

Ten Billion Trees Tsunami Program: Mitigating the Non-Traditional Security Threat of Climate Change and Water Crisis in Pakistan

Dr. Muhammad Akram Zaheer (Corresponding Author)

Lecturer in Political Science, University of Okara, Okara

Email: akramzaheer86@yahoo.com

Publication History:

Received: May 16, 2023

Revised: May 29, 2023

Accepted: June 04, 2023

Published Online: July 01, 2023

Keywords:

Ten Billion Trees Tsunami Program,
Climate change,
Water crisis,
Pakistan,
Non-traditional Security Threat,
Mitigation,

Research related to Academic Areas:

Pakistan Studies, Social Sciences,

Acknowledgment:

This paper is a sole academic initiative of the author.

Ethical Consideration:

This study has no aim to hurt any ideological or social segment but purely based on academic purposes.

Abstract

The Ten Billion Trees Tsunami Program is a massive initiative in Pakistan aimed at mitigating the non-traditional security threats of climate change and water crisis by planting ten billion trees over the course of five years in areas prone to deforestation and drought. This program seeks to increase forest cover, improve water availability, mitigate soil erosion, and enhance the overall environmental resilience of the country. Additionally, it aims to create job opportunities for local communities and promote eco-tourism. This paper discusses the key objectives, implementation strategies, and potential outcomes of the program, highlighting its significance in addressing the urgent environmental challenges faced by Pakistan.

Copyright © 2023 IPICS Journal as an academic research-oriented non-profit initiative of Rehmat and Maryam Researches (SMC-Pvt) Limited, publishing from Islamabad, Rawalpindi, and Lodhran under the registration from Security and Exchange Commission of Pakistan (SECP). This is an open-access article. However, its distribution and/or reproduction in any medium is subject to the proper citation of the original work.

Introduction

Enjoying Northern East location on the globe, Pakistan is lies into a subtropical and semi-arid region, with magnitude of 24.30' N– 37° N as well as 61° E – 75° E, just above tropic of Cancer 23.5° N, roughly the agriculture and climate are greatly influenced by the Arabian Sea coastline existing in 1046 km south. Summer monsoons bring, approximately 38% received rainfall (408.3mm) in the 2020 which was more than 1961-2010 (average 297.6 mm) and winter brings a very few rain showers (PMD, January 28, 2021). However, seasonal showers used for purpose of agricultural, and today the productivity are influenced most by the global warming and climatic variability. About 3.1% comprises of water reservoirs and 96.9% is soil region, with 90% agricultural land irrigated and 10% remains on rain water for total 23.04 million hectares cropped area of country.

Water security or term defined by UN water, (2018) “water scarcity” literally means a shortage of freshwater, foundation of life and livings, and the key to sustainable development (Guppy & Anderson, 2017, p. 01) emphasize distinguishes that socio-economic, environmental and political factors cause in the availability of water relative demand for the emergence of its scarcity or influence the amount shortage. Veldkamp discovered the water shortage as the most dangerous risks for humanity, changing socio-economic and hydro-climate situation (Veldkamp T I, 2015, pp. 18-29).

Water security is becoming an increasingly important issue globally as population growth, climate change, and other factors place greater strain on water resources. Lack of water security can lead to water scarcity, which can have significant social, economic, and environmental consequences, including reduced agricultural productivity, increased food prices, and conflicts over water resources.

Pakistan is one of the most water-stressed countries globally, with a per capita availability of water of only 1017 cubic meters per year. This figure is well below the United Nations' minimum threshold of 1700 cubic meters per year, indicating water scarcity.

Pakistan relies heavily on irrigation agriculture, which accounts for approximately 90% of its total water usage. However, much of this water is lost due to inefficient irrigation systems, resulting in reduced crop yields and waterlogging in some areas. Furthermore, climate change has led to more frequent and intense droughts and floods, exacerbating Pakistan's water insecurity.

