

Impact Of Climate Change on Environment and Ecology with Reference to Uttrakhand

By
Awadh Kumar Singh
IFS (Retired)



Basic Meaning of Environment and Ecology

Environment

- The surrounding or conditions in which an organism lives or operates.
- Includes both living and non-living components

Components of environment

- **Abiotic/Non-living/Physical**
 - Include land, energy, water, climate (temperature and humidity), gases, winds, fire, gravity, soil, etc.
- **Biotic/Living**
 - Are living things in an ecosystem, such as plants, animals and micro-organisms.

Ecology

- Study of organisms and environment i.e. how organisms interact with each other and with their environment.
- Term first coined by German Biologist “Ernst Haeckel”.
- It also deals with study of populations, communities, ecosystems, biomes and biosphere.

Climate Change

The Attention has been given to climate change by United Nations in under the headline “Climate Action” at Sustainable goal number 13

Goal 13	Climate Action	“Take urgent action to combat climate change and its impacts by regulating emissions and promoting developments in renewable energy”
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Climate Change

It is the long term rise of Earth’s temperature and alteration of normal weather patterns in a region.

- It refers to broad range of changes that are happening our planet such as:
 - ❖ Rising global warming
 - ❖ Rise of sea level
 - ❖ Shrinking mountain glaciers,
 - ❖ Accelerating ice melt in Green land, Antartica and Arctic
 - ❖ Shifts in flower/plant blooming times.

Impacts of Climate Change

- Sea Level Rise
- Melting Glaciers and Permafrost
- Change in Precipitation Patterns
- Rise in the Extreme Events
- Agriculture, Food Security and Human Health
- Effect on Oceans
- Biodiversity loss

Green House Effect

- ✓ Once absorbed, the planet releases some of the energy back into the atmosphere as long wave infrared radiation.
- ✓ Greenhouse gases (GHGS) like water vapor (H₂O), Carbon dioxide (CO₂), and Methane (CH₄) absorb the heat energy, slowing or preventing the loss of heat to space.
- ✓ In this way, GHGs act like a blanket, making Earth warmer than it would otherwise be. This process is commonly known as the 'Greenhouse Effect'.

Carbon dioxide (CO ₂)	Burning of fossil fuels, deforestation, etc.
Chlorofluorocarbons (CFCs)	Refrigeration, solvents, insulation foams, aero propellants, industrial and commercial uses,
Methane (CH ₄)	Growing paddy, excreta of cattle and other livestock, termites, small ruminants, burning of fossil fuel, wood, and landfills,
Nitrous oxide (N ₂ O)	Burning of fossil fuel, fertilizers, wood and crop residue.
Sulphur hexafluoride (SF ₆)	Dielectric field
Hydrofluorocarbon (HFCs)	Used in industries, refrigerants as substitute
Per-fluorocarbons (CF ₄ , C ₂ F ₆)	Manufacturing of semiconductors, refrigeration equipment and production of Aluminium, etc

Global Warming

- ❖ Global Warming refers to the long-term warming of the planet.
- ❖ Since the Pre Industrial period, the average surface temperature has gone up by about 1.1°C.
- ❖ According to the Fifth Assessment Report of Intergovernmental Panel on Climate Change (IPCC), there is more than 95% probability that human-produced greenhouse gases like Carbon dioxide, Methane and Nitrous oxide have caused much of the observed increase in Earth's temperatures over the past 50 years.

WHAT IS DISASTER?

- The definition of disaster is a way of describing what a disaster is and what it involves. Different sources may have slightly different definitions, but they usually share some common elements. For example, according to the International Federation of Red Cross and Red Crescent Societies (IFRC), a disaster is “a sudden, calamitous event that seriously disrupts the functioning of a community or society and causes human, material, and economic or environmental losses that exceed the community’s or society’s ability to cope using its own resources.”
- **Some key aspects of this definition are:**
- A disaster is a **sudden** event that happens unexpectedly and requires immediate action.
- A disaster is a **calamitous** event that causes great harm or damage to people or things.
- A disaster **seriously disrupts** the normal functioning of a community or society and affects its ability to meet its basic needs and goals.
- A disaster causes **losses** that can be measured in terms of human lives, physical assets, economic resources, or environmental quality.
- A disaster **exceeds** the capacity of the affected community or society to cope with the situation using its own resources, skills, and networks.
- A disaster may require **external assistance** from other communities, organizations, or governments to provide relief and recovery support.

TYPES OF DISASTERS

Type	Examples	Characteristics
Natural	Earthquakes, floods, droughts, wildfires, volcanic eruptions, etc.	Caused by natural events or processes that can occur suddenly or gradually and affect large areas.
Human-made or technological	Industrial accidents, terrorism, war, fire, power outages, etc.	Caused by human actions or errors that can also occur suddenly or gradually and affect small or large areas.
Complex emergencies	Conflict, violence, displacement, disease, etc.	Caused by a combination of natural or human-made factors that affect large populations and require humanitarian assistance.

* A natural disaster may trigger a human-made disaster or a complex emergency. The impacts of disasters may also vary depending on the context and the vulnerability of the affected people and places.

Sendai Framework for Disaster Risk Reduction

- The Sendai Framework for Disaster Risk Reduction 2015-2030 is an international document adopted by the United Nations member states in March 2015 at the World Conference on Disaster Risk Reduction held in Sendai, Japan.
- It is the first major agreement of the post-2015 development agenda and provides Member States with concrete actions to protect development gains from the risk of disaster.
- The Sendai Framework aims to achieve the substantial reduction of disaster risk and losses in lives, livelihoods, health, and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries over the next 15 years.
- It has seven global targets and four priorities for action: Understanding disaster risk, Strengthening disaster risk governance, Investing in disaster risk reduction, and Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation, and reconstruction.
- The state has the primary role to reduce disaster risk but that responsibility should be shared with other stakeholders including local government, the private sector, and other stakeholders.
- The framework recognizes the need for a multi-hazard approach, a people-centered and inclusive approach, a gender-sensitive approach, respect for human rights and cultural diversity, and a stronger international cooperation and global partnership.
- The Sendai Framework is the successor instrument to the Hyogo Framework for Action (HFA) 2005-2015: Building the Resilience of Nations and Communities to Disasters.
- UNDRR is tasked to support the implementation, follow-up and review of the Sendai Framework.
- It provides guidance, monitors progress, reports on trends and challenges, advocates for disaster risk reduction and resilience building, facilitates coordination and partnerships, mobilizes resources, and supports capacity development.
- The Sendai Framework works hand in hand with other 2030 Agenda agreements, including The Paris Agreement on Climate Change, The Addis Ababa Action Agenda on Financing for Development, the New Urban Agenda, and ultimately the Sustainable Development Goals.

What is National Disaster risk index with reference to India?

The National Disaster Risk Index (NDRI) is a tool that measures the disaster risk of each state and union territory in India.

It is developed by the National Disaster Management Authority (NDMA) of India.

It assigns scores to each state and union territory on a scale of 0 to 1, with higher scores indicating higher risk.

It takes into account a wide range of indicators, including demographic, social, economic, and environmental factors that contribute to disaster risk.

It is updated every two years to reflect changes in vulnerability and exposure to different types of disasters.

The first NDRI report published in 2019 ranked the states with the highest disaster risk as Mizoram, followed by Delhi, Uttarakhand, Himachal Pradesh, and Nagaland.

The first NDRI report published in 2019 ranked the states with the lowest disaster risk as Gujarat, followed by Maharashtra, Tamil Nadu, Chhattisgarh, and Andhra Pradesh.

The NDRI aims to help policymakers and stakeholders in disaster management planning and implementation.

State/Union Territory	Disaster Risk Score
Mizoram	0.74
Delhi	0.69
Uttarakhand	0.67
Himachal Pradesh	0.66
Nagaland	0.65
Tripura	0.63
Bihar	0.62
Assam	0.61
Meghalaya	0.61
Jammu and Kashmir	0.60
Kerala	0.59
Manipur	0.59
Arunachal Pradesh	0.58
West Bengal	0.58
Sikkim	0.57
Rajasthan	0.56
Karnataka	0.55
Uttar Pradesh	0.55
Madhya Pradesh	0.54
Andhra Pradesh	0.53
Punjab	0.53
Haryana	0.52
Jharkhand	0.51
Odisha	0.51
Telangana	0.50
Chhattisgarh	0.49
Tamil Nadu	0.49
Maharashtra	0.48
Gujarat	0.47

Why Himalayan Mountains are More Vulnerable than Alps of Europe and Andes Mountains of South America?

