

"Climate Change in Pakistan: Causes and Consequences"

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THE ESSAY

When glaciers that feed our rivers melt faster than ever, when scorching heatwaves turn fertile lands to dust, and when deadly floods drown entire villages, it is no longer a distant warning. Climate change is here, and Pakistan is on the front line.⁴³ Climate change is one of the most urgent ^{global} challenges of the 21st Century, with its devastating effects being felt across different continents. For developing nations like Pakistan, the situation is particularly alarming due to its geographical vulnerability, limited resources and rapid growth in population. Rising temperatures, extreme weather patterns, and the increasing frequency of natural disasters are no longer distant threats. They are present-day realities affecting millions. From the melting glaciers of the north to dry lands in Sindh and Balochistan, the environment imbalance is clear. This essay explores the key causes behind climate change in Pakistan, including Greenhouse effect, deforestation, rapid urbanization and agricultural practices. It further examines the severe consequences the country faces such as water shortage, floods, decline in agriculture and economic disruption. Finally, the essay highlights the viable solutions that can mitigate the crisis by emphasizing the urgent need for a collective and sustainable approach to combat climate change in Pakistan.

Pakistan's climate change is driven by several interlinked factors that boost each other. Firstly, greenhouse gas emissions have surged notably from energy, industry, transport and agriculture. Heat is trapped in the atmosphere causing the temperatures to rise. Industrial pollution worsens this issue. Different factories, power plants, coal fired plants release large quantities of Carbondioxide (CO_2) and black carbon into the air. Transport emissions also play a major role. About 13% of national greenhouse gas emissions come from fossil fuel powered vehicles. In 2023, transport alone emitted approximately 44.9 Mt of CO_2 . Roughly the transport emissions were almost equal to those from industry.

In addition, deforestation and land degradation further prevent the land's natural ability to absorb and store CO_2 . Pakistan's forests cover only about 5% of the land and are shrinking at around 27000 hectares annually especially around Karachi, Khyber Pakhtunkhwa, Sindh and Balochistan. Land degradation affects nearly 3 quarters of the country with 1.5 - 2.5 million hectares of irrigated land and 3.5 - 4 million hectares of rain fed land becoming barren annually. Degraded soils are less able to store carbon and are more prone to erosion which further deepens the environmental derastation.

Moreover, the non-eco friendly farming methods significantly contribute to emissions. Agriculture accounts for ~~emissions~~ around 37 - 43% of total greenhouse gases in Pakistan. Methane emissions, primarily from cattle and rice paddies, reached a record.

The excessive use of chemical fertilizers, insufficient irrigation, stubble burning and poor soil management damage land fertility and enhance emissions, causing pollution and broadening the climate effects. impacts.

Furthermore, the rapid urbanisation intensifies these problems by increasing demand for energy, vehicles and construction. Unplanned growth and expansion of infrastructure and gated communities have led to the loss of millions of trees. An analysis was noted that over 500,000 mango trees were removed for a housing scheme near Multan. This unregulated development damages ecosystems, increasing energy use and enhance pollution. Moreover, the urban waste management remains weak. According to a report, Karachi alone dumps roughly 500 million gallons of untreated wastewater daily into coastal waters, while 87% of hazardous industrial waste enters the sea without treatment (The Express Tribune + Dawn News). These causes reinforce each other, creating a feedback loop that accelerates Pakistan's warming, degrades natural systems and diminishes resilience.

Climate change is profoundly reshaping Pakistan's environmental and socio-economic landscape. Pakistan is increasingly facing extreme weather events due to climate change, disrupting lives, infrastructure, and agriculture. In 2025, record breaking heatwaves gripped Sindh, Punjab and Balochistan with temperatures soaring above $48-50^{\circ}\text{C}$, prompting health warnings as heatstroke cases surged (GeoNews, April 2025). Following the heatwave, deadly windstorms struck Punjab and Khyber Pakhtunkhwa, killing at least

14 people and injuring hundreds. (Outlook Business, May 2025). By July, unprecedented monsoon rains and glacier lake outbursts devastated Punjab, Sindh and Gilgit Baltistan, leaving over 180 dead and displacing thousands (The Guardian, July 2025). Earlier in April, a sudden hailstorm in Islamabad caused significant damage to property and crops. (The News, April 2025). These events highlight Pakistan's growing exposure to climate driven disasters.

