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Acknowledgement

We thank all the contributors for their immensely valuable contributions and for making this endeavour a success.

Foreword

In the 51st edition of *The Green Files*, iCED's quarterly journal, we delve into the crucial relationship between air pollution and its multifaceted impacts on health, agriculture, and the environment. This volume brings together a series of articles and features that provide a comprehensive perspective on the subject.

This edition highlights multiple sectors and perspectives on Air Pollution with a focus on the environment. The article on COP 29, sheds light on India's participation and stance at this pivotal conference.

Another article discusses the concept, significance, and effects of air pollution globally, including the latest data and a review of policies aimed at combating it in India. Additionally, an article on India's participation at COP 29 highlighting pathways taken by India to achieve its commitment.

An article on Performance Audit Report assesses the effectiveness of air pollution control measures implemented by the Government of Gujarat in 2022. Furthermore, a discussion emphasizes how air pollution contributes to climate change, underlining the interconnectedness of these environmental challenges and its impact on public health. Insights from an audit report by the European Court of Auditors will illustrate how our health remains inadequately protected from air pollution. A case study will showcase cities or countries that have successfully implemented air pollution prevention measures, providing examples of best practices. The impact of air pollution on agricultural yields and food security is also explored, alongside an examination of emerging technologies aimed at reducing emissions, such as electric vehicles and air purifiers.

On behalf of the entire team of “Green Files” at iCED, we look forward to your suggestions to make Green Files as informative and user friendly as possible. Your contributions within the broad scope of this quarterly journal will be highly appreciated, including any feedback you may like to share on the featured articles.

(Dr. Abhishek Gupta)

Additional Dy. Comptroller and Auditor General and Director General,
iCED, Jaipur

Message from the Director (Training & Research)

iCED's quarterly journal, "Green Files," offers insights into environmental and sustainable development issues from the perspective of public sector auditing. Additionally, it provides snapshots of the capacity-building and research activities undertaken at iCED during the covered period. The last five volumes highlighted issues related to Climate Change, the Blue Economy and Agriculture with a focus on the Environment. The current volume focuses on the theme of Air Pollution, with an emphasis on the environment.

This 51st volume of "Green Files" presents articles that highlight multiple dimensions of air pollution with a focus on the environment, aiming to enhance understanding from an auditing perspective. It covers critical aspects such as the concept and significance of air pollution globally, the relationship between Air Pollution and Climate Change, its impact on agricultural yields, and technological innovations aimed at reducing air pollution. Furthermore, this edition includes articles related to air pollution issues in the Performance Audit Report of Gujarat and contributions from the European Court of Auditors.

We hope that this edition will prove to be valuable in enhancing comprehension of the diverse facets of the Agriculture Section focused on environment, especially for their relevance to the auditing professionals.

(Mehul Grover)
Director (Training & Research)
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Air Pollution: Concept, Significance, and Global Impact

By: Shri Manish Mangal, AAO and Shri Ashutosh Goyal, Sr. Ar.

1. Introduction

Air pollution is contamination of the indoor or outdoor environment by any chemical, physical or biological agent that modifies the natural characteristics of the atmosphere. (WHO, 2025)

2. Concept of Air Pollution

Air pollutants are categorized into primary pollutants, directly emitted from sources like vehicles and industries, and secondary pollutants, formed through chemical reactions in the atmosphere. Common sources of air pollutants include industrial emissions, vehicular exhaust, biomass burning, and natural events like wildfires. Air pollution manifests both indoors and outdoors, with indoor pollution often resulting from cooking fuels and building materials. (University of California, 2024)

3. Significance and effect of Air Pollution

- **Human Health:** Exposure to pollutants such as PM2.5 and PM10 leads to irritation in the eyes, nose, and throat; cause breathing problems like wheezing, coughing, and chest tightness; worsen lung and heart conditions such as asthma; increase the risk of heart attacks and cancer; and harm the immune, neurological, reproductive, and respiratory systems.
- **Environmental Impact:** Air pollution contributes to climate change, acid rain, Eutrophication, Ozone depletion, and the degradation of ecosystems.
- **Economy:** Air pollution harms crops and trees, impacting the economy by reducing agricultural and commercial forest yields. Ground-level ozone diminishes crop productivity, stunts tree seedling growth, and increases plant vulnerability to diseases, pests, and environmental stresses like harsh weather. Additionally, damage from acid rain and increased UV radiation due to ozone depletion further exacerbates losses, leading to economic setbacks in agriculture, forestry, and related industries.
- **Ecosystems and Biodiversity:** The Earth's atmosphere naturally traps heat to maintain a stable temperature, but air pollution have disrupted this balance due to increased

greenhouse gases like carbon dioxide and methane. This has led to global warming, which threatens ecosystems and biodiversity by altering habitats, stressing wildlife, impacting forests, water resources, and agriculture, and increasing risks to coastal areas. (Department of Enviornment Protection 2025)

4. Current Status of Air Pollution Worldwide

- Air pollution remains a significant global health challenge, contributing to 8.1 million deaths in 2021, accounting for 12% of all deaths worldwide. Fine particulate matter (PM2.5) is the primary pollutant, with a global average exposure of 31.3 µg/m³ in 2020, far exceeding World Health Organization (WHO) guidelines. Regions like South Asia, Africa, and the Middle East experience the highest PM2.5 levels, with exposure in low- and middle-income countries up to four times higher than in high-income nations.
- Air pollution significantly impacts health, being responsible for 28% of ischemic heart disease deaths and 30% of deaths from lower respiratory infections. Household Air Pollution (HAP), driven by the use of solid fuels for cooking, affects 47% of the global population, predominantly in South Asia and Africa.
- While there has been a 36% reduction in HAP-related deaths since 2000, disparities persist. Additionally, nitrogen dioxide (NO_2) pollution remains high in urban areas of developed and Middle Eastern countries, while ozone pollution contributed to 490,000 Chronic Obstructive Pulmonary Disease (COPD) deaths globally in 2021. Despite some progress, only 14% of countries met the strictest WHO PM2.5 guideline of 10 µg/m³, underscoring the need for continued global action to reduce air pollution and its health impacts. (Health Effects Institute, 2024)

5. Air Pollution in India

India continues to grapple with severe air pollution challenges. In November 2024, New Delhi faced extreme pollution levels, with the Air Quality Index (AQI) reaching hazardous levels around 400. Major contributors include industrial emissions, vehicular pollution, construction dust, and seasonal factors like stubble burning. Below is the graph drawn from Air Quality Index bulletin on January 20, 2025, at 4 PM for 234 major Indian cities.

