

COPING WITH UNPREDICTABLE SHIFTS IN MONSOON PATTERN OF PAKISTAN: AN INDICATOR OF CLIMATE CHANGE

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*(Views expressed in the brief are those of the author, and do
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Background

The earth's climate has been evolving since it came into being. However, the extreme climatic events observed in the 21st century, mainly due to increasing influence of human activities, have highlighted climate change as a global concern. The main measures of climate change include rise in global temperature and spatio-temporal variations in precipitation patterns. Climate change is hitting water resources of world catastrophically as the ice covers are decreasing, sea levels are rising, heat waves are more frequent and rainfall patterns are shifting due to global warming, affecting some nations more than others in terms of magnitude and rate of change.¹ According to the Global Climate Risk Index published by non-profit group German watch, Pakistan is one of the most vulnerable nations in the world when it comes to the effects of climate change over the past two decades with eighth rank among most affected countries.² Pakistan has suffered tremendously in terms of lives as well as economic losses due to recurrent extreme weather events such as floods, droughts, cyclones, glacial

1 Thornton, P. K., Ericksen, P. J., Herrero, M. & Challinor, A. J. Climate variability and vulnerability to climate change: a review. *Glob. Chang. Biol.* **20**, 3313–3328 (2014).

2 David Eckstein, Vera Künzel & Laura Schäfer. *Global Climate Risk Index 2021*. <https://www.germanwatch.org/en/19777> (2021).

lake outbursts, cloud bursts and heatwaves. While speaking at a summit “The Future Summit – What’s Coming Next”, Dr. Shamshad Akhtar, Chairperson, Pakistan Stock Exchange stated that climate change has cost Pakistan about \$3.8 billion annual economic losses over the last two decades.³ The monsoon floods of 2010 alone killed more than 1600 people, inundating over 20 percent land and causing damage worth roughly \$10 billion.⁴

Profile of Pakistan

In summer, Pakistan receives the monsoon rainfall while the winter rainfall is brought by the western depression. The country mostly consists of arid to semi-arid areas and about three-fourth of the country receives an average of less than 250 mm rainfall while the rest receives about 125 mm rainfall. The Sub- Mountain regions and the southern slopes of the Himalayan range are exceptions with the annual rainfall ranging from 760-2000mm. The driest areas of country receive an average 210mm rainfall annually, located in the Balochistan province.⁵

The annual mean temperature of Pakistan has increased by approximately 0.5°C during the last 50 years, bringing about high variability in annual precipitation. The monsoon precipitation has been observed to increase except in coastal areas, however, the winter rains exhibit a mixed pattern with an overall decreasing trend in Sulaiman and Kirthar Ranges of Balochistan, Western Highlands, and Great Himalayas. Given the global emissions scenario, there is an expected rise of 3°C to 5°C in the annual mean temperature of Pakistan by the end of the 21st century, with high inter-annual variability in average rainfall. However, the long-term rainfall trends cannot be projected due to unpredictable shifts in precipitation patterns.⁶

A very noticeable decline in monsoon rainfall was recorded from 2010 to 2017 with typically heavy rainfalls in 2010 and overall weaker and warmer monsoons over the northern monsoon belt of Pakistan later.⁷ The data collected by Pakistan Meteorological Department, illustrated in Figure 1 below, highlights sudden shifts in monsoon rainfalls with the average 9.04mm decrease in past five years.

³ Keynote address by Dr. Shamshad Akhtar (Chairperson, Pakistan Stock Exchange & Karandaaz. (2022).

⁴ Memon, N. *Malevolent Floods of Pakistan 2010-2012*. (2013).

⁵ Chaudhry, Q.-Z., Mahmood, A., Rasul, G. & Afzaal, M. *Climate Change Indicators of Pakistan*. Pakistan Meteorological Department, Technical Report No. PMD-22/2009 (2009).

⁶ Asian Development Bank. *Climate Change Profile of Pakistan*. (2017)
doi:<http://dx.doi.org/10.22617/TCS178761>

⁷ Safdar, F., Khokhar, M. F., Arshad, M. & Adil, I. H. Climate Change Indicators and Spatiotemporal Shift in Monsoon Patterns in Pakistan. *Adv. Meteorol.* **2019**, (2019).

