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Social, Economic and Environmental Impacts of Hydrologic Extremes in Pakistan: A Meta-Analysis Approach

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Abstract

Hydrologic extremes are a complex phenomenon and global issue that affects every sphere of human activities. A deeper understanding and awareness of its social, economic, and environmental impacts in Pakistan is necessary. Therefore, this research synthesized qualitative investigations about social, economic, and environmental impacts in Pakistan and included a thematic analysis. Findings show that the social, economic, and environmental impacts of the hydrologic extremes in Pakistan were uneven. While areas near sea, rivers and dams, are vulnerable to flood, arid areas are vulnerable to droughts. Likewise, there were already serious inequalities in power relations and access to resources before every hydrologic extremes event, which influenced in numerous ways how households can recover. Women and children faced more complex social issues. Poor men faced more economic challenges.

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Introduction

Hydrologic extremes (HEs) are a complex phenomenon and global issue that affects every sphere of human activities. Globally drought has had a significant impact on environment and socioeconomic situations (Saleem et al., 2021). Therefore drought is a global issue. “United Nation Environmental Program” and “United Nations Water Division” are trying to manage drought issues by providing financial support to the countries that are unable to address its social, economic and environmental impacts (Khalid, 2020). Drought forecasting is beneficial for early warning and preparing the people of most affected areas (Khan et al., 2020).

As a result of climate change (Fahad & Wang, 2019), more than 82% of drought occurrences in the Chian Pakistan Economic Corredor (CPEC) region are attributed to atmospheric status in Pakistan, therefore, it is necessary to integrate climate data into water management (Deng et al., 2025; Nazirullah et al., 2023).). Drought has been a common occurrence in Pakistan (Hussain, 2011). Drought is classified into several types, including meteorological, hydrological, agricultural, and socioeconomic (Khan & Gadiwala, 2013).

Drought is often referred to as a "creeping disaster" since it takes time to mature and the effects might last for a long time after the event has ended (Mazhar et al., 2015). Drought is unusual among environmental dangers in terms of the amount of time that passes between the first signs of a drought forming and the point at which it begins to harm the people of the afflicted areas (Khan & Khan, 2014).

Flood severity and duration are increasing year after year (Manzoor et al., 2022). By 2099, Southern Pakistan is projected to face heavy rainfall events leading towards heightened risk of future flooding in the region (Arshad et al., 2025). Floods are classified into several categories, including flash, coastal, and riverine floods (Shah et al., 2020). Climate change may lead to environmental challenges (Salma, 2011). Climate change impacts are already here in Pakistan (Nevitt, 2022). Due

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to an arid climate, drought risk is greater in Sindh (Khan & Gadiwala, 2013) and Balochistan (Mazhar et al., 2015). In Punjab, rain-fed areas are extremely vulnerable to drought (Qaiser et al., 2021).

Flood disasters have a high propensity to influence the built environment and inflict massive losses due to property destruction, including buildings and infrastructure (Cigler, 2017). Because of its socioeconomic characteristics, population geography, and terrain properties, Pakistan has traditionally been exposed to significant flooding mortality events (Nazirullah et al., 2023; Paulikas & Rahman, 2013). The United Nations, the Government of Pakistan, provincial government departments, and non-governmental organizations, are trying to decrease the water-related impacts of climate change (Ahmed et al., 2016). In 2012, the Ministry of Climate Change developed a national strategy to make Pakistan a climate-resilient country, outlining a unique area of policy action (Malik, 2020).

The disaster risk management cycle is a well-known tool for controlling disaster occurrences and their effects. The cycle's efficacy, however, is now in doubt. Local institutions continue to use reactive techniques and sporadically manage the danger of flooding despite the development of catastrophe risk reduction strategies. Flood risk management is challenging because of poor governance and the lack of adequate reforms for current development patterns (Rana et al., 2021).

Pakistan is developing Disaster Risk Financing (DRF) programmers. Catastrophe Risk Financing (DRF) programmers are intended to enable civil society actors in each country to manage catastrophe risks proactively. The user community is better equipped to enable early disaster relief activities to help decrease the human and economic costs of catastrophes by evaluating risks in advance of disasters, pre-positioning money, and releasing them according to pre-agreed plans (Bevington et al., 2022). HEs have increased the potential to cause further social, economic, and environmental damages (Hussain et al., 2019).