The country faces challenges in managing and distributing its water resources effectively. The Indus River System, which provides most of Pakistan's water supply, is shared with India, leading to water disputes between the two countries. Water security remains a significant challenge for Pakistan, with implications for food security, public health, and economic development. Addressing this issue will require improved water management practices, investment in water infrastructure, and international cooperation to resolve water disputes.

Pakistan is now only 30 years away from becoming water scarce, which will affect our agricultural, industrial, domestic sectors with a result of our economy devastation. Presently, conservative about the cost of various water-related risks estimate that 4 percent of our GDP is used (or \$12 billion) a year (Young, 2019, p.xv). The majority of these costs relate to poor sanitation and water supply. This insecurity makes Pakistan one of the top 33 countries under extreme water stress and Karachi is recognized as the 6th most vulnerable city (Eckstein, Hutfils, & Wings, 2018, p. 30). The Global Climate Risk Index (GCRI) by German Watch found that Pakistan was the nation most influenced by the climate in 2012. A reassessment of GCRI by the German reveals that Pakistan moved to 7th position in the vulnerability index as shown in

Causes of the Threats

More recently, Muhammad Abubakar, (2020) explained that GCRI in its annual report for 2020 placed Pakistan on the 5th spot on the list in most vulnerable to climate change (Zuberi, January 25, 2021). According to NASA 9,989 lives have suffered economic losses worth US\$3.8 billion and witnessed 152 extreme weather events from 1999 to 2018, in 19 years. The IPCC concluded that the vulnerability to climate change is on increase (NASA, August 19, 2022).

With 220 million increasing inhabitants, supply remains 191 million against the demand 274 million acre-feet water for achieving the UN Sustainable Development Goal (SDG) to ensure availability of management of sustainable water resource and sanitation for all (Ahmad, et al., September 2022; 81).

In 2010, per capita availability around 1,040 cubic meters, Ministry of Water Resource, Pakistan, (2018) predicts with an expected to drop to around 500 cubic meters by 2035 (Zeshan & Shakeel, August 2020, p. 02). The water scarcity issues are inter-alia derived by the climate change including droughts, floods, pollution as well as overuse of water, increase in residents and intensive use of water in cultivation (Alam, January 31, 2015). The fresh sources of underground water were not refilled as a result of the human, agricultural and industrial wastes. The current water storage capacity remains less than ten percent (about 13.7 million acre feet, MAF onwards) of the total water received (about 145 MAF) every year (GoP, April 24, 2018).

In 2010, Ministry of Water Resources Pakistan (2018) proposed that the per capita availability of water was around 1,040 cubic meters till 2035 (Sharif, 2016, pp. 117-131).

In 2011, WAPDA reported that the potential hydro generation capacity in the Indus river system was about 59,000 MW, but only 6,595 MW was being exploited. Additionally, there is potential to bring 22 million acres of land under irrigation by extending the Indus basin irrigation network to the arid areas of Pakistan (WAPDA, 2011, p. 11). However, the World Economic Forum has identified the water crisis as a long-term threat to Pakistan (Durani, March 11, 2020, p. 02), as the availability of water on an annual basis is less than 1000 cubic meters. By 2025, the demand for water will reach 274 million acre-feet, but the supply will only be around 191 million-acre-feet (Meribole, April 29, 2020). If necessary measures are not taken, the International Monetary Fund predicts that Pakistan will become barren and dry by 2025 (Baloch, June 07, 2020).

Causes of Water Crisis

The causes of the water crisis are multiple, including weather and climate problems, wastage of water, and climate change. Climate change has caused a fluctuation in temperature, leading to a shortage of freshwater for human life and food production, which is happening in Pakistan and is likely to get worse in the future (BBC, November 02, 2022). Pakistan uses 145 million acre-feet of water each year, but only 13.7 million acre-feet are saved. The country needs 40 million acre-feet of water, but 29 million acre-feet of floodwater is wasted due to a lack of dams (Shah, September 14, 2020). Additionally, India has been accused of being irresponsible in the Indus Water Treaty and showing a sense of selfishness in providing water through its rivers to Pakistan (Vater, June 23, 2021). Pakistan's per capita availability of water has fallen to only 1017 cubic meters, which is much less than the 1500 cubic meters in 2009 (Talpur, September 16, 2019).