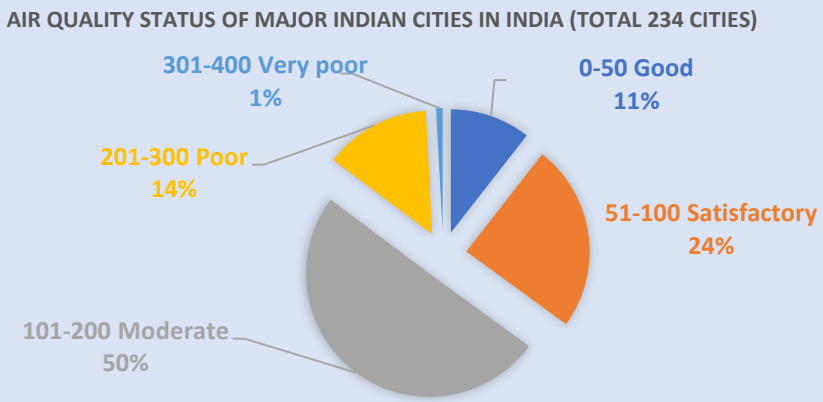

Figure 1: Air Quality status of major Indian cities as on 20.01.2025 (Central Pollution Control Board 2025)

The bulletin reveals that most cities have "Moderate" air quality (AQI 101-200), posing risks to sensitive groups, while 31 cities fall under "Poor" air quality (201-300) and 2 cities under "Very Poor" air quality (301-400), indicating serious health concerns. Encouragingly, 25 cities have "Good" air quality, and 58 are "Satisfactory" air quality. No cities fall into the "Severe" category, highlighting the need for targeted pollution control in affected areas.

6. Policies and Regulations to Combat Air Pollution in India

- **Air (Prevention and Control of Pollution) Act, 1981 & Rules 1982:** These Act & Rules provides a framework for controlling air pollution by establishing pollution control boards at the central and state levels, amended time to time for inclusion of new policies to combat growing challenges to fight air pollution.
- **Environment Protection Act, 1986:** This act empowers the government to take measures to protect and improve environmental quality.
- **Vehicle Emission Norms:** The introduction of Bharat Stage VI (BS-VI) emission standards in April 2020 marked a significant step towards reducing vehicular emissions.
- **Industrial Emission Controls**: Notification of SO_2 and NOx emission standards has been issued for Thermal Power Plants. The use of pet coke and furnace oil as fuel has been banned in National Capital Region (NCR) states since October 24, 2017, and the use of imported pet coke has been prohibited nationwide since July 26, 2018, except for permitted industrial processes.

7. Efforts by the Indian Government

- **Graded Response Action Plan (GRAP)**: GRAP includes predetermined set of measures and was prepared for implementation under different Air Quality Index (AQI) categories. The GRAP for the NCR has been classified under four different stages of adverse air quality in Delhi viz. Stage - I 'Poor' (AQI 201 - 300), Stage - II 'Very Poor (AQI 301-400), Stage - III 'Severe' (AQI 401-450) and Stage - IV 'Severe +' (AQI >450) respectively. Restrictive actions are undertaken as per GRAP category.
- **National Clean Air Programme (NCAP):** The NCAP, launched by the Ministry of Environment, Forest and Climate Change in January 2019, aims to improve air quality in 131 cities across 24 states by reducing PM10 levels by up to 40% or achieving national standards (60 µg/m³) by 2025-26. City-specific Clean Air Action Plans (CAAPs) target sources like road dust, vehicles, domestic fuel, waste burning, construction, and industries. Implementation is supported by performance-based funding and resource convergence from Central and State schemes, including Swachh Bharat Mission, Atal Mission for Rejuvenation and Urban Transformation, Smart Cities Mission, FAME-II, and others. Cities have developed grievance redressal portals, emergency response systems, and 88 cities have shown improved air quality in FY 2022-23 compared to the 2017-18 baseline.
- **Air Quality Monitoring**: Government launched National Air Quality Index (AQI) in 2015 for public awareness through daily bulletins. A robust network of 1447 ambient air quality monitoring stations spans 516 cities in 28 states and 7 UTs. The Central Pollution Control Board (CPCB) operates a Central Control Room for real-time tracking of PM levels, live AQI data, and air quality forecasts, particularly for Delhi-NCR. These efforts enable informed decision-making and urgent actions by the Commission for Air Quality Management (CAQM) to combat pollution.
- **Promotion of Renewable Energy:** As part of the updated Nationally Determined Contributions (NDCs) submitted to the United Nations Framework Convention on Climate Change (UNFCCC) in August 2022, India committed to reduce its emissions intensity by 45% by 2030 (compared to 2005 levels), achieving 50% of cumulative electric power generation capacity from non-fossil fuel sources by 2030.
- **Control of Vehicular emission (EVs):** RFID-based toll and Environment Compensation Charge collection in Delhi, subsidies for e-vehicles under the FAME-II scheme, the Sustainable Alternative Towards Affordable Transportation (SATAT)

initiative for Compressed Bio-Gas (CBG) production, and operationalizing expressways and highways to divert non-destined traffic.

- **Measures for control of emissions**- Measures to curb stubble burning include subsidies for crop residue management machinery, financial aid for pelletization plants, and CPCB flying squads for monitoring. For waste management, guidelines address legacy waste, and anti-smog guns and sweepers are deployed. Technical interventions include research with IITs and National Environmental Engineering Research Institute (NEERI) on air pollution control and the use of dust suppressants to manage road dust emissions.
- **Afforestation Projects:** Initiatives like the Nagar Van Yojana aim to create urban forests to improve air quality. (Press Information Bureau 2023)

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Air Pollution and Climate Change: A Unified Global Challenge

By: Shri Rajesh Kumar, AAO and Shri Sonu Dayma, Sr. Ar.