It is critical to evaluate interactions between these closely related HEs when developing disaster risk reduction (DRR) measures and strategies (Ward et al., 2020). It is critical to identify important impacts in order to lessen vulnerability to drought (Anjum et al., 2010). Effective risk avoidance requires a thorough understanding of flood consequences (Manzoor et al., 2022). In Pakistan, a better knowledge and awareness of its social, economic, and environmental effects are required. Therefore, the objective of this research is to investigate the social, economic, and environmental impacts of hydrologic extremes in Pakistan.

Research Objectives

1) To examine the social, economic, and environmental impacts of hydrologic extremes in Pakistan.
2) To analyze the differences in the impacts of hydrologic extremes in Pakistan based on socio-economic status, gender, and age.

Research Questions

- What are the social, economic, and environmental impacts of hydrologic extremes in Pakistan?
- What are the differences in impacts of hydrologic extremes in Pakistan on the basis of socio-economic status, gender, and age?

Research Methods

It is a descriptive and inductive research design used to synthesize qualitative investigations. A qualitative meta-analysis is a deliberate and systematic way of analyzing data from several qualitative investigations. The emphasis is on translating studies, which are then methodically compared or translated within and across studies while keeping the structure of the relationships between important concepts or themes and including a thematic analysis. The researchers relied on secondary resources and descriptive sorts of study material in the form of literature, based on the

social, economic, and environmental impacts of hydrologic extremes in Pakistan published in 2011 to 2025.

Results and Discussion

Findings show that different socio-economic statuses, genders, and age groups were affected differently by HEs in Pakistan. Children and old people were more vulnerable due to their physical limitations and weaker immune systems. HEs displaced the families, led to disruption in education and increased health risks. During droughts, women travelled long distances to fetch water, which increased gender-based violence. Men were affected differently based on their occupation.

Themes: The four themes have emerged from the literature review.

(1) Impacts of Droughts,

(2) Impacts of Flood

(3) Challenges in Post-Flood Areas and Disaster Relief Camps

(4) Micro and Macro Level Recommendations.

Impacts of Droughts: Droughts have negatively influenced social life (Abuzar et al., 2019), agriculture (Khan et al., 2021), water availability (Hina & Saleem, 2019; Adnan & Ullah, 2020), and food security in the world (Abbas & Kousar, 2021). The negative effect of the drought increased the proportion of households affected in the village (Majid, 2022). The crop price increases during drought periods because of the hike in the price of water (Yokomatsu et al., 2020). Drought has also had an impact on the growth of the economy and exports (Khan et al., 2014). The occurrence of droughts was more pronounced in Sindh and Baluchistan, whereas some parts of southern Punjab also experienced intense dry spells (Hina & Saleem, 2019).

The drought of 1998-2002 is considered the worst in Pakistan. The drought was at its peak in Balochistan and Sindh; 26 districts in Balochistan suffered from severe famine. 1.2 million People were affected. At that time, Nushki had not seen any drizzle for the last 5 years. The drought in Balochistan affected millions of people and killed two million animals. In Sindh, 127 people died, mostly in the Tharparkar region near the Indian border (See Figure 1). As a result of severe water shortages and dehydration, nearly 60% of the population of Sindh migrated to irrigated land (Hussain, 2011).