The construction of new dams, namely the Diamer Basha and Mohmand dam, requires both national and international help in raising funds of \$16.98 billion to build them (Sigamony, January 13, 2023).

Causes of Climate Change

Climate Change has also affected the current situation as well. Extreme heat, melting glaciers and the gas emission has contributed in the water crisis. The rivers and seas are soaking year by year due to extreme weather.

The present situation has also been affected by climate change. The emission of gases, melting of glaciers, and extreme heat has all contributed to the water crisis. The excessive weather conditions have caused the rivers and seas to become shallower every year. The global temperature has risen by 0.6 degrees Celsius, and it is predicted to increase by 1 degree Celsius by the end of the century. This change will increase the heat in Southern areas, which play an important role in earning revenue from tourism. Furthermore, this change in climate has resulted in cyclones, droughts, floods, and heat waves. The melting of Karakoram glaciers has altered the rainfall patterns, and flash flooding occurs every year in Northern areas. There has been no visible change or rise in water level from 1969 to 2014, comparing to the highest flows each year with total flow capacity each year in UIB and Indus River (NASA, Devastating Floods in Pakistan, August 28, 2022). The monsoon season is also uncertain, and experts are facing difficulties in predicting the monsoon due to the impact of climate change. (Shehzad, Choudhry, & Ghuman, June 2020, p. 47). The duration of winters has also decreased from four months to two months in recent decades due to greenhouse emissions and extreme hot weather (Costa, Sprout, & Teng, December 14, 2022).

Dams and Population Growth

Population growth has also contributed to the water crisis across Pakistan. The construction of Kalabagh Dam, located on the Indus River in the Mianwali district of Punjab, has been pending for almost 40 years due to regional debates. The construction of the ongoing Diamer Bhasha dam may help resolve the issue of water crisis by providing water for irrigation and drinking purposes. It will have a water storage capacity of 85,000,000 acres feet once it is completed. It will also be used as the protector of the Terbela Dam as it will help in stopping flow of silt towards Terbela Dam that is decreasing the storing capacity of the dam (Ghuman, December 14, 2022).

Population Growth and Need of Water

Experts predict that there will be horrible water situations in 2025 with a decrease of 31M ac-ft. to no water, showing complete drought (Shehzad, Choudhry, & Ghuman, June 2020, p. 50). This situation will lead to food shortage, deforestation, and survival becoming difficult for almost 1.8 billion citizens. Pakistan has faced this issue because there is no proper planning for distribution and consumption, and there are no preventive or preservation measures in place for this natural resource (Watto, Mitchell, & Bashir, 2021, p. 228). The per capita water has decreased from 1,500m³ to 1,017m³. Pakistan's two larger dams, Mangla and Tarbela, have reduced the storage capacity from 145 million Acre-Feet to 14 million Acre-Feet, which have high debris and sand, reflecting the critical point in respect of water reservoirs (The Express Tribune, August 02, 2022).

The Indus River Issue

The Indus River is one of the largest in South Asia, stretching for 3000 km with a drainage basin of 1 million km. The major tributaries of the river are located in the Himalayan and Karakoram Mountain ranges of Tibet and India, and the Hindu Kush ranges of Afghanistan. The river flows through both Indian and Pakistani-controlled areas, covering 70% of Pakistan's territory, including Punjab, Sindh, the North-West Frontier Province, and part of Baluchistan (Agriculture, January 31, 2022).

The Indus River is the only source of water for Pakistan, with six other tributaries, including Chenab, Sutlej, Beas, Jhelum, and Indus. The water provided by the Indus River is sufficient to meet the needs of 300 million individuals. Pakistan was given the Indus, Jhelum, and Chenab rivers, while India was given the Beas, Ravi, and Sutlej rivers (The World Bank, June 11, 2018). The Kabul River originating from the Hindu Kush falls in Indus River. Farmers in Khyber Pakhtunkhwa depend on KRB. India is also starting hydropower projects on KRB to increase pressure on Pakistan for water (VoA, March 15, 2017).