In today's world, air pollution and climate change are two of the most urgent environmental crises being faced by humanity. While they may seem like separate issues, they are intricately connected and mutually reinforcing, with air pollution acting as a major contributor to global warming. The impacts of both pollution and climate change are far-reaching, threatening human health, biodiversity, and the stability of ecosystems. Understanding how air pollution contributes to global warming and climate change is critical to formulating effective solutions to mitigate these pressing challenges.

1. The Link Between Air Pollution and Climate Change

Air pollution consists of a complex mix of harmful substances, including particulate matter (PM), greenhouse gases, volatile organic compounds (VOCs), and nitrogen oxides (NOx). Some of these pollutants directly contribute to climate change by trapping heat in the atmosphere, while others have more indirect, yet equally significant, effects. Among the most significant pollutants are **greenhouse gases** such as carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and fluorinated gases. These gases trap heat in the atmosphere, creating the "greenhouse effect," which leads to a warming of the Earth's surface and shifts in climate patterns.

The primary source of these greenhouse gases is human activity, particularly the burning of fossil fuels. Power plants, transportation, and industrial processes release vast quantities of CO_2 and other greenhouse gases into the atmosphere. As these gases accumulate, they enhance the natural greenhouse effect, leading to higher global temperatures, more frequent extreme weather events, rising sea levels, and disruptions to ecosystems. Methane, another potent greenhouse gas, is emitted during agricultural activities (especially livestock farming) and from fossil fuel extraction processes. Nitrous oxide, often released through fertilizer use in agriculture, further compounds the problem by contributing to global warming.

In addition to these gases, **black carbon**, or soot, released from the incomplete combustion of fossil fuels and biomass, also plays a significant role in climate change. Black carbon absorbs sunlight and directly warms the atmosphere. It also contributes to the melting of ice in polar regions, exacerbating the effects of global warming. As glaciers and ice sheets shrink, the

Earth's reflectivity (albedo) decreases, leading to further warming and the potential for even faster ice melt. This feedback loop accelerates the negative impacts of climate change.

2. The Impact of Air Pollution on Public Health

Air pollution does not only contribute to climate change—it also has severe consequences for public health. Exposure to pollutants such as fine particulate matter (PM2.5), NOx, and ozone has been linked to a variety of respiratory and cardiovascular diseases. According to the World Health Organization (WHO), approximately 7 million people die prematurely each year due to air pollution, with the majority of deaths are occurring in low- and middle-income countries. These pollutants can cause or exacerbate conditions like asthma, lung cancer, and heart disease, placing a significant burden on global health systems.

Furthermore, the effects of climate change, driven in part by air pollution, also have direct health impacts. Rising temperatures increase the frequency of heatwaves, which can cause dehydration, heat exhaustion, and exacerbate pre-existing medical conditions. Climate change also influences the spread of infectious diseases, as changing weather patterns can alter the habitats of disease-carrying insects such as mosquitoes, thereby expanding the reach of diseases like malaria and dengue fever.

3. Solutions: A Dual Approach to Combat Air Pollution and Climate Change

To effectively address the interconnected challenges of air pollution and climate change, a comprehensive, multi-faceted approach is needed. Reducing air pollution can simultaneously mitigate the effects of climate change, creating co-benefits for both human health and the environment. Some of the most effective strategies include:

- **Transitioning to Clean Energy**: Shifting away from fossil fuels to renewable energy sources like solar, wind, and hydropower can significantly reduce greenhouse gas emissions, improve air quality, and contribute to a more sustainable energy future. Solar and wind power, in particular, produce no direct emissions and help mitigate the harmful effects of burning coal, oil, and natural gas.
- **Electrification of Transportation**: The transportation sector is one of the largest contributors to both air pollution and greenhouse gas emissions. By promoting the widespread adoption of electric vehicles (EVs) and improving public transportation networks, we can reduce emissions from the sector and improve urban air quality. EVs

produce zero tailpipe emissions and, when powered by renewable energy, contribute little to global warming.

- **Promoting Sustainable Agriculture**: Agriculture is a major source of methane and nitrous oxide emissions. By adopting practices such as reducing livestock methane emissions, improving fertilizer use efficiency, and promoting agroforestry, we can reduce the environmental footprint of food production while also preserving biodiversity and improving soil health.
- **Enhancing Pollution Control Technologies**: The use of carbon capture and storage (CCS) technologies can help reduce CO_2 emissions from industrial sources, such as power plants and cement factories. In addition, stronger regulations and stricter emission standards for industries, including transportation, can help limit harmful pollutants like NOx and particulate matter from entering the atmosphere.
- **Reforestation and Forest Protection**: Forests play a critical role in sequestering carbon, absorbing CO_2 from the atmosphere, and helping to regulate the global climate. Protecting forests from deforestation and promoting reforestation efforts can help restore vital carbon sinks and reduce the harmful impacts of air pollution. Additionally, sustainable forestry practices can ensure that forests remain healthy and resilient in the face of climate change.
- **Raising Awareness and Building Public Support**: Education and advocacy are crucial for ensuring that communities understand the interconnectedness of air pollution and climate change. Public awareness campaigns can encourage individuals to adopt cleaner lifestyles, reduce energy consumption, and support policies aimed at improving air quality and reducing emissions.

Conclusion

Air pollution and climate change are inextricably linked, and addressing both issues requires coordinated global action. By reducing emissions of greenhouse gases and harmful pollutants, transitioning to cleaner energy sources, and implementing sustainable practices across sectors, we can mitigate the effects of climate change while also improving air quality and public health. The solutions are available, but they require bold leadership, collaboration, and commitment at local, national, and global levels. By working together, we can protect the planet for future generations and build a more sustainable, healthy, and resilient world.