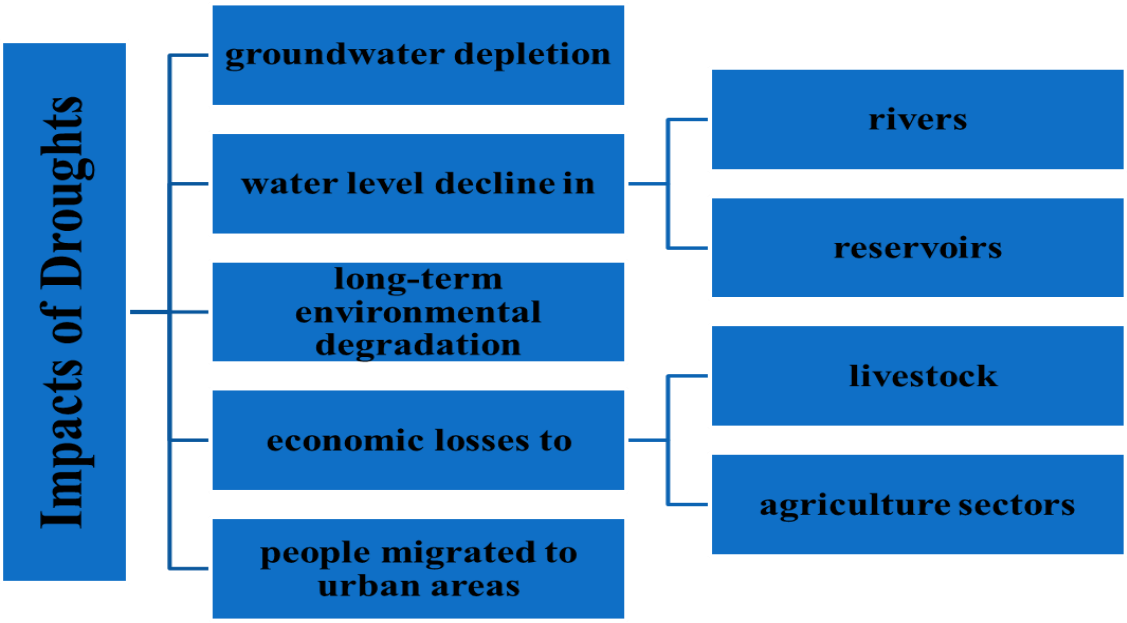

Figure 1: Impacts of Droughts

Wheat Rabi cropping seasons in the Thal region of Punjab faced extreme agricultural drought from 2000 to 2002 (Amin et al., 2020). The drought of 2004-2005 was an intermittent occurrence. Drought affected Pakistan's lower regions, primarily Baluchistan and Sindh. However, no damage or deaths were reported throughout the time period, presumably as a result of the flooding in 2003. A weak drought emerged in upper Pakistan from mid-2009 to mid-2010, affecting Punjab, Khyber, Gilgit, Kashmir, and Northern Balochistan. This drought had no effect on Sindh (Hussain, 2011). Agricultural production, particularly crops and vegetables, decreased significantly during the 2017 drought (Khan et al., 2022).

Impacts of Flood

In Pakistan, the first major flood occurred in 1950. Every year from 1955 to 1957, then in 1959, 1973, then from 1975 to 1978, then in 1981, 1983, 1984, 1988, 1992, 1994, and 1995, there were consecutive floods (See Figure 2). Since 2010 there have been floods every year (Raza, 2022).