The Global Climate Risk Index (CRI) is an annual report produced by German watch, a non-profit organization that analyzes and ranks countries based on their vulnerability and exposure to climate change. According to the 2021 Global Climate Risk Index, Pakistan ranks 8th among countries the most affected by climate change from 2019 to 2000. The CRI report measures the impact of extreme weather events such as floods, storms, and heatwaves on a country's economy, infrastructure, and human life (Siddiqui, May 21, 2022). The country with 33 million people has suffered from many deadly climate events. It is especially prone to earthquakes and heavy floods (Red Cross, December 6, 2022).

Pakistan has suffered from many deadly climate events, ranking eighth among countries most affected by climate change from 2000 to 2019. The country is prone to earthquakes and heavy floods, experiencing floods, droughts, and heatwaves resulting in significant economic losses and human suffering (Mukhtar, 2020, p. 64).

Pakistan needs to address the non-traditional security threats of climate change, investing in climate adaptation measures, reducing greenhouse gas emissions, and building resilience against extreme weather events. The greenhouse gas emission to mitigate the effects of climate changes and builds resilience against its impacts (NASA, Responding to Climate Change, 2018).

The worst earthquake in Pakistan occurred on October 8, 2005, causing the deaths of 73,338 people. The 2010 floods affected over 20 million people in 132,000 square km, causing the deaths of 1,767 people and damaging 1,884,708 households (Hut, July 2, 2018). Pakistan Tehreek-e-Insaf initiated a massive tree-planting campaign called the Billion Tree Tsunami in 2014 to improve climate conditions (Hut, July 2, 2018). As claimed by PTI, the campaign was aimed at improving climate conditions. As claimed by the government, the campaign was aimed at improving climate conditions (Khan, March 14, 2021).

Ten Billion Trees Tsunami

Pakistan's forests are mostly located in the north, and deforestation is occurring at a rate of 4% per year. By 2025, Pakistan will be short of major food crops by 28 million tons and will need to import edible oils and large quantities of wheat (Agriculture, January 31, 2022, p. 19). The Government of Khyber

Pakhtunkhwa has launched a vision of green growth to address sustainable forestry development, generating green jobs, gender empowerment, preserving natural capital, and tackling the global issue of climate change.

Region Division

- **Central-Southern Forest Region-I Peshawar:** D.I. Khan, Bannu, Kohat, Peshawar, Mardan
- **Northern Forest Region-II Abbottabad:** Haripur, Agror Tanawal, Tor Ghar, Gallies, Siran, Kaghan, Hazara Tribal, Lower Kohistan, Upper Kohistan, Daur Watershed, Kohistan Watershed, Unhar Watershed, Kunhar Watershed, Buner Watershed
- **Northern Forest Region-III Malakand:** Malakand, Buner, Lower Dir, Swat, Alpuri, Kalam, Upper Dir, Dir Kohistan, Chitral (Hut, July 2, 2018)

On September 3rd, 2018, the 10 billion Tree Tsunami program was praised by the United Nations Environment Program (UNEP) and the World Economic Forum for its accomplishments. During the period of July to March in 2021, approximately 350 million plants were planted and around 100,000 daily workers were employed up until March 2021. In total, over 800 million plants have been regenerated or planted in the past two years. The program achieved a plantation of 350 million plants in the first three quarters of 2021 and employed about 100,000 daily workers until March 2021. The goal is to reach one billion plants by June 2021 (Agriculture, January 31, 2022). The Saudi Arabian government contacted the Pakistani government on the basis of this international appreciation to plant 10 billion trees in their own country (Malik, January 31, 2022).

