hyderabad will run out of groundwater by 2020 if usage continues at the current rate.
- This entails immediate action plan for water resource management in India.

Water situation in India:-

- India has just 4% of the world's fresh water — but 18% of the global population.
- The single largest source of fresh water is monsoons with an annual precipitation of about 4000 BCM (billion cubic metres) which is equivalent to1170 mm of rainfall. This is distributed both temporally and spatially. 3000 BCM is concentrated in 3-4 months of monsoons. Simultaneously, some northern states are water surplus whereas several states like Maharashtra, Tamil Nadu, and Rajasthan are water scarce.
- Out of the 4000 BCM, utilizable water is only 1120 BCM. Out of the utilizable water 690 BCM is available as surface water and 430 BCM as groundwater.
- In 1951, India's per capita water availability was 5177 cubic metres which decreased to 1545 cubic metres in 2011 and is predicted to further reduce to 1300 cubic metre by 2030

Causes for the Water vulnerability:-

- Excessive use of groundwater for irrigation in agriculture has also caused a strain in the resource. As India is one of the top agriculture producers in the world, the consumption of water for land and crops is also one of the highest.
- Water sources are contaminated with biological pollutants. Indian water bodies also have increased amount of solid wastes.
- Reduction in traditional water recharging areas and Sewage and wastewater drainage into traditional water bodies has exacerbated the water scarcity situation in the country.
- Increasing demand due to population growth, industrialisation, and rapid urbanisation have pushed the demand for water further.

Major steps and water management strategies adopted by Government:-

Ministry of Jal Shakti was formed by merging two ministries i.e. Ministry of Water Resources, River Development & Ganga Rejuvenation and Ministry of Drinking Water and Sanitation.

■ River Basin Planning

- Central water Commission has divided the country into 20 rivers basins comprising 12 major and 8 composite river basins. To address the multi-faceted nature of water management, government has introduced an integrated approach to water resources management at the national and basin level. This includes improving institutional arrangements and working practices.

■ Indian Rivers Inter-link

- The Indian Rivers Inter-link is a proposed large-scale civil engineering project that aims to effectively manage water resources in India by linking Indian rivers by a network of reservoirs and canals and so reduce persistent floods in some parts and water shortages in other parts of India.

■ Watershed management programmes in India

- **Prime Minister Krishi Sinchayee Yojna**: (Watershed Development Component) (WDC-PMKSY) - The main objectives of the WDC-PMKSY are to restore the ecological balance by harnessing, conserving and developing degraded natural resources such as soil, vegetative cover.
- **Neeranchal Watershed Program**: Neeranchal is a World Bank assisted National Watershed Management Project. Neeranchal is designed to further strengthen and provide technical assistance to the Watershed Component of PMKSY, in particular and all components of PMKSY, in general, to enhance its delivery capacity.

■ State specific lead in water management programmes

- **Mission Kakatiya** - launched by Telangana government aims to develop minor irrigation infrastructure, and strengthen community based irrigation management
- **Jalyukt-shivir** – is a project of Maharashtra government which aims to make 5000 villages free of water scarcity every year.
- **Mukhya Mantri Jal Swavlamban Abhiyan** – has been launched by Rajasthan for effective implementation of water conservation and water harvesting in rural areas.

23 Interconnected Disasters Risk

Context:

The UN Interconnected Disasters Risk Report, analyses 10 interconnected disasters that took place in 2020/2021.

Introduction

Our world today is facing an unprecedented level of extreme events impacting people and nature, evident in the ever-increasing frequency of severe weather events, epidemics and human-made disasters. In 2020/2021, the world witnessed a number of record-breaking disasters that showed us clearer than ever before how interconnected we are, for better or worse.