Performance Audit of Air Pollution Control by Government of Gujarat 2022 (Report No. 2 of 2022)

By: Shri Rohan Sharma, AAO and Shri Akesh Kumar Yadav, Sr. Ar.

1. Introduction: The Performance Audit Report on Air Pollution control by Government of Gujarat aimed to evaluate the efficiency of enforcement of the Air (Prevention and Control of Pollution) Act, 1981, assess coordination across various schemes and initiatives for air pollution control, and determine whether the Gujarat Pollution Control Board had adequate human resources for effective regulation and monitoring. The report paints a concerning picture, highlighting significant lapses in the state government's efforts to combat this pressing environmental issue.

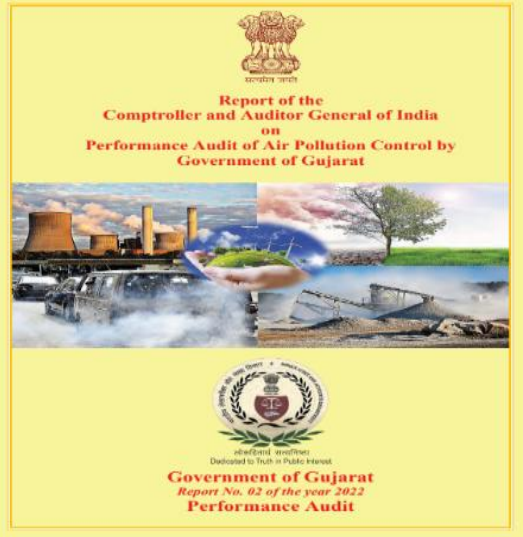

Figure 2: *Report of the C&AG on Performance Audit of Air Pollution Control by Government of Gujarat*

2. Audit Criteria

The audit assessed the pollution control measures against the following:

- **Legislative Framework**:
  - Air (Prevention and Control of Pollution) Act, 1981.
  - Noise Pollution (Regulation and Control) Rules, 2000.
  - Standards under Environment (Protection) Act, 1986.
- **Environmental Policies and Guidelines**:
  - National Environment Policy, 2006.
  - Comprehensive Environmental Pollution Index (CEPI).
  - National Clean Air Programme (NCAP).
- **Directives and Notifications**:
  - Court and National Green Tribunal directives.
  - Guidelines issued by Central Pollution Control Board (CPCB) and Gujarat Pollution Control Board (GPCB).

3. Audit Scope & Methodology

The audit assessed the efficiency of air pollution control measures implemented by the Government of Gujarat, focusing on:

- Implementation of the Air (Prevention and Control of Pollution) Act, 1981.
- Effectiveness of coordination among various state departments.
- Adequacy of human resources at the Gujarat Pollution Control Board (GPCB) to monitor and regulate air pollution.

4. Duration and Coverage: The audit covered the period from 2014-15 to 2020-21, involving records from the Forests & Environment Department, GPCB, and Commissioner of Transport, among others.

5. Sampling:

- 55 units from highly polluting categories and 34 units from red/ orange categories were randomly selected.
- Assessment of AAQ (Ambient Air Quality) and other parameters was carried out across various regions.

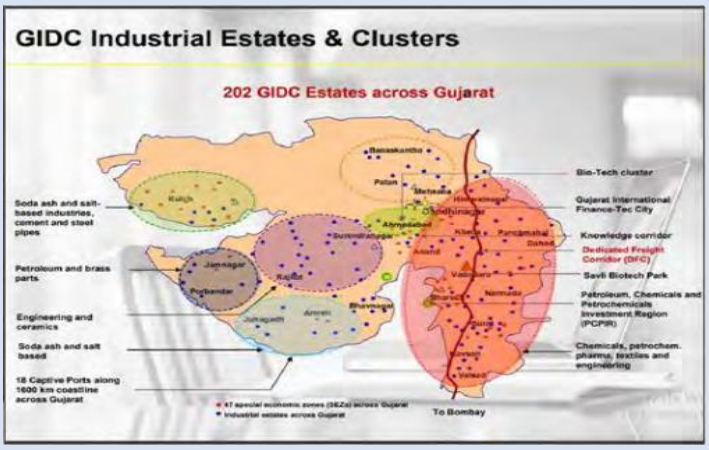

Figure 3: *Industrial clusters of Gujarat Industrial Development Corporation and monitoring stations*

6. Key Audit Findings

- **Air Quality Monitoring**:
  - PM10 and PM2.5 concentrations increased from 2011-12 to 2018-19, indicating deteriorating air quality. Improvements were observed post-2019.

Figure 4*: 14 locations of 62 monitoring stations*

  - Gujarat's 202 industrial estates, administered by of Gujarat Industrial Development Corporation (GIDC) along with private estates near cities, contribute significantly to air pollution through PM10, PM2.5, and other pollutants. Clusters like Vatrak, Chitrasani, and lignite

mines in Kachchh and Surat are major sources of fugitive emissions from mining and stone crushing activities.

- Monitoring was restricted to only 62 stations in 14 cities, leaving several industrial and mining areas uncovered.

- **Source Emissions**:
  - GPCB failed to enforce Online Continuous Emission Monitoring Systems (OCEMS) in 67 highly polluting units.
  - Benzene and volatile organic compounds (VOC) levels increased, posing health risks.
  - Insufficient air sampling (only 4,415 samples in 2020-21, compared to 21,992 water samples).
- **Fugitive Emissions**:
  - Non-scientific disposal of solid waste and legacy waste contributed significantly to emissions in Gandhinagar and Ahmedabad.
  - Non-compliance with siting and air control measures by stone crushers, brick kilns, and hot mix plants.
- **Vehicular Emissions**:
  - Insufficient Pollution Under Control (PUC) centres (1,192 for 2.52 crore vehicles).
  - Inadequate monitoring of fuel quality at petrol stations.
- **Thermal Power Plants**:
  - Delayed implementation of flue-gas desulfurization technology in thermal power plants.
  - Significant legacy stocks of fly ash remained undisposed.
- **Critically Polluted Areas**:
  - Non-installation of Continuous Ambient Air Quality Monitoring Stations (CAAQMS) in critically polluted zones.
  - Lack of health impact studies in these areas

Good Practices

The GPCB promoted several innovative practices to mitigate air pollution. Common boilers were introduced in industrial estates to reduce particulate emissions, and natural gas was adopted in ceramic industries in Morbi, replacing coal and lignite. The Air Action Plan for Ahmedabad and Surat encouraged electric public transport and solid waste conversion into organic manure. GPCB's actions like revising compliance norms for industries and inspecting unauthorized fly ash dumping demonstrate proactive measures for environmental sustainability.