The billion trees program received praise from the United Nations Environment Program (UNEP), with their statement reading: "We are at a point in history where we need to act and Pakistan is leading on this important effort (UN, March 29, 2022; Hut, July 2, 2018). Furthermore, Pakistan was congratulated for reaching its target of planting one billion trees ahead of schedule. Khyber Pakhtunkhwa, a province in Pakistan, became the first international entity to complete the challenge. As a result of the Bonn challenge's success, the Head of the International Union for Conservation of Nature (IUCN), Inger Anderson, referred to the project as "a true conservation success story (UN, March 29, 2022; Hut, July 2, 2018). Pakistan's Billion Tree Tsunami surpasses Bonn challenge commitment (Janat, August 15, 2017).

Potential of TBTT to Alleviate the Water Crisis

This initiative was launched by the Pakistani government in 2014, with the purpose of combating climate change, preventing water scarcity, and promoting peace within the country.

The Ten Billion Trees Tsunami aims to tackle these challenges by focusing on conservation, afforestation, and reforestation. The objective is to cover an area of 865,000 hectares with the planting of one billion trees, while also preserving existing forests and promoting sustainable forestry practices. This project has the potential to increase forest coverage and restore degraded ecosystems, which can improve water quality and availability. Trees serve as natural water filters and can help replenish groundwater reserves, which are essential for agriculture and human consumption. Furthermore, by increasing forest cover, the

initiative can minimize soil erosion and prevent sedimentation in rivers, which further improves water quality (Duffy, Donoghue, Ryan, Kilcline, Upton, & Spillance, July 2020, p. Online).

The project aims to alleviate the negative impacts of climate change that are worsening the water crisis in Pakistan. Trees are effective in absorbing carbon dioxide from the atmosphere and reducing greenhouse gas emissions that cause climate change. Moreover, the project can prevent soil erosion and sedimentation in rivers, which in turn mitigates the effects of extreme weather conditions like floods and droughts that are becoming more frequent in Pakistan (World Weather Attribution, September 14, 2022).

The project, known as the Ten Billion Trees Tsunami initiative, can also encourage sustainable land use and raise awareness on conservation and environmental protection. Engaging local communities in the project can provide job opportunities and improve livelihoods, while promoting a culture of sustainability and conservation (UN, Pakistan's Ten Billion Tree Tsunami, June 2, 2021).

Trees play a crucial role in maintaining the water cycle by absorbing water from the soil and releasing it into the atmosphere through transpiration. This can increase rainfall and improve soil moisture levels, which can have positive long-term effects on water availability (Stockholm, March 15, 2022). Additionally, planting trees in strategic locations, such as along riverbanks, can help reduce soil erosion and improve the health of watersheds, which are vital for maintaining water resources (Haris, 2023).

However, while the initiative is an important step towards addressing environmental and water-related issues in Pakistan, it alone cannot completely resolve the complex and multifaceted water crisis in the country. A comprehensive and coordinated approach is required that addresses underlying causes of water scarcity, including poor water management, outdated infrastructure, and over-extraction of groundwater. Therefore, while the Ten Billion Trees Tsunami initiative is a positive step towards addressing environmental and water-related issues in Pakistan, it should be seen as part of a larger strategy that includes measures to improve water governance, infrastructure, and agricultural practices, and to promote conservation and efficiency in water use (Haris, 2023, p. 57).

The Ten Billion Trees Tsunami initiative can increase the carbon sink capacity of the country by planting one billion trees, which will help offset carbon emissions and reduce the carbon footprint. The initiative also aims to restore watersheds and promote sustainable water management practices, which can prevent water crises. Additionally, planting trees can provide habitat for wildlife, conserve soil, and regulate climate, reducing conflicts over natural resources (Anderson, Gauthier, Thomas, & Wondelock, January 15, 1996). The initiative has created job opportunities and generated revenue for the government through the sale of timber and other forest products, providing economic opportunities for local communities (FAO, March 12, 2023).

The Billion Trees Tsunami initiative is a comprehensive approach to addressing the non-traditional security threats of climate change and water crisis in Pakistan. Its success highlights the importance of investing in sustainable forestry practices and conservation efforts to address environmental challenges globally (Haris, 2023, p. 57).

