CLIMATE CHANGE AND WATER SECURITY: FOCUS ON PAKISTAN

Kinza Tasleem Chauhdry & Umbreen Javed[*]

Abstract

Climate change has discernably created imbalance in many bio systems. Among these systems, the water cycle has been conspicuously disrupted, as a primary fall-out of climate change. Water is the fundamental element of life. Accessing good quality of water has become the major concern of mankind. The poorly managed water resources are cause of catastrophes (floods, droughts, heavy rains, famine etc.). Water security, being one of the seven components of human security, has a direct impact on human life. This article draws attention towards the effects of climate-change over water security, with a focus on Pakistan. The focus on the impacts of climate change on water security was undertaken at a pivotal time in the region. Notwithstanding the debate, as to whether these observed extremes are evidence of climate change, an investigation is needed regarding the extent to which the country is resilient to these shocks. High temperature, increasing salt-water imposition in coastal ranges, a growing threat of glacier lake outburst floods, more intense rainfall, and changes in monsoon and winter rainfall patterns are just some of the ways in which climate changes are expected to affect Pakistan's hydrologic resources. These risks amplify an already problematic situation, given that Pakistan is among the most water stressed countries in the world. Per capita access to surface and groundwater sources is expected to continue to decline in the decades ahead, driven largely by rapid population growth and urbanization. It is, thus, timely, and critical, to focus on climate risks for water security in the Indus basin of Pakistan.

Key Words: Climate-change, Population, Temperature, Hydrologic, Global

Introduction

Water security refers to the 'sustainable access' of adequate quantities of water of good quality to keep the health of human beings and ecosystem intact.[1] Water security is important for national security.[2] Water's importance can be understood by conflicts for access to water around the globe and competing demands for finite water resources. Climate change poses a major threat to water security at present.[3] Water scarcity and floods in many regions of the world make them vulnerable to water security. Global warming, population growth, urbanization and growing consumption of water and energy continue to disrupt our already fragile ecosystem. By 2025, it is estimated that global population will increase from 7.2 billion to 8 billion, which will put

[*] Ms. Kinza Tasleem Chauhdry Ph.D Scholar, Department of Political Science University of the Punjab, Lahore, Pakistan and Professor Dr Umbreen Javaid Dean, Faculty of Behavioral & Social Sciences University of the Punjab, Lahore, Pakistan.

pressure on water demand for production of both food and energy.[4] Good quality water is not in access of one sixth of the population of the world, as reported by United Nations.[5] In 2025, almost half of the world's states will be facing water shortages, as predicted in a UN report. Change in weather patterns for prolonged durations is known as Climate Change. The depletion of ozone layer is responsible for melting of ice in Polar Regions. This results in an increase in sea levels. This rising sea level is threatening to the countries like Maldives, Sri Lanka, and Marshall islands.[6] Climate change has been playing the role of catalyst regarding water insecurity by exacerbating the temperature fluctuations, melting of polar ice, instable patterns of rainfall. Good quality and adequate quantity of water is not in access of many human beings on the globe. No doubt that the realities of climate change and related hydro-politics can be considered as one of the biggest challenges of this century.[7] As a matter of fact, climate change itself has been evolved as a serious security issue.[8]

Impact of Climate Change on Fresh Water Security

In future, water will be a scarce natural commodity. Distribution of water on our planet can explain this threat of fresh water scarcity[9], as 98% of total water on Earth is salty and only the remaining 2% of water is fresh. Approximately 70% of this fresh water is snow and ice, 30% of it makes groundwater, while surface water which includes lakes and river water, is less than 0.5% of this 2% fresh water, and the fresh water in atmosphere is less than 0.05%. These water proportions are severely affected by climate change at a global level. The melting of polar ice converts more fresh water into salty water of sea, thus, affecting the fresh water supply.[10] Availability of fresh water can be affected by either deficiency of water or absence of supply infrastructure. 'Climate change and human actions are the cause of land degradation, which convert fertile land into arid, semi-arid and sub-humid place', as explained in The International Convention on Desertification.[11] Increase in evapotranspiration, decrease in cyclic rate of precipitation and dryness of rivers and lakes present in permafrost lands are the other impacts of climate change, which affect the availability of water. Climate change also affects water quality, by increased growth of pollutants, due to flooding, turbidity and erosion. According to an estimate, the world will require 50% more energy and food by 2030, which needs water too.[12]