Geology	The Himalayas' younger rocks are more prone to erosion, making them susceptible to landslides and rockfalls.
Tectonic Activity	High tectonic activity in the region leads to frequent earthquakes and landslides.
Climate	Extreme weather conditions in the Himalayas, including heavy monsoon rains, snowfall, and rapid temperature changes, can cause erosion and landslides.
Human Activities	Deforestation, mining, and construction in the Himalayas increase the region's vulnerability to landslides and other natural disasters.
Glacial Melting	Melting glaciers in the Himalayas have led to the formation of glacial lakes that can cause devastating floods downstream.
Poor Infrastructure	Many areas in the Himalayas lack proper infrastructure, making it difficult for relief efforts during natural disasters.
Population Pressure	Densely populated areas in remote locations make relief efforts challenging.

Why Uttarakhand Deserves more Attention Regarding Climate Change

Vulnerability to Climate Change

- Uttarakhand is at high risk of climate change impacts, including melting glaciers and extreme weather events such as floods and landslides.

High Altitude and Mountainous Terrain

- Uttarakhand's steep slopes and high altitude make it particularly vulnerable to climate change impacts such as landslides and soil erosion.

Rich Biodiversity

- Uttarakhand is home to many endangered species such as the snow leopard and Himalayan black bear, which are at risk due to climate change impacts such as habitat loss.

Dependence on Natural Resources

- Uttarakhand's economy relies heavily on natural resources such as forests, water, and tourism, which are at risk due to climate change impacts such as forest fires and reduced water availability.

Importance of the Ganges River

- The Ganges river, which originates in Uttarakhand, is essential for millions of people downstream who rely on it for their livelihoods and well-being.
- Climate change impacts such as melting glaciers and changes in precipitation patterns can affect the quantity and quality of water in the river..

Importance of Traditional Knowledge and Practices

- Indigenous communities in Uttarakhand have valuable traditional knowledge and practices for adapting to and mitigating the impacts of climate change.

Potential for Renewable Energy

- Uttarakhand has significant potential for developing renewable energy sources such as hydropower and solar power, which can help to reduce the state's greenhouse gas emissions.

Climate Change Policies and Initiatives

- The Uttarakhand state government has implemented several policies and taken many initiatives to address the state's vulnerability to climate change and promote sustainable development, such as the Uttarakhand Climate Change Action Plan and the Uttarakhand Renewable Energy Development Agency.

Why Uttarakhand is More Prone to Earthquakes than other Hill States of India?

Uttarakhand is located in a seismically active region in the Himalayan region of India.

The collision of the Indian and Eurasian tectonic plates causes earthquakes in the region.

The Indian plate moving northward at a rate of 45 mm per year.

The Himalayan region is known for high seismicity, and Uttarakhand is located in the central part of this region.

The state is situated on the Main Central Thrust (MCT) fault zone, which is responsible for several major earthquakes.

Other smaller faults in Uttarakhand can also cause earthquakes, and complex geological structures, such as folds and thrusts, can increase the likelihood of earthquakes.

Due to the combination of high seismicity, active faults, and complex geological structures, Uttarakhand is more prone to earthquakes than other hill states in India.

To mitigate the risk, the state government has taken measures to improve earthquake preparedness and response, such as developing earthquake-resistant building codes and evacuation plans, and conducting awareness campaigns and drills.

Factors that Make Uttarakhand More Prone to Earthquakes than Other Hill States in India

Population Density

- Uttarakhand has a relatively high population density, which increases the risk of damage and loss of life in the event of an earthquake.

Infrastructure and Development

- The rapid pace of development has led to the construction of large-scale infrastructure projects, which can have a significant impact on the local environment and increase the risk of earthquakes. Construction activities can also destabilize the ground.

Deforestation and Landslides

- Deforestation and landslides can weaken the stability of the mountains and hillsides, making them more susceptible to earthquakes. Uttarakhand has a history of landslides and deforestation, which can exacerbate the risk of earthquakes.

Climate Change

- Rising temperatures can lead to the melting of glaciers and permafrost, which can destabilize the ground and increase the risk of landslides and earthquakes.

Why Garhwal Region in Uttarakhand is More Susceptible to Climate Disasters?

High elevation and mountainous terrain	Vulnerable to landslides, rockfalls, and avalanches due to steep slopes, heavy rainfall, and snowfall.
Fragile ecosystem	Sensitive to changes in temperature and precipitation, causing melting glaciers, extreme weather, and altered precipitation patterns.
High dependence on natural resources	The economy relies on forests, water, and tourism, making forest fires, water scarcity, and changes in tourism patterns significant economic impacts.
Rapid urbanization	Deforestation, soil erosion, and land use changes exacerbate floods and landslides in urban areas..
Limited infrastructure	Lack of roads, bridges, and communication networks hinders disaster response, evacuation, and emergency relief efforts.
Geology and seismic activity	Seismically active region with several faults and fractures, making it more vulnerable to landslides, rockfalls, and avalanches.
Water resource management	Changes in precipitation patterns can lead to water scarcity, affecting agriculture and hydroelectric power production.
Cultural heritage and biodiversity	Climate disasters can damage cultural heritage sites and cause biodiversity loss.
Poor planning and development	Encroachment of riverbeds and floodplains, uncontrolled construction, and improper waste disposal exacerbate climate disasters.
Limited awareness and preparedness	Lack of knowledge about climate change, inadequate early warning systems, and limited resources for disaster response and recovery make the region more vulnerable to climate disasters.



Faults and Fractures in Garhwal Regions in Utrakhand and their Role in Causing Earthquakes and Landslides

Main Central Thrust (MCT)

- A major fault that separates the Lesser and Greater Himalayas and responsible for several earthquakes in the region.

Main Boundary Thrust (MBT)

- Another major fault that separates the Indian and Eurasian plates and responsible for several earthquakes in the region, including the devastating 1905 earthquake.

South Tibetan Detachment (STD)

- A large-scale fault that separates the Indian and Tibetan plates and responsible for earthquakes, including the significant 1991 earthquake.

Ramgarh Thrust

- A north-dipping thrust fault responsible for landslides in the region.

Bhagirathi Thrust

- A south-dipping thrust fault responsible for landslides in the region.

CONTROLLING FOREST FIRES

- **Aerial attack:** This is when firefighters use flying machines like helicopters or planes to pour water, foam, or chemicals on the fire from the sky.
- **Backburn:** This is when firefighters make a small fire on purpose along the edge of the area they want to protect from the big fire. The small fire eats up the dry leaves, twigs, and other things that can burn easily, so that the big fire has nothing to feed on and stops spreading.
- **Burnout:** This is similar to backburn, but instead of making a small fire, firefighters burn everything or most of the things that can catch fire between the edge of the area they want to protect and the big fire. This makes a bigger gap between the two fires and reduces the chance of sparks or embers flying over and starting a new fire.
- **Cold trailing:** This is when firefighters touch the ground with their bare hands to feel if there is any heat left from the fire. If they find any heat, they put it out with water or dirt.
- **Flanking:** This is when firefighters attack a fire by working along its sides, either at the same time or one after another, from a point where the fire is less active or where they have already stopped it. They try to join two areas where they have stopped the fire at the front of the fire.
- **Hot spotting:** This is when firefighters focus their efforts on the most active or dangerous part of a fire before dealing with less critical areas.
- **Knocking down:** This is when firefighters reduce the flame or heat on the parts of a fire that are burning more strongly or faster.
- **Remote sensing:** This is when firefighters use pictures from satellites, special cameras that can see heat, or devices that can sense fire to find, watch, and map forest fires and burned areas.
- **Optical remote sensing systems:** These systems use cameras, satellites, or drones to capture images of the forest and analyze them using computer vision and machine learning algorithms to detect flames or smoke.
- **Fire weather index system:** This system uses meteorological data such as temperature, humidity, wind speed, and precipitation to calculate the risk of fire occurrence and spread based on the Canadian Forest Fire Danger Rating System (CFFDRS).
- **AI-powered forest fire detection system:** This system uses various sensors such as cameras, satellites, drones, and thermal sensors to detect fires in real-time and alert the authorities using artificial intelligence and cloud computing.