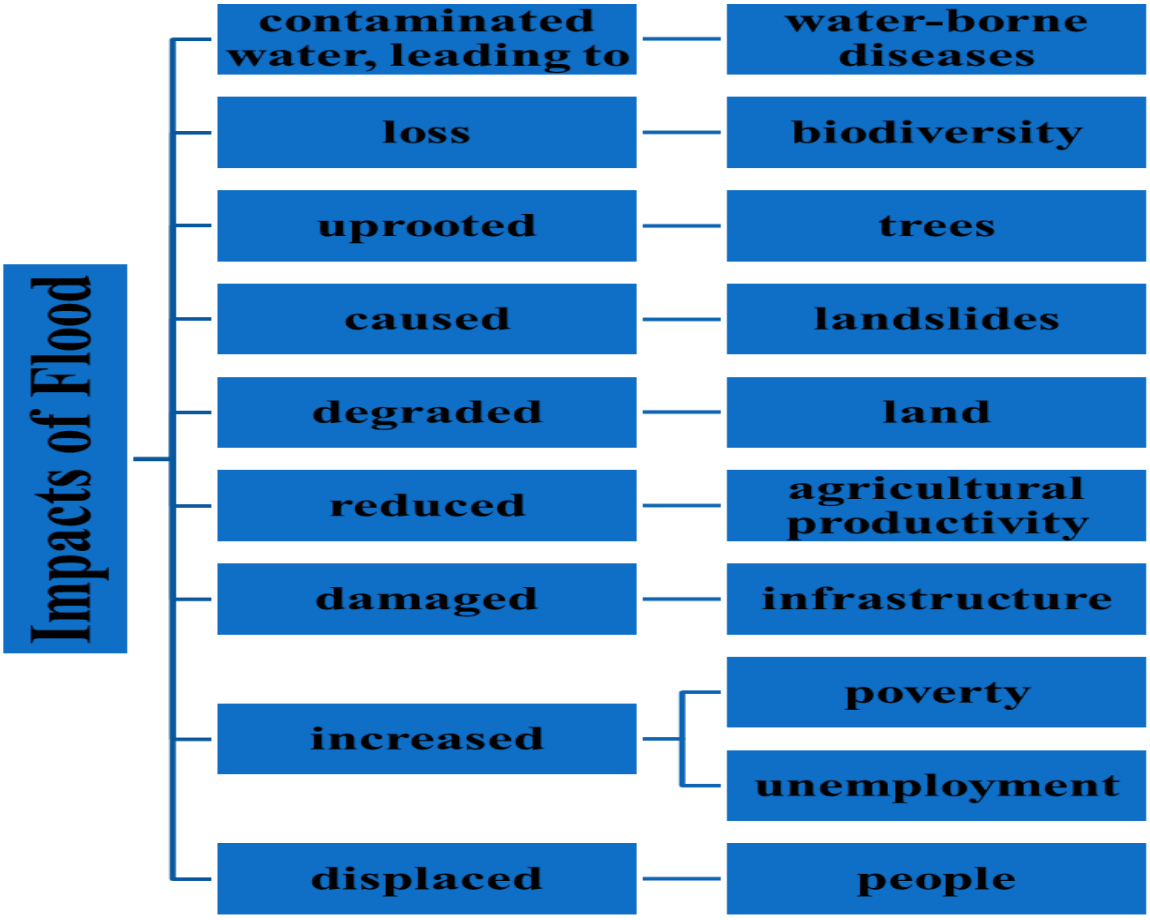

Figure 2: Impacts of Floods

In 1950,1965, and 2010, there were significant flood related deaths (Paulikas et al., 2013). Then in 2010 to 2014 floods damaged infrastructure, animals, and food. In 2014 Punjab, Gilgit Baltistan and Jammu and Kashmir were affected badly by flood (Rehman et al., 2015). Twenty three significant floodS in Pakistan between 1947 and 2015 have caused loss of USD 38.165 billions (Aslam, 2018). The presence of microbial contamination makes water risky for domestic consumption in flood-affected areas (Saeed & Attaullah, 2014).

In Pakistan in 2022 floods caused over USD 2.3 billion worth of agricultural damage (Shehzad, 2023), also damaged property and human especially in Sindh and Baluchistan (Nanditha et al., 2023). Pakistan was already suffering from an economic crisis before the flood of 2022. Pakistan, with the lowest carbon footprint, blames the developed world and calls for international help (Shahzad, 2022).

Challenges in Post-Flood Areas and Disaster Relief Camps

The livelihood strategies of local women and men in post-flood 2010 areas were different from each other. They perceived and coped with different kinds of social, economic, and environmental challenges from each other (Nyborg et al., 2012). Gender based, sociocultural, economic and geopolitical issues influenced the difficulties faced by displaced mothers in disaster relief camps with regard to their experiences, behaviors and practices (Hirani et al., 2019).

Children living in refugee camps in Pakistan following the 2010 flood faced social difficulties because their mothers lacked the ability to watch over and shield them from the risk of abuse and assault (Asad et al., 2013). Children experienced effects from the floods in 2010, 2011, 2012, 2013, and 2014. These effects were physical, psychological, and educational. The proximity to disaster-prone locations, a poor diet, and parental loss were strong predictors of psychological susceptibility,

while damage to dwellings and emotional distress were significant predictors of physical vulnerability. The primary determinants of educational vulnerability were child displacement, delayed enrollment, numerous relocations, and family instability (Shah et al., 2022).

Micro and Macro Level Recommendations

- Dams and reservoirs
- Capture rainwater from flooding years
- Use stored rainwater in dry years
- Turn HEs into a new economic opportunity
- Advance sustainable development
- Encourages new forms of cleaner technologies, industries, and jobs
- Government should generate public awareness initiatives
- Educate the public
- Plan for reducing the risks of future HEs

It looks like Pakistan has had a few years of drought followed by a few years of significant rains. More dams and reservoirs must be built to capture rainwater from flooding years and store it for use in dry years (Hussain, 2011). As shown in this study, Pakistan has witnessed multiple hydrologic extremes (HEs) of variable intensity since 1947. The government was required to pay subsidies, import food, and use its foreign exchange reserves to aid in the relief and recovery process following HEs. Water resources and ecosystems were impacted by droughts. The loss of groundwater and declining water levels in rivers and reservoirs caused long-term environmental damage as well as economic losses to Pakistan's livestock and agricultural industries, which are the country's two largest industries. For improved living conditions, a lot of individuals migrated to urban areas.

Floods contaminated water, leading to water-borne diseases; caused a loss of biodiversity; uprooted trees and caused landslides; caused land degradation by washing away topsoil and altering the natural landscape; reduced agricultural productivity; damaged infrastructure, leading to economic losses. Floods displaced people from their homes. They lost their property. Their livelihoods were disrupted.