Conclusion

The Billion Trees Tsunami initiative has shown that investing in sustainable forestry practices and conservation efforts can effectively combat the non-traditional security threats posed by climate change and water crises. This initiative has helped alleviate the effects of climate change, averted water crises, and facilitated peace-building in Pakistan. Additionally, it has created economic opportunities for local communities by generating jobs and revenue for the government. The success of the Billion Trees Tsunami initiative in Pakistan serves as a model for other countries facing similar environmental challenges. Countries can address environmental challenges and build resilience against non-traditional security threats by adopting sustainable forestry practices, investing in afforestation and reforestation, and promoting conservation efforts. The Ten Billion Trees Tsunami project has the potential to mitigate the non-traditional security threat of the water crisis in Pakistan by enhancing water quality and availability, mitigating the effects of climate change, and promoting sustainable land use practices. However, it is important to note that the project alone cannot solve all of the country's water-related problems, and additional measures are required to address the underlying causes of the water crisis, such as poor water management practices, rapid population growth, and urbanization.

References

- Agriculture. (January 31, 2022). Finance Division. Retrieved from Government of Pakistan.
- Ahmad, S., Zehra, J., Ali, M., Ali, S., Iqbal, S., Kamaal, S., et al. (September 2022; 81). Impact of water insecurity amidst endemic and pandemic in Pakistan: Two tales unsolved. *Ann Med Surg (Lond)*., doi: 10.1016/j.amsu.2022.104350.
- Alam, K. (January 31, 2015). Farmers' adaptation to water scarcity in drought-prone environments: A case study of Rajshahi District, Bangladesh. *Agricultural Water Management*, Volume 148,, 196-206.
- Aljazeera. (MAy 13, 2022). Pakistan city hits nearly 50C as blistering heatwave grips nation. Retrieved March 26, 2023, from <https://www.aljazeera.com/news/2022/5/13/pakistan-city-hits-nearly-50c-as-blistering-heatwave-grips-nation>
- Anderson, J., Gauthier, M., Thomas, G., & Wondelock, J. (January 15, 1996). Summary of Discussion Papers. <https://www.fao.org/3/AC697E/AC697E12.htm#TopOfPage>: FAO.
- The Express Tribune. (August 02, 2022). Retrieved March 16, 2023, from Tarbela nearing full capacity: FFD report: <https://tribune.com.pk/story/2369078/tarbela-nearing-full-capacity-ffd-report>
- Baloch, S. M. (June 07, 2020). Water crisis: How is Pakistan running dry.? Retrieved February 11, 2023, from DW: <https://www.dw.com/en/water-crisis-why-is-pakistan-running-dry/a-44110280#:~:text=%22Pakistan%20receives%20around%20145%20million,because%20we%20have%20few%20dams>
- BBC. (November 02, 2022). What is climate change? A really simple guide. Retrieved February 11, 2023, from BBC: <https://www.bbc.com/news/science-environment-24021772>

Costa, H., Sprout, E., & Teng, S. (December 14, 2022). Greenhouse Effect. Retrieved March 20, 2023, from National Geographic: <https://education.nationalgeographic.org/resource/greenhouse-effect/>

Red Cross. (December 6, 2022). Retrieved March 26, 2023, from Flooding in Pakistan: the latest news: <https://www.redcross.org.uk/stories/disasters-and-emergencies/world/climate-change-and-pakistan-flooding-affecting-millions#:~:text=Over%207.9%20million%20people%20are,clean%20water%2C%20and%20toilet%20facilities.>

Duffy, C., Donoghue, C. O., Ryan, M., Kilcline, K., Upton, V., & Spillance, C. (July 2020). The University of Rhode Island. Forest Policy and Economics, Volume 116,0, online.

Durani, Z. K. (March 11, 2020). Water Scarcity and Social Vulnerabilities: A Multi-Dimensional Perspective of Water Challenges in Pakistan. Journal of Sustainability Education.

Eckstein, D., Hutfils, M.-L., & Wings, M. (2018). Global Climate Risk Index 2019. BRIEFING PAPER German Watch.

