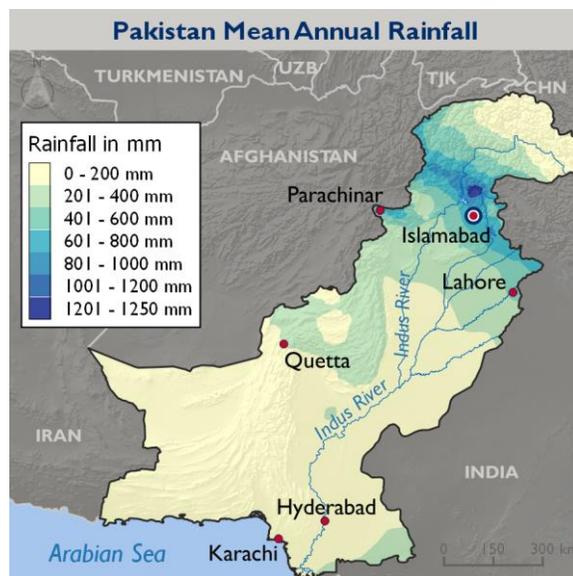




CLIMATE CHANGE RISK PROFILE PAKISTAN

COUNTRY OVERVIEW

Pakistan, the sixth most populous country in the world, lies in a mostly arid and semi-arid geographic area prone to recurring large-scale floods, earthquakes, droughts and landslides. Despite recent economic growth, nearly 30 percent of Pakistan's 189 million people live below the poverty line and high rates of malnutrition and food security persist. Climate change is expected to exacerbate these challenges. Natural disasters, which already disrupt livelihoods and the economy, are expected to increase in frequency and intensity. Floods in 2010 affected more than 18 million people and caused an estimated \$10 billion in damages. They were followed by heavy monsoon rains in 2011 that affected some 9.7 million people in Sindh and Balochistan Provinces. Projected temperature increases are expected to be above global averages, negatively impacting agricultural production, water availability and human health. This will be particularly true for large parts of Punjab, Sindh and Baluchistan Provinces, already considered intense heat zones. In addition, sea level rise and saline intrusion threaten coastal infrastructure, agricultural lands and aquifers in Karachi (Pakistan's largest city) and the adjoining Indus deltaic region. Water scarcity is a major impediment to planned growth and development, with far-reaching impacts across all sectors. Current water scarcity is expected to be exacerbated by higher temperatures and longer, more intense droughts. (2, 9, 19, 20, 21)



CLIMATE PROJECTIONS



1.4°–3.7°C increase in temperatures by 2060s



Increased frequency of heavy snow and rainfall, triggering avalanches, floods and landslides



Increased frequency, intensity and duration of heat waves and drought



30–80 cm rise in sea levels by 2100

KEY CLIMATE IMPACTS

Agriculture

Loss of arable lands
Reduced yields and crop failure
Reduced water resources for irrigation



Water

Reduced surface water and groundwater
Increased glacial melt; altered river flows
Increased salinization of groundwater



Energy

Reduced energy production potential
Increased demand for energy services



Human Health

Increased risk of waterborne diseases
Increased risk of malnutrition
Population displacement



Fisheries

Reduced fishery productivity
Loss of mangrove habitat for shrimp
Habitat loss from reduced river flows



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CLIMATE SUMMARY

Pakistan has distinct climate zones, with high altitude mountains in the north and west, arid deserts in the south, the hot and dry Indus River Valley in the center and south, and a humid 990-km coastline. Generally, the lower half of the country is hot and dry, while the north is more temperate and wet. During summer monsoon months (July–September), average temperatures do not exceed 15°C in the north, but reach 35°C in the south and central Indus Valley. Most of the country receives very little rainfall (less than 200 mm/year on average nationally), with the majority occurring in the summer monsoon season. During winter months (December–March), average temperatures are well below 0°C in the highest northern altitudes and 20°–25°C in the low-lying south. Winter also brings substantial precipitation in northern regions. Interannual rainfall varies significantly, leading to successive patterns of flood and drought. (1, 8, 9, 10, 11, 21)

HISTORICAL CLIMATE

Historical climate trends since 1960 include:

- Average annual temperature increased 0.6°–1.0°C, with temperature increases higher in the north.
- Maximum and minimum temperatures increased, resulting in shorter winters and longer summers.
- Mean annual rainfall decreased 10–15 percent in arid plains and the coastal belt, but increased in the north due to increased winter precipitation.
- Number of days considered “hot” increased by 20 and nights by 23.
- Number of heavy rainfall events increased.
- Snow cover decreased by about 10 percent.
- Sea levels rose by 1.2 mm per year.