7. Recommendations

- Strengthen GPCB's human resources and infrastructure for monitoring and enforcement.
- Establish more air quality monitoring stations, especially in industrial and mining areas.
- Improve compliance with air quality standards for all 12 pollutants as mandated.
- Enforce the installation of OCEMS across all highly polluting units.
- Promote the use of cleaner technologies, particularly in industries like brick kilns.
- Formulate policies to utilize fly ash in construction and ensure proper disposal.
- Enhance the monitoring of vehicular emissions and fuel quality.
- Expedite the implementation of flue-gas desulfurization systems in power plants.
- Conduct health studies in critically polluted areas and implement remedial action plans.

The C&AG's report serves as a wake-up call for the Gujarat government. Addressing the issues highlighted in the report is crucial to safeguarding public health and environmental sustainability. By implementing the recommended measures, the state can significantly improve its air quality and create a healthier future for its citizens. (CAG, India 2022)

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COP 29, India's Participation and Stand

By: Dr. Mahesh Kumar Saini (Research Associate)

Image source: (GEN, 2024)

The 29th Conference of the Parties (COP 29) under the UNFCCC[1] is a crucial event to enhance climate action and achieve the Paris Agreement goals. It provides a platform for nations to strengthen commitments to reduce greenhouse gas emissions and mobilize climate finance (UNFCCC, 2024). India, a significant player in global climate negotiations, emphasizes renewable energy, climate adaptation funding, and the principle of "Common but Differentiated Responsibilities and Respective Capabilities". With ambitious targets for renewable energy and a commitment to net-zero emissions by 2070, India aims to lead by example and advocate for equitable solutions to the climate crisis (MoEFCC, 2022).

1. Benefit for India

Paris Agreement facilitates the monetization of emission reductions while ensuring environmental integrity, aligning with India's domestic carbon market framework. The proposed India Carbon Markets (ICM) under the Carbon Credit Trading Scheme for Decarbonisation aims to integrate with global carbon market registries using new standards (MoEFCC, 2024).

A key advancement under Article 6.4 is the standardization of carbon market registries, which can harmonize carbon credit pricing across global markets. This uniformity offers several advantages for India, including price stability for carbon credits from renewable energy and reforestation projects, enhanced market confidence by reducing transaction risks, and seamless integration into global trade. By aligning with international norms, Indian businesses can effectively trade carbon credits, fostering economic integration and supporting the country's efforts to achieve its climate objectives (Devesh & Sanish, 2024).

[1] **United Nations Framework Convention on Climate Change**

2. Commitment by India

India is committed to take significant climate action at COP 29, aiming to strengthen its Nationally Determined Contributions (NDCs) by increasing renewable energy capacity and reducing carbon emissions. The country has set a target of achieving 500 Gigawatt of non-fossil fuel-based energy by 2030 and aims for net-zero emissions by 2070 (Ministry of Science & Technology, 2023). India advocates for technology transfer from developed nations to support developing countries and emphasizes the principle of "Common but Differentiated Responsibilities" (CBDR), which recognizes that developed countries should lead in addressing climate change due to their historical emissions. Additionally, India is focusing on promoting renewable energy initiatives, such as solar and wind projects, and building resilience in vulnerable communities through effective adaptation strategies. By prioritising these commitments, India seeks to play a leading role in global climate negotiations and foster equitable solutions to combat climate change (Ministry of External Affairs, 2024).

3. Pathways and Approaches taken by India:

S. No.	Event Name	Date & Venue	Organizers	Key Highlights
1.	Integrating Disaster Resilient Infrastructure into the Adaptation Strategies	13.11.2024 (CDRI Pavilion)	Government of India (MoEFCC) and Coalition for Disaster Resilient Infrastructure (CDRI)	Focused on integrating Disaster Risk Reduction (DRI) into adaptation strategies; discussed challenges, opportunities, financing mechanisms, and CDRI initiatives like Infrastructure for Resilient Island States (IRIS) and Global Infrastructure Resilience Initiative (GIRI) for resilient infrastructure.
2.	LeadIT Member Meet	14.11.2024 (India Delegation Office)	Government of India (MoEFCC), Government of Sweden, LeadIT Secretariat	Addressed industry transition challenges; members (e.g., Tata Steel, SAIL) discussed decarbonization, CO2 capture, hydrogen-based DRI, and collaborations for the low-carbon transition.
3.	India-Sweden Industry Transition Partnership	16.11.2024 (Swedish Pavilion)	Government of India (MoEFCC), Government of	Reviewed progress under India-Sweden ITP and links with Brazil-UK Decarbonisation Hubs; set the stage for COP30 commitments.

