

## IMPACTS OF CLIMATE CHANGE AND FLOOD DISASTERS IN PAKISTAN

A. Panhwar<sup>1\*</sup>, H. R. Nawaz<sup>1</sup>, N. Jalbani<sup>1</sup>, R. Sultana<sup>1</sup>, S. H. Solangi<sup>1</sup>, U. Rashid<sup>2</sup>, and M. Hai<sup>1</sup>

<sup>1</sup>Pakistan Council of Scientific & Industrial Research Laboratories Complex, Karachi, Sindh, Pakistan.

<sup>2</sup>Pakistan Council of Scientific and Industrial Research Laboratories Islamabad.

\*Corresponding Author: aijazap@yahoo.com, Cell: +923003922677.

**ABSTRACT:** Ecosystems and human life depends on availability of water. Pakistan holds its 4<sup>th</sup> position for consuming of freshwater in the world. Pakistan is considered a water-stressed country and is rapidly approaching water scarcity. Pakistan may face climate change challenges in terms of related to water. The quality of drinking water is likewise degrading rapidly. Since independence in 1947, Pakistan has witnessed 29 floods up to 2023, including the first ever flood in 1950 and almost every second year in 1950, 1955, 1956, 1957, 1959, 1973, 1975, 1976, 1977, 1978, 1981, 1983, 1984, 1988, 1992, 1994, 1995, and 2010 up to 2023. There is still no exact data available on the loss to the economy. In 2022, the country is witnessing more than \$15 billion in losses. In 2010 calamity, around 1,600 peoples were killed and 38,600 km<sup>2</sup> inundated, almost \$10 billion (855 billion PKR) was damaged and 578 billion needed for the reconstruction of flood damages. Efficient climate change policy can support the management of water resources as well as boost economic growth, boost agricultural output, and meet food demand. Climate change's effects on expanding cities, rising wages, and growing populations will combine to create a world where water demand will rise exponentially while availability will become more limited and unpredictable.

**Keywords:** Climate Change, Disasters, Drinking water, Ecosystem, Environmental Challenges, Floods.

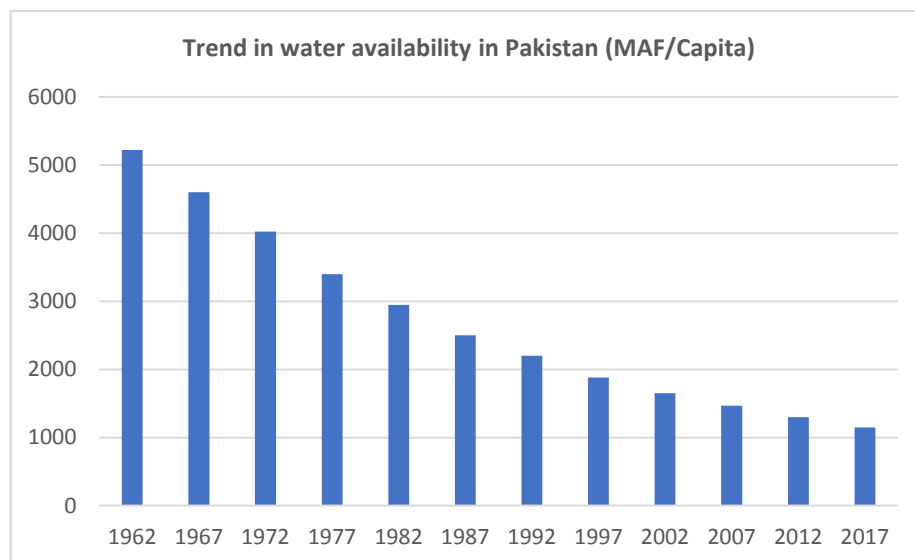
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### INTRODUCTION

Although Pakistan is endowed with an abundance of water resources, the unfavorable effects of climate change, a lack of storage facilities, and inadequate water administration are causing a severe water crisis. Water resources are being further taxed by

the growing population, which is currently 225 million and is projected to reach 250 million by 2025. Per capita availability of water is rapidly declining, from 5,000 m<sup>3</sup> in 1951 to 1,100 m<sup>3</sup> in 2005, and is predicted to drop to 800 m<sup>3</sup> by 2025.