Accordingly, the allied impacts of any sort of water unavailability have a great impact on human beings and the environment. One of the effects of rising temperature and warming is the increase in atmospheric water, which leads to denser rainfall at the cooling of the air around. Though increased rainfall can enhance the freshwater resources, but there is swift water movement from air back to the oceans, which reduces the human capacity to store and utilize this water.[13] The phenomenon of evaporation increases due to warmer air, which ultimately replaces snowfall by rainfall. Another impact of rising temperature is the melting of glaciers, which increases the short term water supply to fresh water resources. In semi-arid lands, the climate change has resulted in a reduced rainfall. Overall, climate change has intensified the water cycle, thus, resulting in heavy floods and severe droughts around the globe.

According to a recent United Nations Environment Programme report, fresh water scarcity is not the only apprehension to look after, as direct effect of climate change, but it brings a chain of concerns with it. Population explosion leads to the increase in agricultural demand, which involves excessive water for irrigation purposes as well as excessive water pollution.

Another major factor is the water-intensive lifestyles led by populations in many countries, including Pakistan. Similarly, swiftly developing countries with a robust industry overlooks pollution control and water conservation due to lack of modern technology.[9] Therefore, climate change concerns should be managed along with pollution and water demand.

The Impact of Climate Change on Water Resources

Hydrological system determines everyday human life, thus, it is required to comprehend the impact of climate change on drinking water, food, sanitation, and energy usage. Climate and water have a complex but significant relationship and are closely linked. Climate change can easily upset the security of water systems of any settled civilization.

The changing patterns of precipitation and access to quality water, due to glaciers melting, has shown the negative impact of climate change, as it increases the chance of flood and drought. Overall, summers are getting dry effect, due to a perceptible decrease in periodic precipitation, deicing permafrost, rising temperatures, and amplified evapotranspiration. At many places, availability of water has become least predictable. Floods have become a

continuous threat of contamination for fresh water reservoirs and sanitation points.[14]

Conventionally, water has been considered a free source. Water footprint is a term used for the measurement of water used in the making of food or any goods. Education of the water footprint at every level of society is direly required to instruct the masses regarding value of water and ultimately their behavior for water consumption. The condition is known as Water Stress, when water demand surpasses the accessible amount during a particular tenure or when water is not useable due to its poor quality. Only human beings are not affected by this water stress; it can also threaten the existence of many flora and fauna. To mitigate drastic effects of climate change, strategies are needed to ensure the access of living beings to sustainable water sanitation.

Climate is Water

To contend climate change and to adapt to its drastic effects, all nations assembled to coordinate their joint ambitious effort in the form of The Paris Agreement. The Paris conference took a strong initiative "Climate is water" to mobilize civil society and all stake holders.[15] It focuses on the vulnerability of water in view of climate change to raise global awareness. It also proposes climate and water in same agenda to ensure the integration of water security in climate change discussions.