FAO. (March 12, 2023). National forest products statistics, Pakistan. Retrieved from Food Agriculture Organization: <https://www.fao.org/3/ac778e/AC778E15.htm>

Ghuman, M. (December 14, 2022). Briefing on Diamer-Bhasha Dam sought: Senate panel discusses sedimentation at Tarbela Dam. Retrieved March 12, 2023, from Business Recorder: <https://www.brecorder.com/news/40215455>

GoP. (April 24, 2018). NATIONAL WATER POLICY 2018. <https://mowr.gov.pk/Detail/MWEwYjg0ZWQtdmMwLWlxZTQtNjM1ZmZkZDZlZjU2>: Ministry of Water Resources.

Guppy, L., & Anderson, K. (2017). GLOBAL WATER CRISIS: THE FACTS. United Nations University Institute for Water, Environment and Health.

Haris, J. (2023). Socioeconomic Impacts of the Ten Billion Tree Tsunami (TBTT) Plantation Project on the Participating Communities. SLU, <https://stud.epsilon.slu.se>.

Hut, R. (July 2, 2018). Pakistan has planted over a billion trees. Retrieved March 20, 2023, from World Economic Forum: <https://www.weforum.org/agenda/2018/07/pakistan-s-billion-tree-tsunami-is-astonishing/>

Janat, S. (August 15, 2017). Pakistan's 'Billion Tree Tsunami' surpasses Bonn challenge commitment. Retrieved March 12, 2023, from World Asia: <https://gulfnews.com/world/asia/pakistan/pakistans-billion-tree-tsunami-surpasses-bonn-challenge-commitment-1.2074800>

The World Bank. (June 11, 2018). Retrieved March 12, 2023, from Fact Sheet: The Indus Waters Treaty 1960 and the Role of the World Bank: <https://www.worldbank.org/en/region/sar/brief/fact-sheet-the-indus-waters-treaty-1960-and-the-world-bank>

Khalid, F., Taj, M. B., Jamil, A., Kamal, H., & Afzal, T. (2020). Deforestation Dynamics in Pakistan: A Critical Review. *Pakistan Academy of Science* 57 (3): 27-34, 27-34.

Khan, I. (march 14, 2021). The Express Tribune. Retrieved March 26, 2023, from PTI's environment policies being recognized globally: PM Imran: <https://tribune.com.pk/story/2289392/ptis-environment-policies-being-recognised-globally-pm-imran>

Malik, S. (January 31, 2022). Saudi Arabia to plant 10 billion trees in Pakistani style. Retrieved March 14, 2023, from The Express Tribune: <https://tribune.com.pk/story/2341228/saudi-arabia-to-plant-10-billion-trees-in-pakistani-style>

VoA. (March 15, 2017). Retrieved March 15, 2023, from India Approves Hydropower Projects on Rivers That Flow Into Pakistan: <https://www.voanews.com/a/india-hydropower-projects-indus-river-pakistan/3768491.html>

The World Bank. (March 27, 2023). Retrieved 03 27, 2023, from Population, total Pakistan: <https://data.worldbank.org/indicator/SP.POP.TOTL?locations=PK>

Meribole, J. (April 29, 2020). he Water Crisis In Pakistan. Retrieved Feb. 11, 2023, from Borgen Magazine: <https://www.borgenmagazine.com/water-crisis-in-pakistan/>.

Mukhtar, A. (2020). Climate Change and Water Security: Case of Pakistan. *JSSA Vol. VI, No. 1*, 56-85.

NASA. (2018). Responding to Climate Change. Retrieved March 29, 2023, from <https://climate.nasa.gov/solutions/adaptation-mitigation/>

NASA. (August 19, 2022). Global Climate Change. Retrieved 01 17, 2023, from The Effects of Climate Change: <https://climate.nasa.gov/effects/>

NASA. (August 28, 2022). Devastating Floods in Pakistan. Retrieved March 20, 2023, from Earth Observatory: <https://earthobservatory.nasa.gov/images/150279/devastating-floods-in-pakistan>

PMD. (January 28, 2021). State of Pakistan's Climate in 2020. <http://www.pmd.gov.pk/cdpc/home.htm>: Pakistan Meteorological Department.