Highlights of the Report

■ 10 interconnected disasters

The report analyses 10 interconnected disasters that took place in 2020/2021. They were selected for their notoriety and representation of larger global issues, which have changed or will change our lives across the world:

- **Amazon Wildfires –** Wildfires fueled by global appetite
- **Arctic Heatwave –** Spiraling into a climate disaster
- **Beirut Explosion –** When the global community abandons ship
- **Central Viet Nam Floods –** When being prepared is no longer enough
- **Chinese Paddlefish Extinction –** The fish that survived the dinosaur extinction but not humankind
- **COVID-19 Pandemic –** How a pandemic is showing us the value of biodiversity

- **Cyclone Amphan –** When a cyclone and a pandemic combine
- **Desert Locust outbreak –** How manageable risks spin out of control
- **Great Barrier Reef bleaching –** Losing more than a natural wonder
- **Texas cold wave –** A preventable catastrophe

Disasters are interconnected

- One example of this interconnectivity is the link between the Arctic heatwave and the Texas cold wave.
- In 2020, the Arctic experienced the second-highest air temperatures and second-lowest amount of sea ice coverage on record.
- These changes have impacts on the climate outside of the Arctic and can lead to intense cold spells and heatwaves in Europe and North America, such as the Texas cold wave in February 2021.

Disasters co-occur

- Interconnections of disasters are not limited to those between faraway locations; they can also compound each other, as happened with the COVID-19 pandemic and Cyclone Amphan in the border region of India and Bangladesh.
- In an area where almost 50 per cent of the population is living under the poverty line, the COVID-19 pandemic and subsequent lockdowns left many people without income options, including migrant workers who were forced to return to their home areas and were housed in cyclone shelters while under quarantine.
- On 20 May 2020, Super Cyclone Amphan hit the region causing over 100 fatalities, damages in excess of $13 billion and displacing 4.9 million people.
- Many people, concerned over social distancing, hygiene and privacy, avoided evacuating to shelters.
- While the pandemic made it more difficult to prepare for the cyclone, the cyclone in turn also worsened the conditions for pandemic response in its aftermath, as health centres were destroyed and COVID-19 cases spiked.
- The pandemic also influenced response capacities to the desert locust outbreak, for example by disrupting supply chains for pesticides.
- As the number of disasters per year continues to rise, co-occurring disasters will become much more frequent.

Disasters can be connected to individual and collective human behaviour

- A high global demand for meat means that there is also a high demand for animal fodder, such as soy, which requires large plots of farmland.
- Combined with local political decisions and limited monitoring and enforcement, this has led to a record rate of deforestation and wildfires in the Amazon.
- Through the interconnections of global supply chains, meat consumption is one of the root causes contributing to the destruction of the Amazon.
- The impacts of forest fires and widespread deforestation are already felt globally as they exacerbate climate change and threaten biodiversity.
- Therefore the individual decision to eat meat and poultry can contribute to disaster risks.

Disasters share the same root causes

- Root causes are the underlying factors that create conditions for disasters to occur.

- If we think of an event such as the Texas cold wave as an iceberg, the unusually freezing temperatures that led to power outages and suffering were just the tip of this iceberg.
- However, this tip is how we perceive disasters, and this is where the media and discussions usually tend to focus.
- Far below the tip, there are deeper systems and structures that allowed the disaster to occur, and they are surprisingly similar for many seemingly unrelated events.
- After identifying sets of root causes for each event, the three most commonly identified root causes shared between these 10 events are human-induced greenhouse gas emissions, insufficient disaster risk management and under-valuing environmental costs and benefits in decision-making.
- Human-induced greenhouse gas emissions were one of the reasons why Texas experienced the freezing temperatures to begin with, but they also contribute to the formation of cyclones such as Amphan or the Arctic heatwave, for example – entirely different disasters in entirely different parts of the world. Insufficient disaster risk management led to the large impacts of the Texas cold wave, where there was inadequate cold weather protection in place even though similar cold waves had already disrupted the delivery of electricity in 1989 and 2011, and there had been warnings of another cold winter.
- This same root cause also played a role in other events such as the Beirut explosion or the desert locust outbreak.