EFFORTS IN UTTRAKHAND IN MAKING OTHER PRODUCTS FROM CHIR PINE NEEDLES

- **Generating electricity from pine needles:** A local inventor, Rajnish Jain, developed a technology to convert pine needles into electricity using gasification. He set up a company called Avani Bio Energy, which installs power plants that run on pine needles in remote villages of Uttarakhand. These plants not only provide clean energy to the villagers, but also create employment opportunities for them, as they collect and sell the pine needles to the company.
- **Making handicrafts from pine needles:** Various handicraft items can be made from these pine needles, such as baskets, trays, mats, purses, etc. These items can be sold in local markets or online platforms, generating income for the artisans. Some NGOs and self-help groups are also involved in training and promoting pine needle handicrafts in Uttarakhand.
- **Producing bio-oil from pine needles:** A team of researchers from IIT Roorkee developed a process to produce bio-oil from pine needles using fast pyrolysis. Bio-oil is a liquid fuel that can be used for various purposes, such as cooking, heating, lighting, etc. The process also produces bio-char and gases as by-products, which can be used as soil amendments and energy sources respectively. The researchers claimed that this process can help mitigate forest fires and also create a value chain for pine needle products.
- **Avani Bio Energy** is a company that generates electricity from pine needles using gasification technology in Uttarakhand. It has set up two power plants using this technology, one in its own campus at Tripuradevi village in Pithoragarh district and another in Chachreda village in Pithoragarh district. The electricity generated by these plants is sold to the state grid through a power purchase agreement.
- Avani Bio Energy has also received exclusive rights from the local Van Panchayats (village forest administrative bodies) to collect pine needles from the forest areas. The pine needles are collected by local women, who are paid for their work and also benefit from the reduced fire risk. The pine needles are then densified into 5 kg blocks before being used in the gasifier.

USES OF CHIR PINE CONES

- **Producing resin:** Chir pine cones are a source of resin, which is a sticky substance that exudes from the cone scales. Resin is used for various purposes, such as making paper, soap, cosmetics, paint, varnish, rubber, polish, linoleum, explosives, insecticides, disinfectants, etc
- **Making handicrafts:** Chir pine cones can be used to make various handicraft items, such as wreaths, ornaments, centerpieces, bird feeders, etc. They can be painted, glittered, or decorated with ribbons, beads, or other materials to create attractive and eco-friendly products
- **Acting as mulch:** Chir pine cones can be used as mulch around trees and plants in the garden. They can help protect the plant roots, retain moisture, prevent weeds, and add organic matter to the soil. They can also deter pests and rodents from digging up the plants
- **Providing fuel:** Chir pine cones can be used as fuel for fireplaces, stoves, or campfires. They can burn well and produce a pleasant aroma. They can also be mixed with other materials, such as wax or sawdust, to make fire starters or fire logs.
- **Offering health benefits:** Chir pine cones have some medicinal properties, such as anti-inflammatory, antiseptic, expectorant, and diuretic. They can be used to make natural remedies for coughs, colds, bronchitis, asthma, kidney stones, rheumatism, etc. They can be used to make syrup, decoction, infusion, oil extract, or tincture.
- **Feeding wildlife:** Chir pine cones can be used to feed wildlife, such as birds and squirrels. They can be hung from trees or bird feeders with strings or wires. They can also be filled with peanut butter or suet and sprinkled with seeds or nuts to attract more animals.

EFFORTS TO CONTROL LANDSLIDES IN UTTRAKHAND

- Establishing the Disaster Mitigation and Management Centre (DMMC) to coordinate and implement various disaster management activities, including landslide hazard zonation mapping, vulnerability analysis, early warning systems, structural and non-structural mitigation measures, capacity building, and awareness generation.
- Seeking help from the Army, the National Disaster Response Force (NDRF), and other agencies to conduct rescue and relief operations in the affected areas.
- Providing financial assistance and compensation to the victims of landslides and facilitating their rehabilitation.
- Monitoring the land subsidence and slope stability in the landslide-prone areas and taking necessary actions to prevent further damage.
- Geometric methods: These methods change the shape or size of the slope to make it more stable. For example, flattening the slope, removing part of the soil or rock, or adding a berm at the bottom of the slope.
- Hydrological methods: These methods lower the water content or pressure in the soil or rock to make it more stable. For example, installing drains, filters, or freezing or heating the ground.
- Chemical and mechanical methods: These methods increase the strength or resistance of the soil or rock to make it more stable. For example, using grouting, concrete, gabions, piles, bolts, nails, geosynthetics, or walls.

Cloud Burst and its Occurrence in Uttarakhand

- According to the India Meteorological Department (IMD), a cloud burst features very heavy rainfall over a localized area at a very high rate of the order of 10 cm per hour featuring strong winds and lightning over a geographical region of approximately 20 to 30 Sq. Kms
- A cloud burst can cause flash floods, landslides, and damage to life and property. A cloud burst is often accompanied by thunder and hail
- A cloud burst is different from a normal rainfall because it has a very high rainfall rate, which can exceed 100 mm per hour. A cloud burst can occur when a warm and moist air mass rises rapidly and condenses into clouds, releasing a large amount of latent heat
- A cloud burst can also occur when a cold front or a mountain range forces a warm and moist air mass to rise and cool rapidly, forming clouds and precipitation. A cloud burst is more likely to happen in regions with complex topography, such as mountains, hills, or plateaus, where the air flow is disturbed and uplifted by the terrain
- In the Indian subcontinent, a cloud burst usually occurs when a monsoon cloud drifts northwards, from the Bay of Bengal or Arabian Sea across the plains, then onto the Himalayas and bursts, bringing rainfall as high as 75 millimeters per hour
- In India, cloud bursts occur mainly during the monsoon season from June to September, especially in the hilly states of Himachal Pradesh, Uttarakhand, Jammu and Kashmir, Sikkim, Arunachal Pradesh, Meghalaya, and Assam
- **Some of the major recent incidents of cloud bursts in Uttarakhand: The 2013 Uttarakhand floods that killed over 5,000 people and caused widespread devastation; The 2016 Pithoragarh cloudburst that killed over 30 people and triggered landslides; The 2020 Uttarakhand cloudbursts that killed over 20 people and damaged roads and bridges**
- Some of the impacts of cloud bursts are: Loss of lives, livestock, crops, houses, infrastructure, and public utilities; Disruption of transport, communication, power supply, water supply, health care, education, and tourism; Increased risk of waterborne diseases, epidemics, malnutrition, and mental stress; Degradation of soil quality

Cloud Burst and its Occurrence in Uttarakhand

- A study published in Earth Science Reviews in 2020 analysed 30 major cloudburst events reported from the southern rim of the Himalayas between 1970 and 2019. The study found that 19 of these events occurred in Uttarakhand, making it the most vulnerable state to cloudbursts in the region. The study also found that most of the cloudbursts occurred during the monsoon season (June-September) and were associated with flash floods and landslides.
- The table below shows the number and location of cloudburst events reported in Uttarakhand from 2018 to 2021.

Year	Number of events	Location
2021	24 (as of June)	Chamoli, Rudraprayag, Tehri Garhwal, Pithoragarh, Uttarkashi, Dehradun
2020	7	Chamoli, Pithoragarh, Tehri Garhwal
2019	1	Chamoli
2018	12	Chamoli, Pithoragarh, Tehri Garhwal, Rudraprayag

Summary of the Climate Summit at Glasgow

- ❖ The United Nations Climate Change Conference, also known as COP26, was held in Glasgow, Scotland from October 31 to November 12, 2021.
- ❖ The conference brought together leaders from around the world to discuss and address the global climate crisis.

Ambitious targets	• Many countries pledged net-zero emissions by 2050 or earlier.
Phasing out coal	• Over 40 countries vowed to phase out coal power.
Carbon markets	• A new carbon market rulebook was agreed upon to encourage low-carbon investments.
Climate finance	• Wealthy countries promised \$100 billion per year to support developing countries.
Adaptation	• More funding for climate-resilient infrastructure and measures to protect vulnerable communities.
Loss and damage	• Discussions on addressing loss and damage caused by extreme weather events.
Glasgow Leaders' Declaration	• Heads of state issued a declaration urging collective action on climate change.
Methane pledge	• Over 100 countries committed to reducing methane emissions by 30% by 2030.
Global methane assessment	• A global methane assessment showed reducing methane emissions can have a significant impact on slowing down climate change.
Glasgow Financial Alliance for Net Zero	• A group of over 450 financial institutions launched an alliance to transition to a net-zero economy.
Youth and civil society engagement	• Youth and civil society groups voiced their demands for urgent climate action at the conference.

