

## CLIMATE VULNERABILITY IN BALOCHISTAN: CHALLENGES, SOCIOECONOMIC IMPACTS, AND THE NEED FOR GOVERNANCE-LED ADAPTATION

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### ABSTRACT

Pakistan's contribution to global greenhouse gas emissions is among the lowest in the world, with the province of Balochistan contributing almost none. However, Pakistan, particularly Balochistan, is one of the most vulnerable regions to the impacts of climate change. Studies indicate a clear trend of climate change affecting nearly every part of the province, including increased frequency and severity of extreme weather events such as floods, cyclones, and unprecedented monsoon rains. These events lead to regular siltation of small dams, subsequent overflows, and prolonged droughts. Additionally, snowfall has decreased significantly compared to previous years, and the groundwater table continues to decline, exacerbating the already critical water scarcity in the region. Balochistan lacks the necessary infrastructure for water storage and faces numerous socioeconomic challenges, including widespread poverty, inadequate access to education, limited healthcare, and insufficient disaster management systems. These issues, combined with a heavy reliance on natural resources, limited technological capacity, and inadequate financial resources, make the province particularly vulnerable to climate extremes and deepen poverty levels. Addressing these challenges requires urgent prioritization of adaptation and mitigation measures, particularly nature-based solutions tailored to provincial and local contexts. However, poor governance remains a significant barrier. Sustainable solutions demand competent and practical governmental decision-making to effectively implement climate action plans.

**Keywords:** Climate Change, Environment, Droughts, Water Scarcity, Rains, Flood

### INTRODUCTION

Public sector extension is a state responsibility that Climate change refers to the prolonged regional and worldwide alterations in average temperature, humidity, and precipitation patterns. In contrast to weather, which may alter within hours, climate change represents a substantial alteration in typical weather conditions across seasons or several decades. Occasionally, these changes may occur naturally due to fluctuations in the solar cycle. Human activities associated with scientific and

industrial advancements, together with the excessive use of fossil fuels since the 18th century, are the primary catalysts of this problem. The fast escalation of greenhouse gases (carbon dioxide, methane, nitrous oxide, and other synthetic compounds) and the combustion of fossil fuels in the Earth's atmosphere lead to the warming of the planet and its seas, resulting in rising sea levels and the melting of snow and ice. It alters ocean currents, modifies storm patterns, induces more

intense heat events including wildfires, alters rainfall patterns, and results in floods and droughts. In some instances, these implications may also include infrastructure, freshwater supplies, human health, agriculture, forests, coastlines, and marine systems.

Pakistan's per-capita greenhouse gas (GHG) emissions are quite low relative to global norms. Pakistan's total greenhouse gas emissions from 2017 to 2018 amounted to just 490 million tons of CO<sub>2</sub> equivalents. However, it is profoundly affected by the consequences of climate change. Additionally, it is formulating a strategy to bolster global initiatives aimed at further diminishing greenhouse gas emissions via energy conservation, enhanced energy efficiency, and optimized fuel composition.(Global Economy,2020).

The province of Balochistan is very susceptible to climate change, as it contends with several issues related to its severe topography and climate. Furthermore, climate change exacerbates the existing environmental difficulties faced by the region.

The province has seen a notable escalation in the frequency and intensity of severe weather events, leading to sea-level rise, cyclones, elevated temperatures, declining health, reduced agricultural and livestock output, animal fatalities, and starvation. Conversely, intense droughts caused by decreased yearly precipitation and flash floods in some regions transpire annually during the monsoon, leading to consistent siltation of tiny dams.( Qamar et ,2009). Flash floods damage and deplete soils, resulting in the loss of livelihoods, infrastructure, food shortages, and the proliferation of disease. Balochistan has seen elevated heat waves above historical norms in recent decades. Snowfall has significantly decreased in comparison to historical records. The groundwater table is declining daily, resulting in reduced water availability throughout the province. This is resulting in catastrophic consequences for agriculture and cattle in the province. The problem is exacerbated by shifting precipitation patterns, cycles, and rising temperatures. This may impact health, exacerbate heatwaves, and elevate the need for artificial cooling. Water scarcity, food insecurity, health hazards, and escalating energy demands may lead to migration triggered by

climate change. The migration to neighboring provinces would engender significant socio-political challenges, resulting in widespread societal discontent. The Balochistan coastline, including around 70% of Pakistan's total coastline, is susceptible to sea level rise, which may lead to increased cyclonic activity, saltwater intrusion into groundwater, and detrimental effects on fisheries, coastal ecosystems, and livelihoods.(Tariq and Rabbani,2005).