	(ITP) – Road to Belém		Sweden, LeadIT Secretariat	
4.	Unlocking Investments for Climate Resilient and Sustainable Infrastructure in Small Island Developing States (SIDS)	18.11.2024 (CDRI Pavilion)	Government of India (MoEFCC) and CDRI	Showcased CDRI's IRIS initiative supporting SIDS with finance, tools, and partnerships for resilient infrastructure; highlighted India's Security and Growth for All in the Region (SAGAR) and Forum for India–Pacific Islands Cooperation (FIPIC) initiatives.
5.	Energy Transitions for the Global South: Unleashing the Role of Solar	19.11.2024 (ISA Pavilion)	Government of India (MoEFCC), International Solar Alliance (ISA)	Emphasized solar energy's role in energy transition for the Global South; called for a 20x increase in solar adoption by 2050 to meet 75% of grid energy needs.
6.	LeadIT Summit 2024	20.11.2024 (EU Office)	Government of India (MoEFCC), Government of Sweden, LeadIT Secretariat	Celebrated five years of LeadIT; launched a five-year report; discussed industrial low-carbon transition strategies with global representatives and industry leaders.
7.	Solarizing Communities through Women-led Climate Action	21.11.2024 (ISA Pavilion)	Government of India (MoEFCC & MNRE), ISA, NRDC	Highlighted women-led clean energy solutions for rural communities; discussed gender-balanced approaches in policies, job creation, and enhancing adaptive capacities of communities to climate change through renewable energy adoption.

Source: (MoEFCC, 2024)

4. Financial Support and Outcomes:

Developed countries agreed to mobilize $100 billion per year by 2020, a timeframe that has been extended to 2025. However, this aim is already seen as insufficient for poor nations' financial requirements, and the quantity raised has been much less promising. The $100 billion promise was made in 2009, 15 years ago, and there is a five-year framework for expressing objectives. India stressed that industrialized nations must commit to contributing and mobilizing at least $1.3 trillion per year till 2030 (MoEFCC, 2022). This money should be provided through grants, concessional financing, and non-debt-inducing assistance tailored to developing nations' changing needs and objectives while ensuring that financial terms do not impose limits that impede their economic progress (MoEFCC 2022).

COP29 brought together nearly 200 countries in Baku, Azerbaijan, and reached a breakthrough agreement such as triple finance to developing countries, from the previous goal of USD 100 billion annually, to USD 300 billion annually by 2035. Secure efforts of all actors to work together to scale up financing to developing countries, from public and private sources to the amount of USD 1.3 trillion per year by 2035 (UNFCCC, 2024).

5. Conclusion:

India’s strong leadership in renewable energy, its commitment to achieving net-zero emissions by 2070, and its focus on technology transfer reflect its proactive stance. Key events at COP 29 highlighted India’s integrated strategies for disaster-resilient infrastructure, industry decarbonisation, and solar energy adoption, while also advocating for gender-balanced approaches to climate adaptation. With its ambitious targets, India aims to lead the Global South, emphasizing the principle of "Common but Differentiated Responsibilities."

Despite financial support commitments by developed nations, the unmet $100 billion pledge underscores the need for robust financial mechanisms, including India’s call for $1.3 trillion in grants and concessional financing by 2030. Through collaborative initiatives and resilient pathways, COP 29 reaffirmed India’s role in fostering a just, inclusive, and sustainable global climate transition.

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Best Practices for Air Pollution Mitigation: Case Study of Seoul, Incheon, and Gyeonggi in the Republic of Korea

By: Shri Saurabh Sharma, AAO

Air pollution has emerged as a critical global concern due to its risks on human health, ecosystems and the economy. According to the estimates of World Health Organization (WHO), the air pollution is responsible for approximately 6.7 million premature deaths annually (World Health Organisation 2024). Air pollution is mainly driven by hazardous components such as particulate matter (PM), carbon monoxide (CO), ozone (O_3), nitrogen dioxide (NO_2) and sulphur dioxide (SO_2) and directly attributable to non-communicable diseases such as stroke, ischemic heart disease, chronic obstructive pulmonary disease (COPD) and lung cancer etc. Air pollution not only harms health but also attributes to climate change, as one of the components of air pollution is emission of greenhouse gases which disrupts weather patterns in long term and therefore termed as a dual threat to the environment and human well-being.

Given the global challenge of urban air pollution, almost all the countries around the world especially developing/ undeveloped countries are compelled to adopt innovative solutions. This study examines the innovations and actions taken in Seoul, Incheon, and Gyeonggi regions in the Republic of Korea, which have achieved significant improvement in the air quality of these cities in the past decade. The results of the World Air Quality Report-2023 (IQAir 2023) also indicate that these cities have performed well in improving the air quality and thus can provide valuable insights for other metropolitan cities around the world.

Seoul, Incheon, and Gyeonggi, hereafter referred to as SIG in this document are three regions in the northwest of the Republic of Korea, which cover over 12,000 square kilometres and having a population of 26 million people, making them one of the largest metropolitan areas in the world. According to a report published by the World Bank in 2016, this region had a contribution of around 48 percent of GDP against the total GDP of the Republic of Korea (World Bank 2024).

Owing to this high population density and economic activity, SIG have led to increased transport, industrial output, waste generation, electricity production, and other activities that significantly contributed to the air pollution in this region. As a result, in the last decade, the

concentrations of harmful pollutants such as particulate matter (PM) exceeded the national as well as World Health Organization (WHO) air quality standards. However, in the last few years, the air pollution levels in SIG have significantly decreased as an outcome of implementation of coordinated actions and a strong governance framework.

Some of the key actions taken by SIG to mitigate air pollution and improve the air quality are described below:

- **Real-time Air Quality Monitoring and Transparency:** SIG have set an example in air quality monitoring and transparency. The region has a large network of monitoring stations that provide real-time (United Nations Environment Programme 2023) data on pollutants like PM2.5, PM10 and other pollutants, which is shared with the public on real time basis to help them stay informed. SIG also keeps a detailed record of pollution sources to identify and address the biggest contributors. Further, regular data monitoring of air pollution have been done to track the trends and to identify the associated health impacts and to guide the policies. They have regulated strong laws and significant fundings are made to ensure effective actions against pollution and provide regular updates to the public on progress. These efforts have made a big difference in improving air quality of this region.
- **Promotion of Green Transportation Solutions:** SIG have implemented several green transportation initiatives to improve air quality and reduce the emissions. Seoul was a pioneer in these initiatives by commercializing electric buses in 2010 and introducing compressed natural gas (CNG) buses in 2014. By 2022, the city was operating over 1,000 electric and hydrogen-powered buses. Incheon and Gyeonggi have also followed this model of Seoul with Incheon planning a fleet of 2,000 hydrogen buses by 2030. To support these changes, SIG has invested in expanding charging infrastructure, including hydrogen filling stations, with Incheon aiming for 52 stations by 2030. Additionally, restrictions on high-emission vehicles, such as Seoul's "green traffic area", have helped in phasing our older diesel vehicles. Collaborative efforts between the government and private sectors, including subsidies for eco-friendly transport, have further accelerated the shift to green mobility, making SIG a global model for sustainable urban transportation (United Nations Environment Programme 2023).
- **Transition to Renewable Energy:** SIG are making significant strides in transitioning to renewable energy as part of their carbon neutrality goals. By 2050, the regions aim to