Pakistan's mountain north hosts over 7253 glaciers that are vital to the Indus River System but they are melting rapidly due to rising global temperatures. Scientists warn that climate change could cause a loss of upto 75% of glacier mass by 2100, endangering the Indus River System, which supplies water for agriculture, hydropower and drinking needs. (Dawn, Feb 2025). In 2025, unusually high heat triggered glacial lake outburst floods (GLOFs) in Gilgit Baltistan, killing dozens and washing away entire villages. (The Guardian, July 2025). Meanwhile, rainfall deficits of 40% left reservoirs critically low, intensifying water shortages in Sindh and Balochistan (The News, May 2025). Experts caution that melting glaciers, combined with heavy rainfall, pose a dual threat to Pakistan's food security and urban water supplies.

Pakistan is witnessing a worrying rise in climate-related disasters, with floods, droughts, and extreme heat becoming increasingly frequent. Unprecedented monsoon rains and glacier melt triggered devastating floods across Punjab, Sindh and Gilgit Baltistan.

Concurrently, prolonged rainfall deficits large parts of Sindh and Balochistan facing severe droughts, with reservoirs dropping to critical levels. (Dawn, Feb 2025). Record breaking heatwaves with temperatures surpassing 48°C , turned April and May into public health emergencies causing widespread heatstroke, dehydration and increased hospital admissions. The combination of floods, droughts and deadly heatwaves underscores Pakistan's vulnerability to climate change as communities struggle with both immediate disasters and long term health risks.

Climate change poses a growing threat to Pakistan's agriculture, which sustains nearly 40% of the workforce. Unpredictable monsoon patterns, rising temperature and glacier melt are disrupting crop cycles and reducing yields. In 2025, extreme heatwaves scorched wheat and mango crops, with temperatures exceeding 48°C across Sindh and Punjab. Prolonged droughts and critically low reservoirs have further intensified irrigation challenges, particularly in Sindh and Balochistan. Concurrently, flash floods and glacial lake outbursts washed away farmland in Gilgit Baltistan. (The Guardian, July 2025). These threats endanger food security and rural livelihood.

Climate change is destabilizing Pakistan's ecosystems, threatening biodiversity and natural resources. Extreme monsoon rains, prolonged droughts and rising temperatures are degrading wetlands, forests, and rangelands, endangering species and reducing ecosystems.

Pakistan faces huge economic setbacks as climate

change intensifies extreme weather events. Agriculture, the backbone of the economy, suffers from heavy rainfall, prolonged droughts and heatwaves that reduce crop yields and disrupt livestock production. Frequent floods wash away infrastructure, damaging roads, bridges, and irrigation networks, demanding costly repairs (Dawn, Feb 25). Rising temperatures also strain energy systems increasing demand for cooling and reducing hydropower generation (The News, May 2025). Analysts warn that climate related damages now cost billions annually, undermining economic stability and threatening livelihood across vulnerable rural and urban communities. (The Guardian, July 2025).

Effective solutions demand urgent, collective action to combat climate change. Pakistan's reliance on fossil fuels for power generation significantly contributes to greenhouse gas emissions, worsening climate change. Transitioning to renewable energy, particularly solar, is crucial given the country's abundant sunlight. Expanding solar infrastructure can meet rising energy demands while reducing carbon footprints and cutting import dependence on costly fuels. Government initiatives like net metering and solar subsidies must be scaled up to encourage residential, agricultural and industrial adoption. Invest in wind, hydropower and off grid solar projects can also bring clean energy to rural communities, improving access and reducing pressure on the national grid. Promoting local manufacturing of solar panels and training a green^{work}force will strengthen energy security, create jobs and drive Pakistan towards a sustainable climate resilient future.

