



Anthropogenic And Technological Impacts On India's Environment: A Critical Review

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Abstract

India is undergoing rapid technological transformation and economic growth. However, this progress comes with significant environmental consequences. This paper examines how current technological developments and human activities—including industrialization, urban expansion, agriculture, and energy production—are impacting India's environment. It analyzes key issues such as air and water pollution, deforestation, and climate change. The paper also reviews government policies and concludes with recommendations for sustainable development and environmental protection.

Keywords: Technological advancement, Economic growth, Environmental degradation, India, Industrialization, Urban expansion, Agriculture, Energy production, Deforestation, Climate change, Government policy, Sustainable development, Environmental protection

I. Introduction

Technological innovation and human activity have drastically changed the Indian landscape over the past few decades. As India strives to become a global economic leader, it faces the dual challenge of sustaining development while preserving its environment. Unregulated industrial growth, mass urbanization, deforestation, and energy demands have led to significant environmental degradation. This paper explores how current technologies and human activities are affecting India's natural resources and ecosystems. It highlights specific environmental challenges and evaluates efforts being made to mitigate their impact.[1][2]

II. Methodology

This research paper is based on a **qualitative and analytical approach**, relying primarily on secondary data sources. The following methods were employed[3][4]:

- a. **Literature Review:** Scholarly articles, government reports, environmental journals, and research studies were analyzed to gather relevant data on technological and human impacts on the environment in India.
- b. **Case Studies:** Real-world examples such as Delhi's air pollution crisis and the Ganga River's pollution levels were included to illustrate the severity and complexity of environmental issues.
- c. **Policy Review:** Government policies, schemes, and legal frameworks such as the Environmental Protection Act, National Green Tribunal (NGT), and National Clean Air Programme (NCAP) were examined.
- d. **Comparative Analysis:** Environmental indicators such as air and water quality, deforestation rates, and emission levels were compared over time to understand trends and changes.

This methodology helps in building a comprehensive understanding of how different factors contribute to environmental challenges and evaluates the effectiveness of current responses.

III. Environmental Impacts of Technology and Human Activities[5][6][11][12]

a. Industrialization and Emissions

With rapid industrialization, especially in cities like Delhi, Mumbai, and Chennai, there has been a surge in the emission of pollutants such as carbon dioxide (CO₂), nitrogen oxides (NO_x), and sulfur dioxide (SO₂). These contribute heavily to air pollution and climate change.

b. Urbanization and E-Waste

Urban areas are expanding rapidly, leading to high energy consumption and electronic waste (e-waste). India generates more than 3.2 million metric tons of e-waste annually, with inadequate recycling facilities.

c. Energy Production

India relies heavily on coal-based thermal power plants, which are major sources of greenhouse gases and particulate matter. Although the use of renewable energy is growing, it still constitutes a relatively small share of the total energy mix.

d. Transportation

The number of vehicles on Indian roads has exploded in recent years, especially in urban areas. This has led to increased levels of air pollution, traffic congestion, and fuel consumption.

e. Deforestation and Land Use

Forests are being cleared for agriculture, mining, and urban development. This leads to habitat loss, soil erosion, and reduced carbon sequestration.

f. Agriculture and Pesticide Use

While agriculture remains a backbone of the Indian economy, the excessive use of chemical fertilizers and pesticides has degraded soil quality and polluted water bodies.

g. Water Pollution

Rivers like the Ganga and Yamuna are heavily polluted due to industrial discharge, domestic sewage, and religious rituals. Groundwater contamination is also a growing concern, particularly in rural areas.

h. Mining and Resource Extraction

Mining activities, especially in states like Jharkhand and Odisha, have caused deforestation, loss of biodiversity, and water contamination due to the disposal of mining waste.

IV. Case Studies

a. Hyderabad University: 400-Acre Land Controversy

In April 2025, a major environmental issue arose in Hyderabad when the Telangana government proposed to clear 400 acres of land near the University of Hyderabad for an IT park. This green zone is home to various flora and fauna and serves as an urban forest and ecological buffer. Students and environmentalists protested, emphasizing the damage to biodiversity and carbon sinks. The Telangana High Court halted the land clearance and called for an environmental impact review. This incident reflects the ongoing conflict between development and conservation.

b. India's Cities Among the World's Most Polluted

Recent air quality reports from 2024–2025 show that 13 of the world's 20 most polluted cities are in India. Delhi remains the most polluted capital city globally, with other cities like Ghaziabad, Kanpur, and Varanasi also showing extremely high levels of PM_{2.5} pollutants. Byrnihat in Meghalaya topped the list with PM_{2.5} levels reaching 128.2 µg/m³—far above the WHO recommended limit of 5 µg/m³. The primary

causes are vehicular emissions, construction dust, crop burning, and industrial discharge.

c. Water Pollution in Yamuna and Hindon Rivers

In early 2025, Noida and nearby regions witnessed a worsening water crisis due to pollution in the Yamuna and Hindon Rivers. The Central Pollution Control Board (CPCB) labeled the Hindon as 'ecologically dead' with dangerously low dissolved oxygen levels. Untreated sewage, industrial effluents, and chemical runoff have turned the rivers into toxic waterways. This situation threatens aquatic biodiversity and contaminates groundwater, directly affecting human health.