generate approximately 72% of electricity and 50% of heat from renewable sources, replacing fossil fuels. These efforts are supported by policies like the Carbon Neutrality Act, which sets clear targets for reducing greenhouse gas emissions. Further, the other initiatives include deploying renewable energy technologies such as solar and wind power, improving energy efficiency in industries and buildings and electrifying the vehicle fleet. These measures have not only reduced greenhouse gas emissions but also substantially lowered the air pollutants like PM2.5 and NOx, which has improved the air quality across this region (United Nations Environment Programme 2023).

- **Technological Solutions for Air Purification:** To address air pollution in Seoul, Incheon, and Gyeonggi, a range of technological solutions have been implemented. Seoul Metro has installed thousands of air purifiers and particulate monitors in subway stations, adjusting ventilation and cleaning processes based on real-time air quality data to reduce fine dust levels. On the consumer side, big companies are engaged in manufacturing the air purifiers for residential and commercial use, with products that effectively remove airborne contaminants. The South Korean government has also introduced policies, such as the "Special Act on the Improvement of Air Quality in the Seoul Metropolitan Area," which set goals for reducing pollutants and has led to a notable decrease in particulate matter over the years (Food and Argiculture Organisation 2015).
- **Community Engagement and Citizen Participation:** In recent years, significant emphasis has been placed on community engagement and citizen participation to improve air quality in the SIG region. Local governments in these areas have also collaborated with international organizations, such as the United Nations Environment Programme (UNEP), to adopt successful strategies for air pollution control. In Gyeonggi Province, the Clean Air International Forum (CAIF) provides a key platform for raising awareness on air quality issues as it brings together citizens, experts and policymakers to discuss and implement effective solutions for improving air quality and reducing pollution (United Cities and Local Governments Asia Pacific 2022).

Additionally, the Republic of Korea has established a national air pollution monitoring network, which consists of 584 stations spread across the country. This extensive network tracks real-time pollution levels and citizens can utilize this information to stay informed and actively participate in collaborated efforts to reduce air pollution in the whole nation (United Cities and Local Governments Asia Pacific 2022).

Summing Up and Way Forward: Lessons for Other Cities

These initiatives not only contribute to improving air quality in SIG but also set a valuable example for countries like India, where most of the northern cities are facing similar challenges. By combining technological advancements, government policies and active community engagement, these regions have developed a comprehensive approach to tackling air pollution.

This model can be adapted by other cities worldwide, particularly those in urbanizing regions, to enhance air quality and build sustainable urban environments. Expanding air quality monitoring systems, encouraging citizen participation in environmental efforts, and adopting clean technologies can serve as effective strategies for global efforts to reduce pollution and improve public health. The success of these efforts demonstrates the importance of collaboration, innovation, and public involvement in creating healthier, more sustainable cities around the world.

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Special Report on Air pollution: Our health still insufficiently protected by European Court of Auditors

By: Shri Kailash Chand Bajya, AAO

and Shri Mohan Meena, Asstt. Supervisor

1. **Air pollution** is characterized by the release of harmful gases, dust particles, and smoke into the atmosphere. The World Health Organization (WHO) identifies (www.who.int, 2023) it as the most significant environmental health risk in Europe.

2. **Introduction**: The European Court of Auditors (ECA) has released a report 23/2018 "Air pollution: Our health still insufficiently protected" highlighting that the health of European Union (EU) citizens remains inadequately protected from air pollution. (www.eca.europa.eu, 2018) The audit report highlighted the shortcomings of existing European Union policies and enforcement mechanisms in adequately protecting citizens from harmful air quality.

3. **Legislative Framework:** The Ambient Air Quality Directive 2008 is fundamental to the EU's clean air policy, as it establishes standards for pollutant concentrations in the atmosphere. While there has been some progress in reducing emissions, air quality has not improved at a comparable rate, resulting in continued public health challenges.

4. **Audit Scope and Approach**:

In this audit, the audit team assessed whether EU actions have been effective to protect human health from air pollution. The following points were examined during the audit.

- The design and effectiveness of the Ambient Air Quality Directive.
- The implementation of this directive by Member States.
- The European Commission's monitoring and enforcement capabilities.
- The integration of air quality considerations into other EU policies.
- Public awareness regarding air quality issues.

5. **Audit Findings:**

A. **Impact on Health**: As per this report, Air pollution significantly impacted the health of European citizens, and the same led to approximately 400,000 premature deaths each year due to harmful pollutants like particulate matter, nitrogen dioxide, and

ozone. Despite the existence of EU clean air legislation for nearly three decades, which sets limits on pollutant concentrations, poor air quality remains prevalent in many EU Member States and cities. The economic impact of this health crisis is significant, with estimates ranging from €330 billion to €940 billion annually due to health-related issues. Urban populations of the European Union are especially at risk, as they are exposed to harmful pollutants such as particulate matter (PM), nitrogen dioxide (NO_2), and ground-level ozone (O_3).

B. Weak Standards and Implementation: This report, emphasizes significant concerns regarding the inadequate standards established by the Ambient Air Quality Directive (AAQ Directive) and the difficulties associated with their implementation in EU member states.