**Figure-1. Water availability in Pakistan:** Pakistan's water consumption is growing at an average annual rate

of 10%, meaning that by 2025, the country's water resource will be 240–258 km<sup>3</sup>, while its demand will rise

to 338 km<sup>3</sup>. Pakistan is considered a water-stressed country and is rapidly approaching water scarcity. The quality of drinking water is likewise degrading rapidly (Ishaque *et al.*, 2022). About 74% of the surface water that is available is extracted, and 83% of the groundwater is utilized for agriculture and other purposes. This is a remarkably high ratio for a country with limited water resources like Pakistan. Drought and flooding are occurring nearly annually as a result of extreme weather brought on by the negative effects of climate change. Insufficient water storage facilities, excessive water usage in families and agriculture, insufficient wastewater recovery, and tainted drinking water pose health hazards that have escalated into significant national security issues for Pakistan (Waseem *et al.*, 2023).

With an estimated 225 million people living there and an average annual growth rate of 1.75%, Pakistan is the fifth most populated country in the world (WB, 2022b). Geographically, it ranks 33rd with 340,590 square miles of land area and 650 miles of coastline along the Arabian Sea and the Gulf of Oman. The demand for water has been rising dramatically as the world's population rises. The growing global population over the past century has resulted in an approximately six-fold increase in the amount of water required globally (Tehsin *et al.*, 2019). The water demand for domestic and industrial uses, as well as agricultural uses, will rise by 8% in 2025 as a result of the population's exponential growth (Parry, 2016). According to a survey of the literature, Pakistan's per capita water availability was 5,260 m<sup>3</sup> in 1951, dropped to 1,187 m<sup>3</sup> in 2017, and is

predicted to drop to 800 m<sup>3</sup> by 2025 (Qureshi and Ashraf, 2019, PIDE, 2022).

**Climate Change and Pakistan:** Climate change has become a familiar word throughout the world and an alarming word for climate-affected countries. Pakistan has witnessed 29 floods up to 2023, the first ever flood in 1950, and almost every second year: 1950, 1955, 1956, 1957, 1959, 1973, 1975, 1976, 1977, 1978, 1981, 1983, 1984, 1988, 1992, 1994, 1995, and 2010 up to 2023 (*thefridaytimes.com*, accessed on Saturday, March 30, 2024, written by Momna Tahir), but the state has not developed a robust system to protect lives and properties from destruction and devastation. Collectively, between 1951 and 2020, Pakistan lost 13262 lives and 197273 village damages over 616558 sq. km. There is still no exact data available on the loss to the economy. In 2022, the country is witnessing more than \$15 billion in losses. In 2010, around \$10 billion (855 billion PKR) was damaged and we needed 578 billion for reconstruction of flood damages (Economic Survey 2010-11, Special Edition, Pakistan Flood Impacts Assessment, [www.finance.gov.pk](http://www.finance.gov.pk)). While the highest temperature history is more than 100 years old, 52.8 °C was recorded in Jacobabad in 1919 ([Wikipedia.org/wiki/List of Extreme Weather Records in Pakistan](http://Wikipedia.org/wiki/List_of_Extreme_Weather_Records_in_Pakistan), accessed on March 29, 2024). In terms of the ratio of water withdrawals to water resources, Pakistan was ranked 160th in 2017 (WRI 2022), outperforming only eighteen other countries.