FUTURE CLIMATE

Projected changes in climate include:

- Increased temperatures of 1.4°–3.7°C by the 2060s and of 6.0°C by the 2090s, with projected increases higher during winter and in the north.
- Uncertain mean annual precipitation changes, with projected monthly rainfall changes ranging from a decrease of 20 percent to an increase of 41 percent by the 2090s.
- While large uncertainties remain, climate models point to increased rainfall from January–June and decreased from July–September.
- Decreased glacier volume and snow cover.
- Increased frequency and intensity of extreme climate events.
- Rise in sea levels of 30–80 cm by 2100.

SECTOR IMPACTS AND VULNERABILITIES

AGRICULTURE

Agriculture employs 45 percent of Pakistan’s workforce and nearly all arable land is cultivated. Production is dependent on a glacier- and snow-fed irrigation network, making it extremely vulnerable to climate change. Increasing temperatures and extreme events contribute to devastating crop losses, altered growing seasons and increased incidence of pests and soil erosion. While a warmer climate may lead to minor yield improvements in the north by extending the growing period, staple crop yields of wheat, maize and rice predominantly grown in the south are projected to decrease, resulting in increased food prices, food insecurity and malnutrition. In recent years, soil salinity induced by irrigation caused a 40–60 percent reduction in major crop production. Salinization of land and aquifers threatens the fertile Indus Delta, which has lost almost 2 million acres of arable land due to saline intrusion from reduced river flows and rising seas, and is a major contributor to the current outmigration along the Sindh coast. Livestock production is also

Climate Stressors and Climate Risks AGRICULTURE	
Stressors	Risks
Increased temperatures	Reduced availability of irrigation water, limiting crop productivity
	Altered growing periods, adversely affecting staple crops
Rainfall variability	Damaged crops and rangelands from floods and droughts
Increase in the frequency and intensity of extreme weather events	Deteriorated agricultural land due to saline intrusion, soil erosion and waterlogging
	Reduced food security, foreign exchange earnings and agricultural livelihood security
Sea level rise	Decreased livestock productivity and increased stress on feed and water sources

projected to be negatively affected as higher temperatures and drought lead to heat stress and reduced productivity in animals, and reduce animal fodder production and stress rangelands and water sources. (4, 5, 6, 15)

WATER RESOURCES

Climate change will decrease water availability and quality in Pakistan. The Indus River, Pakistan’s primary freshwater source, receives 50–80 percent of its flows from snow and glacier melt, with the remainder coming from monsoon rains. Increased temperatures are rapidly melting glaciers and reducing winter snowfall, which will increase stream flows and glacial lake outburst floods in the next few decades, but will significantly reduce long-term water levels as glaciers disappear. Pakistan’s per capita water availability, now about 1000 m³, is projected to decrease to 800 m³ by 2025, transitioning it from a water-stressed to a water-scarce country. Water scarcity will reduce agricultural productivity, which utilizes 93 percent of the water supply – half of which is sourced from heavily exploited groundwater. Pakistan’s water insecurity is

ENERGY

Hydropower generates 31 percent of Pakistan’s energy supply, yet reduced water supplies from decreasing or variable rainfall and increasing temperatures may undermine the country’s goals to increase energy availability and eliminate the power supply-demand gap by 2025. Hydropower production is concentrated in the north, where temperature increases are projected to be highest. While access to electricity rose from 59 percent in 2000 to 74 percent by 2010, ongoing power outages, especially during the summer when demand for cooling is highest, have crippled the

HUMAN HEALTH

Climate change threatens to exacerbate Pakistan’s already low health indicators (e.g., life expectancy, maternal and child mortality, malnutrition). The majority of Pakistan’s population lives along the flood-prone Indus River, and diarrheal disease from contaminated water is a leading cause of morbidity and mortality. Higher temperatures increase the risk of heatstroke. In 2015, an unprecedented heat wave with temperatures as high as 49°C killed more than 1,200 in Karachi. In 2010, unprecedented monsoon rainfall flooded 20 percent of the country, affecting 21 million people and triggering infectious disease outbreaks and diarrheal illness due to contaminated drinking water and unhygienic conditions in makeshift camps. The climate risks to food security, such as crop loss/failure, could also have implications for malnutrition, which is already

Climate Stressors and Climate Risks WATER RESOURCES	
Stressors	Risks
Increased temperatures	Reduced water table and access to water supplies
	Increased conflicts over limited water resources
Accelerated snow and glacier melt	Reduced storage capacity in reservoirs due to siltation
Irregular monsoon rains	High stream flows and glacial outburst in the short term, leading to increased flooding, turbidity and sedimentation
	Decreased water supply and quality from higher pollutant concentrations and saline intrusion
Droughts	

compounded by the country’s limited 30-day storage capacity and the indecision over the Indus River headwaters in Kashmir. (4, 8, 16)

Climate Stressors and Climate Risks ENERGY	
Stressors	Risks
Increased temperatures	Increased demand for energy services, particularly cooling
Increased incidence of drought, flooding and more variable rainfall	Increased power outages and resultant economic losses
	Reduced hydropower production
	Limited prospects for hydropower development

economy, with an estimated annual loss of 2 percent of GDP. (2, 16)