Deforestation, overgrazing and urban expansion are depleting Pakistan's forest and degrading ecosystems, intensifying climate impacts. Large scale reforestation initiatives like the Billion Tree Tsunami, should be expanded to restore degraded lands. Protecting mangroves, wetlands and rangelands is vital for ecological balance and resilience against extreme weather. Conservation must include strict enforcement against illegal logging, incentives for community forestry and sustainable land use planning. Reforestation improves soil fertility, enhances water retention, and generates rural jobs. Prioritizing ecosystem restoration and nature based solutions strengthens climate resilience, protects wildlife and secures environmental services crucial for agriculture, water management and long term ecological stability.

Climate adaption needs informed and engaged citizens. Raising awareness about climate change impacts is vital for responsible behaviours. Educational campaigns in schools, universities and rural areas can promote water conservation, tree planting and sustainable farming. Empowering youth, women and farmers through training builds capacity for ecofriendly practices. Community based early warning systems, resilient livelihoods and participatory planning disaster vulnerability. Media, civil society and religious bodies must unite to instill environmental management. Embedding climate literacy in daily life fosters a culture of sustainability where collective action mitigates risks and strengthens resilience against evolving climate challenges.

Climate change magnifies the frequency of extreme weather events, exposing Pakistan's infrastructure gaps. Strengthening climate resilient infrastructure such as flood resistant roads, embankments, and water storage systems is vital to safeguard lives and economic assets. Urban drainage systems must be upgraded to withstand heavy monsoon rains, preventing urban flooding and economic disruption. Expanding meteorological networks and early warning systems can improve forecasting accuracy, enabling timely evacuations and response. Investment in disaster resilient housing, renewable powered shelters and emergency relief frameworks ensures better preparedness for floods, heatwaves and droughts. Integrating climate risk assessments into national development planning is essential. Prioritizing resilient infrastructure will protect vulnerable communities, minimize economic losses and enhance nation's adaptive capacity to withstand climate induced disaster.

Addressing climate change requires Pakistan to engage actively in global partnerships and secure international support. As one of the countries, most vulnerable to climate shocks, Pakistan must access climate finance through mechanisms like the Green Climate Fund for adaptation and mitigation projects. Collaboration with developed nations can provide technology transfer, expertise and capacity building in renewable energy, climate smart agriculture, and disaster management. Strengthening participation in global environmental agreements enhances Pakistan's ability to advocate for equitable climate justice. Regional Cooperation

On shared water resources and early warning systems can mitigate transboundary risks. By fostering international alliances and leveraging global support, Pakistan can accelerate its climate action, build resilience and move toward a sustainable low carbon future.

In conclusion, climate change poses an existential challenge for Pakistan, affecting every sector of the economy and threatening the wellbeing of millions. Its causes are rooted in human-driven activities such as industrial emissions, rapid urbanization and unsustainable land use, while the consequences manifest in frequent floods, prolonged droughts, shrinking glaciers, extreme heatwaves and severe health crises. Agriculture, the backbone of the economy, faces declining yields, while fragile ecosystems continue to degrade, resulting in biodiversity loss and rising economic damages. Addressing this crisis requires urgent, coordinated action. A transition toward renewable energy, especially solar power, can reduce greenhouse gas emissions and ease energy dependence. Large scale reforestation, ecosystem conservation and balanced land management are crucial for long term resilience. Empowering communities through awareness and education, alongside resilient infrastructure and disaster readiness can greatly reduce vulnerabilities. Global Cooperation should ensure climate finance, technological support and expertise to aid adaption. Through strong policies and united commitment, Pakistan can protect its natural assets, sustain livelihoods and progress towards a climate resilient future for present and future generations.