PVWRM. (May 14, 2003). Pakistan's Vision of Water Resource Management. Islamabad: Minister for Water and Power.

World Weather Attribution. (September 14, 2022). Retrieved March 30, 2023, from Climate change likely increased extreme monsoon rainfall, flooding highly vulnerable communities in Pakistan: <https://www.worldweatherattribution.org/climate-change-likely-increased-extreme-monsoon-rainfall-flooding-highly-vulnerable-communities-in-pakistan/>

Shah, A. S. (September 14, 2020). Water Crisis, A Bigger Threat Than Terrorism. Retrieved February 26, 2023, from Daily Times: <https://dailytimes.com.pk/666539/water-crisis-a-bigger-threat-than-terrorism/>

Sharif, M. J. (2016). Managing Water Availability and Requirements in Pakistan: Challenges and Way Forward'. *Agric. Res.*, Vol. 54(1).

Shehzad, T., Choudhry, S., & Ghuman, K. (June 2020). Climate Change and Water Shortage in Pakistan: An Analysis. *Orient Research Journal of Social Sciences* Vol.5, No. 1, 45-55.

Siddiqui, U. (May 21, 2022). Perfect climate storm': Pakistan reels from extreme heat. Retrieved March 23, 2023, from Aljazeera: <https://www.aljazeera.com/news/2022/5/21/hold-heatwave-in-pakistan-and-climate-change#:~:text=Between%20000%20and%202019%2C%20the,whole%20period%2C%20the%20group%20said.>

Sigamony, T. J. (January 13, 2023). Fund for construction of dams: Amount increased to Rs16.53bn, SC told. Retrieved February 14, 2023, from Business Recorder: <https://www.brecorder.com/news/40219991>

Stockholm. (March 15, 2022). Pakistan's Ten Billion Tree Tsunami leading the way in ecosystem restoration decade. Retrieved March 13, 2023, from https://few.kp.gov.pk/page/about_billion_tree_tsunami_afforestation_project

Talpur, M. (September 16, 2019). Future of water in Pakistan. Retrieved February 22, 2023, from Daily Times: <https://dailytimes.com.pk/466856/future-of-water-in-pakistan/>

UN. (June 2, 2021). Pakistan's Ten Billion Tree Tsunami. Retrieved March 12, 2023, from UN Environment Program: <https://www.unep.org/news-and-stories/story/pakistans-ten-billion-tree-tsunami>

UN. (March 29, 2022). Daily Times. Retrieved March 23, 2023, from Pakistan leading the Global Ecosystem restoration efforts: UNEP: <https://dailytimes.com.pk/909902/pakistan-leading-the-global-ecosystem-restoration-efforts-unep/>

Vater, J. J. (June 23, 2021). The Indus Waters Treaty: Prospects for India-Pakistan Peace. Retrieved February 18, 2023, from ISAS institute of South Asian Studies: <https://www.isas.nus.edu.sg/papers/the-indus-waters-treaty-prospects-for-india-pakistan-peace/>

Veldkamp T I, W. Y. (2015). Changing mechanism of global water scarcity events: Impacts of socioeconomic changes and inter-annual hydro-climatic variability. *Global Environmental Change* 32:, 18–29.

WAPDA. (2011). An Overview of Electricity Sector in Pakistan. ICCI.

Watto, M. A., Mitchell, M., & Bashir, S. (2021). *Water Resources of Pakistan: Issues and Impacts*. Singapore: Springer.

Young, W. A. (2019, p.xv). *Pakistan: Getting More from Water*. World Bank.

Zeshan, M., & Shakeel, M. (August 2020). Water Crisis in Pakistan: A Dynamic CGE-Water Model. *Research Square*, 01-24.

Zuberi, M. (January 25, 2021). Pakistan 5th most vulnerable country to climate change. Retrieved 02 11, 2023, from Business Recorder: <https://www.brecorder.com/news/40225687/imf-govt-talks-give-birth-to-mini-budget>