Interconnected root causes call for interconnected solutions

- As the interconnected nature of events and their underlying root causes are increasingly creating emerging risks at all scales, it is time to recognize the shortcomings of fragmented responses.
- Ideally, the solutions we implement will have benefits across different dimensions.
- Cutting our greenhouse gas emissions, for instance, could eventually reduce the frequency and severity of hazards linked to atmosphere and ocean warming (such as the Central Viet Nam floods, driven by a series of tropical storms and cyclones), thus reducing risk in vulnerable areas.
- Additionally, slowing down climate change is beneficial for biodiversity and ecosystems as it gives more time for ecosystems and species to adapt to changing conditions.
- This would not only help to protect biodiversity, for example in the Great Barrier Reef, but would also allow us to maintain the benefits a healthy reef provides to society such as coastal protection, recreational value and fish for consumption.
- These types of solutions use interconnectivity to our advantage to reduce risks and the severity of impacts, and they also help to avoid a cascade of disastrous events and therefore the emerging risks they contribute to.

24 Great Barrier Reef as World Heritage in Danger

Context:

The UNESCO World Heritage Committee lamented that the Great Barrier Reef of Australia has deteriorated so much that it should be listed as a 'world heritage site in danger', which has drawn sharp criticism from Australia.

About Great Barrier Reef

- The Great Barrier Reef is a site of remarkable variety and beauty on the north-east coast of Australia.
- It contains the world's largest collection of coral reefs, with 400 types of coral, 1,500 species of fish and 4,000 types of mollusc, plus a great diversity of sponges, anemones, marine worms, crustaceans, and other species.
- It also holds great scientific interest as the habitat of species such as the dugong ('sea cow') and the large green turtle, which are threatened with extinction.
- No other World Heritage property contains such biodiversity.
- This diversity, especially the endemic species, means the GBR is of enormous scientific and intrinsic importance, and it also contains a significant number of threatened species.

What are the threats to GBR?

- **Climate Change**
- **Rising sea temperatures**
  - Rising sea temperatures mean the Reef is at greater risk of heat stress and mass coral bleaching, decreasing the capacity for corals to build skeletons.
- **Ocean Acidification**
  - The more acidic seawater becomes the less calcium carbonate it can hold. Many marine species, including coral, need calcium carbonate to build their protective shells and exoskeletons.
- **Severe weather events**
  - Increased frequency of severe weather events, such as cyclones and record rainfall levels can destroy reef structures and send an influx of freshwater and sediment further out from the coast on to the Reef.
- **Coastal Development**
- **Agriculture**
  - Most land in the Great Barrier Reef catchment is used for grazing, crops, dairy and horticulture, with more than 80 per cent of the catchment supporting some form of agriculture.
- **Mining**
  - Historically, extensive small-scale mining operations occurred through much of the Great Barrier Reef catchment.
  - Production of saleable coal in Queensland has more than doubled since the early 1990s and the region is now associated with some of the world's largest mines and coal ports.
- **Urban and industrial development**
  - Urban and industrial development, excluding mining, in the Great Barrier Reef catchment is not extensive; however future economic projections suggest an increase in these types of land uses.
  - Population growth in coastal areas is increasing the demand for infrastructure and services such as roads, water, sewerage and power.
- **Port development**
  - Port development has been the major reason for coastal reclamation — infilling areas of ocean, wetlands or other water bodies — along the Great Barrier Reef coast.
  - Port development can also create artificial barriers to freshwater flow, such as bund walls and infrastructure in waterways.

- **Aquaculture**
  - Over the past decade there has been little expansion of land-based aquaculture adjacent to the Great Barrier Reef region, however there are no marine-based aquaculture operations within the region at present.
- **Island development**
  - Some Great Barrier Reef islands support residential areas and tourism resorts.
- **Crown-Of-Thorns Starfish**
  - Crown-of-thorns starfish feed on coral. These spiky marine creatures occur naturally on reefs in the Indo Pacific region, including the Great Barrier Reef.
- **Water Quality**
  - Declining marine/coastal water quality, influenced by land-based run-off, is recognised as one of the most significant threats to the long-term health and resilience of the Great Barrier Reef.
  - Increased sedimentation and nutrients can cause higher algal growth, build-up of pollutants in sediments and marine species, and reduced light and smothered corals.