- **Outdated Air Quality Standards**: The report highlights that numerous air quality standards established nearly two decades ago do not reflect the most recent scientific findings and recommendations from the World Health Organization (WHO). For example, the current EU limits for particulate matter (PM_{10} and $PM_{2.5}$) are considerably higher than the updated WHO guidelines, which increases the risks to public health.
- **Inadequate Protection Levels**: The current standards fail to sufficiently safeguard vulnerable populations, such as children, the elderly, and individuals with pre-existing health conditions. The report highlights that these groups are disproportionately impacted by air pollution, yet the existing regulatory framework does not adequately address this pressing concern.
- **Failure to Address Emerging Pollutants**: The AAQ Directive inadequately tackles emerging pollutants, including ultrafine particles and specific volatile organic compounds, which are known to have harmful health effects. This regulatory shortfall contributes to persistent public health risks.

C. Implementation Challenges

- **Non-Compliance by Member States:** The report reveals that numerous EU member states consistently fail to adhere to air quality standards. For instance, several countries have reported ongoing violations of limits for nitrogen dioxide (NO_2) and particulate matter (PM), indicating a lack of effective national measures to enhance air quality.

- **Slow Enforcement Processes**: The European Commission encountered difficulties in ensuring compliance among member states. The report pointed out that enforcement actions tend to be slow and ineffective, leading to extended periods during which citizens are exposed to harmful levels of pollution without sufficient remedies.
- **Inadequate Monitoring Systems**: The system for monitoring air quality and ensuring compliance with established standards are often lacking. The ECA pointed out that while there are monitoring stations, their locations may not be optimal for accurately capturing pollution levels in densely populated areas. This misplacement can lead to an underreporting of air quality problems.
- **Lack of Accountability**: As per this report, there are insufficient mechanisms to hold member states accountable for failing to meet air quality standards. The report indicated that without more robust enforcement measures and penalties for non-compliance, there is minimal motivation for countries to take the necessary steps to lower pollution levels.

D. Policy Integration: The report emphasizes the necessity for integrating air quality considerations into policy management within the European Union. It pointed out that various EU policies such as those concerning climate change, energy, transportation, industry, and agriculture have a direct effect on air quality but many of these policies do not adequately emphasize the urgent need to improve air quality.

To effectively enhance air quality, the report advocated for prioritizing and incorporating air quality issues into all relevant EU policies. This means ensuring that decisions made in these sectors actively contribute to lowering pollution levels rather than worsening them.

6. Recommendations: The report provides several key recommendations aimed at improving air quality across the European Union:

- **Update the Ambient Air Quality Directive:** The Commission should update the Ambient Air Quality Directive to ensure that air quality standards are in line with the most recent scientific research and the guidelines set by the WHO.
- **Strengthen Enforcement Actions:** This report recommends Establishment of more robust enforcement mechanisms and to impose penalties on member states that do not comply with air quality standards, thereby enhancing accountability and motivating countries to take necessary actions to reduce pollution levels.

- **Integrate Air Quality into Other Policies:** This report recommends Intergradation and prioritization of air quality considerations across all relevant EU policies, including those pertaining to climate change, energy, transportation, industry, and agriculture, to ensure that these sectors actively contribute to the enhancement of air quality.
- **Enhance Public Awareness and Information:** As per this report, air quality information should be enhanced for the clarity and accessibility of citizens. It should be ensured that the public is well-informed about their rights concerning air quality and their access to justice.
- **Targeted EU Funding:** As per this report, it should be ensured that EU funding for air quality initiatives is strategically allocated to projects that are expected to significantly enhance air quality, so that the effectiveness of financial support may be maximized.

7. Conclusion: The ECA audit highlighted an urgent need for stronger measures to combat air pollution in Europe. As per this report, despite existing regulations, there are significant gaps in enforcement and compliance that jeopardize public health. The report serves as a call to action for EU institutions and Member States to prioritize effective strategies that safeguard citizens from the harmful effects of air pollution and enhance overall air quality throughout Europe. This thorough evaluation not only sheds light on current challenges but also aims to inform future policy directions that can lead to substantial improvements in public health outcomes related to air quality.

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Birds at iCED

By: Shri Vikas Dhir, AAO

White-eared Bulbul (*Pycnonotus leucotis*)

Image Source: Captured by Shri Vikas Dhir AAO, iCED

The **white-eared Bulbul** (*Pycnonotus leucotis*) belongs to the bulbul family and is distributed across southwestern Asia, extending from India to the Arabian Peninsula. This species is native to the western regions of India, large parts of Pakistan, southern Afghanistan, coastal Iran, and the two-river basin in Iraq, Kuwait, and Bahrain. Additionally, it has been introduced to other countries in the Arabian Gulf, including Oman, the UAE, and Qatar.

As of 2018, the International Union for Conservation of Nature (IUCN) categorizes this species as "Least Concern," although its population is currently experiencing a decline. (Animalia n.d.)

Laughing dove (*Spilopelia senegalensis*)

Image Source: Captured by Shri Vikas Dhir AAO, iCED

The **Laughing dove** (*Spilopelia senegalensis*) is a widely distributed pigeon found across Africa, the Middle East, and South Asia. It was introduced to Perth in 1889, where it has since established itself in Western Australia. This slender, long-tailed dove features a pinkish-brown underside, a lilac-tinged head and neck, and pinkish hues that transition to buff on the lower abdomen.

While primarily sedentary, some populations may exhibit migratory behaviour. Laughing doves thrive in various habitats, including dry scrub, wooded savannas, grasslands, dry farmlands, and urban areas.

They are often seen in pairs or small groups, feeding on the ground and foraging for seeds and other plant materials. (Animalia n.d.)

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Crossword Puzzle

Down

1. The top layer of the Earth's surface, crucial for plant growth.

2. The process by which plants use sunlight to synthesize food.

3. A term for the excessive growth of algae due to nutrient pollution in water.

4. The layer of the atmosphere that protects us from UV radiation.

5. The farming of aquatic organisms like fish and shellfish.

Across

4. A farming method that avoids synthetic fertilizers and pesticides.

6. The process of planting trees to restore forests.

7. The variety of life in the world or a particular habitat.

8. A large-scale ecosystem with distinct climate, flora, and fauna.

9. The process by which forests are cut down at a large scale.