Air Quality and Population Density Analysis Report

The approach of our project was to explore the relationship between air pollution levels and urban population density and merge data collected this two datas across the world's most densely populated cities. Data was collected from Wikipedia's (List of cities proper by population density), enriched with geographic coordinates and air quality indicators (Open-Meteo Air Quality API).

After data cleaning and merging, we refined dataset was created, containing valid air pollution by area and population data for most cities. We prepare a final table with the most 50 cities with the all necessary data.

Results

- Average air pollution levels: PM2.5 = 13.07 µg/m³, PM10 = 17.98 µg/m³, CO = 297.61 µg/m³;
- Most densely populated city: Giza(Egypt) – 45045 human in 1 km²;
- Most polluted and cleanest city: Bogotá (Colombia) – 350.8 index pollution, Monaco (Monaco) – 46.96 index pollution;
- Top 10 most polluted cities: the highest pollution levels were found in cities with very high density and industrial activity, often located in Philippines;
- Top 10 most cleanest cities: The cleanest cities typically have better urban planning, green zones, and effective pollution control policies, often located in Europe;

After all necessary results, we creating visualizations to communicate insights:

- Top 10 most polluted and cleanest cities;
- The relationship between population density and pollution levels;
- Correlation between population density and air pollution;

Key Insights

- There is a positive correlation between population density and the pollution index, indicating that in denser cities, air quality tends to be worse.
- The correlation heat map revealed a stronger relationship between PM2.5 and PM10 (both due to particulate emissions), while CO showed a weaker correlation with density.
- However, in some cities with high population densities, the air remains relatively clean, suggesting that effective policy measures can mitigate the effects of urban crowding.

Conclusions

1. Urban density contributes significantly to air pollution, but governance and technology play crucial roles in mitigating it.
2. The Pollution Index effectively summarizes multiple pollutants and allows comparative ranking of cities.
3. Geospatial and open APIs (OpenStreetMap, Open-Meteo) provide a powerful foundation for global environmental analysis.