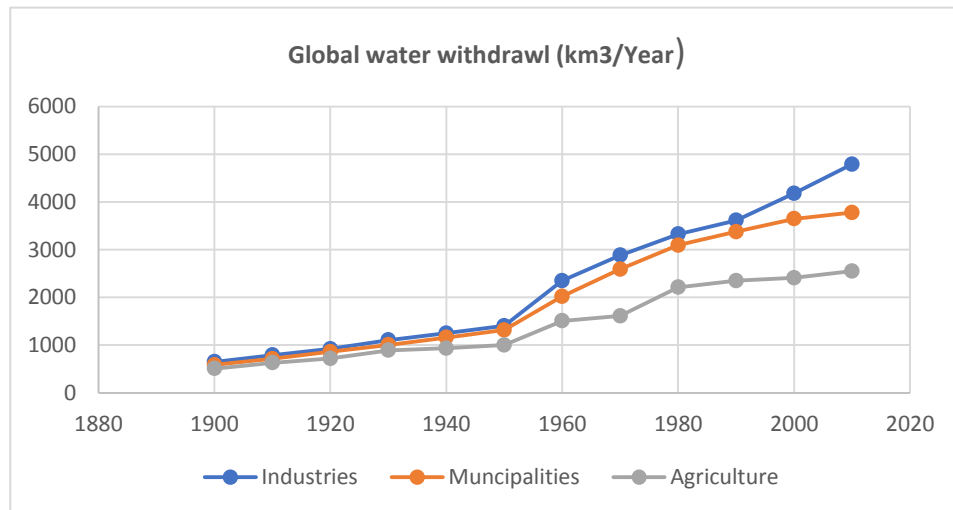


Figure- 2. Global water withdrawal

The biggest users of water are homes and industry, followed by agriculture. What's more concerning is that Pakistan's groundwater reserves, the last line of defense for water security, are likewise running out quickly. The Indus Basin's undersea aquifer

is the second-most stressed water resource in the world, and its rivers and tributaries are Pakistan's primary water resources. The amount of water is expected to increase, primarily because of growing cities, rising incomes, and

an expanding population, reaching 274 million acre-feet (MAF) by 2025.

It is anticipated that rainfall will become less consistent and more erratic at the same time that storm surges and floods will intensify due to warmer ocean temperatures. In addition to the already demanding trends in water use, climate change will intensify shocks connected to water. By 2050, freshwater availability may be reduced by as much as two-thirds in cities compared to 2015 levels due to competition from other uses like energy and agriculture. Then it is anticipated that climate change will have an impact on groundwater reservoirs both directly through altered patterns of recharge and indirectly through increased demand, particularly from irrigation, which now accounts for 70% of groundwater withdrawals worldwide. Additionally, groundwater supplies will decline. Aquifer water quality is also at risk due to climate change. Pakistan and other hotter regions may have higher groundwater salinity because more water evaporates before it can get to deeper depths (Aijaz, 2022).

The demand-supply gap is estimated to be around 81 MAF, with supply anticipated to be steady at 193 MAF (50 MAF from groundwater plus 143 MAF from river inputs) (IMF, 2015). Over the past three decades, heat waves have increased fivefold, while the country's mean annual temperature has grown by only 0.5 °C during last five decades (Chaudhry, 2005; Qamar, 2017). Pakistan ranks 14th out of 17 countries with "extremely high water risk," indicating that it already has a water-stressed population (WRI 2022). Pakistan has been one of the world's top 10 most vulnerable nations to climate change during the past 20 years, with 10,000 deaths from climate-related disasters and \$4 billion in losses owing to 173 extreme weather events (Eckstein *et al.*, 2021). Water resources management affects our society, including health, because of low availability of water, wastage of water, droughts, and directly hit production, which ultimately burdens human life, increases household expenses due to high rates of commodities, and suffers due to a lower income. Pakistan is severely suffering from climate change effects despite its very low contribution to GHG releases. Put another way, Pakistan, which has the fifth-largest population in the world, was placed 36th out of 184 nations in 2017 (FAO 2022) for total renewable water resources, whereas India was ranked 8th and Bangladesh was ranked 12th. Climate change is not the only factor contributing to the water crisis in Pakistan. Poor water resources management, such as traditional agricultural practices, i.e., sugarcane and rice crops, are the largest water consumers in the sector; but it worsens already-existing circumstances, making it harder to control water availability and quality and necessitating the development of new management techniques (Nazam 2022). Pakistan's susceptibility to climate threats has also been validated by