Climate Stressors and Climate Risks HUMAN HEALTH	
Stressors	Risks
Increased temperatures	Increased heat-related mortality
	Expansion of vector-borne diseases like malaria and dengue
Increase in the frequency and intensity of extreme weather events	Increase in diarrheal disease outbreaks attributable to climate change
	Reduced access to health care systems, water and food supplies in extreme weather events
Sea level rise	Loss of life and livelihoods from flood and landslide disasters
	Population displacement in disaster risk areas

severe in Pakistan – nearly half of all children are malnourished. (3, 4, 13, 14, 17, 18)

FISHERIES

Climate change threatens Pakistan’s freshwater, marine and aquaculture fisheries, which account for 1.3 percent of GDP and provide the sole source of employment and income generation in most coastal communities. Increased temperatures will decrease river flows, resulting in greater habitat loss and reduced ranges of fish species in the Indus Delta. Increased surface water temperatures also affect the growth, survival, reproduction and migration of cold-water species in both mountainous regions and the Arabian Sea, while sea level rise destroys critical estuary and mangrove ecosystems due to higher salinity levels. Shrimp from mangrove areas are Pakistan’s major fisheries sector export, accounting for 68 percent of the \$100 million in foreign exchange earned from fisheries. Pakistan’s mangroves are experiencing an alarming rate of decline, estimated at 4,900 hectares per year, as

POLICY CONTEXT

INSTITUTIONAL FRAMEWORK

Since signing the United Nations Framework Convention on Climate Change (UNFCCC) in 1992 and ratifying the treaty in 1994, the Pakistani government has taken actions to fulfill its commitments under the convention. The Ministry of the Environment (MoE) drafted the National Climate Change Policy in 2011 to provide a policy framework to steer Pakistan toward climate-resilient development. The following year, Parliament adopted the NCCP, abolished the MoE, and established the Ministry of Climate Change to oversee all climate change-related actions. The Ministry of Climate Change (downgraded to a division in 2013 and reinstated to a ministry in 2015)

Climate Stressors and Climate Risks	
FISHERIES	
Stressors	Risks
Increased temperatures and surface water temperatures	Reduced freshwater flows, limiting fisheries in Indus Delta
	Fish migration to colder and/or less saline waters
Precipitation variability	Increased salinity, destroying mangrove ecosystems and reducing fisheries’ productivity, especially shrimp fishery
Sea level rise	Loss of mangroves as shoreline defense, accelerating coastal erosion and threatening coastal fish production

mangroves are cut to build shrimp farms and other coastal developments. An estimated 80 percent of the fish caught in coastal waters spend at least part of their lifecycle in the mangrove creeks or depend on the mangrove ecosystem’s food web. (7, 12)

developed the Framework for Implementation of Climate Change Policy, which outlines adaptation actions and proposed implementation through 2030, with particular focus on water, agriculture and livestock, coastal areas, Indus deltaic region, forests and other vulnerable ecosystems. (3, 10)

NATIONAL STRATEGIES AND PLANS

- [Initial National Communication on Climate Change](#) (2003)
- [National Climate Change Policy](#) (2012)
- [National Disaster Risk Reduction Policy](#) (2012)
- [Framework for Implementation of Climate Change Policy](#) (2013)
- [Pakistan Vision 2025](#) (2014)

Key Resources

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- Map source: [WorldClim Global Climate Data](#) and Hijmans, R.J. et al. 2005. [Very high resolution interpolated climate surfaces for global land areas](#). *International Journal of Climatology* 25: 1965–1978.

SELECTED ONGOING EXPERIENCES

The table below summarizes recent and ongoing donor-funded programs related to climate change adaptation in Pakistan.

Selected Program	Amount	Donor	Year	Implementer
Sindh Resilience Project	\$120 million	World Bank	2016–2022	Government of Sindh
Disaster and Climate Resilience Improvement Project	\$125 million	World Bank	2015–2019	Government of Punjab
Balochistan Integrated Water Resources Management & Development Project	\$209 million	World Bank	2015–2022	Balochistan Irrigation Department
Disaster Risk Reduction in Pakistan	\$61 million	UNDP	2013–2017	UNDP
Balochistan Agriculture Project	\$25.4 million	USAID/FAO	2009–2015	USAID, FAO, Government of Balochistan
Building Capacity on Climate Change Adaptation in Coastal Areas of Pakistan (CCAP)	Not available	European Commission	2011–2015	WWF Pakistan
Agricultural Information System-Building Provincial Capacity for Crop Estimation, Forecasting and Reporting based on the Integral Use of Remotely Sensed Data	\$1.9 million	FAO	2011–2015	FAO
Protection and Management of Pakistan Wetlands	\$12 million	UNDP/GEF	2005–2011	Ministry of Environment