What is World Heritage in danger?

- The List of World Heritage in Danger is designed to inform the international community of conditions which threaten the very characteristics for which a property was inscribed on the World Heritage List, and to encourage corrective action.
- Under the **1972 World Heritage Convention**, a World Heritage property can be inscribed on the List of World Heritage in Danger by the Committee when it finds that the condition of the property corresponds to at least one of the criteria in either of the **two cases** described below:
  - **For cultural properties**
    - Ascertained Danger
      - serious deterioration of materials;
      - serious deterioration of structure and/or ornamental features;
    - Potential Danger
      - modification of juridical status of the property diminishing the degree of its protection;
      - lack of conservation policy;
  - **For natural properties**
    - Ascertained Danger
      - A serious decline in the population of the endangered species or the other species of Outstanding Universal Value for which the property was legally established to protect, either by natural factors such as disease or by humanmade factors such as poaching.
      - Severe deterioration of the natural beauty or scientific value of the property, as by human settlement, construction of reservoirs which flood important parts of the property, industrial and agricultural development including use of pesticides and fertilizers, major public works, mining, pollution, logging, firewood collection, etc.
    - Potential Danger
      - a modification of the legal protective status of the area
      - planned resettlement or development projects within the property or so situated that the impacts threaten the property

List of World Heritage in Danger

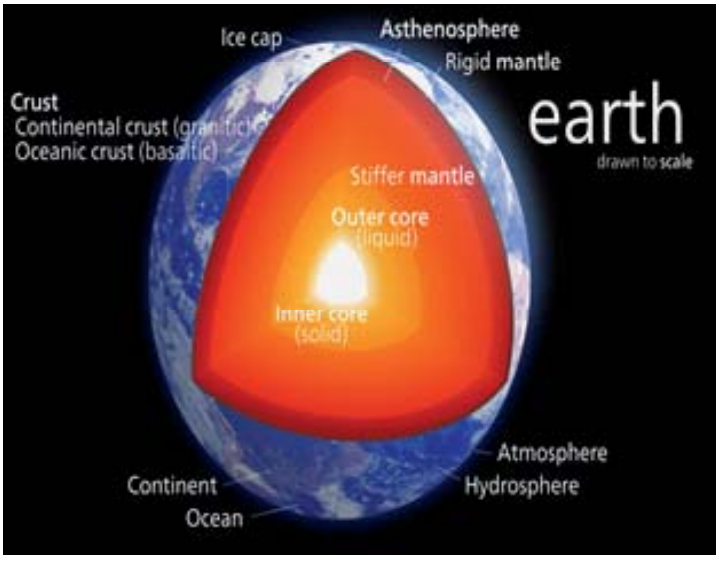
- It is designed to inform the international community of conditions that threaten sites listed on the World Heritage List and to encourage corrective action.
- Under the 1972 World Heritage Convention, a World Heritage property - as defined in Articles 1 and 2 of the Convention.
- It can be inscribed on the List of World Heritage in Danger by the Committee when it finds that the condition of the property corresponds to at least one of the criteria in either of the two cases of ascertained danger and potential danger.
- The cultural and Natural sites could be put on the list if they show certain conditions.
- Inscribing a site on the List of World Heritage in Danger allows the World Heritage Committee to allocate immediate assistance from the World Heritage Fund to the endangered property.
- Some of the sites listed in the danger list-
  - **Iranian City of Bam**
  - **Bamiyan Valley in Afghanistan**

25 Age of Earth's inner core revised

Context:

Researchers have revised the estimate of the age of Earth's solid inner core to 1-1.3 billion years from 565 million years old.