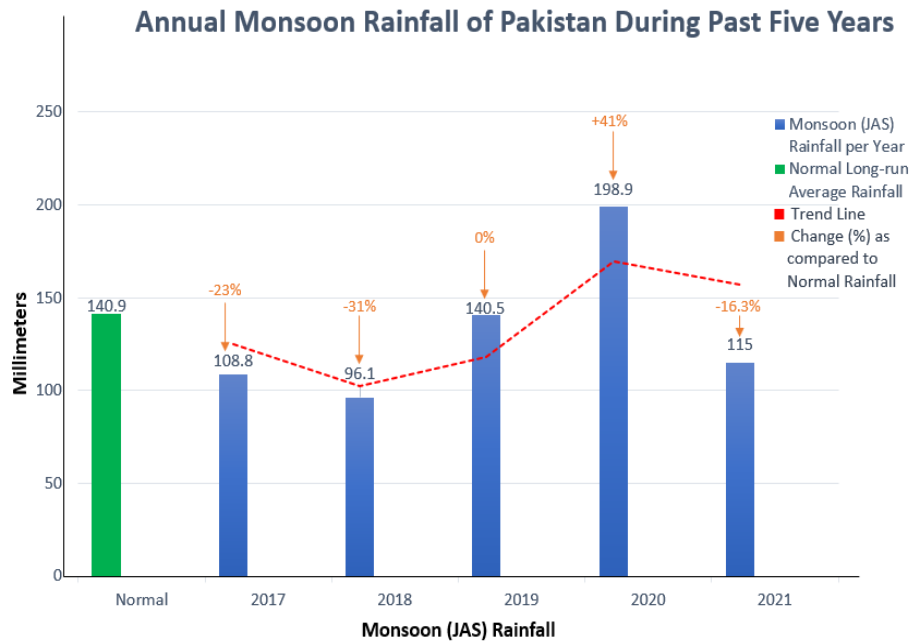


Figure 1: The annual monsoon rainfall patterns of Pakistan since 2017

In the ongoing year, 2022, monsoon season started a day earlier (30th June) than its normal onset in the northern regions of country. Rainfall in July 2022 has been recorded 181 percent above average i.e., 177.6 mm against normal 63.1mm. Monthly rainfall of July 2022 alone surpassed the total normal monsoon rainfall by 26% where excessive rain was recorded in Balochistan at 450% above normal and Sindh at 308% above normal, achieving the record of wettest July since 1961. Balochistan and Sindh were ranked the wettest during 62 years of July and Punjab ranked second wettest with 116% above average rainfall. The torrential rain has brought about massive flash floods in Balochistan, Sindh and southwest Punjab, costing human lives as well as economic losses.⁸ According to National Disaster Management Authority (NDMA), about 1 million people have been affected by floods since mid-June 2022, death count has reached 580 including women and children, 939 people were severely injured and 10,000 people have been displaced as of 9 August 2022. More than 56,000 hectares of crop area and about 42,000 houses have been damaged in these monsoon floods.⁹

⁸ Pakistan Meteorological Department. *Climate Data Processing Centre*. <http://www.pmd.gov.pk/cdpc/home.htm>.

⁹ Teoh, J. & Iqbal, F. *Pakistan 2022 Flash Floods*. https://reliefweb.int/attachments/cd4a2da0-da9c-4da4-bb8f-a2735caee33d/Pakistan_Floods_2022_OCHA_SitRep_02_-_12_August_2022.pdf (2022).

