

Understanding Pakistan's Climate Risks: A Comprehensive Analysis

1. Introduction to Climate Vulnerability

Pakistan consistently ranks among the top ten most vulnerable countries to climate change globally, according to the Germanwatch Global Climate Risk Index. Despite contributing less than 1% to global greenhouse gas emissions, the country bears a disproportionate burden of climate-induced disasters. This vulnerability stems from its geographic location, heavy reliance on agriculture, and limited adaptive capacity. The economic cost of climate change for Pakistan is estimated at billions of dollars annually, affecting infrastructure, health, and livelihoods.

2. Melting Glaciers and the Water Crisis

Pakistan's water security is inextricably linked to the Hindu Kush, Karakoram, and Himalayan (HKH) mountain ranges, which contain more ice than any other region outside the polar caps. These glaciers feed the Indus River System, the lifeblood of Pakistan's agriculture. As global temperatures rise, these glaciers are retreating at an accelerated pace. In the short term, this rapid melting causes Glacial Lake Outburst Floods (GLOFs), which devastate mountain communities in Gilgit-Baltistan and Khyber Pakhtunkhwa. In the long term, the loss of glacial mass threatens a severe reduction in freshwater availability, posing an existential threat to drinking water supplies and hydropower generation.

3. Extreme Weather Events: Floods and Droughts

The frequency and intensity of extreme weather events have increased dramatically over the last two decades. The super floods of 2010 and the catastrophic floods of 2022 submerged one-third of the country, displacing millions, destroying vast tracts of agricultural land, and decimating infrastructure. Conversely, regions like Balochistan and the Thar desert in Sindh frequently suffer from prolonged droughts. These shifting patterns make historical weather data obsolete and severely challenge disaster management agencies like the NDMA (National

Disaster Management Authority).

4. Threat to Agriculture and National Food Security

Agriculture contributes nearly 24% to Pakistan's GDP and employs roughly half of the labor force. The sector is highly sensitive to temperature fluctuations and water availability. Changing monsoon patterns, delayed winters, and intense heatwaves severely disrupt traditional crop cycles. For instance, sudden temperature spikes in March and April can cause wheat grains to shrivel before maturing, drastically reducing yields. Similarly, erratic rainfall affects cotton production, which is a critical export commodity. This poses a direct threat to national food security and export revenues.

5. Coastal Vulnerability and Sea Level Rise

The coastal areas of Sindh and Balochistan, spanning over 1,000 kilometers, face significant threats from rising sea levels. Intrusion of seawater is degrading fertile agricultural land in the Indus River Delta, turning once-productive areas into barren salt flats. This also destroys critical mangrove forests, which act as natural barriers against cyclones and tsunamis. The coastal megacity of Karachi, an economic hub, faces increased risks of urban flooding and cyclonic activity from the Arabian Sea.

6. Urban Heat Islands and Public Health

Rapid and unplanned urbanization has exacerbated the 'Urban Heat Island' effect. Cities expanding with concrete and asphalt, while simultaneously shrinking their green cover, trap heat efficiently. This leads to lethal heatwaves, such as the one that struck Karachi in 2015, resulting in over a thousand fatalities. Furthermore, changing climates expand the geographic range and seasonality of vector-borne diseases like Dengue and Malaria, severely straining the public health infrastructure.