The province lacks critical infrastructure for water storage and disaster management, facing environmental, topographical, and socioeconomic challenges, such as poverty, limited access to education, and insufficient healthcare facilities. The nation's and province's technical and financial resources are inadequate to address the adverse impacts of climate change. Likewise, climate change presents a substantial threat to poverty reduction efforts and might undermine decades of socioeconomic advancements.

In summary, over the next decades, this province will likely have reduced availability to food and water, along with a much more hostile environment, rendering it more susceptible to the repercussions of climate change. The people of Balochistan may have significant survival challenges due to the aforementioned concerns, particularly with food security, energy, and water resources.

### **Methodology**

This research has used both primary and secondary data. The data for this research was obtained from credible sources, including international organizations, governmental papers, and scholarly journals. A descriptive and analytical methodology was used to elucidate the effects of climate change on Balochistan. This research is crucial since it identifies the effects of climate change on Balochistan. This research aims to provide policymakers with critical insights into the intricate effects of climate change on Balochistan. Furthermore, it outlines essential initiatives for tackling climate change adaptation and mitigation, including both long-term and short-term measures within the framework of Balochistan.

### **Climate Change and Impact on Balochistan**

The impacts of climate change in Balochistan are apparent across several critical sectors and have far-reaching effects. Climate change is expected to exacerbate the vulnerability of Balochistan, the province with the lowest Human Development Index in Pakistan. Surface temperatures in Balochistan are expected to increase owing to global warming, leading to seasonal alterations. These seasonal fluctuations might disturb the characteristics of typical meteorological conditions in the province. It is anticipated that winters would be shorter and colder, while summers will have heightened intensity and prolonged length.

### **Rainfall Changes, Droughts and Floods**

The province's hydrological cycle has been altered by climate change. Precipitation in Balochistan has become erratic and sparse. Historically, snowfall occurred in several regions of northern Balochistan and the elevated plateaus around Kalat-Mastung; however, both its frequency and severity have significantly diminished over time in some areas. The province's water resources are deteriorating in both quantity and quality as a consequence. A decrease in water availability for human, plant, and animal consumption results in droughts. The IPCC forecasts that temperature fluctuations of two to three degrees Celsius would affect Pakistan and other South Asian nations. The average precipitation will decrease as a result of these temperature fluctuations, impacting water availability. As a result, the province will experience droughts in several regions and drought-like conditions in most others. Floods may also transpire in certain regions. The province had an extended drought that started in the late 1990s and persisted for almost 10 years, with its effects still evident due to the little rainfall in wide portions of the region. The forest cover is diminishing owing to extensive drought and water constraint.

Flooding is among the most severe calamities. Certain districts in Balochistan are susceptible to floods, including Naseerabad, Jaffarabad, Lasbela, Jal Magsi, Bolan (Kachhi), Khuzdar, Qila Saifullah, and Qila Abdullah. These regions experience annual flooding, however the intensity varies according on the locale. Annually,

catastrophic flooding displaces hundreds and impacts millions of people. Residents in these regions grew more susceptible due to the flood, losing practically all their possessions along with their means of livelihood. Additionally, flash floods occur annually during the monsoon season as a result of intense rainfall. The floods in Naseerabad in 2022 and the latest flood in Gwadar on 27 February 2024 have adversely affected municipal infrastructure and the livelihoods of residents.

### **Sealevel Changes and Coastal Area**

Climate change has modified the province's hydrological cycle. Precipitation in Balochistan has become irregular and insufficient. Historically, snowfall was prevalent in several places of northern Balochistan and the high plateaus around Kalat-Mastung; however, its frequency and intensity have markedly decreased over time in some localities. The province's water resources are declining in both volume and quality as a result. A reduction in water availability for human, plant, and animal use leads to droughts. The IPCC predicts that temperature variations of two to three degrees Celsius would impact Pakistan and other South Asian countries. The average precipitation will decrease due to these temperature variations, affecting water availability. Consequently, the province is anticipated to encounter droughts in several places and drought-like circumstances in the majority of others. Floods may also occur in certain locations.