the GCI 2021. Pakistan's position on the Vulnerability Index is eighth. The analysis that is provided demonstrates the serious effects of climate change on Pakistan, which range from terrible foods to intense heat and drought (Eckstein *et al.*, 2021). Developed countries are responsible for emissions of GHG; the contribution of the USA, Canada, and Australia is 6 metric tons per capita, and in western European countries it is 2–5 mt per capita, while Japan contributes the same amount and developing countries contribute 0.6 mt per capita. There is less contribution from developing countries in GHG and they are facing huge losses from climate change consequences. (Gross 2022) while 50 developing countries are contributing less than 0.2 mt per capita. Pakistan is particularly susceptible to the negative effects of climate change. The study looks at how climate change would affect Pakistan in 2022, with unheard-of heatwaves and droughts in the summers and unusual monsoon season rains and floods (Waseem *et al.*, 2022). In recent years, there has been a vast migration activity from rural to urban areas, especially to Karachi, Lahore, and Faisalabad. The migration of population from rural to urban areas has greatly increased due to more facilities and opportunities in urban areas as compared to rural or village life. Unimaginable losses resulted from the 2010 floods in Pakistan: approximately 20 million people were affected, 436 healthcare facilities were destroyed, 80% of food reserves were destroyed, 2.9 million households suffered severe damage, nearly 1.1 million houses were damaged, and 135 districts lost \$9.7 billion in economic value.

The flood in 2022 have resulted in enormous losses and unparalleled harm to the world's water supplies. 33 million people are direct sufferers, with the death toll exceeding 1500. While 63% of flood victims are having difficulty finding enough clean water channels, 30% of water channels are badly disrupted. An estimate of the financial damages incurred is \$30 billion USD. The world's atmosphere is changing due to the buildup of greenhouse gases (GHGs), which is raising temperatures worldwide and endangering biodiversity. Other effects include disturbed biogeochemical cycles, food insecurity, water scarcity, migration, and loss of forest cover. Migration and anthropogenic activities are also responsible for the deterioration of water quality (Xi-Liu and Qing Xian, 2018). In 20 years span 2000-2020, greenhouse gas emission decreased 4% on agricultural lands and other gases 13% increased, and livestock contribution was 57% (FAO 2022, page-50).

The UN Secretary General, Mr. Antonio Guterres, is a witness to the devastation of climate change in Pakistan in 2022. He visited the affected areas on 9-10 September 2022. He insisted on the developed world playing its role and contributing to climate change. He claimed that Pakistan, which produces less than 1% of global emissions, has been assaulted by nature, citing the

effects of developed-nation emissions and climate pollution (Guterres, 2022b). Pakistan is ranked number 8 on the Global Climate Index (GCI) 2021 (Eckstein *et al.*, 2021) for vulnerability to climate threats, further supporting the country's weaknesses. The information that is being given demonstrates the dire effects of climate change on Pakistan, which range from terrible floods to intense heat and drought. As a result, Pakistan's long-term water sustainability is quite vulnerable to variations in weather patterns.

**Pakistan and Water Security:** Freshwater resources on Earth's surface have not changed in the past 100 years, but due to urbanization, deforestation, and high population expansion, there is an uneven distribution of access to these resources (Sorenson *et al.*, 2011). Likewise, excessive water scarcity is mostly caused by other problems, including technological waste, expanding industrialization, global warming, and climate change (Woodward *et al.*, 2010). Water security is becoming a problem in Pakistan; though Pakistan is the sixth-most populous country in the world, its water resources are relatively abundant only 16 countries possess more water because of its low population density.