Stand Of India At Glasgow Summit

India focused on climate adaptation, technology transfer, and finance at the summit.

India's Prime Minister announced a net-zero emissions target for 2070 and called for \$1 trillion per year for adaptation and mitigation.

India launched initiatives and partnerships such as the International Solar Alliance and the Coalition for Disaster Resilient Infrastructure.

India stressed the importance of global cooperation and a balanced approach to climate action.

India emphasized the importance of preserving biodiversity and sustainable agriculture.

India announced plans to launch the Satoyama Initiative for Sustainable Landscapes and Seascapes in South Asia.

India highlighted the need for enhancing the capacity of developing countries in climate science, technology, and finance.

Some Additional Initiatives

India has been taking various steps to address climate change and reduce its greenhouse gas emissions. Some of the strategies that

India has adopted or announced are:

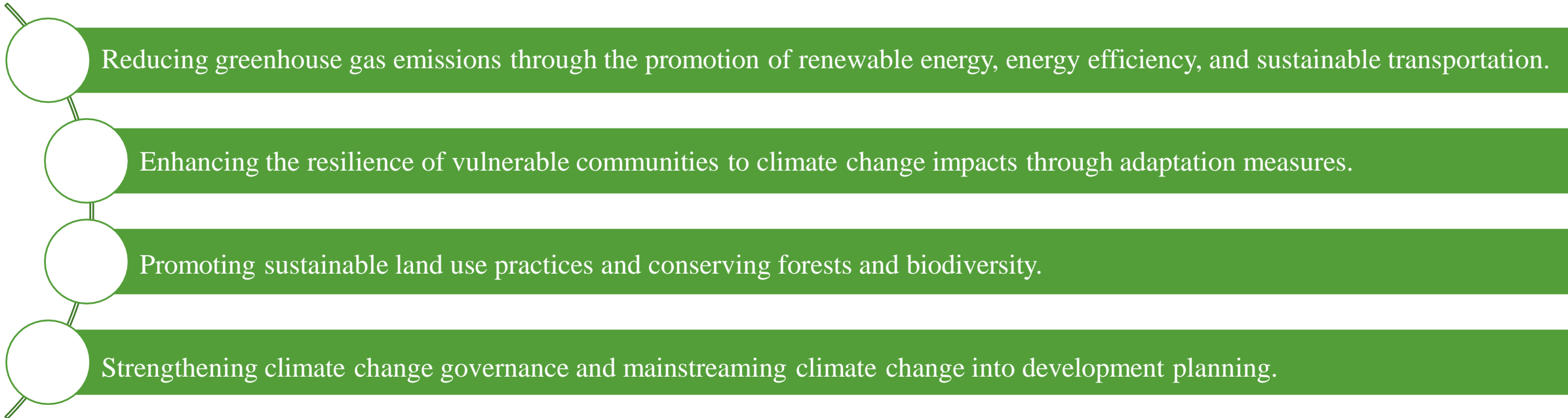
- Reducing the emissions intensity of its GDP by 45% by 2030
- Generating 50% of its electricity from non-fossil fuel sources by 2030
- Expanding non-fossils capacity to 500 GW by 2030
- Launching the National Hydrogen Mission to make India a green hydrogen hub
- Increasing ethanol blending in petrol to 20% by 2025
- Enhancing forest and tree cover to sequester more carbon

10 Point Program of Government of India Regarding Disaster Management, Climate Resilience, And Adaptation

National Disaster Management Plan	<ul style="list-style-type: none">• The Government of India has prepared a National Disaster Management Plan (NDMP) to ensure timely and effective response to disasters.
National Disaster Response Force	<ul style="list-style-type: none">• The National Disaster Response Force (NDRF) has been established to respond to disasters and provide relief and rehabilitation to affected communities.
National Cyclone Risk Mitigation Project	<ul style="list-style-type: none">• The National Cyclone Risk Mitigation Project (NCRMP) aims to reduce the vulnerability of coastal communities to cyclones and other natural disasters.
National Action Plan on Climate Change	<ul style="list-style-type: none">• The National Action Plan on Climate Change (NAPCC) outlines a comprehensive strategy to deal with the challenges of climate change.
National Adaptation Fund for Climate Change	<ul style="list-style-type: none">• The National Adaptation Fund for Climate Change (NAFCC) has been set up to support adaptation projects and programs in vulnerable sectors and regions.
Green India Mission	<ul style="list-style-type: none">• The Green India Mission (GIM) aims to increase forest cover and enhance ecosystem services, including carbon sequestration, in the country.
National Initiative on Climate Resilient Agriculture	<ul style="list-style-type: none">• The National Initiative on Climate Resilient Agriculture (NICRA) aims to increase the resilience of agriculture to climate change and variability.
National Solar Mission	<ul style="list-style-type: none">• The National Solar Mission aims to promote the development and use of solar energy in the country.
National Mission for Sustainable Agriculture	<ul style="list-style-type: none">• The National Mission for Sustainable Agriculture (NMSA) aims to promote sustainable agriculture practices that increase productivity, resilience, and adaptation to climate change.
National Mission for Himalayan Studies	<ul style="list-style-type: none">• The National Mission for Himalayan Studies (NMHS) aims to undertake research and development activities in the Himalayan region to address the challenges of climate change and other environmental issues.

Uttarakhand Climate Action Plan (UCAP)

- Uttarakhand Climate Action Plan (UCAP) is a comprehensive framework developed by the Government of Uttarakhand to address the impacts of climate change and promote sustainable development in the state. The plan was launched in 2018 and covers a wide range of sectors, including energy, water, agriculture, forests, and biodiversity.



Climate Disasters in Various Districts of Uttarakhand Since Year 1990

Disaster	Year	Affected Districts	Fatalities
Uttarkashi earthquake	1991	Uttarkashi, Chamoli, Rudraprayag	700+
Chamoli landslide	1998	Chamoli	250
Uttarakhand blizzard	2003	Chamoli, Uttarkashi	100+
Uttarakhand flash floods	2010	Pithoragarh, Chamoli, Uttarkashi	-
Uttarakhand forest fires	2012	Nainital, Almora, Pauri Garhwal	-
Rudraprayag cloudburst	2012	Rudraprayag	34+
North India floods	2013	Uttarkashi, Chamoli, Rudraprayag, Pithoragarh	6,000+
Uttarakhand forest fires	2016	Nainital, Almora, Pauri Garhwal	-
Almora landslide	2016	Almora	18+
Pithoragarh floods	2017	Pithoragarh	12+
Tehri flash floods	2018	Tehri	-
Uttarakhand hailstorm	2019	Dehradun, Haridwar, Udham Singh Nagar	-
Uttarkashi floods	2020	Uttarkashi	-
Chamoli disaster	2021	Chamoli	80+
Sinking of Joshimath & Karnprayag	2022	Joshimath & Karnprayag	-

Developing Resilience/Adaptation Against Climate Change in Uttarakhand

Category	Measures
Early warning systems	Weather monitoring stations, flood forecasting models, and mobile applications
Disaster management plans	Evacuation, search and rescue, relief and rehabilitation, and reconstruction
Sustainable agriculture practices	Organic farming, crop diversification, and water conservation
Forest conservation	Forest conservation, reforestation, and forest fire prevention
Green infrastructure	Green roofs, rain gardens, and permeable pavements
Sustainable tourism practices	Eco-tourism, low-impact tourism, and community-based tourism
Capacity building	Training in disaster management, climate-smart agriculture, and sustainable forest management
Water conservation	Rainwater harvesting, watershed management, and water use efficiency
Renewable energy	Solar, wind, and hydropower
Biodiversity conservation	Protected area management, wildlife conservation, and ecological restoration
Community-based adaptation	Involving local communities in the planning and implementation of climate change adaptation measures
Research and development	Climate modeling, climate impact assessments, and technology development
Public awareness	Public awareness campaigns to educate the population about the risks and impacts of climate change and the measures that can be taken to develop resilience and adaptation