The province had a prolonged drought beginning in the late 1990s, lasting almost a decade, with its repercussions still apparent owing to little rainfall in extensive areas of the territory. The forest cover is declining due to severe drought and water scarcity. Flooding is among the most catastrophic disasters. Specific districts in Balochistan are prone to flooding, including Naseerabad, Jaffarabad, Lasbela, Jal Magsi, Bolan (Kachhi), Khuzdar, Qila Saifullah, and Qila Abdullah. These places have yearly floods; however, the severity varies according on the location. Annually, devastating floods displaces hundreds and impacts millions. Inhabitants in these areas grew progressively susceptible to the flood, forfeiting practically all their belongings and means of



subsistence. Moreover, flash floods transpire regularly during the monsoon season due to heavy precipitation. The floods in Naseerabad in 2022 and the recent flood in Gwadar on 27 February 2024 have negatively impacted municipal infrastructure and the lives of inhabitants.

### **The impact on Water Resources in Balochistan**

The scarcity of water has intensified, and the quality of water has declined, manifesting in both rural and urban regions of Balochistan. Over the last 20 years, average rainfall has decreased, resulting in inadequate replenishment of the water table, which has consequently reduced due to climate change. The water resources are further depleted by water-mining tube wells, without a definite extraction plan. Over the last five to six years, groundwater levels have significantly declined. Despite accessing "hard rock," groundwater extraction has often been ineffective in several areas. The province's Karez system is almost exhausted owing to inadequate groundwater, worsened by the effects of climate change.

### **The agriculture and livestock Impact**

For several residents in the province, small-scale farming and agriculture are their main source of income. Sixty-seven percent of Balochistan's population is engaged in agriculture and livestock, which provide over half of the province's GDP. Over fifty-three percent (53%) of Balochistan's arable land is used for Sailaba (floodwater) and Khushkhaba (rainfall and runoff) agricultural methods. Despite just 1.09% of the land being irrigated, the most impoverished segments of society rely on non-irrigated agricultural methods for their sustenance, and little changes in hydrology and weather may have catastrophic consequences for their existence. (PK, 2015). An increase in temperature hastens the drying out of the soil, reducing its water content and fertility. This poses a threat to food security in the province by negatively affecting crop and horticultural production (Iqbal, 2009)

The province already receives very little rainfall and the agriculture and livestock sector are particularly vulnerable to further climate change impacts including harsh weather, droughts, and

epidemics. The water level in some areas of the province has reached the dead zone. Since most places cannot draw water to irrigate crops, this shortage has significantly affected agriculture. Crop produce has become challenging due to seasonal swings since inexperienced farmers find it difficult to keep up. The majority of agricultural methods in Balochistan is rain-fed and the irregular precipitation makes crop cultivation challenging and jeopardizes crop quality and yield (Sarfaza, 2017). The Northern region in the province was well-known for its abundant fruit and the dense tree cover that provides a variety of fruits and the Quetta city used to be called the fruit basket of the country. However, the previous five to six years have seen a significant decrease in the amount of tree cover due to changes in temperature, unpredictable rainfall, and a decrease in the amount of water available. Consequently, there has been less agricultural activity. In addition, frequent dry spells, a lack of rainfall, and sometimes irregular heavy rainfalls have impacted the common people, and specifically the farmers and shepherds. Most of the farmers had given up on farming, and shepherds keep few livestock.

Rangelands constitute over 80% of Balochistan's geographical area, serving as the primary foundation for the province's livestock production. It provides ecosystem services such as carbon sequestration, firewood for domestic energy, nutrient recycling, biodiversity, animal habitat, and ecotourism. The deterioration of these rangelands poses risks to floral and faunal biodiversity and ecological stability. Significantly, it has altered conventional pastoral migratory pathways and heightened the vulnerability of impoverished pastoral communities.

