



## Carbon Dioxide Emissions From Forest Fires

**For Prelims:** [Extratropical and Tropical](#), Pyromes, [Climate Change Effects](#), [Carbon Emissions](#), [Greenhouse Gases](#), [Carbon Market](#), [Carbon Credits](#), CO<sub>2</sub>.

**For Mains:** Impact of Forest Fires on Climate Change, Regional Variations in Fire Dynamics, Policy Implications for Fire Management, Role of Human Activities in Forest Fires

[Source: DTE](#)

### Why in News?

Recently, a study by the **Centre for Wildfire Research** has found that global CO<sub>2</sub> emissions from forest fires have surged by **60% since 2001**.

- Emissions from **boreal forests in Eurasia and North America** have nearly **tripled**, with climate change being identified as a major driver behind this increase.

### What is Forest Fire?

- **About:**
  - A wildfire, also known as a **bushfire or vegetation fire**, refers to any uncontrolled and non-prescribed burning of plants in natural environments such as forests, grasslands, or tundras.
  - These fires spread based on environmental factors like wind and topography and consume natural fuels. For a wildfire to sustain combustion, three essential elements are required: fuel (plant material), oxygen, and a heat source.
- **Classification:**
  - **Surface Fire:** Burns along the ground, consuming dry grasses, leaves, and twigs on the forest floor.
  - **Underground/Zombie Fire:** Low-intensity fires burning beneath the forest floor, affecting organic matter.
  - **Canopy/Crown Fire:** Spreads through the tree canopy, driven by wind and dry conditions, often intense and hard to control.
  - **Controlled Deliberate Fires:** Prescribed burns by forest agencies to reduce fuel loads, lower wildfire risks, and maintain ecosystem health.

### What are the Key Findings of the Study?

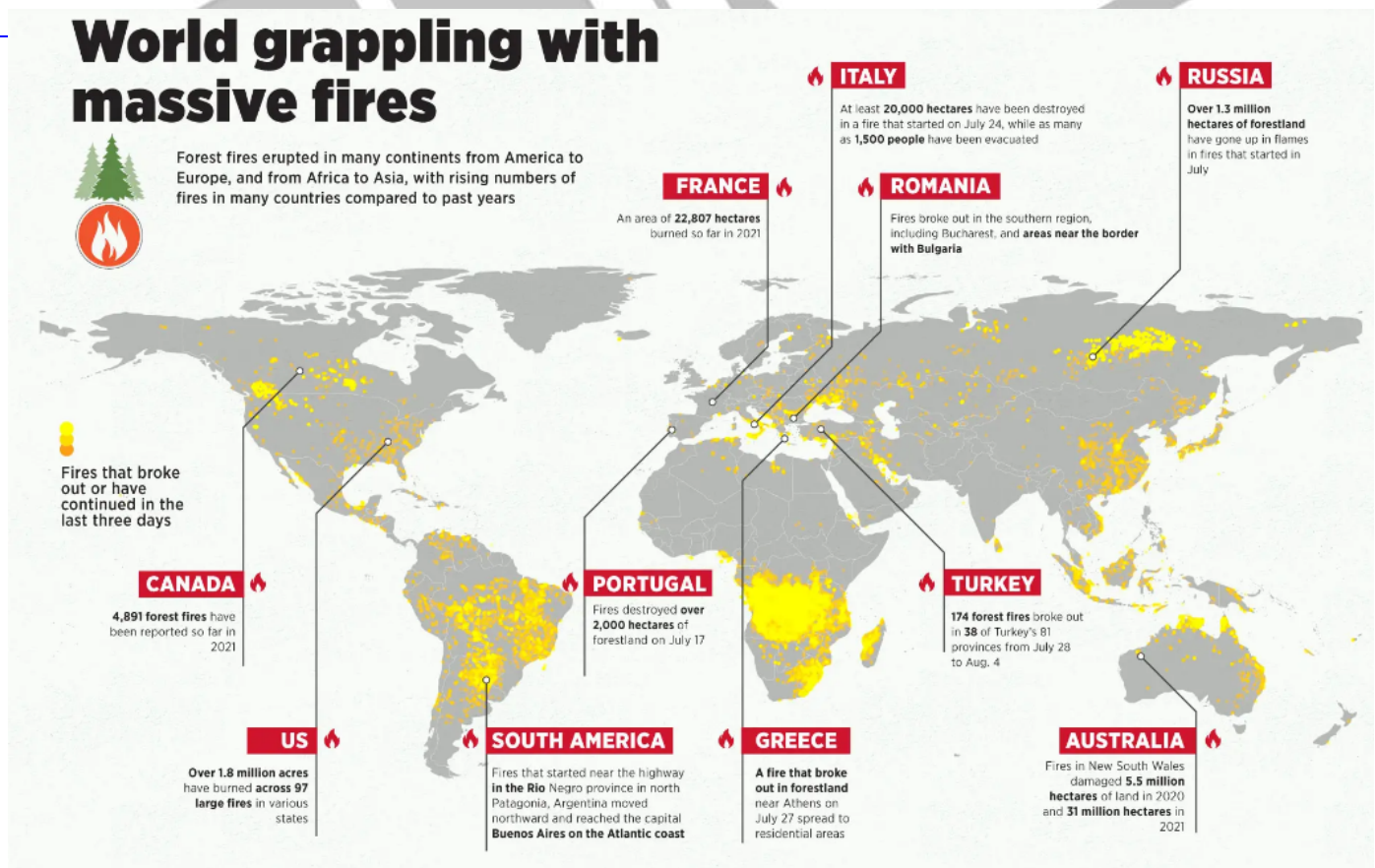
- **Pyromes and Global Fire Patterns:** The study uses [machine learning](#) to group global forest ecoregions into 12 distinct "**pyromes**," **zones** where forest fires exhibit similar patterns influenced by **climate, vegetation, and human activities**.