Role Of NDMA In Prevention And Mitigation Of Climate Change In Uttarakhand

Area of Focus	Role of NDMA
Early warning systems	Early warning systems for extreme weather events to the state government and local population to take preventive measures.
Capacity building	Training programs to enhance the knowledge and skills of vulnerable communities in responding to climate-related risks.
Disaster response	Supports the state government in disaster response operations, including search and rescue, relief and rehabilitation, and reconstruction.
Risk assessment	Conducts risk assessments to identify and prioritize vulnerable areas and communities.
Policy support	Policy support to develop and implement climate change adaptation policies and programs.
Knowledge sharing	NDMA facilitates knowledge sharing to promote learning and innovation in climate change adaptation.
Technology development	Supports the development and deployment of new technologies and innovations for climate change adaptation.
Public-private partnerships	Promotes partnerships with the private sector to develop and implement climate change adaptation projects.
International cooperation	Facilitates international cooperation and collaboration in climate change adaptation by participating in global and regional initiatives and networks.
Monitoring and evaluation	Monitoring and evaluation of climate change adaptation projects to assess their effectiveness and ensure accountability and transparency in project implementation.

The Role of State Government in Prevention / Risk Reduction in Climate Disasters of Uttarakhand

Key Actions	Strategies
Policy and planning	Develops policies and plans for climate change adaptation and disaster risk reduction based on scientific evidence
Infrastructure development	Invests in flood control structures and landslide mitigation measures
Early warning systems	Establishes and maintains early warning systems for climate disasters
Capacity building	Conducts capacity building programs to enhance knowledge and skills of vulnerable communities
Disaster response	Leads disaster response operations and provides logistical support, financial resources, and technical assistance
Risk assessment	Conducts risk assessments to identify and prioritize vulnerable areas and communities
Public awareness	Promotes public awareness of climate change and its impacts
Sustainable land use planning	Promotes sustainable land use planning to reduce the impact of climate disasters
Climate-smart agriculture	Promotes climate-smart agriculture practices to enhance the resilience of agricultural systems
Forest conservation and management	Promotes forest conservation and management as a key strategy to reduce the impact of climate disasters
Water management	Promotes water management practices that reduce the impact of climate disasters
Public-private partnerships	Promotes public-private partnerships to leverage the resources and expertise of the private sector
Community-based approaches	Promotes community-based approaches to climate change adaptation and disaster risk reduction

Role of Local Communities in Prevention / Mitigation Risk Reduction and Recovery Rehabilitation in Climate Disasters in Uttarakhand

Effort	Local Communities' Contributions
Prevention	Adopting sustainable practices, reducing carbon footprint, implementing rainwater harvesting techniques, adopting organic farming practices, and reducing the use of fossil fuels.
Mitigation and Risk Reduction	Preparing and implementing disaster management plans, conducting regular disaster drills, creating early warning systems, identifying and addressing vulnerabilities in infrastructure.
Recovery and Rehabilitation	Providing immediate support such as food, shelter, and medical aid, rebuilding infrastructure, and restoring livelihoods.
Awareness and Education	Raising awareness and educating people about the risks and impacts of climate disasters, organizing awareness campaigns, workshops, and training sessions on disaster preparedness, risk reduction, and climate change adaptation.
Traditional Knowledge and Practices	Preserving traditional knowledge and practices such as agroforestry that can help in disaster management efforts.
Community-based Adaptation	Empowering local communities to identify and implement climate change adaptation strategies tailored to their specific needs and circumstances.
Disaster Risk Reduction through Tourism	Promoting responsible tourism practices that respect the local environment and culture to reduce the impact of tourism on the environment and enhance resilience to climate disasters.

How National Disaster Risk Index Can Be Used Practically In Uttarakhand ?

Strategies	Description
Identify high-risk areas	Identifies high-risk areas for targeted risk reduction measures.
Prioritize resources	Prioritizes resources for disaster management based on NDRI risk assessment.
Monitor progress	Monitors progress and evaluates effectiveness of risk reduction measures.
Plan for future disasters	Informs disaster management planning and projections for future risk levels.
Allocate resources	Allocates resources effectively by directing them to high-risk areas.
Assist disaster response	Helps disaster response teams prioritize efforts in vulnerable areas.
Infrastructure planning	Informs infrastructure planning for disaster-resistant construction.
Engage communities	Engages communities in disaster management by sharing risk assessments.
Communicate risk levels	Communicates risk levels to raise awareness about disaster preparedness.

Loss of Biodiversity in Uttarakhand due to Climate Change

Impact on Biodiversity	Description
Habitat loss	Changes in temperature and precipitation patterns causing loss
Changes in phenology	Shifts in timing of biological events, disrupting interactions
Changes in species composition	Some species expanding range, others contracting
Disease and invasive species	Increasing prevalence, negatively impacting biodiversity
Changes in water availability	Impacting aquatic species and vegetation
Glacier retreat	Impacting water availability, disrupting glacier ecosystems
Forest fires	Increasing frequency and intensity, destroying habitats
Soil erosion	Extreme weather causing erosion, impacting plant and animal
Loss of genetic diversity	Species adapting or migrating, leading to loss of diversity
Human-wildlife conflict	Changes in distribution and behavior increasing conflict

Role of State Biodiversity Board Uttarakhand in Preserving the Biodiversity

Role	Description
Biodiversity conservation	Identify and conserve high biodiversity areas, protect threatened species, etc.
Research and monitoring	Conduct research to understand biodiversity and formulate conservation policies.
Capacity building	Provide training programs for stakeholders to increase understanding of conservation.
Awareness-raising	Raise public awareness about biodiversity and conservation through campaigns.
Policy development	Provide technical support to develop policies and legislation related to biodiversity.
Implementation of Biological Diversity Act	Ensure compliance of the Act and promote conservation and sustainable use.
Preparation of People's Biodiversity Registers	Prepare comprehensive documents that list biodiversity resources and traditional knowledge.
Conservation of Sacred Groves	Work towards the conservation of sacred groves due to their high biodiversity.
Establishment of Biodiversity Management Committees	Establish committees responsible for creating and implementing management plans.
Collaboration with other organizations	Collaborate with other organizations to promote biodiversity conservation.

Types of Medicinal Herbs of Uttarakhand and Medicines

Natural and sustainable

- Medicinal herbs of Uttarakhand offer natural and sustainable medicines that are less likely to cause side effects and are more affordable than synthetic drugs.

Wide range of therapeutic properties

- Herbs have a wide range of therapeutic properties and can be used to treat various ailments such as respiratory diseases, digestive disorders, skin problems, and more.

Cultural heritage

- The traditional systems of medicine that use medicinal herbs are an important part of Uttarakhand's cultural heritage, and promoting their use can help to preserve this heritage for future generations.

Local economic development

- Many of the medicinal herbs are grown and harvested by local communities, and promoting their sustainable use can support local economies and provide livelihoods for people in the region.

Environmental conservation

- Sustainable harvesting of medicinal herbs can help to conserve the environment and protect biodiversity, as many of these herbs grow naturally in the region's forests and other natural areas.

Medicinal Herbs of Uttarakhand

Himalayan Yew (<i>Taxus wallichiana</i>)	Bark used to make chemotherapy drug paclitaxel for cancer.
Kutki (<i>Picrorhiza kurroa</i>)	Bitter herb for liver, respiratory disorders, fever, constipation, and inflammation.
Kalmegh (<i>Andrographis paniculata</i>)	Bitter herb for fever, colds, digestive disorders, anti-inflammatory, and analgesic.
Brahmi (<i>Bacopa monnieri</i>)	Herb for memory, cognitive function, anxiety, depression, and insomnia.
Guggul (<i>Commiphora wightii</i>)	Resin for arthritis, obesity, high cholesterol, anti-inflammatory, and analgesic.
Ashwagandha (<i>Withania somnifera</i>)	Herb for stress, anxiety, depression, arthritis, diabetes, and hypertension.
Giloy (<i>Tinospora cordifolia</i>)	Herb for immunity, fever, arthritis, and diabetes.
Chamomile (<i>Matricaria chamomilla</i>)	Herb for anxiety, insomnia, digestive disorders, anti-inflammatory, and analgesic.
Aloe Vera (<i>Aloe barbadensis</i>)	Herb for burns, wounds, eczema, anti-inflammatory, and analgesic.
Turmeric (<i>Curcuma longa</i>)	Spice for arthritis, digestive disorders, skin conditions, anti-inflammatory.
Neem (<i>Azadirachta indica</i>)	Herb for skin disorders, insecticide, fever, malaria, and other illnesses.
Haritaki (<i>Terminalia chebula</i>)	Herb for digestive disorders, respiratory disorders, asthma, and bronchitis.
Shankpushpi (<i>Convolvulus pluricaulis</i>)	Herb for memory, cognitive function, anxiety, depression, and insomnia.
Bhringraj (<i>Eclipta prostrata</i>)	Herb for hair growth and liver disorders.