### **Out-of-Season Rainfall And Rise In Temperature**

The province used to see three or four spells of rain throughout the monsoon season, but lately the rains are out of sync, either there is an unexpected, intense downpour that causes a deluge, or there is no rain for months. Due to climate change, temperature is increasing, and extreme weather events like heat waves have started taking place in the province. Quetta City has not seen snowfall in the recent years. Although the surrounding

mountains do receive some snowfall each winter. However, in past decades, the city used to experience a fair quantity of snow in the winter, and due to its scenic beauty and snow, it used to be known as ‘Little London’ which is not the case anylonger. Furthermore, wildfires and superstorms have also been reported in the past years.

### **The Health Impact**

Balochistan is Pakistan's least populated province with the lowest HDI score. Inadequate support for health services, resulting from a variety of factors such as a shortage of facilities and qualified medical personnel, communities living in remote or nomadic areas and other sociocultural barriers limit basic health services.

Over 60% of BHUs lack electricity, over 70% lack running water, and over 90% lack public toilets. Consequently, the risk of water-borne diseases, epidemics, and malnutrition rises<sup>1</sup>. Merely 24% of expected pregnancies during a given timeframe register for prenatal treatment at BHUs, and 15% register for delivery. Balochistan has one of the highest infant mortality rates of 79 per 1000 live births. Lack of access and availability of all basic health necessities and services in addition to climate-induced effects may have a detrimental effect on the already vulnerable population of Balochistan.

### **The Energy Impact**

According to data, Balochistan's overall electricity demand is estimated to be between 1,400 and 1,600 MW annually, however the supply is closer to 700 MW. The province's electricity grid networks lack the capacity to transmit energy to meet demand in full. Increased investments in the province are anticipated as a result of the China-Pakistan Economic Corridor. Two examples of these projects are the 1,320 MW coal-based power plant in Hub, Balochistan, and the 300 MW imported coal-based power project at Gwadar. Balochistan is a significant player in Pakistan's power sector and has made significant energy-related investments in recent decades, therefore it is crucial to carefully consider its choices for demand of energy. In view of the climate change impacts the rising

temperatures have also led to an increase in energy needs since households depend more on electrical appliances to stay cool during the long, hot summers.

### **Disaster Risk Reduction**

A primary cause and climate-related impediment to Balochistan's growth is the recurrent drought, which has adversely affected Gwadar and Lasbela in recent years. This phenomena notably impacts the province by diminishing agricultural production, decreasing water levels, and increasing mortality rates among animals and wildlife. The province is especially susceptible to flooding during the monsoon season, particularly affecting residents located in villages adjacent to the three primary watershed areas: the Hub River Basin, the Porlai River Basin, and the Gwadar Ormara Basin. In Lasbela, severe precipitation in 2007 destroyed over 40% of healthcare facilities. In 2005, substantial water flows caused the Makran Coastal Highway to erode, leading to millions of dollars in damages. The province has difficulties in delivering relief and rescue after catastrophes due to the predominance of its people residing in isolated settlements and the insufficiency of its physical infrastructure. This highlights the significance of early warning systems and proactive adaption strategies.

### **Responses and Recommendations**

Adaptive capacity, or adaptability, refers to a system's ability to adjust and respond to the impacts of drought or other stressors, as well as to foresee such occurrences and prepare in advance. It is the capacity of a system to adjust to climate change by alleviating potential harms, capitalizing on opportunities, or managing the repercussions and consequences. In other terms, adaptive capacity refers to the system's capability to formulate and implement effective adaptation strategies or to react to evolving stressors and threats, hence reducing the probability of these risks emerging due to climate change.

The susceptibility of Pakistan, especially Balochistan, to the ramifications of climate change necessitates the prioritization and implementation of adaptation and mitigation measures. Ensuring

water, food, and energy security for the province's populace, while mitigating the impact of natural disasters on the economy, human life, health, and property, necessitates the strategic planning and implementation of appropriate adaptation measures, ideally nature-based solutions, at both national and local levels. Ultimately, the crux of the problem lies in poor governance, and viable remedies can only be enacted if the government executes effective, practical judgments. This section outlines essential initiatives for climate change adaptation and mitigation, including both long-term and short-term policies relevant to Balochistan.