Looking inside the Earth



- The Earth's interior is composed of four layers, three solid and one liquid—not magma but molten metal, nearly as hot as the surface of the sun.
- **Inner core:** The deepest layer is a solid iron ball, about 1,500 miles (2,400 kilometers) in diameter.
  - Although this inner core is white hot, the pressure is so high the iron cannot melt.
  - The iron isn't pure—scientists believe it contains sulfur and nickel, plus smaller amounts of other elements.
  - Estimates of its temperature vary, but it is probably somewhere between 9,000 and 13,000 degrees Fahrenheit (5,000 and 7,000 degrees Celsius).
- **Outer core:** Above the inner core is the outer core, a shell of liquid iron. This layer is cooler but still very hot, perhaps 7,200 to 9,000 degrees Fahrenheit (4,000 to 5,000 degrees Celsius).
  - It too is composed mostly of iron, plus substantial amounts of sulfur and nickel. It creates the Earth's magnetic field and is about 1,400 miles (2,300 kilometers) thick.

- **Mantle:** The next layer is the mantle. Many people think of this as lava, but it's actually rock. The rock is so hot, however, that it flows under pressure, like road tar. This creates very slow-moving currents as hot rock rises from the depths and cooler rock descends.
- **Crust:** The crust is the outermost layer of the Earth. It is the familiar landscape on which we live: rocks, soil, and seabed. It ranges from about five miles (eight kilometers) thick beneath the oceans to an average of 25 miles (40 kilometers) thick beneath the continents.

Key-highlights of the study:

- The new research looked at the paradox and found a solution by keeping the temperature of the core within **realistic parameters.**
- The researchers achieved these conditions by squeezing laser-heated samples of iron between two diamond anvils.
- **Result:** The new conductivity was measured at 30-50 per cent less than the conductivity of the young core estimate.
- The research suggested that geodynamo was sustained by two different energy sources and mechanisms:
- Thermal convection (the buoyancy is due to temperature fluctuations)
- Compositional convection (buoyancy produced by light material released at the inner-core boundary)
- That is, at the time the inner core started to grow, the geodynamo got powered by a new source of energy.
- With improved information on conductivity and heat transfer over time, the researchers made a more precise estimate of the age of the inner core.

Geodynamo paradox

- Earth's inner core is the **innermost geologic layer** of the Earth, it is made of iron and is solid. And it is very hot, about 6,000 degrees Celsius.
- The outer core is also **iron**, but is liquid due to relatively lower pressure.
- As lighter elements rise through the liquid iron of the outer core at different temperatures, they cause convection currents, believed to resemble a dynamo.
- The process is like cream swirling in a mug of coffee.
- The circulation of liquid metal creates electric currents (kinetic energy is converted into magnetic energy) and turns Earth into a giant electromagnet.
- This is how Earth's magnetic field is generated. The process is called **geodynamo**, and is fed by **convection**.

How the age of the inner core was 'earlier' calculated?

- The age of the inner core, however, has been essentially calculated by the effectiveness of iron to transfer heat, known as **thermal conductivity.**
- But there was a paradox with the previously determined younger estimates of the age of the inner core: The core would have had to reach unrealistically high temperatures to sustain the **geodynamo** for billions of years before the inner core would be formed.
- The high amount of conductivity of the iron core, however, was impossible because it would have little energy to convection.
- It also only supported the existence of the geodynamo for about a billion year, whereas other studies have showed that the process has existed for at least 3.4 billion years.

Earth's magnetic field

- This revised age of the inner core could correlate with a spike in the strength of the Earth's magnetic field as recorded by the arrangement of magnetic materials in rocks that were formed around this time.
- Together, the evidence suggests that the formation of the inner core was an essential part of creating today's robust magnetic fields.
- The Earth's magnetic field, generated 3,000 km below our feet in the liquid iron core, is crucially important to life on our planet.
- It extends out into space, wrapping us in an electromagnetic blanket that shields the atmosphere and satellites from solar radiation.
- The magnetic field is the weakest at the equator, where the dent is located, which makes it worse than if it were at any other place.

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