Endangered Plant Species of Uttarakhand and Efforts to Conserve Them

Brahma Kamal (*Saussurea obvallata*)

- Endangered flower in Uttarakhand due to habitat loss and overgrazing. Conservation efforts include protected areas and government initiatives.

Himalayan Yew (*Taxus wallichiana*)

- Tree species used for chemotherapy drug. Over-harvesting has led to population decline. Conservation efforts include a ban on felling and cultivation in nurseries.

Uttarakhand Willow (*Salix tetrasperma*)

- Rare willow species facing threats from habitat loss and climate change. Conservation efforts include propagation through seedlings and a protected area.

Cheerful Palm (*Chamaedorea elegans*)

- Endangered palm tree species facing threats from habitat loss and over-harvesting. Conservation efforts include propagation and a protected area.

Indian Gooseberry (*Phyllanthus emblica*)

- Medicinal plant facing threats from over-harvesting. Conservation efforts include a protected area.

Efforts To Conserve Endangered Plant Species In Uttarakhand

Creation of Biodiversity Parks	Govt. established parks, e.g., Harsil, Govind Pashu Vihar, and Valley of Flowers, for endangered plant species' protection.
Establishment of Botanical Gardens	Several botanical gardens, such as the Herbal Garden in Ranikhet, for medicinal plant cultivation.
Implementation of Wildlife Protection Acts	Uttarakhand Forest Department and State Biodiversity Board enforce the Wildlife Protection Act of 1972 for endangered species' protection.
Promotion of Sustainable Agriculture Practices	Organic farming and traditional crops promote endangered plant species' conservation.
Research and Development	Institutions like ICFRE and GBPNIHESD are developing techniques for conservation and propagation of endangered plant species.
Community-based Conservation	Initiatives to involve local communities in conservation and provide incentives for protecting natural habitats.
Capacity Building	Training on plant identification, conservation techniques, and sustainable harvesting practices for forest department staff, NGOs, and local communities.
Eco-tourism	Providing alternative livelihoods through eco-tourism initiatives, including nature trails and interpretation centers.
Seed Banks	Established to conserve the genetic diversity of endangered plant species and help in their propagation and reintroduction in natural habitats.
Conservation through Education	Educational programs for creating awareness about the importance of conserving endangered plant species.

Advance Technologies to be Used in Uttarakhand Regarding Climate Disasters

Early Warning Systems

- Use satellite data and weather models to forecast natural disasters, allowing for preparation and evacuation.

Remote Sensing and GIS

- Map and monitor the environment, identify vulnerable areas, and plan for mitigation and adaptation.

Artificial Intelligence (AI)

- Analyze data from various sources, develop predictive models, and identify areas at risk of climate disasters.

3D Printing

- Quickly produce replacement parts, tools, and equipment during disasters, reducing recovery time and cost.

Drones

- Assess damage, search and rescue, and provide situational awareness to responders.

Renewable Energy

- Reduce dependence on fossil fuels and provide power during disasters.

Smart Grids

- Optimize energy distribution, reduce waste and increase efficiency, and manage energy during times of high demand or disruption.

Cause of Recent Subsidence of Joshimath and Karnprayag Towns of Uttarakhand

Glacial melting and retreat causing subsidence

- Melting glaciers and retreat of Rishi Ganga Glacier have caused sinking ground and tilting of buildings in the region.

Thawing permafrost and climate change

- Thawing of permafrost due to rising temperatures is also causing ground sinking. Climate change is the underlying cause of most of the factors mentioned.

Impact of climate change on human settlements

- The subsidence in Joshimath and Karnprayag highlights the need for better understanding and management of risks associated with climate change and improved disaster management measures to protect local populations.

Human activities contributing to subsidence

- Rapid urbanization, deforestation, and land-use change have destabilized the soil and made it more prone to subsidence.

Natural factors contributing to subsidence

- Intense rainfall events and seismic activity in the highly seismic zone are also contributing factors to ground sinking.

Affect of Climate Change on Air Quality Index of Uttarakhand

Increased Temperature	Climate change can worsen air quality in Uttarakhand by increasing the frequency and severity of forest fires and the concentration of particulate matter in the air.
Changes in Precipitation Patterns	Changes in precipitation patterns can lead to increased humidity, trapping pollutants close to the ground.
Glacial Melting	Melting glaciers due to climate change can increase dust and soot in the air, worsening air quality.
Changes in Vegetation	Climate change can impact the release of VOCs into the air, which can react with other pollutants to form ground-level ozone.
Increased Tourism	Tourism can lead to more traffic and emissions, further worsening air quality in Uttarakhand.
Increased Wildfire Risk	Climate change can increase the risk of wildfires, releasing smoke and particulate matter into the air.
More Frequent Dust Storms	Climate change can lead to more frequent and intense dust storms, impacting air quality.
Health Impacts	Exposure to air pollution can cause respiratory problems, heart disease, and other health problems.
Economic Impacts	Poor air quality can lead to decreased productivity of crops, increased healthcare costs, and decreased tourism.
Environmental Impacts:	Air pollution can damage vegetation, soil, and water resources.

Particulate Matters PM 2.5 and PM 10.0

- In India, the Central Pollution Control Board (CPCB) has set the National Ambient Air Quality Standards (NAAQS) for PM 2.5 and PM 10.0 as follows:

PM 2.5: Annual average of 40 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$)

PM 10.0: Annual average of 60 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$)

- Therefore, these values can be considered as the normal concentration of PM 2.5 and PM 10.0 in Indian conditions as per the national standards. However, it's important to note that these values may still pose health risks to certain individuals, and efforts to further improve air quality are still needed.

- **Particulate Matter 2.5 (PM2.5)** refers to tiny particles in the air that have a diameter up to 2.5 micrometers (μm). These particles are small enough to be inhaled deeply into the lungs, where they can cause a range of health problems.
- **Particulate Matter 10 (PM10)** refers to particles in the air that have a diameter of more than 2.5 micrometers (μm) and up to 10.0 micrometers (μm). These particles can be inhaled into the lungs and can cause a range of health problems Both PM 2.5 and PM 10.0 can be composed of variety of materials including
 - **Combustion-related particles:** These are particles that are released into the air during combustion processes, such as burning fossil fuels, wood, or other organic matter. They can include a range of substances, such as carbon, sulfur, and nitrogen compounds.
 - **Dust and soil particles:** These particles are generated by natural processes such as wind erosion or construction activities.
 - **Biological particles:** These are particles that are released into the air by living organisms, such as pollen, mold spores, and bacteria.
 - **Industrial and chemical particles:** These are particles that are released during industrial processes, such as metal processing or chemical production. They can include a range of substances, such as metals, acids, and organic chemicals.
- Overall these particles are a complex mixture of particles from various sources, and its composition can vary depending on factors such as location, season, and weather patterns.

AQI Range	Air Quality Level
0-50	Good
51-100	Satisfactory
101-200	Moderate
201-300	Poor
301-400	Very Poor
401-500	Severe

What are Rain Gardens with Reference to Uttarakhand?

Rain gardens are shallow, landscaped depressions designed to capture, store, and filter rainwater runoff.

They can reduce the volume and velocity of runoff, prevent erosion, protect water quality, and recharge groundwater, making them effective in managing stormwater runoff and preventing flooding in Uttarakhand.

Rain gardens can also enhance biodiversity, aesthetics, and provide wildlife habitat, adding value to the state's green infrastructure.

To create a rain garden, an area is excavated and filled with a special soil mix, and native plants adapted to local conditions are planted in the garden.