### **Water**

The province's water status necessitates the regulation of groundwater use to prevent excessive extraction.

Regulate and address the demand for water storage and delivery within the province.

Establish the necessary infrastructure to fully harness the potential of hill torrents.

Conserve water wherever feasible, including reducing losses in irrigation systems and providing incentives for the use of more efficient irrigation techniques.

Enact and enforce the legislation and regulations required to create a groundwater regulatory framework and to manage water resources efficiently.

Encourage and assist farmers in Balochistan to preserve and develop the traditional Sailaba agricultural irrigation system, which has significant potential for enhancement if constructed and managed appropriately.

Develop seasonal hydro-meteorological projections, specifically for the storage and use of monsoon rains.

### **Forests**

Despite the little geographical area of the province occupied by trees, it has Juniper forests in Ziarat and Chilghoza forests near Zhob. These forests provide several benefits, including soil erosion management, water flow regulation, medicinal plant resources, significant carbon sequestration, and support for local lifestyles. The little allocation of public monies for repair is unpromising. To

mitigate the dangers and vulnerabilities to forests and biodiversity posed by climate change, Balochistan province, in collaboration with the federal government, must implement the following policies:

Promote forest pathology research at the provincial level to mitigate damage to forests from insects and diseases, as the world's second-largest juniper forest in Ziarat Valley, cultivated over millennia, is threatened by climate change and a disease known as Dieback. The removal of juniper trees continues in and around Ziarat. Villagers down trees for shelter and fuel during severe cold weather, when temperatures plummet below freezing across the valley, causing a significant decrease in gas pressure in the pipelines and leaving them without gas for extended periods. In Ziarat, gas supply has been absent for more than two years. These trees are also felled for many objectives, including agricultural expansion, building, medical applications, and furniture production. The government should consistently provide the local community with energy sources, such as gas and electricity, without any interruptions. In addition to energy provision, it is essential to implement effective measures to safeguard the interests of communities reliant on forests, including the creation of employment opportunities and the development of targeted forest conservation policies that may aid in preserving these ecosystems for the benefit of both current and future generations.

Promote and implement regeneration and afforestation initiatives utilizing climate-resilient plantations, while advocating for alternative fuel sources to mitigate deforestation of pine forests in the Sulaiman range and mangrove ecosystems along the coastal belt and other provincial areas. • Develop forest protection and fire prediction services, enhancing the capacity of forest departments to manage wildfires and engage local communities in the detection and suppression of such incidents. On May 10, 2022, a fire ignited in the pine nut and olive forest of Sherani District, Zhob Division, and we now lack the necessary equipment to extinguish it. The fire rapidly escalated into a significant conflagration. Firefighters from provincial and national crisis management agencies have been attempting to



extinguish the fires for many days, using rescue vehicles and firefighting apparatus, with little success. The fire was ultimately doused with the assistance of Iran's largest firefighting aircraft, the Ilyushin Il-76. Pakistan could contemplate the development of such aircraft.

Facilitate community engagement in the conservation of mountain biodiversity and promote the introduction of drought-resistant, high-altitude cereal crops in Balochistan by advocating for research on drought- and pest-resistant varieties, along with "low delta crops". Furthermore, promote the use of hydraulic ram pumps and gravity drip irrigation in the province's hilly areas, while dissuading the cultivation of high water-demanding plants unless situated in flood-prone sites.

### **Agriculture and livestock**

- Introduce a new variety of crops with high yield capacity that can resist heat stress and drought, and which are less prone to severe rainstorms.
- Introduce and improve livestock breeds that are more productive in terms of milk and meat production, which are also less vulnerable to heat stress, and are more drought-tolerant.
- Improve irrigation methods by applying contemporary strategies, including trickle irrigation and the usage of sprinklers.
- Ensure availability of high-quality feed and fodder for livestock to enhance their grazing on rangelands.
- To lower the risk of crop failure, encourage farmers, especially in rain-fed areas, to cultivate a mix of heat- and drought-resistant low delta crops rather than monoculture.