- Grouping these regions aids in understanding fire behavior and predicting the effects of [climate change or land use](#), supporting better [fire management](#) and risk assessment.
- **Geographical Shift in Fire Emissions:** The analysis also revealed that apart from **tropical and subtropical forest areas**, **extratropical forest fire carbon emissions** from areas located outside the tropics have increased significantly due to climate change.
- **Fire Severity and Carbon Combustion:** Globally, the carbon combustion rate in forest fires has **risen by 47%**, with forests now contributing more to fire emissions than savannahs and grasslands.
  - Increased fire severity is indicated by more fuel being consumed per unit of burned forest area.
- **Climate Change and Fire Weather:** Anthropogenic climate change is driving more frequent and severe droughts, creating "**fire weather**" conditions, characterized by low fuel moisture and dry, flammable vegetation.
  - Increased lightning frequency, especially in high-altitude regions, is also contributing to the rise in forest fires.
- **Forest Carbon Stock Destabilization:** Carbon stocks in multiple forest types including temperate coniferous forests, boreal forests, Mediterranean forests, and subtropical dry and moist broadleaf forests, are destabilizing due to increased fire severity.
- **Impact on Carbon Accounting:** The rise in carbon emissions from forest fires presents challenges to **carbon accounting and greenhouse gas (GHG)** inventories submitted to the United Nations.
  - For example, Canada's 2023 wildfires are thought to have offset much of the carbon sink accumulated in its forests over the previous decade.

## Carbon Capture and Storage (CCS)

- It is a process designed to mitigate the emissions of carbon dioxide (CO<sub>2</sub>) generated from industrial processes and the burning of fossil fuels, particularly in power plants.
- The goal of CCS is to prevent a significant amount of CO<sub>2</sub> from entering the atmosphere and contributing to [global warming](#) and [climate change](#).

//



## What Are the Challenges Related to Forest Fires?

- **Environmental Impact:** Forest fires cause massive loss of biodiversity, damage ecosystems, and release large amounts of carbon dioxide, contributing to climate change.
  - Fires emit harmful pollutants **like particulate matter and greenhouse gases**, affecting air quality and causing respiratory issues.
- **Soil Degradation:** High-intensity fires destroy nutrients in the soil, reducing fertility and disrupting ecosystems.
- **Resource Loss:** Forests provide essential resources like timber, food, and livelihoods for local communities, which are endangered by fires.
- **Difficult Management:** The increasing frequency and intensity of fires, exacerbated by climate change, make effective management and control challenging.
- **Human Health:** Fires cause health problems for nearby communities due to air pollution and heat exposure, leading to increased healthcare burdens.
- **Economic Loss:** Forest fires result in significant economic losses, including costs for firefighting, property damage, and recovery efforts.

## What are the Forest Fires Scenario in India?

- **Forest Fire Season and Incidence:**
  - India's forest fire season extends from November to June, peaking in April-May.
  - According to the **Forest Survey of India (FSI)**, 35.47% of India's forests are fire-prone, with varying degrees of risk across regions.
  - Most vulnerable areas include Northeast India, Odisha, Maharashtra, Jharkhand, Chhattisgarh, and Uttarakhand.
- **Recent Incidents (2024):**
  - Uttarakhand reported 1,309 forest fires between January and June 2024, an increase from previous years.
  - ISRO data shows rising fires since March 2024, impacting multiple regions, including Maharashtra, Gujarat, and Odisha.
- **Government Initiatives:**
  - **National Action Plan for Forest Fires (NAPFF):** Launched in 2018 to engage forest communities and reduce fire occurrences.
  - **Forest Fire Prevention and Management Scheme (FPM):** Initiated in 2017 to assist states in managing forest fires through technical and financial support.

