Official Statistics:Air Pollution and Policy Interventions
Project-3 MTH312

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Introduction

Air pollution is a major environmental challenge in India, with worsening air quality posing serious health and ecological risks. Key pollutants such as PM2.5, PM10, NOx, SO, and VOCs significantly impact air quality, and the Air Quality Index (AQI) provides a standardized measure to assess their effects on human health. This project analyzes AQI variations in major Indian cities, correlating them with environmental, economic, and policy factors to identify primary pollution contributors. Additionally, we evaluate the effectiveness of government policies in mitigating pollution and provide data-driven policy recommendations.

Background on Data Used

We have used the following Data in our analysis:

1. Forest Cover: The data were from the reports of the Forest Survey of India(FSI). We used data for the year 2015. The data lists the percentage of the total area of a state/UT covered by forests for every Indian state and UT.

2. Pollution: This dataset contains daily air quality measurements for states from 2015 to 2019. It includes data on pollutant concentrations (PM2.5, NO, NO2, NOx, CO, SO2, O3, Benzene, Toluene, Xylene), AQI values, and AQI categories. The data shows significant fluctuations in air quality, with AQI ranging from "Good" to "Severe" and higher pollution levels often occurring in winter months.

3. Vehicles Data: The file contains columns for Total Electric Vehicle, Total Non-Electric Vehicle, Total vehicles, and Area (km2) for each state/union territory.It also includes a calculated metric of Non EV per Area, which represents the density of non-electric vehicles per square kilometer.

Analysis

Effectiveness of Odd-Even rule in Delhi

The odd-even rule was implemented by the Delhi government in 2017. The rule said that on even days, only the cars with numbers ending in a even-digit will be allowed on the roads and vice-versa for odd days.

The rule led to significant reduction in traffic and thus vehicular pollution in Delhi. As can be seen from the graph, the average AQI has reduced in Delhi from 2017.

Stubble burning in Punjab, Haryana, and Uttar Pradesh occurs post-harvest (Oct–Nov), releasing PM2.5 and black carbon. This is a major contributor to Delhi's winter smog, leading to severe air quality deterioration and reduced visibility.