Rain gardens also help reduce the heat island effect in urban areas, cool down the surrounding environment, and improve air quality by reducing polluted runoff.

They are low-cost and easy to maintain, requiring minimal watering, fertilizer, and pesticide use.

In Uttarakhand, where there are several urban areas and dense settlements, rain gardens can be an effective solution for managing stormwater and creating green spaces.

By using rain gardens, communities can protect the environment and provide numerous benefits to local communities.

What are Green Roofs with Reference to Uttarakhand?

Green roofs are roofs covered with vegetation, becoming increasingly popular in Uttarakhand as a sustainable solution for buildings.

Green roofs provide several benefits such as improving air quality, reducing energy consumption, and providing habitat for birds and wildlife.

Green roofs can also help to reduce stormwater runoff, preventing flooding and erosion.

Uttarakhand has several examples of green roofs being installed on government buildings, schools, and private homes.

The state government has launched initiatives to promote the adoption of green roofs, providing incentives for building owners and developers to install them.

Green roofs can provide opportunities for urban agriculture, increase food security, and provide recreational spaces for residents.

The lack of awareness and understanding about the benefits and installation process is a major challenge in implementing green roofs in Uttarakhand.

Proper planning and design can address maintenance challenges such as irrigation and pest management, making green roofs a sustainable and resilient solution for buildings in Uttarakhand.

What Is Urban Heat Island Effect With Reference To Uttarakhand?

Urban heat island effect refers to the phenomenon where urban areas have higher temperatures than surrounding rural areas due to heat absorption and retention by buildings, roads, and other infrastructure.

In Uttarakhand, UHI effect is becoming significant due to rapid urban growth in recent years.

UHI effect leads to increased energy consumption, decreased air quality, and increased health risks for vulnerable populations.

Strategies to address the UHI effect include increasing green spaces, promoting cool roofs and pavements, and implementing urban design strategies that prioritize shading and natural ventilation.

Public awareness campaigns can help raise awareness and encourage action to mitigate the UHI effect's impacts.

The UHI effect can have significant impacts on local ecology and biodiversity in Uttarakhand.

Prioritizing green infrastructure and ecosystem-based approaches to urban development can address these challenges.

Coordinated and integrated planning and management strategies involving various stakeholders are needed to address the complex interrelationships between urban development, environmental sustainability, and public health.

What is Climate Modelling with Reference to Uttarakhand?

Climate modelling uses mathematical models and computer simulations to predict future climate conditions.

These models help scientists and policymakers to understand how the climate is changing and how it may continue to change in the future.

Climate modelling is important for understanding the potential impacts of climate change on Uttarakhand's environment, economy, and society.

Climate models can predict the magnitude and timing of impacts and identify areas of the state that are most vulnerable to climate change.

Information from climate modelling can be used to develop and implement adaptation and mitigation strategies.

Climate modelling can be used to assess the effectiveness of different climate policies and measures.

Climate modelling can help to identify potential opportunities for climate action in Uttarakhand, such as increasing renewable energy use.

Climate modelling can improve the accuracy and reliability of weather forecasting and early warning systems in Uttarakhand, reducing the risk of loss of life and property.

What is Risk Assessment with Reference to Climate Change in Uttarakhand?

Risk assessment is a process of evaluating the potential impacts and consequences of climate change in Uttarakhand.

It involves identifying hazards and vulnerabilities associated with climate change and assessing the likelihood and severity of potential impacts.

Risk assessment can help in decision-making and prioritize actions that help to reduce risk and build resilience to climate change.

Climate change is expected to have significant impacts on water resources, agriculture, biodiversity, infrastructure, and human health in Uttarakhand.

Risk assessment can help identify vulnerable areas and populations and effective adaptation and mitigation measures.

It can identify areas at risk of flooding or landslides and promote flood protection infrastructure and early warning systems.

Risk assessment can identify potential impacts of climate change on agriculture and food security and promote resilient and adaptive agricultural practices.

Local knowledge and perspectives are critical in risk assessment to build trust and collaboration and increase the effectiveness and sustainability of climate action in the state.

What are the Early Warning Systems Regarding Climate Disasters in Uttarakhand?

Early warning systems are crucial for reducing the risk and impact of climate disasters in Uttarakhand due to its susceptibility to various climate-related hazards.

Examples of early warning systems

- The State Disaster Management Authority's (SDMA) Flood Forecasting and Warning System uses real-time data to forecast potential flood events and issue timely warnings to local communities and emergency responders.
- The Integrated Landslide Early Warning System (ILEWS) uses satellite-based data and other sources to monitor potential landslide hazards and issue early warnings to local communities and authorities.

Other initiatives to improve disaster preparedness and response

- Community-based disaster risk reduction programs
- Capacity-building initiatives for emergency responders
- Public awareness campaigns on disaster preparedness

Overall significance of early warning systems

- Early warning systems can protect local communities, infrastructure, and ecosystems and build resilience to the impacts of climate change.
- The State Emergency Operation Center (SEOC) in Uttarakhand monitors disasters, coordinates responses, and disseminates alerts using real-time data. Regular training is conducted to prepare responders and communities.
- By improving early warning systems, enhancing public awareness, and strengthening response capacities, the state can better manage the impacts of climate-related disasters and build resilience to future disasters.

Other Early Warning Systems and Initiatives in Uttarakhand to Address Climate Disasters

Avalanche Warning System

- A system using weather data and ground observations to issue warnings about potential avalanches.

Forest Fire Early Warning System

- A system using satellite data and ground-based observations to detect and monitor potential forest fires. (Installation of automatic weather stations and fire sensors in vulnerable areas of the forests)

Heat Wave Early Warning System

- A system that uses weather data to issue alerts to local communities, health officials, and other stakeholders.

Glacier Lake Outburst Flood (GLOF) Early Warning System

- A system using satellite data, weather data, and ground-based observations to detect and monitor potential GLOF events.

Disaster Risk Reduction Plans

- Comprehensive disaster risk reduction plans for the state by USDMA.

Flood Control Measures

- Implementation of flood control measures such as construction of flood embankments, river training works, channelization of rivers, water level sensors and rain gauges.

Afforestation and Forest Conservation

- Afforestation and forest conservation programs to protect and restore forest cover

Climate Adaptation Strategies

- Development of climate adaptation strategies such as crop diversification, promotion of climate-resilient agricultural practices, and water harvesting and conservation structures.

Disaster Management Training

- USDMA provides disaster management training to local communities and emergency responders to improve preparedness and response.

Thawing of Permafrost in Uttarakhand Hills

Permafrost is soil or rock frozen for two or more consecutive years, found at elevations above 4,500 meters in the Himalayan region.

Thawing of permafrost can destabilize slopes, leading to landslides and rockfall, and affect water resources and infrastructure in the region.

The thawing of permafrost is primarily attributed to rising temperatures due to climate change, and this trend is expected to continue in the future.

Thawing of permafrost can have economic consequences, such as negative impacts on the tourism industry.

Strategies such as the use of renewable energy sources and sustainable tourism practices can be employed to address the challenges posed by permafrost thaw.

Investment in research and monitoring of permafrost thaw in the region is essential to study its impacts and develop early warning systems.

Proactive measures must be taken, including reducing greenhouse gas emissions, promoting sustainable tourism, and investing in infrastructure and research.

The thawing of permafrost in the Uttarakhand hills is a significant concern with far-reaching impacts on the environment, social fabric, and the economy.

Renewable Energy

- Energy sources like solar, wind, hydro, geothermal and biomass are sustainable, renewable, more equitably distributed, environmentally friendly and cheaper than conventional sources.
- They are obtained from the regular and repetitive flows of energy happening in the natural environment.

Hydroelectric Energy

- Hydroelectric energy is a form of energy that harnesses the power of water in motion, such as water flowing over a waterfall to generate electricity. It uses hydroelectric power plant which consists of a high dam that is built across a large river to create a reservoir, and a station where the process of energy conversion to electricity takes place.

Solar Energy

- Solar energy is a renewable source of energy that is sustainable and totally inexhaustible, unlike fossil fuels that are finite. It is also a non-polluting source of energy and it does not emit any greenhouse gases when producing electricity. Solar energy is captured in a variety of ways, the most common of which is with photovoltaic solar panels that convert the sun's rays into usable electricity.