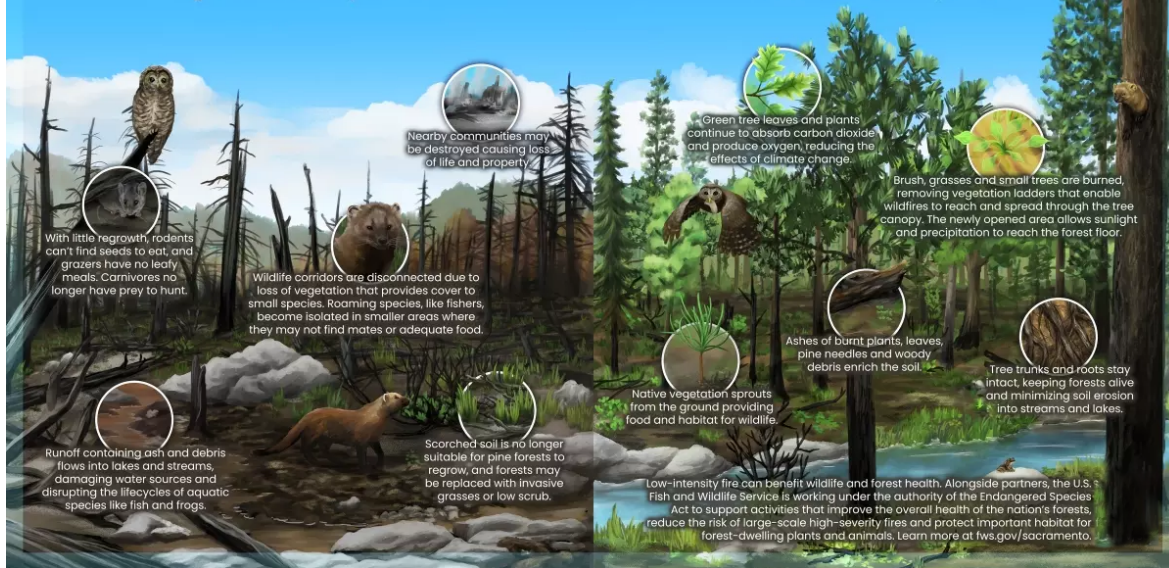
## How does fire impact forests and wildlife?

Wildfires are inevitable, but not all fire is harmful to forests. Low-intensity fires can naturally "clean" and thin the forest by removing flammable and thick vegetation on the forest floor. The result is improved habitat for wildlife, healthier soil and new growth of native plants.

It also helps reduce the risk of large-scale high-severity fires that burn through the forest—from the floor to the canopy—with intense heat. High-severity fires across large landscapes can be devastating for wildlife, habitat and surrounding communities.

### High-Severity Fire

### Low-Intensity Fire



## FAO Fire Management Guidelines

- **Integration of Knowledge:**
  - The guidelines stress the importance of **integrating science and traditional knowledge** from Indigenous Peoples and local knowledge holders.
  - This approach enhances fire management decisions, helps in preventing wildfires, managing fire outbreaks, and restoring areas affected by severe burning.
  - **Gender inclusion** and diverse fire management knowledge are also promoted.

## Way Forward

- **Management Strategies:** Effective **forest management** is crucial, particularly in extratropical regions. Monitoring vegetation and prioritizing areas for intervention can help mitigate risks.
- **Tropical Strategies:** In **tropical regions**, reducing ignitions during extreme fire-prone weather and **preventing further forest fragmentation** are essential for protecting forests.
- **Fire Management Shifts:** In regions with heavy fire suppression history, adopting ecologically beneficial fire practices may prevent forests from turning into carbon sources.
- **Need for Accurate Reporting:** The study calls for **better reporting of forest fire emissions** to the **United Nations**, addressing the gaps in current **carbon budget** reports linked to human-induced climate change.
- **Carbon Credits Risk:** The increasing risk of fire disturbances must be factored into **reafforestation and carbon credit schemes**, especially in extratropical regions, to avoid overestimating carbon storage potential.

Read More: [FAO Guidelines on Wildfire Management](#)

### Drishti Mains Question

What are the implications of increasing global forest fire emissions on climate change, and how should policies be adjusted to mitigate these risks?

## UPSC Civil Services Examination Previous Year Question (PYQ)

### Prelims

**Q. Consider the following: (2019)**

1. Carbon monoxide
2. Methane
3. Ozone
4. Sulphur dioxide

**Which of the above are released into atmosphere due to the burning of crop/biomass residue?**

- (a) 1 and 2 only  
(b) 2, 3 and 4 only  
(c) 1 and 4 only  
(d) 1, 2, 3 and 4

**Ans: (d)**

PDF Reference URL: <https://www.drishtiias.com/printpdf/carbon-dioxide-emissions-from-forest-fires>

