**Summertime smog**

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It is well known that air pollutants and airborne particulate pollution emitted from car exhausts, wear and tear of brakes and tyres, industries, and fuelwood can worsen chronic health implications. Photochemical smog—a phenomenon infamously associated with Los Angeles—is common during the summer months. If you live in a city in Pakistan, you will already know of winter smog; a combination of cool weather and airborne pollutant precursors. Air pollution levels in Pakistan’s major cities are mostly toxic all year round, but the conversation around air pollution usually happens in winter or what is now popularly known as the ‘smog season’. However, there is little conversation around summertime smog. Summertime smog, because of its material constitution, is not as visible as winter smog but can be just as deadly. The combination of rising global temperatures, the toxic blend of exhaust emissions, and extreme heat events (such as the 2022 heatwave) will only increase the frequency of this phenomenon.

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In Pakistan, the summers are marked by hot and sunny days with little to no wind, offering ideal conditions to produce ground-level ozone. High day temperatures and the presence of sunlight start a chain of reaction between a mixture of gases to form ground-level ozone. This is essentially a reaction of sunlight and heat with volatile organic compounds (VOCs), sulfur dioxides (SO2) and oxides of Nitrogen (NOx) from vehicular exhausts. It is only after the sun sets and the cool night air reels in that we see the ozone concentration, and consequently summertime smog, begin to reduce in the day.

Punjab’s Environment Protection Department (EPD) air quality reports, found on its website, do not have any data on ozone concentration levels and there is no designation for ‘ozone’ as a pollutant. It is questionable how Punjab is calculating their air quality index (AQI) without measuring certain pollutants that are designated in the US AQI. This is the case with other provinces and regions of Pakistan too—Sindh, KP, Balochistan, Gilgit.

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To get observational data, one can look at data from Plume Labs for Lahore at various levels of granularity (https://air.plumelabs.com/air-quality-in-Lahore-4V0v). At first glance, daily averages of ozone fall below 100 ug/m3 and thus, you might be inclined to overlook this hazardous pollutant. However, as noted above, the daytime hours provide some telling clues. If one takes an 8-hour daily average for the daytime hours (09 00- 17 00) for spring-summer months, one can see that ozone levels average around 160 ug/m3. Anything higher than 100 ug/m3 over an 8-hour average is considered a moderate to high air pollution episode where vulnerable citizens are required to take action to reduce their exposure.

Urban centres in South Asian countries, including Pakistan, are in the top 3 of the highest population-weighted ozone concentrations. Ozone is both 1) a toxic gas in the lower atmosphere and 2) a greenhouse gas— absorbing radiation and warming the planet. It is also known that ozone can reduce crop yield by inhibiting photosynthesis through oxidative damage. With climate change, rising greenhouse gases and subsequent higher global temperatures and hot weather episodes, summertime smog is only going to get worse in Pakistani cities.

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While the ozone layer is a vital element of the upper atmosphere (or stratosphere), where it shields the Earth from harmful rays from the sun, it is perilous for human health when concentrations exceed a certain threshold in the lower atmosphere. Breathing unhealthy levels of ozone in the lower atmosphere can have serious implications for people with existing respiratory problems causing irritation, coughing, triggering asthma attacks, and even increasing mortality due to cardiovascular diseases.

In a warmer world, we will experience more abnormal to extreme weather conditions, and many cities will face worse air quality in summer as a combination of higher temperatures and smog precursors. Therefore, it is imperative that the precursors of ozone (i.e., VOCs and NOx) and surface-level ozone are regularly monitored in cities and rural areas across South Asia. Governments in the region need to take strict measures to cut down anthropogenic precursors of ground-level ozone—most of which are industrial or traffic-related.