Impact of Climate Change in Pakistan

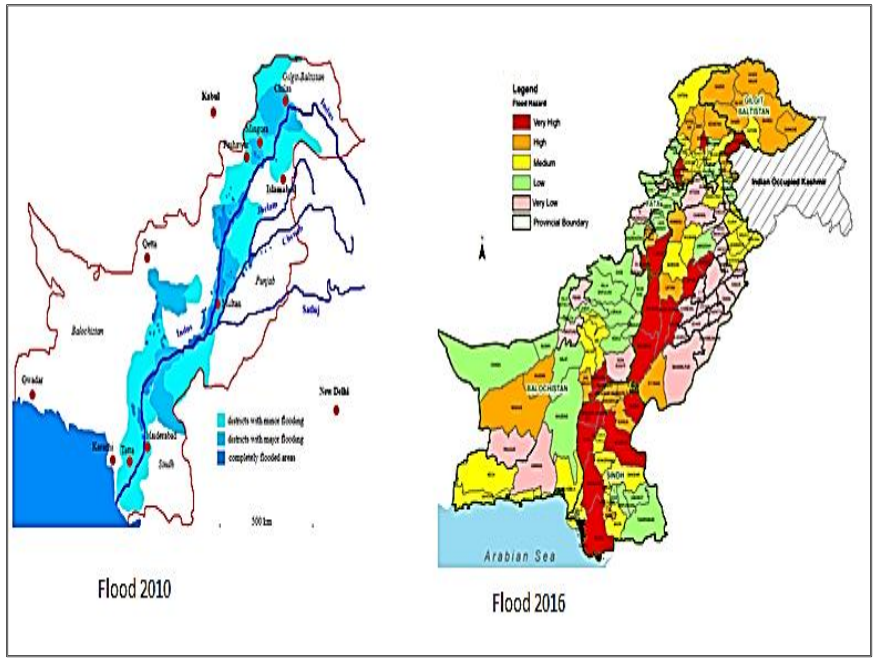
Climate change has drastic environmental, social and economic impacts for developing states like Pakistan. Floods, cyclones and droughts are some of natural calamities, which are frequently faced by Pakistan. The effect of these natural hazards increases the vulnerability of the population, when combined with poverty, mismanagement and wrong political decisions.[16] Population pressure along with shrinking natural resources and mounting poverty depicts a grim scenario. In contemporary times, there are various factors, which clearly affect the access to usable water. Continuously growing population, rampant urbanization, overuse and misuse of groundwater, agricultural changes due to development, mounting contamination of fresh water properties and several effects of climate change are some of these factors.

The emission of greenhouse gases in Pakistan has doubled during previous couple of decades. Pakistan stands at 135th position in the world regarding per capita Green House Gas emissions. This unexpected climate change has largely beset the agriculture sector of Pakistan, where 65-70% of population is related to agriculture, directly or indirectly. Diminishing water resources along with rising population are challenging the food security.[17] The rampant scarcity of water resources is one of the major causes of food insecurity in Pakistan.[18]

High temperature and stressed water resources are the peculiar features of arid and semi-arid regions, making them more vulnerable to changing climate patterns. Pakistan is geographically positioned in a region, which is semi-arid and does not have equally proportioned rainfall throughout the year. The significance of rainfall is factual as a major source of water. In 2009, drought conditions arose as a result of low rainfall, while more than 20 million people were affected as a result of disastrous monsoon in 2010. According to a watchful survey, this flood caused damages, estimating a cost of 10 billion US dollar, which included approximately half amount resulting from agricultural sector. In 2011, 1.2 million peoples were affected in Sindh province, where human life losses estimated to reach 361, as a result of massive rains. In 2012, flood flattened Khyber Pakhtunkhwa, Southern Punjab and Upper Sindh, destroying arable land and homes and resulted in death of 100 people. Similarly, death toll reached 80 people in 2013. In 2014, catchment areas of Punjab, Gilgit Baltistan and Azad Kashmir (AJK) were flooded, as a result of heavy monsoon, resulting human losses and affecting small enterprises, manufacturing and processing businesses with loss of employment.[19]According to a recent study, climate change has risked 49.6% of population and 22.8% of land in Pakistan.

Climate change has significantly affected the agriculture sector of the country, which is already facing water competition, due to growing population and rising temperatures. The probability of severe drop in the production of cash crops is the major challenge.[20] Another major issue includes the stressed water availability, which leads to the change in crop rotations and cropping patterns.