d. Ganga River and the Threat to Gangetic Dolphins

A 2025 study by the Wildlife Institute of India revealed the presence of 39 endocrine-disrupting chemicals in the Ganga River. These pollutants interfere with the hormonal systems of aquatic species, including the endangered Gangetic dolphins. Accumulation of toxins through the food chain may lead to reproductive issues and population decline. This case highlights how water pollution not only affects ecosystems but also threatens species on the brink of extinction.

e. Bhopal's Adampur Dump Yard Fire

In April 2025, a massive fire broke out at the Adampur landfill in Bhopal, raising alarms over solid waste management and public health. The fire released toxic fumes and affected over 10,000 nearby residents. The Supreme Court of India ordered the Central Pollution Control Board to investigate the incident, assess environmental and health damages, and identify those responsible. This case emphasizes the risks of unregulated waste disposal and the urgent need for proper landfill management systems.

V. Government Policies, Initiatives, and Environmental Laws

India has developed a comprehensive legal and policy framework to combat environmental degradation and promote sustainability. Below are key policies and laws currently in force[7][8][14][16]:

1. Environmental Protection Act, 1986

- **Purpose:** A comprehensive law that provides a framework for environmental protection and regulation.
- **Key Provisions:**
 - Authorizes the central government to set environmental quality standards.
 - Enables the regulation of industrial emissions and hazardous substances.
 - Provides for penalties and closure of polluting units.
- **Significance:** Acts as the umbrella legislation for all environmental laws in India.

2. Air (Prevention and Control of Pollution) Act, 1981

- **Purpose:** To control and reduce air pollution in India.
- **Key Provisions:**
 - Empowers Central and State Pollution Control Boards to monitor and enforce air quality standards.
 - Mandates permits for operating polluting industries.
- **Significance:** Basis for initiatives like the **National Clean Air Programme (NCAP)**.

3. Water (Prevention and Control of Pollution) Act, 1974

- **Purpose:** To prevent and control pollution in rivers, lakes, and groundwater.
- **Key Provisions:**
 - Sets up Central and State Boards to oversee water quality.
 - Requires treatment of industrial effluents before discharge.

- **Significance:** Critical for managing the quality of India's rivers like the Ganga and Yamuna.

4. Forest (Conservation) Act, 1980

- **Purpose:** Regulates the use of forest land for non-forest purposes.
- **Key Provisions:**
 - Requires central government approval before diverting forest land.
 - Mandates compensatory afforestation for diverted land.
- **Significance:** Protects forest ecosystems from urban and industrial encroachment.

5. Wildlife Protection Act, 1972

- **Purpose:** Protects wild animals, birds, and plant species.
- **Key Provisions:**
 - Establishes protected areas like national parks and wildlife sanctuaries.
 - Prohibits hunting and trade of endangered species.
- **Significance:** Helps conserve biodiversity, including species like the Gangetic dolphin.

6. Namami Gange Programme

- This integrated mission focuses on the conservation and rejuvenation of the Ganga River. Activities include sewage treatment infrastructure, river surface cleaning, afforestation, and public participation.

VI. Results and Findings[9][10][15]

The research reveals that the rapid pace of technological advancement and unregulated human activities in India have led to significant environmental consequences. Key findings include:

- Air Pollution:** Cities like Delhi, Kanpur, and Byrnihat consistently rank among the most polluted in the world, with PM2.5 levels far exceeding safe limits. The sources are primarily vehicular emissions, construction, and industrial activity.
- Water Pollution:** Major rivers such as the Yamuna, Hindon, and Ganga are severely polluted due to untreated sewage, industrial waste, and chemical run-offs. In some regions, water bodies have been declared 'dead' due to dangerously low dissolved oxygen levels.
- Deforestation and Land Use Change:** The Hyderabad University case exemplifies the ongoing loss of urban green spaces due to real estate and infrastructural development. This contributes to biodiversity loss and increased urban heat islands.
- Biodiversity Loss:** Endangered species like the Gangetic dolphin face threats from toxic pollutants in aquatic ecosystems. Habitat destruction due to land clearance and pollution is a major driver of species extinction.
- Waste Mismanagement:** The Adampur dump yard fire in Bhopal highlights severe issues with solid waste handling and its impacts on air and groundwater pollution.
- Policy Gaps and Enforcement Issues:** While India has numerous environmental laws and national missions, inconsistent implementation, corruption, and lack of public participation weaken their effectiveness.

VII. Conclusion

The study concludes that while technological and economic growth have propelled India forward, they have also contributed to escalating environmental degradation. The effects are visible in deteriorating air and water quality, shrinking green spaces, biodiversity loss, and the increasing frequency of environmental disasters.

India's environmental challenges are not due to a lack of policies but are rooted in weak enforcement, fragmented governance, and low public awareness. Sustainable development must become a national priority, balancing growth with ecological preservation.

Recommendations include:

- a. Strengthening enforcement of environmental laws.
- b. Promoting green technologies and clean energy.
- c. Enhancing public awareness and participation in environmental protection.
- d. Integrating environmental impact assessments into all major development projects.
- e. Empowering local bodies and civil society in monitoring and implementation.

If India is to ensure a livable future for its population and fulfill its global climate commitments, a coordinated, science-based, and people-centric approach to environmental governance is imperative

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