

Using Machine Learning to Combat Urban Air Pollution

Advancing SDG 11: Sustainable Cities and Communities

By David Waihenya

The Problem: Air Pollution in Cities

Urban areas worldwide face a growing challenge—**air pollution**. According to the WHO, over 90% of people in cities are exposed to air quality levels that exceed safe limits. This results in respiratory illnesses, premature deaths, and declining quality of life. Yet, cities often lack the data-driven tools to identify pollution hotspots and act accordingly.

SDG Alignment: Goal 11 – Sustainable Cities

This project aligns with **UN Sustainable Development Goal 11**, which seeks to make cities inclusive, safe, resilient, and sustainable. Specifically, it addresses **Target 11.6**: *"Reduce the environmental impact of cities, including by improving air quality."*

Our ML Solution: K-Means Clustering

Using **unsupervised machine learning**, we applied **K-Means clustering** to group urban regions based on their air pollution metrics:

- PM2.5 levels
- Population density
- Green area coverage
- Income level

We used **Python, Pandas, Scikit-learn**, and **Google Colab** to develop and visualize this model.

The model successfully identified clusters representing high, medium, and low pollution risk areas. This allows local governments to **prioritize interventions** and make more informed decisions on urban planning and air quality policies.

Key Results

- **3 Distinct Clusters** were identified, highlighting socio-environmental patterns.
- Regions with low green coverage and high population density had the highest pollution levels.
- Visualizations using **PCA** showed clearly separated clusters, aiding interpretation.

Ethical Considerations

- **Bias Awareness:** Socio-economic factors may influence pollution exposure; we advocate for **fair** and **equitable action**.
- **Transparency:** All clustering steps and assumptions are clearly documented for reproducibility.
- **Scalability:** The model can be improved with real-time data from APIs or sensors.

The Impact

This project shows how **AI can empower local decision-making**. By identifying pollution hotspots, cities can act faster—planting trees, adjusting traffic flows, and targeting high-risk neighborhoods with public health alerts.

Call to Action

We invite communities, policymakers, and AI developers to **scale this idea** by integrating more environmental data and deploying it in dashboards or mobile apps for real-time air quality insights.