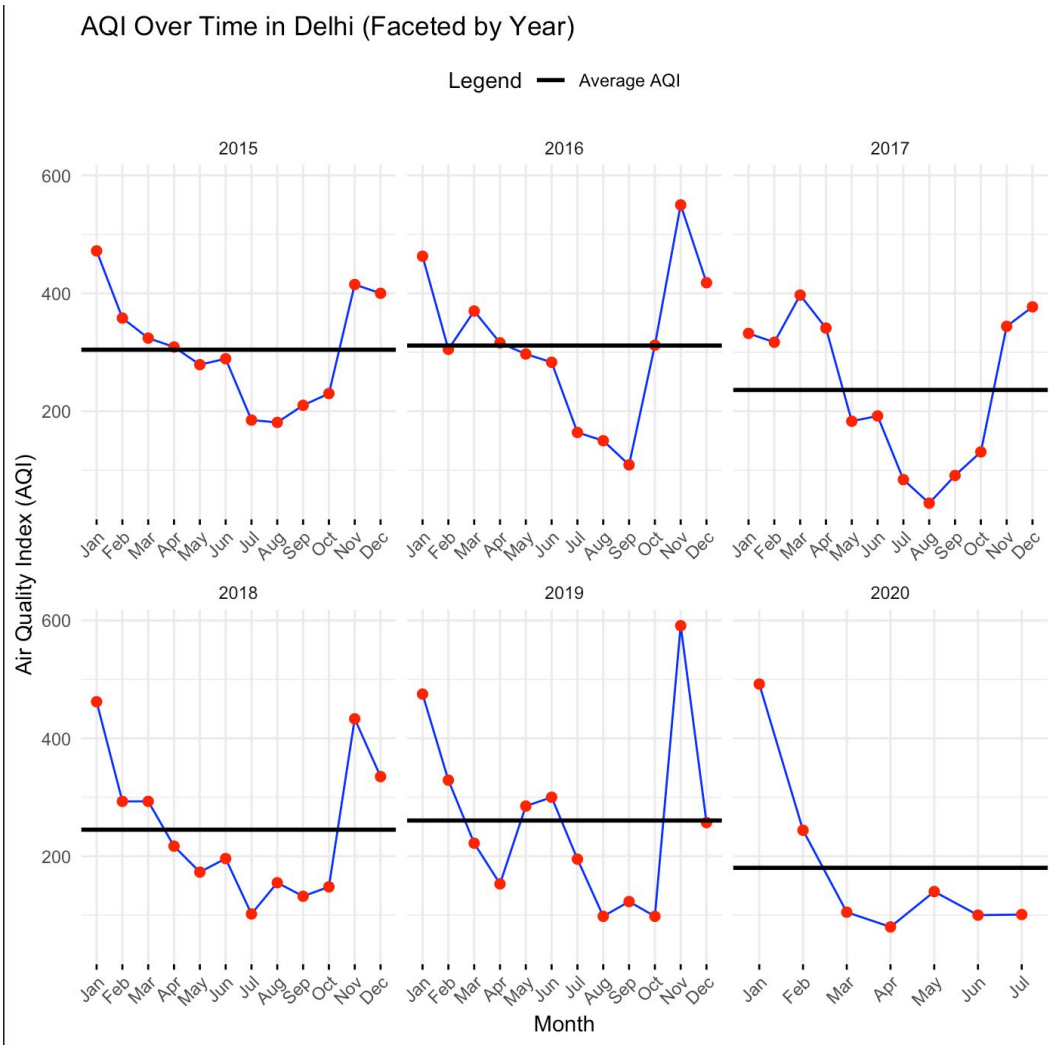

Figure 1: AQI vs Month

Policy Suggestions:

- Implement the odd-even rule again during peak pollution periods (October–January), when Delhi's AQI exceeds 400, as seen in post-monsoon months where vehicular emissions worsen smog conditions.
- Provide direct financial incentives to farmers for adopting mechanized alternatives like the Happy Seeder, which reduces reliance on stubble burning while maintaining soil health.

Effect of Forest Cover on pollution levels

The AQI-metric for each state has been calculated by taking the average AQI of all the major cities in the state for 2015. The graph shows that states with higher forest cover are less likely to have high AQI whereas the states with lower forest covers are more prone to having high AQI.