With a shift in patterns of monsoon, it has been third year that the crops are damaged by a pre-monsoon rainfall and hailing in March.[21] These hailstorms in southern Punjab could seriously affect, the fruit quality. Similarly mangoes could also face a knock off due to strong winds. The threat has spread to affect



the Rabi crops, including lentils, mustard, potato, gram, and other vegetables harvested in the summers. Therefore, a chain pattern of changes happen, which includes fluctuations in sowing time of crops which, in turn, fluctuates the irrigation conditions, which results in the change of soil quality.[22] These changes have increased the threat of disease and pest attack, adversely affecting the agricultural productivity. Similarly another challenge is strained rangelands, causing significant drop in livestock production. A great risk to general health arising due to poor water quality, is likely as the frequency of heavy rainfall events, floods and droughts increases with climate change.[23] Moreover, it is well-recognized that climate change will influence the occurrence of waterborne and water-related diseases such as malaria and cholera. However, understanding of the role of climate change in influencing future disease patterns in Pakistan is quite limited.

Strains over Water

Water availability is still challenging for industrial, agricultural and urban use, while keeping in mind the glacial melt-down, due to increasing temperatures.[24] It challenges the environmental flows in particular. Differences with neighboring India over sharing water resources are cause of major tension.

Similarly, the disputes over sharing water resources are a bone of contention among various provinces of Pakistan.[25] Grossly intensified climate and limited natural resources like water will lead to internal migration.

"Re-location of inhabitants from one place to another due to environmental issues like floods, drought etc., is source of anomalies both for emigrants and host communities."[26] Till now, the Indus Waters Treaty has been the major pacifier for water disputes between Pakistan and India.[27] Indus Water Treaty legalizes the rights of Pakistan and India over the tributary rivers of the Indus. Pakistan has reservation over India's unjust use of water in violation of the treaty, but Pakistan "probably pollute and waste more water than India is allegedly 'stealing".[28] In Pakistan, the water flow between Sindh and Punjab is regulated by the Indus River System Authority, which is still unable to resolve the apprehensions by both the provinces on the allocation and use of Indus Basin waters.

The geography of division of British India is tinted as hydrology was completely ignored during the partition.[29] India appeared as an upper riparian by having the control of head works of the rivers, which supply water to the Pakistan. In 1948, India caused severe agricultural damage to Pakistan by blocking the flow of River Sutlej. This materialized the dilemma of water insecurity right from the partition.[30] In May 1948, Pakistan and India signed an interim treaty, known as 'Inter Dominion Accord'.[31] According to this treaty, India decided the payment claims for water released into Pakistan as well as the quantity of that water.[32] This water dispute aggravated the situation between both countries and they went through a war over Kashmir in the same year.

Pakistan and Water Insecurity Concerns

Pakistan is rapidly becoming a water-scarce country, because there are evidences of depletion of its fresh water resources in big cities with a population growth rate of 1.6 % per annum. Moreover, climate variations like draught and erratic monsoon patterns have additionally worsened the situation as well.[33] These facts are accepted by every government in Pakistan without taking any necessary measurements. At present, Pakistan's agricultural economy is dependent upon Indus Basin emerging from Jammu and Kashmir. In fact, Kashmir issue between Pakistan and India is also interlinked with Indus basin water dispute. This fact was acknowledged by a former president of Pakistan

Pervez Musharraf in a speech that the Jammu and Kashmir dispute was primarily based on the distribution of the waters of the Indus and its tributaries between India and Pakistan and, if one of the two were resolved, the other would not exist.[34] India, being upper riparian, has a complete control over water, placing Pakistan in a very precarious situation.[35] Pakistani policy-makers are worried that India is not only fast building dams on the western rivers; it is also simultaneously engaged in activities aimed at stopping Pakistan from building water storage dams on these rivers, by controlling the supply of water by filling water in its dams in clear violation of the Indus Water Treaty.[36]

Pakistan is dependent on the Indus Basin water to meet its agricultural, domestic, and commercial needs. Indian hydro-projects (Wullar Barrage, Kishenganga and Baglihar dams) in Occupied Kashmir on the western rivers of Pakistan have raised insecurity in Pakistan, which relies on western rivers for its water supply. Another reason of insecurity is the vulnerability of Pakistan, being a lower riparian state with all the head works of western rivers under the control of India in occupied Kashmir.[37]