Conclusion and Recommendations

Pakistan's climate has seen considerable changes in recent years. This increases hydrologic extremes (HEs). HEs are a complex phenomenon that influences many aspects of human life. The social, economic, and environmental impacts of the hydrologic extremes in Pakistan were uneven. Drought frequency is increasing in the hyper-arid and arid zones. Areas near the sea, rivers, and dams are vulnerable to flooding. Likewise, there were already serious inequalities in power relations and access to resources before every hydrologic extreme event, which influenced in numerous ways how households could recover. Women and children faced more complex social issues. Poor men faced more economic challenges.

Increasing awareness and understanding of the complexity of the issue will help in taking more effective actions to solve the problem. Especially for women and educators, flood preparedness workshops should be arranged. Sociologists should be involved in the policy-making process about handling the social, economic, and environmental impacts of the HEs in Pakistan. Moreover, further research on the impacts of climate change on hydrologic extremes; difference in impacts of HEs on the basis of gender and age; and the role of local people, especially women, in accelerating mitigation activities; is suggested, as it will help policymakers.

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The Conception and design: Munazza Madani. Collection and assembly of data and Analysis and interpretation of the data: Syeda Saba Hashmi. Drafting and Critical revision of the article. The intellectual content Management: Maryam Jan.
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References

Abir, T., Kalimullah, N. A., Husain, T., Yazdani, D. M. N. A., Nury, A. T. M. S., Salahin, K. F., & Agho, K. (2020). Use of the Health Belief Model for the assessment of public knowledge and household preventive practices in Dhaka, Bangladesh, a dengue-endemic city. *Journal of Xi'an University of Architecture & Technology*, *12*, 2800–2815.

Abbas, S., & Kousar, S. (2021). Spatial analysis of drought severity and magnitude using the standardized precipitation index and stream flow drought index over the upper Indus Basin, Pakistan. *Environment, Development and Sustainability*, *23*(10), 15314–15340. https://doi.org/10.1007/s10668-021-01299-y

Abuzar, M. K., Shafiq, M., Mahmood, S. A., Irfan, M., Khalil, T., Khubaib, N., Hamid, A., & Shaista, S. (2019). Drought risk assessment in the khushab region of Pakistan using satellite remote sensing and geospatial methods. *International Journal of Economic and Environmental Geology*, *10*(1), 48–56. https://doi.org/10.46660/ojs.v10i1.217

Adnan, S., & Ullah, K. (2020). Development of drought hazard index for Vulnerability Assessment in Pakistan. *Natural Hazards*, *103*(3), 2989–3010. https://doi.org/10.1007/s11069-020-04116-3

Ahmed, T., Scholz, M., Al-Faraj, F., & Niaz, W. (2016). Water-related impacts of climate change on agriculture and subsequently on Public Health: A review for generalists with particular reference to Pakistan. *International Journal of Environmental Research and Public Health*, *13*(11), 1051. https://doi.org/10.3390/ijerph13111051

Amin, M., Khan, M. R., Hassan, S. S., Khan, A. A., Imran, M., Goheer, M. A., Hina, S. M., & Perveen, A. (2020). Monitoring agricultural drought using geospatial techniques: A case study of thal region of Punjab, Pakistan. *Journal of Water and Climate Change*, *11*(S1), 203–216. https://doi.org/10.2166/wcc.2020.232

Anjum, S., Wang, L., Salhab, J., & Khan, I. (2010). *An assessment of drought extent and impacts in agriculture sector in Pakistan*. Research Gate. Retrieved April 18, 2023, from https://www.researchgate.net/publication/289294966_An_assessment_of_drought_extent_and_impacts_in_agriculture_sector_in_Pakistan

Arshad, A., Mirchi, A., He, C., Shah, A. A., & AghaKouchak, A. (2025). Anthropogenic and climatic drivers of the 2022 mega-flood in Pakistan. *Npj Natural Hazards*, *2*(1). https://doi.org/10.1038/s44304-025-00109-z

Asad, N., Karmaliani, R., Somani, R., Hirani, S., Pasha, A., Hirani, S., Cassum, L., & McFarlane, J. (2013). Preventing abuse and trauma to internally displaced children living in camps due to disasters in Pakistan. *Child Care in Practice*, *19*(3), 267–274. https://doi.org/10.1080/13575279.2013.785936

Asim, M., Nadeem, M., & Saima, G. (2021). Empowering communities to cope flood risk: Learning from flood affected community in Narowal District, Pakistan. *Disaster Advances*, *14*(9), 23–33. https://doi.org/10.25303/149da2333