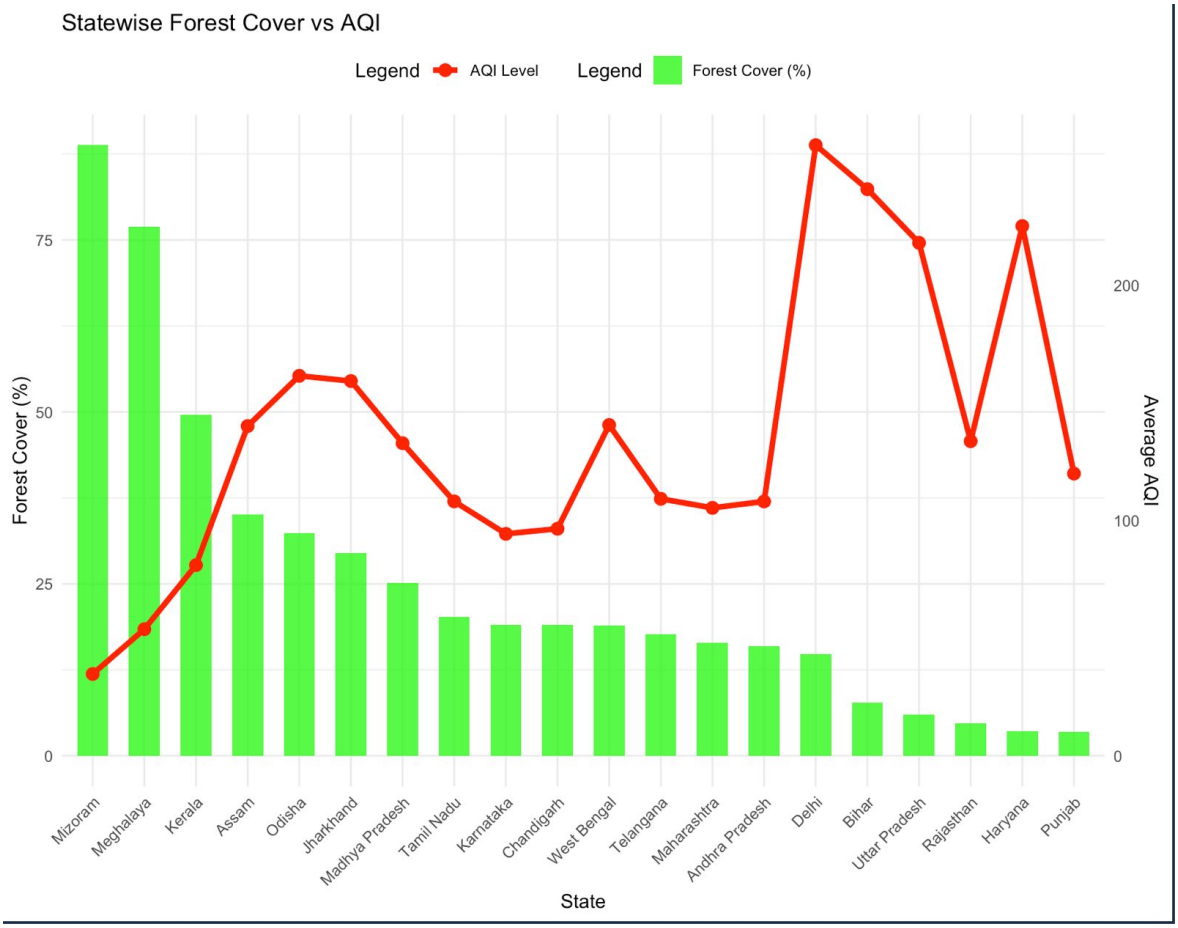

Figure 2: Forest Cover vs State

Policy suggestions:

- Introduce tax incentives and subsidies for private and community-led afforestation projects to encourage large-scale tree planting in high-pollution regions.

State	% Change	State	% Change	State	% Change
Arunachal Pradesh	-0.86	Delhi	-1.60	Tripura	-1.88
Manipur	-2.17	Meghalaya	-0.96	Mizoram	-4.26
Nagaland	-4.14	Sikkim	-0.17		
Andaman & Nicobar	-0.09	Puducherry	-0.74		

Table 1: States with Negative Forest Cover Change (%)

- **Community Forest Management:** Arunachal Pradesh (-0.86%), Meghalaya (-0.96%), and Sikkim (-0.17%) need increased Joint Forest Management (JFM) support with CAMPA funding to sustain local forest conservation.
- **Coastal Ecosystem Restoration:** Andaman and Nicobar Islands (-0.09%) and Puducherry (-0.74%) should implement mangrove restoration projects under the Coastal Mission to counteract erosion and biodiversity loss.

Pollution due to Non electric vehicles

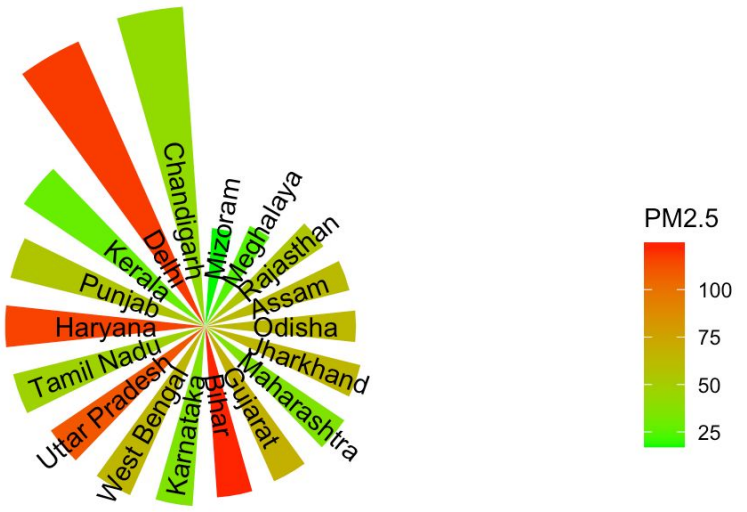

Figure 3: PM2.5 levels are indicated by color intensity, while bar height represents non-electric vehicle density per area.

- Delhi has high vehicle density and severe PM2.5 pollution, as shown by its tall, dark red bar, highlighting a strong link between emissions and poor air quality.
- Kerala and Chandigarh have high vehicle density but lower PM2.5 levels, indicated by green bars, suggesting effective pollution control, cleaner fuel use, or better air circulation.

Policy Suggestions:

To effectively combat air pollution and reduce vehicular emissions, government policies should include substantial subsidies for electric vehicles (EVs). Some suggested policies are as follow:

- **Zero-GST for EV Components:** Reduce GST on EV batteries and components to 0% to encourage domestic manufacturing and lower EV costs. This aligns with the "Make in India" initiative.
- **Income Tax Rebates for EV Owners:** Extend tax benefits under Section 80EEB by increasing the deduction limit on interest paid for EV loans from INR 1.5 lakh to INR 3 lakh.
- **Workplace and Residential EV Incentives:** Offer tax benefits to companies that install EV charging stations in offices and provide rebates for housing societies that adopt shared EV charging infrastructure.