The Indus Water Treaty addresses the minimum supply of water, but it overlooked water distribution as well as demographic changes, which causes an increase in water demand in both countries. Henceforth, it is very challenging for Pakistan as the Indus Water Treaty safeguards the use of water by both states at that time, but it ignores future water interests of each country. India is allowed to build hydroelectric projects to produce energy at small scale without any reservoir, dam or flooding. In these run-of-the-river projects, elevation of a river and its natural flow generate power.[38] Therefore, all reservoirs of India on the Indus, Jhelum and Chenab are run-of-the-river projects, thus, having serious ramifications for the lower riparian state of Pakistan. India can easily manipulate the control of water flowing down into Pakistan, as it can hold water in dry weather and release it in rainy weather, which may cause floods.[39]

Pakistan has a legitimate cause for this concern, as if India constructs all of its planned hydroelectric projects on western rivers, it can gain the capacity of restraining almost a month's river flow during the acute dry season of Pakistan. It would easily devastate the whole planting term of Pakistan, which will adversely affect the agrarian economy of this lower riparian state.[40] This strengthens the notion that Pakistan dreads the control of water supply of

western rivers by India, as a weapon which could destroy the agriculture of Pakistan. The objections of Pakistan on the run-of-the-river projects refers to the violation of the Indus Water Treaty, regarding design criteria and the storage ventures that are being constructed by India on water of the western rivers. Pakistan has not objected to any rational explanation of this by India, but it would never relinquish its due rights as given under the Indus Water Treaty.[41] Therefore, Pakistan is already facing horrid trans-boundary effects on its environment due to Indian projects. They have also affected the power generating capability of the planned projects of Pakistan, as it can be observed in Neelum-Jhelum hydropower project. The recent economic, demographic, and environmental encounters intensified the distrust between both water-stressed states of Pakistan and India. This scenario has escalated the tensions, which can create warlike conditions anytime, thus, threatening the regional stability.

Policy Recommendations

The significance of water policy is determined by its impact. The water policy of one state can have its positive or negative impacts on the water security of other states. There is a dire need of local, national, regional and global authority as well as the catchment link up at all these levels according to the requirement. Water security has become a key policy region. There is a positive evolution of adaptive management discourses regarding water security in recent times. Explicit understanding of water security definitions also indicates its intrinsic environmental, economic, and social intricacy. Adaptive management is absolutely required to cater this social–ecological intricacy, due to its universal approach. It is essential to ensure the water security for humankind all over the globe. It is equally significant to maintain supply and demand from the water resources everywhere for recent and future populations.

- Governments should take initiative to create a will and allocate required resources for the change from 'conventional' methods to 'adaptive' ones.
- The best communal solution to cater the aggregating demand of water is to engineer the re-allocation of fresh water by following strategies:-
  - Build reservoirs to preserve it.
  - Spread pipelines to supply it equally.

- Initiate proper desalination at international and national level to recuperate fresh water from the seas and oceans.
- Regulate the use of ground water to eliminate over exploitation.
- Encourage harvesting from rain and flood water.

This could be a way of minimizing the horrid impacts of rampant climate change. Directed interventions are much more required to minimize the threat to water security posed by climate change in future.

Conclusion

Water has a pivotal role to play in the world adaptation to the changing climate and its effects. The biosphere, water and environmental needs call for a cohesive observation to develop maintainable economic and agricultural systems. This will help in mitigating the adverse impacts of climate change. It will also provide protection against extremes as well as help in adapting to the inevitable in the meantime. To resolve the water scarcity and to meet the increasing water demand, it is required to implement an effective control, regulation and financing, which offer effective technical solutions for water security around the globe. In this scenario, it is urgent to highlight key issues and prospective responses for public awareness to initiate a debate for management and utilization of sustainable resource. Low-income countries, including Pakistan, are quite vulnerable to these climate changes and stressed water supply adds fuel to the fire. Health security and food security are also affected due to non-availability of water.