Aslam, M. (2018). Flood management current state, challenges and prospects in Pakistan: A Review. *Mehran University Research Journal of Engineering and Technology*, *37*(2), 297–314. https://doi.org/10.22581/muet1982.1802.06

Aslam, A. Q., Ahmad, S. R., Ahmad, I., Hussain, Y., & Hussain, M. S. (2017). Vulnerability and impact assessment of extreme climatic event: A case study of southern punjab, Pakistan. *Science of The Total Environment*, *580*, 468–481. https://doi.org/10.1016/j.scitotenv.2016.11.155

Bevington, J., Forbes, H., Shelton, K., Smith, R., Wood, E., Maisey, P., & Ludlam, S. (2022, March 25). *Disaster risk financing systems for fluvial flood risk in Democratic Republic of* Congo *and Pakistan*. CO Meeting Organizer EGU22. Retrieved October 4, 2022, from https://meetingorganizer.copernicus.org/EGU22/EGU22-8204.html

Boland, J. J., & Loucks, D. P. (2021). Infrastructure capacity planning for reducing risks of future hydrologic extremes. *Water Policy*, *23*(S1), 188–201. https://doi.org/10.2166/wp.2021.242

Cigler, B. A. (2017). U.S. floods. *State and Local Government Review*, *49*(2), 127–139. https://doi.org/10.1177/0160323x17731890

Deng, A., Xie, W., Chen, X., Ran, H., Li, Q., Jiang, P., Javed, T., Yu, Q., Feng, H., Yao, N., & Xu, M. (2025). Drought evolution and driving mechanisms in the China-pakistan economic corridor under a changing environment. *Journal of Hydrology: Regional Studies*, *58*, 102263. https://doi.org/10.1016/j.ejrh.2025.102263

Dube, E., Mtapuri, O., & Matunhu, J. (2018). Managing flood disasters on the built environment in the rural communities of Zimbabwe: Lessons learnt. *Jàmbá: Journal of Disaster Risk Studies*, *10*(1). https://doi.org/10.4102/jamba.v10i1.542

Fahad, S., & Wang, J. (2019). Climate change, vulnerability, and its impacts in rural Pakistan: A Review. *Environmental Science and Pollution Research*, *27*(2), 1334–1338. https://doi.org/10.1007/s11356-019-06878-1

Federal Flood Commission. (2017). *Annual flood report-2017*. Ministry of Planning Development & Special Initiatives. Retrieved October 4, 2022, from https://www.pc.gov.pk/uploads/report/Annual-Flood-Report-of-FFC-2017.pdf

Hina, S., & Saleem, F. (2019). Historical analysis (1981-2017) of drought severity and magnitude over a predominantly arid region of Pakistan. *Climate Research*, *78*(3), 189–204. https://doi.org/10.3354/cr01568

Hirani, S. A., Richter, S., Salami, B. O., & Vallianatos, H. (2019). Breastfeeding in disaster relief camps. *Advances in Nursing Science*, *42*(2). https://doi.org/10.1097/ans.0000000000000231

Hussain, B. (2011, May 8). *History of drought in Pakistan – in detail*. Pakistan Weather Portal (PWP). Retrieved October 1, 2022, from https://pakistanweatherportal.com/2011/05/08/history-of-drought-in-pakistan-in-detail/

Hussain, M., Butt, A. R., Uzma, F., Ahmed, R., Irshad, S., Rehman, A., & Yousaf, B. (2019). A comprehensive review of climate change impacts, adaptation, and mitigation on environmental and natural calamities in Pakistan. *Environmental Monitoring and Assessment*, *192*(1). https://doi.org/10.1007/s10661-019-7956-4

Khalid, I. (2020). Impact of climate change on aquatic situation in India: Implications for Pakistan. *Pakistan Social Sciences Review*, *4*(III), 228–243. https://doi.org/10.35484/pssr.2020(4-iii)18

Khan, A. N., & Khan, S. N. (2014). Drought risk and reduction approaches in Pakistan. *Disaster Risk Reduction*, 131–143. https://doi.org/10.1007/978-4-431-55369-4_7

Khan, I. A., Rafiq, M., Saqib, S. E., Ullah, R., & Atiq, M. (2021). Adaptation to climate change among farmers in drought-hit region of Khyber Pakhtunkhwa, Pakistan. https://doi.org/10.21203/rs.3.rs-809046/v1

Khan, M. A., & Gadiwala, M. S. (2013). A Study of Drought over Sindh (Pakistan) Using Standardized Precipitation Index (SPI) 1951 to 2010. *Pakistan Journal of Meteorology*, *9*(18).