In countries where there is less water per person, less than 10% of the world's population resides. While problematic, a country's lack of water does not determine its economic fate. The average gross domestic product (GDP) per capita of the 32 nations that have less water per person than Pakistan is ten times more than that of Pakistan. Of these 32 water-scarce countries, only six are poorer than Pakistan; they are all African countries that heavily rely on traditional rainfed agriculture and have invested little in irrigation. Pakistan does not utilize its water resources to the fullest. Agriculture uses outdated agricultural methods and inadequate resource management to account for a large portion of water demand. Pakistan is ranked 14th out of 17 highly high-risk countries plagued by water renewable resources scarcity, according to a report released by the Pakistan Institute of Development Economics (PIDE), since poor management wastes more than one-third of the available water (Bukhari and Rehman, 2022). Water availability per resident has steadily decreased since 1962, when the Indus Water Treaty (IWT) between India and Pakistan was formalized. This decline began in 1962 and continued until 2017, when it was approximately 1187 cubic meters (Khan, 2019). Even though the water shortage is becoming a major worldwide issue, it has had a significant negative impact on Pakistan and other developing nations, with far-reaching effects across all domains. Pakistan is one of the top ten seriously "high water risk countries," with the most badly impacted industry being agriculture (Iqbal and Iqbal, 2015). Furthermore, it is quite concerning to note that about 80% of the population has a severe water shortage for at least

one month out of the year. Groundwater resources, the final alternative for water supply in the absence of surface water, are being overused. According to the most recent UN report on Pakistan's population growth, the country's population is expected to surpass 366 million by 2050 (Siddiqui, 2022). This would increase the country's water demand, which is expected to reach 274 million acre feet (MAF) by 2025 compared to the 191 MAF of available water supply. Due to poor water management and an expanding population, the disparity between supply and demand will only widen annually [Hoek *et al.*, 2002]. In Pakistan, the quality of the accessible drinking water is appalling. The most often used term in Pakistan these days is "water pollution," which has many different causes that impact the quality of the water that is readily available (Rehman *et al.* 2020). According to Postel *et al.* (1996), the common causes include an increase in air temperatures and the inherent tendency of bacteria, organic compounds, heavy metals, and nutrients to absorb heat to the point where they become toxic. Pakistan is in desperate need of treatment plant installation because every year hospitals are overrun with patients, adults and children alike, who are afflicted with illnesses brought on by tainted water.

**Conclusion:** According to this study, Pakistan's most pressing national security issue is water security. The availability of water is examined in relation to the growing population, agriculture, and other water-related uses. The effects of anomalous glacier melting, the absence of dams to store rainfall, and the ingenuity of agricultural water harvesting techniques have all been investigated to provide factual support for the claims made. Because water is essential to manufacturing, declining water resources may cause growth to slack off and jeopardize economic prospects. Water-related losses in agriculture, health, income, and property might cause some regions to experience continuous negative growth, with growth rates falling by as much as 6% of GDP by 2050. Our farmer's majority is illiterate and unaware of the latest agriculture technologies. The majority of female agriculture workers are also uneducated. This study makes the case that Pakistan's underground and surface water supplies are rapidly declining and that this could become the country's largest national security issue if it is not addressed soon. In order to determine the necessary water availability and usage, the article thoroughly examines Pakistan's surface and subsurface water resources, including storage reservoirs and sectoral use. Due to population growth and surface and groundwater waste, an insufficient water resources management system is creating a gap between supply and demand in the wise use of available water. Pakistan's lack of water is becoming a major national security threat. The policy's execution presents a formidable challenge to the preservation of the available water supplies. The problem

of Pakistan's water security cannot be solved with a single easy fix. All governments and water consumers will need to work together on multiple fronts for many years. There are substantial holes in the infrastructure that need to be filled, which will cost a lot of money. Although they don't address the most urgent problems with water security, large storage reservoirs can help with certain parts of it.

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