The need of the hour is the implementation of effective governance, regulation and financing to allow technical solutions and disaster management strategy for water security. There is a vivid 'gap in governance' for the prevention of expected disaster as a result of degraded environment".[42] In future, Pakistan will be among the countries highly affected by energy crisis, owing to its increasing demands for electricity and high dependence upon water for hydroelectric power generation. At present, water shortage in rivers has directly affected the efficacy of small scale hydroelectric power installations, where energy production has reduced manifolds by unpredictability in water flows. It is high time to better recognize the potential for trade-offs between

energy sector water needs and those of other sectors, particularly the agricultural sector.

Many highlighted needs relate to reducing water demand, such as effective ways to raise public awareness concerning the need to engage in water conservation, household-level rain water harvesting and high-efficiency irrigation systems. Other areas requiring the immediate attention of policy-makers are the revision of water pricing policies, updating the academic curricula regarding sustainable development in a changing climate and strengthening the country's watershed monitoring networks.

Endnotes

[1] Emma Normanet al., "Water Security: A Primer: Program on Water Governance." *University of British Columbia* (2010).

[2] AbdelmohcineAimraneet al., "Climate Change and Water Security: Water Scarcity and Water Flood." In *Handbook of Research on Global Environmental Changes and Human Health*, pp. IGI Global, 2019: 41-52.

[3] Schaar, J. "The relationship between climate change and violent conflict."(2017).

[4] Angela Karp, and Goetz M. Richter. "Meeting the Challenge of Food and Energy Security" *Journal of experimental botany* 62, no. 10 (2011): 3263-3271.

[5] UN Water, "Water in a changing world. The United Nations World Water Development Report." (2009).

[6] Asit K. Biswas Email and Cecilia Tortajada. "Water Security, Climate Change and Sustainable Development: An Introduction." In *Water Security, Climate Change and Sustainable Development*, pp. 1-5. Springer, Singapore, 2016.

[7] Neil McIntyre, "How Will Climate Change Impact on Fresh Water Security?" *Dept. of Civil and Environmental Engineering and Grantham Institute for Climate Change, Imperial College London* (2007).

[8] Jeroen Warner, Ingrid Boas. "Securitization Of Climate Change: How Invoking Global Dangers for Instrumental Ends Can Backfire." *Environment and Planning C: Politics and Space* (2019).https://doi.org/10.1177/2399654419834018.

[9] John Briscoe, "The financing of hydropower, irrigation and water supply infrastructure in developing countries." *International Journal of Water Resources Development* 15, no. 4 (1999): 459-491.

[10] Willem Ligtvoet et al.,*The geography of future water challenges*. PBL Netherlands Environmental Assessment Agency,2018.

[11] Mohammad Kassas, "Desertification: A General Review." *Journal of arid environments* 30, no. 2 (1995): 115-128.

[12] Karp& Richter, "Meeting the challenge of food and energy security", 3267.

[13] Corinna Hawkes, et al., "Current and Planned Research on Agriculture for Improved Nutrition: Amapping and A Gap Analysis." (2012).

[14] Michael Y. Brubaker, et al., "Climate Change Health Assessment: A Novel Approach for Alaska Native Communities" *International Journal of Circumpolar Health* 70, no. 3 (2011): 266-273.

[15] Peter Christoff, "The Promissory Note: COP 21 and the Paris Climate Agreement." *Environmental Politics* 25, no. 5 (2016): 765-787.

[16] Anjum Bari Farooqi, Azmat Hayat Khan, and Hazrat Mir. "Climate change perspective in Pakistan." *Pakistan J. Meteorol* 2, no. 3 (2005).

[17] Rhona K. M. Smith, *Textbook On International Human Rights*. New York: Oxford University Press, 2016.

[18] Daanish Mustafa, MajedAkhter, and Natalie Nasrallah, *Understanding Pakistan's Water-Security Nexus*. Washington, DC: United States Institute of Peace, 2013.

[19] Muhammad Rashid Khan, "Crucial Water Issues between Pakistan and India, CBMs, and the Role of Media." *South Asian Studies* 28, no. 1 (2013): 213.