Khan, N., Sachindra, D. A., Shahid, S., Ahmed, K., Shiru, M. S., & Nawaz, N. (2020). Prediction of droughts over Pakistan using machine learning algorithms. *Advances in Water Resources*, *139*, 103562. https://doi.org/10.1016/j.advwatres.2020.103562

Khan, S. N., Khan, A. N., Khan, M. A., Shah, S. A., & Naqash, T. (2022). Assessment of drought, its causes and consequences in connection with local wisdom: A case study of Kohat Basin Drought-2017, Khyber Pakhtunkhwa, Pakistan. *Disaster Advances*, *15*(3), 29–38. https://doi.org/10.25303/1503da2938

Majid, H. (2022). Drought, farm output and heterogeneity: Evidence from Pakistan. *Journal of South Asian Development*, *17*(1), 32–56. https://doi.org/10.1177/09731741221075929

Malik, S. (2020). Effect of climate change and its implications onward/toward Pakistan. *Environmental Contaminants Reviews*, *3*(1), 13–15. https://doi.org/10.26480/ecr.01.2020.13.15

Manzoor, Z., Ehsan, M., Khan, M. B., Manzoor, A., Akhter, M. M., Sohail, M. T., Hussain, A., Shafi, A., Abu-Alam, T., & Abioui, M. (2022). Floods and flood management and its socio-economic impact on Pakistan: A review of the empirical literature. *Frontiers in Environmental Science*, *10*. https://doi.org/10.3389/fenvs.2022.1021862

Mazhar, N., Nawaz, M., Mirza, A., & Khan, K. (2015, January 1). *[PDF] socio-political impacts of meteorological droughts and their spatial patterns in Pakistan: Semantic scholar*. South Asian Studies. Retrieved April 17, 2023, from https://www.semanticscholar.org/paper/Socio-Political-Impacts-of-Meteorological-Droughts-Mazhar Nawaz/7b99f24e41970a98d247bf5aa17fefce3423e51a

Ministry of Water Resources. (2021). *Annual report 2020*. FFC. Retrieved October 4, 2022, from https://ffc.gov.pk/wp-content/uploads/2021/04/2020-Annual-Report-of-Oo-CEA-CFFC.pdf

Nanditha, J. S., Kushwaha, A. P., Singh, R., Malik, I., Solanki, H., Chuphal, D. S., Dangar, S., Mahto, S. S., Vegad, U., & Mishra, V. (2023). *The Pakistan Flood of August 2022: Causes and implications*. AGU. Retrieved April 17, 2023, from https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2022EF003230

Nevitt, M. (2022, September 8). *Climate justice and loss and damage in the Pakistan Flood Crisis*. SSRN. Retrieved October 4, 2022, from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4210750

Nazirullah, Som, A. P. M., & Al Qassem, A. (2023). The influence of social and economic inequalities on support for tourism in developing community: An intervening effect of tourism resources. *Planning Malaysia*, *21*(1), 180-192. https://doi.org/10.21837/pm.v21i25.1232

Nazirullah, Ullah, F., & Mustafa, M. (2023). Challenges of Food Distribution Process for Internally Displaced Persons in Non-governmental Organizations: An Ethnographic Study. *Progressive Research Journal of Arts and Humanities*, *5*(2), 126-141.

Nyborg, I., Nawab, B., Khan , K., & Jawad Ali, J. (2012). (rep.). *Rural development in Swat, Pakistan: Understanding Food and Livelihood Security in Post-Conflict Contexts*. Ås, Norway: Norad.

Paulikas, M. J., & Rahman, M. (2013). A temporal assessment of flooding fatalities in Pakistan (1950-2012). *Journal of Flood Risk Management*, *8*(1), 62–70. https://doi.org/10.1111/jfr3.12084

Qaiser, G., Tariq, S., Adnan, S., & Latif, M. (2021). Evaluation of a composite drought index to identify seasonal drought and its associated atmospheric dynamics in northern Punjab, Pakistan. *Journal of Arid Environments*, *185*, 104332. https://doi.org/10.1016/j.jaridenv.2020.104332

Rana, I. A., Asim, M., & Aslam, A. B. (2021, June 17). *Disaster Management Cycle and its application for flood risk reduction in urban areas of Pakistan*. Urban Climate. Retrieved April 18, 2023, from https://www.sciencedirect.com/science/article/abs/pii/S2212095521001231

