9. Discuss, in detail, what role can science and technology play to mitigating the effect of climate change situation? How far the India is implementing these technologies?

Introduction: Brief about climate change
Body: Role of science and technology in mitigating climate change situation
Conclusion: Mention some data related to curbing climate issues

Introduction:

Climate change refers to long-term shifts in temperatures and weather patterns. These shifts may be natural, such as through variations in the solar cycle. But since the 1800s, human activities have been the main driver of climate change, primarily due to burning fossil fuels like coal, oil and gas. Climate change threatens people with food and water scarcity, increased flooding, extreme heat, more disease, and economic loss.

Body

Role of science and technology in mitigating climate change situation

Biotechnology

- Energy efficient farming: This can include on-farm renewable energy production such as solar panels and wind turbines, minimizing use of petroleum-based fertilizers and pesticides, and reducing dependence on fossil fuel inputs for farming, storage, and transportation of crops.
- Carbon sequestration: it is the process of capturing and storing atmospheric carbon dioxide. It is one method of reducing the amount of carbon dioxide in the atmosphere with the goal of reducing global climate change.
- Genetically modified crops: Planting genetically modified crops has shown significant reduction in the amount of greenhouse gases emitted.
- Biofuels: Biofuels won't contribute to the greenhouse effect and climate change, biofuels are a promising option because the carbon dioxide (CO2) they emit is recycled through the atmosphere.
- Industrial biotechnology: the exploitation of enzymes, microorganisms, and plants to produce energy, industrial chemicals and consumer goods to mitigate climate change.

Internet of things

- IoT sensors: It reduces energy consumption, generate renewable energy on-site, and measure carbon consumption plus waste.
- IOT reduce carbon footprint: The most common area where IoT helps to optimize consumption is energy. Smart buildings using IoT-enabled devices can adjust lighting, heating, and cooling systems based on occupants' behavior. This cuts down carbon dioxide emissions by reducing the burning of fossil fuels for energy.

Space technology

- Space sensors reduce emissions from heating systems: Miniaturised ceramic gas sensor technology, developed originally for measuring oxygen levels around spacecraft reentry vehicles, is now being used in systems that accurately control heater combustion, one of the major sources of pollutants.
- Satellites to track weather patterns: One such example is NASA's Ice, Cloud and land Elevation Satellite-2 (ICESat-2) spacecraft, which launched in 2018.
- ICESat-2's predecessor showed the thinning of sea ice and how ice cover had disappeared from coastal parts of Greenland and Antarctica. NASA's latest satellite was developed to provide extra information on how ice cover changes over the course of a year.
- Sensors to track animals: The International Co-operation for Animal Research Using Space (Icarus) initiative is using a satellite on the International Space Station (ISS) to create an "internet of animals". Scientists hope to track the migratory patterns of birds and animals from space with the aid of thumbnail-sized transmitters attached to their backs.
- Satellite images transformed into data for farmers: Satellite imagery and climate data can also support other sectors such as agriculture and industry, with additional benefits to the communities they serve.

Artificial intelligence and machine learning

- AI applications could also help design more energy-efficient buildings, improve power storage and optimise renewable energy deployment by feeding solar and wind power into the electricity grid as needed.

- To predict future climate patterns: Researchers are using machine learning techniques on climate model outputs in order to identify climate-vulnerable regions that may be subject to extreme heat, drought or flooding due to climate change.
- Optimize how freight is routed: Machine learning could help find ways to bundle together as many shipments as possible and minimize the total number of trips. Such a system would also be more resilient to transportation disruptions.
- Help make buildings more efficient: Intelligent control systems can dramatically reduce a building's energy consumption by taking weather forecasts, building occupancy, and other environmental conditions into account to adjust the heating, cooling, ventilation, and lighting needs in an indoor space.

Block chain technology

- Uses: Blockchain technology in environmental conservation has immense potential; its application can be used towards social economic activities, including conservation planning and efficient wildlife protection programme implementation.
- Regenerative agriculture: These include efforts to incentivize communities around the world to reduce their carbon footprints through more sustainable land-use practices, usually a combination of planting trees and conservation. Smart contracts that can interact with real-world data make it possible to automatically issue rewards to people who steward these important tracts of land

Nano technology

- Lightweight nano-composite materials - Any effort to reduce emissions in vehicles by reducing their weight , in turn, decreasing fuel consumption can have an immediate and significant global impact. It is estimated that a 10% reduction in weight of the vehicle corresponds to a 10% reduction in fuel consumption, leading to a proportionate fall in emissions.
- Nano-coatings - Nanotechnology coatings are a good short-term way of reducing emissions and and maximizing clean energy production. For example, nano-coatings can be applied to aircraft, which can make aircraft's smoother, reducing drag and also protect the materials from the special conditions of the environment where they are used (instead of the conventional bulk metals such as steel).
- Batteries - Such techniques could increase the efficiency of electric and hybrid vehicles by significantly reducing the weight of the batteries. Nanotechnology is positioned to create significant change across several domains, especially in energy where it may bring large and possibly sudden performance gains to renewable sources and Smart Grids.
- Improved Renewables - Nanotechnology may accelerate the technology behind renewables in various ways: experts are discovering means to apply nanotechnology to photovoltaics, which would produce solar panels with double or triple the output.
- Nanotech sensors - Sensors could be used for the Smart Grid to detect issues ahead of time, ie, to measure degrading of underground cables or to bring down the price of chemical sensors already available for transformers

Nuclear technology

- Low-carbon energy: Nuclear power is one of the world's energy sources that emits the least greenhouse gas Its very low CO_2 emission rate - four times less than solar for example - makes it an essential energy for the low-carbon transition.
- Constant and controllable energy: In addition to being a climate-friendly energy, nuclear power provides continuous electricity thanks to its robust production system, able to adapt to variations in electricity demand.

Conclusion:

India will get its non-fossil energy capacity to 500 gigawatt (GW) by 2030. India will meet 50 per cent of its energy requirements from renewable energy by 2030. India will reduce the total projected carbon emissions by one billion tonnes from now onwards till 2030.

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