[20] M. H. Bukhari and Ejaz Ahmad Sayal, "Emerging Climate Changes And Water Resource Situation In Pakistan." *Pakistan Vision* 12, no. 2 (2011): 236.

[21] Mesfin M. Mekonnen and Arjen Y. Hoekstra, "Four Billion People Facing Severe Water Scarcity." *Science Advances* 2, no. 2 (2016): e1500323.

[22] Khan, "Crucial Water Issues between Pakistan and India" 213.

[23] Charles J. Vörösmarty et al., "Global Threats To Human Water Security And River Biodiversity." *Nature* 467, no. 7315 (2010): 555.

[24] Aaron T. Wolf and Joshua T. Newton, "Case Study OfTransboundary Dispute Resolution: The Indus Water Treaty." *Department of Geosciences, Oregon State University: Corvallis, OR, USA* (2008): 1-10. https://transboundarywaters.science.oregonstate.edu/sites/transboundarywaters.science.oregonstate.edu/files/Database/ResearchProjects/casestudies/indus.pdf

[25] Wendy Barnaby, "Do Nations Go To War Over Water?" *Nature* 458, no. 7236 (2009): 282.

[26] Hawkes, et al., "Current And Planned Research On Agriculture For Improved Nutrition".

[27] Undala Z. Alam, "Questioning The Water Wars Rationale: A Case Study Of The Indus Waters Treaty." *Geographical Journal* 168, no. 4 (2002): 341-353.

[28] UndalaZafarAlam, "Water rationality: mediating the Indus Waters Treaty." PhD Dissertation.,*Durham University*, 1998.

[29] John Briscoe, "The Financing of Hydropower, Irrigation and Water Supply Infrastructure in Developing Countries." *International Journal of Water Resources Development* 15, no. 4 (1999): 459-491.

[30] John Briscoe andUsmanQamar, *Pakistan's Water Economy: Running Dry*. Karachi: Oxford University Press, 2006.

[31] Mian Ahmad NaeemSalik, "Water Security: Challenges of Transboundary Water Issues between Pakistan and India." *Strategic Studies* 35, no. 4 (2015).

[32] Crispin Bates, "The Hidden Story Of Partition And Its Legacies" *BBC,*Published on March 3, 2011.http://www.bbc.co.uk/history/british/modern/partition1947_01.shtml

[33] DrShaheenAkhtar, "Emerging challenges to Indus Waters Treaty." *Reg Stud* 28, no. 4 (2010): 3-66.

[34] Pervez Musharraf, *In the Line of Fire: A Memoir*. Simon and Schuster, 2006.

[35] ShafqatKakaKhel, "The Indus Water Treaty: Negotiation, Implementation, Challenges and Future Prospects." *Pakistan Horizon* 67, no. 1 (2014).

[36] Khan, "Crucial Water Issues between Pakistan and India" 213.

[37] Kari Lipschutz, "Global Insider: The India-Pakistan Water Dispute." *World Politics Review,* Published on June 10, 2010. https://www.worldpoliticsreview.com/trend-lines/5756/global-insider-the-india-pakistan-water-dispute

[38] Peter Guthrie, *Global Water Security-An Engineering Perspective,* London: The Royal Academy of Engineering, (2010).https://www.raeng.org.uk/publications/reports/global-water-security

[39] Shahid Ahmad, "Water Insecurity: A Threat for Pakistan and India"*ISSUE Brief*, Atlantic Council, (2012): 1-8.https://www.files.ethz.ch/isn/154066/Ahmad_Indus.pdf

[40] Marcus Taylor, *ThePolitical Ecology Of Climate Change Adaptation: Livelihoods, Agrarian Change And The Conflicts Of Development*. Routledge, 2014.

[41] Nasir Jamal "Sound Bites: Scrapping The Water Treaty Is No Solution"*Dawn News,* Published on October 03, 2014.https://www.dawn.com/news/1135898

[42] Catherine Allan, JunXia and Claudia Pahl-Wostl, "Climate Change and Water Security: Challenges for Adaptive Water Management" *Current Opinion in Environmental Sustainability* 5, no. 6 (2013): 625-632.