Executive Summary

Introduction

- Objective of the analysis: Assessing air quality trends across cities from 2020–2024.
- Focus: Key pollutants, AQI trends, agricultural practices, and health impacts.
- Cities: Delhi, Kolkata, Mumbai, Bengaluru, and Chandigarh

Key Findings

- **Monthly AQI Trends**:
  - **Winter (November–January)**:
    - AQI levels rise by **30–50%** in northern cities like Delhi and Chandigarh due to stubble burning, lower temperatures, and stagnant air, reducing pollutant dispersion.
  - **Summer (April–June)**:
    - Dust storms and vehicular emissions contribute to moderate pollution spikes, especially in Kolkata and Delhi.
  - **Monsoon (July–September)**:
    - Rainfall improves air quality, reducing PM2.5 and PM10 concentrations by **20–30%** in most cities.
  - **Festive Periods (October–November)**:
    - Diwali-related fireworks increase PM2.5 levels by over **100%** in Delhi and Kolkata.

- **City-Wise Air Quality Insights**:
  - **Delhi**: Records the **worst air quality** with an average AQI in the **"Very Poor"** category (>350). Contributing factors include vehicular emissions, industrial activities, and seasonal stubble burning, with PM2.5 and PM10 accounting for **75%** of the AQI.
    - **Kolkata**: Consistently in the **"Poor"** category, averaging AQI levels around **280–300**, primarily due to vehicular and industrial pollutants.
    - **Mumbai**: Shows **comparatively better air quality**, with most AQI levels in the **"Moderate"** category, thanks to coastal winds and efficient pollution control measures.
    - **Bengaluru**: Maintains AQI levels in the **"Satisfactory"** category for over **80%** of the year, with occasional spikes due to vehicular congestion.

- **Chandigarh**: Faces air quality challenges during winter, with AQI spiking to **"Poor"** due to stubble burning in neighboring states.

- **Pollutant Contributions**:
  - **PM2.5 and PM10** dominate, contributing **60–80%** to AQI levels.
  - **NO2** levels are significant in cities with heavy vehicular traffic (Delhi, Kolkata).
  - **SO2 and CO** are within permissible limits but require monitoring in industrial zones.

- **Agricultural Aspect**:
  - **Stubble Burning**:
    - A primary contributor to winter AQI spikes, particularly in Delhi, Chandigarh, and parts of northern India.
    - Farmers in Punjab and Haryana burn residual crops (stubble) to prepare fields for the next sowing season, releasing large amounts of PM2.5, CO2, and methane.
  - **Government Efforts**:
    - Despite initiatives like subsidized equipment (Happy Seeder, Super Straw Management), adoption rates remain low due to cost and lack of awareness.
  - **Seasonal Impact**:
    - Stubble burning contributes to **25–40%** of winter pollution in northern cities.

- **Health Impact**:
  - Over **40%** of urban residents face exposure to AQI levels in the **"Poor"** or worse categories, leading to a **30% rise** in respiratory illnesses during winter.

Recommendations

1. **Month-Wise Action Plans**:
   - **Winter (Nov–Jan)**:
     - Strengthen enforcement of stubble burning bans with real-time satellite monitoring.
     - Deploy mobile air purifiers and enforce vehicular restrictions (odd-even schemes).
   - **Summer (Apr–Jun)**:

        - Implement dust suppression measures in construction zones and urban highways.
    - **Monsoon (Jul–Sep)**:
        - Use the cleaner period for large-scale afforestation and monitoring infrastructure upgrades.
    - **Festive Seasons (Oct–Nov)**:
        - Ban firecrackers in high-pollution zones and promote green alternatives.

2. **Agriculture-Specific Measures**:
    - **Policy Focus**:
        - Subsidize crop residue management equipment and provide financial incentives for farmers adopting eco-friendly methods.
        - Promote crop diversification (e.g., millets) to reduce reliance on water-intensive crops like paddy, lowering stubble residue.
    - **Relevant Schemes**:
        - **Kisan Urja Suraksha evam Utthaan Mahabhiyan (KUSUM)**: Encourage solar pumps and renewable energy adoption.
        - **State Action Plans on Climate Change (SAPCC)**: Integrate stubble management as a priority.
    - **Awareness Campaigns**:
        - Educate farmers about the long-term benefits of stubble management and its impact on soil health.

3. **City-Specific Recommendations**:
    - **Delhi**:
        - Expand public transport, promote EVs, and implement localized air quality monitoring systems.
        - Strengthen NCAP (National Clean Air Programme) to achieve a **30% particulate reduction**.
    - **Kolkata**:
        - Retrofit industrial units with cleaner technologies and expand green belt projects.
    - **Mumbai**:
        - Promote urban afforestation and regulate emissions from construction activities.
    - **Bengaluru**:
        - Address localized traffic pollution and invest in non-motorized transport infrastructure.
    - **Chandigarh**:
        - Collaborate with Punjab and Haryana governments to enforce stubble burning bans.

4. **Centralized Initiatives**:
    - **Geospatial Monitoring**:
        - Deploy satellite tools to track stubble burning and urban hotspots in real-time.
    - **Citizen Awareness**:
        - Use social media and mobile apps to update AQI levels and issue health advisories.

5. **Data-Driven Planning**:

- Install additional AQI monitoring stations in under-represented regions.
- Utilize predictive analytics to forecast pollution spikes and allocate resources proactively.

Key Government Schemes

1. **National Clean Air Programme (NCAP)**:
    - Aims to reduce PM2.5 and PM10 levels by **20–30%** by 2024.
    - Focuses on 102 non-attainment cities, including Delhi, Kolkata, and Chandigarh.
2. **FAME India Scheme**:
    - Promotes electric vehicle adoption to curb vehicular emissions.
3. **Green India Mission**:
    - Enhances urban greenery to counterbalance emissions.
4. **PM-KUSUM Scheme**:
    - Supports solar pump installations and renewable energy in agricultural practices.
5. **Urban Forestry Scheme**:
    - Focuses on creating green belts in cities like Mumbai and Bengaluru.

Integrated Schemes and Policies

- **National Clean Air Programme (NCAP)**: Enhance city-specific targets and fund clean air initiatives.
- **Swachh Bharat Abhiyan**: Combine clean air efforts with urban waste management to curb open burning.
- **Smart Cities Mission**: Equip urban areas with IoT-enabled AQI monitoring systems.

- **Atal Mission for Rejuvenation and Urban Transformation (AMRUT)**: Promote green urban infrastructure.

Conclusion

This comprehensive analysis highlights the interplay between urbanization, agriculture, and seasonal factors in driving air pollution. Coordinated efforts by governments, industries, and citizens are crucial to achieving cleaner air. By integrating monthly action plans, agricultural interventions, and urban policies, India can make significant strides toward sustainable air quality management.