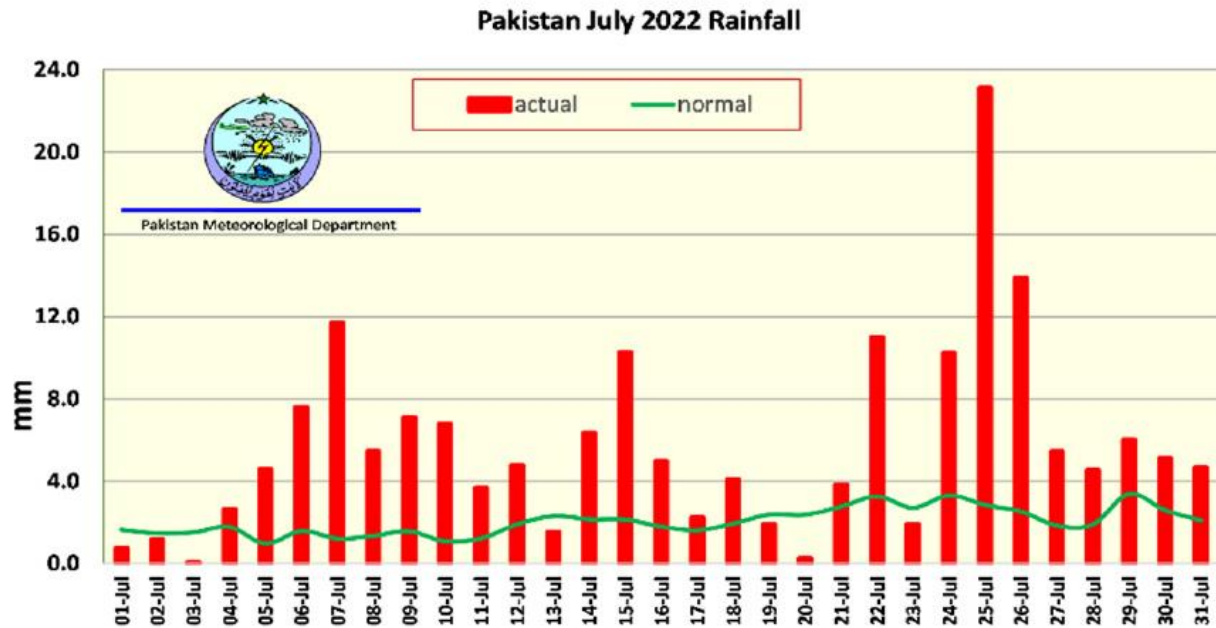


Figure 2: The monthly rainfall recorded in July 2022 (Source: Pakistan Meteorological Department)

Recommendations

Pakistan's reliance on freshwater resources is greatly affected by shifts in rainfall patterns, however, the inefficient water management is the country's own fault. The total dam capacity of Pakistan is 27.81 km³ which is far lesser than country's needs, and current economic conditions have halted the construction of big dam projects.¹⁰ The idea of building smaller dams is becoming more and more popular around the world, and it can be a viable solution to address flood or storm water management in Pakistan as they can be constructed anywhere with manageable cost and smaller footprints for structure and reservoir. Moreover, the capacity building of government officials and the public to prepare for, adapt to and mitigate the risks posed by climatic changes must be mainstreamed in policymaking.

The urban flooding due to heavy rainfalls poses great risk to the welfare of citizens and it can be resolved by improving the infrastructure to harvest rainwater, separate it from the sewer systems, recycle and reuse it. This can help mitigate the damage caused by shifting rainfall patterns and subsequent flooding or water scarcity. China's Sponge City Project in Wuhan is an outstanding example of retaining rainwater for the city's own use instead of funneling it away. Building domestic rainwater harvesting units following the example of north-eastern Peru communities has the potential to avoid groundwater depletion by boring in water scarce urban areas of Pakistan.

¹⁰ Tariq, M. A. U. R. & Van de Giesen, N. Floods and flood management in Pakistan. *Phys. Chem. Earth* **47–48**, 11–20 (2012).

Furthermore, there is a dire need of early warning systems with accurate forecasting equipment and pinpointing of vulnerable areas.

Pakistan needs to build research centers dedicated to furthering the knowledge on climate change to propose multi-pronged strategies to address the mitigation potential and promote climate-resilient water management structures. In addition, the National Climate Change Policy of 2012 and National Disaster Risk Reduction Policy of 2013 lay out guidelines to protect the public from implications of climate-induced disasters but there is a serious lack of implementation and synergy between federal and provincial bodies. Moreover, Pakistan does not allocate an adequate budget for wastewater treatment, desalination, and maintenance of artificial reservoirs. For instance, Dawn reported in 2017 that three of the four desalination plants in the port city of Gwadar were lying idle for more than seven years, while the working one could not operate at maximum capacity due to a lack of infrastructural resources. Despite growing water insecurity, Pakistan does not spend much on improving water management. Hence, serious, and urgent measures are needed to mainstream climate change-induced monsoon precipitation into policymaking and national strategy, investing in climate-smart infrastructure and businesses.