Wind Energy

- The wind is a clean, free, and readily available renewable energy source, used to generate electricity. It uses wind turbines to convert the kinetic energy in the wind into mechanical power which is further converted to the electrical power.

Uttarakhand Renewable Energy Development Agency (UREDA)

- UREDA promotes, develops and deploys renewable energy sources in Uttarakhand, India. It implements renewable energy policies and programs, provides financial and technical assistance, and conducts research in solar, wind, small hydro and bio-energy to achieve India's renewable energy targets.

Formulation and implementation of policies and programs for renewable energy development in the state.

Promotion and development of new and renewable energy sources like solar, wind, small hydro, and bio-energy.

Facilitating the installation of renewable energy systems in homes, businesses, and public institutions.

Providing financial assistance and incentives to individuals, organizations, and government departments for the installation of renewable energy systems.

Capacity building and training of individuals and organizations in renewable energy technologies and applications.

Conducting research and development in renewable energy technologies and applications.

Collaboration with national and international agencies for the development of renewable energy sources.

Earthquake and Climate Resistant Building Code in Uttarakhand

Uttarakhand has implemented earthquake and climate-resistant building codes.

The codes aim to reduce damage caused by natural disasters and ensure safety of residents.

Buildings must be constructed with reinforced concrete and steel to withstand seismic forces.

Buildings must also be constructed on stable ground and at an appropriate elevation to withstand extreme weather events.

The state government has established a Building Safety Council to ensure compliance with the codes.

The council approves building plans and conducts inspections.

The council also provides training and certification to architects, engineers, and builders on earthquake and climate-resistant construction practices.

The codes are important to ensure safety and reduce damage caused by natural disasters in Uttarakhand.

Minutes of the Meeting on “Annual Conference On Capacity Building-2022” Held on April 7 & 8, 2022 at Vigyan Bhawan, New Delhi

- The above meeting was held under the chairmanship of Honourable Home Minister of India and was also attended by Principal Secretary to the Prime Minister and concerned representatives of all the states and Union Territories.
- To strengthen the reaction mechanism, four new battalions of NDRF have been raised to enhance the reach of NDRF.
- A proposal for establishing 28 additional RRCs to be expedited.
- Reduction and Disaster resilience through various community Capacity Building Programmes including School Safety Programmes and Community awareness Programmes.
- Relief centric approach has to be shifted to preparedness, mitigation, response & reconstruction.
- The Apda Mitra scheme has been operational in 350 districts of the country. The scheme aims to train more than 1 lakh young volunteers across country. So, there is need to work in synergy with all the stakeholders to train volunteers and Self help groups in the country.
- To sensitize local people about disaster preparedness and how to act as first responders. This will generate awareness among the people and improves their capability to save their lives at the time of disasters.
- All capacity development efforts for disaster response must empower the local level actors. Neighbours are the first responders. So, they and the local communities must be included in all decision making and preparedness for disaster response. There is need to utilize Panchayati Raj Institutions and local leaders to propagate disaster risk reduction and response programs as they are connected to the local population. In this regard, local-level institutions such as NGOs, Grassroots organisations, Red Cross Volunteers and others must become an integral part of the local level disaster response mechanism.
- Establishing local emergency response teams and upgrading fire services.
- We do have an incident response system in the country, we need to ensure that it may lead to a standardized system of field coordination at the disaster site. The representatives of Indian Red Cross, NGOs and civil society organisation must provide an integrated disaster response system.
- NDRF, and NDMA regularly hold district and state level exercises. These need to be scaled further. The most disaster prone districts must hold at least one meaning full exercise every year.
- Indian response team must follow the internationally agreed procedures and protocols to ensure interoperability with the international disaster response system.

Grey areas regarding forest management in Uttarakhand

How they can be improved

Lack of coordination and convergence among different stakeholders such as forest department, van panchayats, local communities, NGOs, etc.

Strengthening the institutional mechanisms and platforms for dialogue, collaboration and joint action among various actors.

Inadequate financial and technical support to van panchayats for effective forest management and livelihood enhancement.

Enhancing the capacity and resources of van panchayats through training, exposure visits, micro-planning, fund allocation, etc.

Degradation of forest quality and biodiversity due to overexploitation, forest fires, invasive species, climate change, etc.

Implementing scientific and participatory methods of forest restoration, conservation and monitoring. Promoting sustainable use and value addition of forest products.

High vulnerability of forest areas to natural disasters such as landslides, floods, droughts, etc.

Identifying and prioritizing the high-risk zones and implementing appropriate measures such as bio-engineering, soil stabilization, watershed management, etc.

Low awareness and participation of local people in forest management and decision making.

Increasing the outreach and communication of forest department and van panchayats to the local communities. Encouraging the involvement of women, youth and marginalized groups in forest governance.

SACRED GROVES OF UTTRAKHAND

- Sacred groves are patches of forest that are conserved by local communities for their religious and cultural significance.
- Some of the efforts in Uttarakhand regarding conservation of sacred groves are:
 - Documenting sacred groves and their biodiversity: Various researchers and organizations have been documenting the sacred groves of Uttarakhand and their biodiversity. For example, a study by GB Pant National Institute of Himalayan Environment recorded 133 sacred groves from 12 districts of Uttarakhand and identified 202 plant species belonging to 72 families from these groves. Another study by Wildlife Institute of India recorded 26 mammal species, 106 bird species, and 13 reptile species from 10 sacred groves of Uttarakhand.
 - Promoting eco-tourism in sacred groves: The Uttarakhand Biodiversity Board (UBB) has selected 13 sacred groves for eco-tourism, out of which four have been approved by the state forest department. The villagers will be trained to start eco-tourism activities, such as guided walks, homestays, cultural programs, etc., in these groves. This will help generate income for the locals and also create awareness about the importance of these groves.
 - Geotagging sacred groves: The Uttarakhand Space Application Centre (USAC) and the state forest department plan to geotag these sacred groves in Uttarakhand, each of which have more than 250 trees. The aim of this exercise is to preserve these groves, study their unique features, and pass on their traditional values to future generations.

SOME IMPORTANT GUIDELINES FOR NEW INDIAN FOREST SERVICE OFFICERS

- Immediately after joining a forest division, the officer should study the Working plan / Management plan of the division very thoroughly. This will facilitate in inspecting the areas with technical angle.
- Maximum emphasis should be given to field inspections.
- After every field visit, inspection notes must be issued taking into account the previous records.
- The field visits should be utilized to interact with the subordinate staffs as well as the villagers of the area. This will enable the participation of local people in forest protection measures and will apprise the officer with their grievances if any.
- Before writing the inspection notes after the field visit, the prescription mentioned in the Working plan / Management plan for that area should be carefully gone through and the compartment history along with the map must be read and changes in the crop if any should be brought about. This will generate keen interest among the officers for field visits.
- The copy of these inspection notes must be preserved digitally and the officer should think on the lines of making a digital library not only of the inspection notes but also other records of the office. The inspection notes should be circulated to subordinates as well as senior officers.
- A thorough knowledge of Forest Manual is a must for discharging the duties efficiently.
- The officer is expected to have a thorough knowledge of Indian Forest Act, Wildlife Act, Forest Rights Act, Forest Conservation act and other important acts related to forestry.
- The forest accounts are based on the guidelines of financial handbook volume VII. Therefore, it is essential to go through the financial handbook volume VII.

- The officer should keep him/her abreast with modern techniques in nursery, plantation, cloning, forest genetics, new techniques of harvesting, new silvicultural practices, maximizing the yield, etc.
- The officers must read Masleker dictionary and the glossary of technical terms. The officers should carefully observe the regeneration of key species such as Sal, Chir, Oak, Fir, Spruce and suggest technical inputs for promoting natural regeneration.
- The officer should develop a mechanism for interacting with officers of other related department such as Agriculture, Soil Conservation, Horticulture, Animal Husbandry, Tribal Development, AYUSH, etc. for an integrated approach.
- Officer should also look for innovations such as medicinal plants, Species on the verge of extinction, invasive species, proportion of associate species vs main species of the forest.
- The officers should must select an area for their specialization because this is age of excellence and should work hard consistently in their selected field of specialization.
- The officers should function like a Team Leader / Captain rather than a boss. This will evince very good response from the subordinates which will automatically improve the functioning in the field as well as in the office.