Raza, M. (2022, August 31). *Pakistan's history of disasters and the lessons we fail to learn*. DAWN. Retrieved April 17, 2023, from https://www.dawn.com/news/1707390

Rehman, A., Jingdong, L., Du, Y., Khatoon , R., Wagan, S. A., & Nisar, S. K. (2015). *Flood disaster in Pakistan and its impact on Agriculture Growth (a review)*. Research Gate. Retrieved April 18, 2023, from https://www.researchgate.net/publication/286879062_Flood_Disaster_in_Pakistan_and_its_Impact_on_Agriculture_Growth_A_Review

Salma, S. (2011, January 1). *climate change and variability trends in Pakistan and its environmental effects*. Semantic scholar. Retrieved October 4, 2022, from https://www.semanticscholar.org/paper/CLIMATE-CHANGE-AND-VARIABILITY-TRENDS-IN-PAKISTAN-Salma/514cb97bf13472cc2171077b13df05bb7aa6df5b

Saeed, T., & Attaullah, H. (2014). Impact of extreme floods on groundwater quality (in Pakistan). *British Journal of Environment and Climate Change*, *4*(1), 133–151. https://doi.org/10.9734/bjecc/2014/4105

Saleem, F., Arshad, A., Hina, A., & Ullah, I. (2021). Droughts over Pakistan: Possible cycles, precursors and associated mechanisms. *Geomatics, Natural Hazards and Risk*, *12*(1), 1638–1668. https://doi.org/10.1080/19475705.2021.1938703

Saleem, F., Arshad, A., Mirchi, A., Khaliq, T., Zeng, X., Rahman, M. M., Dilawar, A., Pham, Q. B., & Mahmood, K. (2022). Observed changes in crop yield associated with droughts propagation via natural and human-disturbed agro-ecological zones of Pakistan. *Remote Sensing*, *14*(9), 2152. https://doi.org/10.3390/rs14092152

Shah, A. A., Ajiang, C., Gong, Z., Khan, N. A., Ali, M., Ahmad, M., Abbas, A., & Shahid, A. (2022). Reconnoitering school children vulnerability and its determinants: Evidence from flood disaster-hit rural communities of Pakistan. *International Journal of Disaster Risk Reduction*, *70*, 102735. https://doi.org/10.1016/j.ijdrr.2021.102735

Shah, M. H., Mustaffa, Z., Teo, F. Y., Imam, M. A., Yusof, K. W., & Hussein, E. H. (2020, December 3). *A review of the flood hazard and risk management in the South Asian region, particularly Pakistan*. Scientific African. Retrieved April 16, 2023, from https://www.sciencedirect.com/science/article/pii/S2468227620303872#bib0042

Shahzad, A. (2022, August 30). *Pakistan floods cost at least $10 billion, planning minister says*. Reuters. Retrieved April 18, 2023, from https://www.reuters.com/world/asia-pacific/initial-economic-losses-pakistan-floods-least-10-bln-planning-minister-2022-08-29/

Shehzad, K. (2023, March 21). *Extreme flood in Pakistan: Is Pakistan paying the cost of climate change? A short communication*. Science of The Total Environment. Retrieved April 17, 2023, from https://www.sciencedirect.com/science/article/abs/pii/S0048969723015917

Ullah, I., Ma, X., Yin, J., Saleem, F., Syed, S., Omer, A., Habtemicheal, B. A., Liu, M., & Arshad, M. (2021). Observed changes in seasonal drought characteristics and their possible potential drivers over Pakistan. *International Journal of Climatology*, *42*(3), 1576–1596. https://doi.org/10.1002/joc.7321

Ward, P. J., Ruiter, M. C., Mård, J., Schröter, K., Loon, A. V., Veldkamp, T., Uexkull, N. von, Wanders, N., Kouchak, A. A., Nielsen, K. A., Capewell, L., Llasat, M. C., Day, R., Dewals, B., Baldassarre, G. D., Huning, L. S., Kreibich, H., Mazzoleni, M., Savelli, E., … Wens, M. (2020, November 10). *The need to integrate flood and drought disaster risk reduction strategies*. Water Security. Retrieved April 18, 2023, from https://www.sciencedirect.com/science/article/pii/S2468312420300109

Yokomatsu, M., Ishiwata, H., Sawada, Y., Suzuki, Y., Koike, T., Naseer, A., & Cheema, M. J. (2020). A multi-sector multi-region economic growth model of drought and the value of water: A case study in Pakistan. *International Journal of Disaster Risk Reduction*, *43*, 101368. https://doi.org/10.1016/j.ijdrr.2019.101368