### **Coastal**

Building natural barriers like mangrove plantations and regeneration of coastal palms and trees is crucial to reduce soil and sand erosion and mitigate the effects of cyclones and tsunamis. Vulnerable coastal areas need protection from commercial activities and infrastructure construction, and the level of activities allowed in these areas should be determined. Additionally, managing garbage disposal and pollution in bay areas is essential.

### **Health**

Climate change is causing significant health impacts due to increased frequency and intensity of extreme weather events. Floods and storms increase the risk of death and injury, leading to diarrheal illnesses and psychological issues. Vector-borne illnesses like dengue fever and malaria also rise due to climate change. To prevent health impacts and plan for effective interventions, it is crucial to improve disease outbreak monitoring and forecasting systems, adopt water and sanitation safety strategies for rural and urban areas, and expand disease outbreak monitoring and forecasting systems. This will enable earlier planning for interventions and better protection against climate change.

### **Local strategies for floods**

Flood disasters require residents to adopt specific regional coping mechanisms to protect their homes. These strategies include repairing roofs and walls, raising houses off the ground, creating taller rooms, planting trees and grass, and maintaining dry and steady food reserves. Water reservoirs should be built in upper catchments of Naseer Abad and Jaffar Abad to control water flow and reduce flood damage. Modern, efficient irrigation methods like sprinkler, drip, and trickle systems should be used instead of flood irrigation.

### **Disaster Preparedness**

Climate change is expected to increase the frequency and intensity of extreme weather events, including floods, landslides, droughts, and cyclones, in South Asia, particularly Pakistan. These risks are becoming more severe due to climate change, and Pakistan is already experiencing its effects. To mitigate these effects, the Governments of Balochistan and Pakistan should take several measures.

1. Strengthen disaster management institutions to handle various risks and improve resilience.
2. Establish clear protocols for coordination and interministerial decision-making at provincial and federal levels.
3. Enhance local capacities for disaster preparedness and mitigation at district levels.

4. Upgrade and redesign storm drainage capacity in vulnerable monsoon areas and cities to handle short-duration, severe rainfall events.

5. Build flood and cyclone shelters in areas vulnerable to these events.

6. Introduce and develop a curriculum on environmental planning and climate change, focusing on disaster risk reduction (DRR) and incorporating it in the formal education system at all levels, especially in higher education. These measures will help reduce the effects of climate change and ensure the safety and resilience of the region.

### Conclusion

Pakistan's per-capita greenhouse gas (GHG) emissions are quite low relative to global norms. Pakistan's total greenhouse gas emissions from 2017 to 2018 amounted to 490 million tons of CO<sub>2</sub> equivalents. However, it is profoundly affected by the consequences of climate change. Research indicates a worldwide pattern of climate change observable in almost all regions of Balochistan. This encompasses phenomena such as floods, cyclones, water shortages, a notable rise in the frequency and intensity of severe weather events, and erratic monsoon rains leading to recurrent siltation of minor dams and droughts. The province is deficient in essential infrastructure for water storage and disaster management, and it confronts socioeconomic issues like as poverty, inadequate access to education, and restricted healthcare facilities. The interplay of these variables, along with the increased dependence of the Balochistan populace on natural resources, restricted technical proficiency, and insufficient financial means to address climatic extremes, renders them very susceptible.

Water shortage and food insecurity are a significant rising concern that illustrates this dilemma in the climate change discourse of Balochistan. In the next decades, it is probable that food and water availability would diminish compared to present levels, within a climate that is much more adverse, characterized by floods, rising sea levels, cyclones, and increasing temperatures. This province is anticipated to experience declining health, reduced agricultural and livestock output, animal fatalities, starvation, drought, and earthquakes, compounded

by escalating energy costs, rendering it more susceptible to the impacts of climate change. Similarly, climate change poses a significant threat to poverty alleviation initiatives and has the potential to reverse decades of developmental progress.

The susceptibility of Pakistan, especially Balochistan, to the ramifications of climate change necessitates the prioritization and implementation of adaptation and mitigation measures. This can only be accomplished by the development and implementation of appropriate adaptation measures, ideally nature-based solutions, at the provisional and local levels. Nonetheless, the crux of the problem persists as ineffective governance, and any feasible remedies can only be executed if the government adopts objective, proficient, and viable policies

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