Pollution due to Diwali

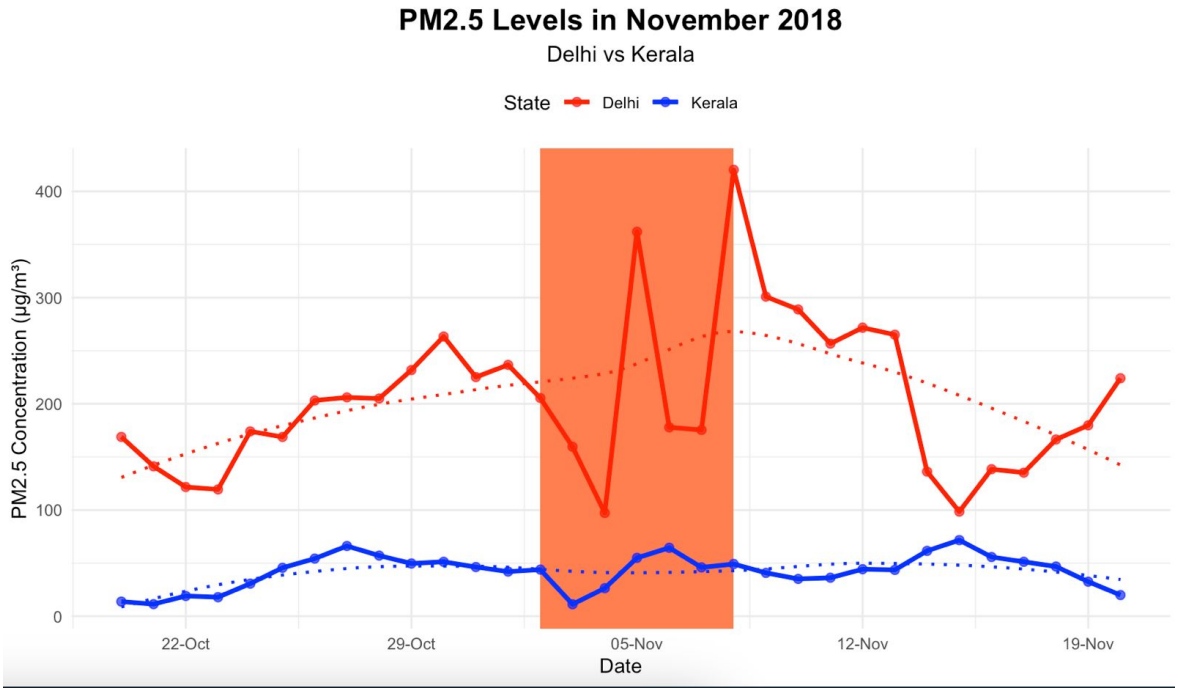

Figure 4: PM2.5 Concentration vs Date

Air quality analysis during Diwali (7 November 2018) shows a sharp but short-lived **PM2.5 spike**, especially in **Northern States**, often exceeding **NAAQS limits by 5x**. firecracker combustion is the primary cause, but pollution levels return to baseline within **24 hours**. Long-term trends are driven by **crop burning, weather, and vehicular emissions**, making Diwali's contribution **transient**.

Quantitative analysis shows the highest Diwali impact in **Northern States**, where pre-festival pollution is lower. so our analysis highlights localized, short-term pollution spikes, with seasonal trends dictated by broader emission sources.

Policy Suggestions:

- Strict enforcement of firecracker ban through real-time surveillance, increased fines, and targeted police action in high-violation areas, especially in northern states where PM2.5 spikes exceed NAAQS limits by 5x.
- Implement temporary nighttime traffic restrictions in high-impact zones on Diwali night to reduce additional vehicular emissions compounding firecracker pollution.

References and Acknowledgement

1. Forest Cover Data: Forest Survey of India(FSI)
2. Pollution Data:The data used has been sourced from the publicly available data by the Central Pollution Control Board (CPCB). https://cpcb.nic.in/
3. Vehicles Data: Ministry of Road Transport and Highways (MoRTH)
4. Ministry of Statistics and Programme Implementation (MoSPI) for providing valuable data