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Strengthening Climate-Resilient WASH Systems in Rural Communities: Water Scarcity, Governance, and Gender Vulnerabilities in Disaster-Prone Regions of Pakistan

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ABSTRACT: Water, sanitation, and hygiene (WASH) are critical to both community health and human health, so it is imperative in less urban areas where these services are critical to the health of the population. This study is significant because climate change has created key challenges to water, sanitation, and hygiene (WASH) systems in the rural areas of Pakistan. The fact that there are increased vulnerabilities among the communities, especially women, as concerns water scarcity and inadequate sanitation, poses an imperative need for having environmentally resilient and gender-inclusive WASH systems that the study aims to bring into focus. Improving governance and infrastructure ensures climate-resilient WASH, better health, and socio-economic outcomes for disaster-prone rural communities. A qualitative methodology was used, whereby interviews, focus groups, and participatory observation mechanisms were deployed to collect data among 90 respondents concerning three areas (all three provinces of Pakistan, i.e., Tharparkar (Sindh), Chitral (Khyber Pakhtunkhwa), and Dera Ismail Khan (Khyber Pakhtunkhwa) cross-cutting across social, governance, and gender dimensions of WASH-related issues. More than 70 percent of the rural populations surveyed complained of a lack of sufficient clean water supply, compounded by the unpredictable weather and disasters caused by climate change, such as floods and droughts. Most of the time, women engaged in water collection spend an average of 2.5 hours every day collecting water; hence, they have limited access to education and economic activities. Also, poor community involvement and lack of coordination among stakeholders are governance weaknesses that block effective delivery of WASH services.

KEYWORDS: Water Scarcity, Climate Resilience, WASH Systems, Gender Inequality, Rural Communities, Governance, Sustainable Infrastructure

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Introduction

Water, Sanitation, and Hygiene (WASH) are highly relevant to the welfare and health of the population, especially in rural populations, where such facilities play a crucial role in the well-being of populations in the world (Khalid et al., 2024). Over the past few decades, the issue of climate change and WASH has been a relatively emerging crisis, since it is foreseen that climate change will exacerbate the availability of water, the

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risks of its contamination, and the strains on the sanitation systems, especially in the vulnerable areas (World Health Organization, 2024). Extreme weather changes that include floods, droughts, and cloud bursts, among others, as well as the long-term effects of increasing temperatures, have resulted in the disruption of water access and almost every sanitation system. More vulnerable groups, such as women, children, and marginalized populations, bear the brunt of these interruptions, and women usually have to find ways to provide water and sanitation support in increasingly challenging conditions (Ashraf et al., 2024).

Insufficient water and sanitation technologies, in combination with the effects of climate, have contributed to the increase of water-borne diseases, malnutrition, and other health-related problems, especially in Sub-Saharan Africa, South Asia, and Latin America regions (Manandhar et al., 2024). There are regions where the problems are increasing mainly because of governance weakness, infrastructure investments, and poor policy formulation. South Asia forms part of the most susceptible regions in the world concerning climate change and its effects on the WASH systems (Qadir et al., 2025). Owing to the changed pattern of precipitation and the spells of abnormal droughts as well as escalating frequencies of floods, very few South Asian countries are facing acute water and sanitation scarcities. At the rural levels of India, Bangladesh, and Nepal, the female gender in the countryside is most exposed, whereby they spend long hours to arrive at water, and lack proper sanitation that exposes them to the risk of poor health (Rasool et al., 2025).

It is also connected to ineffective water management governance in the developing countries of the region, like Pakistan, which further complicates the introduction of effective climate-resilient WASH interventions (Siyal et al., 2025). Climate change is causing a severe water crisis in Pakistan; this is becoming a significant risk to water resources, sanitation, and hygiene activities that are primarily located in the rural areas. Hydrological disturbance by climate change has caused interruption of the hydrological cycle of the country by occasionally causing irregular rains, drought, and floods (Saber et al., 2025). An example could be given of droughts and floods, whereby Sindh and Balochistan districts have experienced the worst effects of these disasters in terms of poor water supply and sanitation. As a result, safe drinking water and proper sanitation facilities are not within reach of the citizens of such regions (Shahzad et al., 2025).

The new extreme weather patterns in the provinces of Tharparkar and Dera Ismail Khan have caused a population drift and destruction of other essential water and sanitary systems, exacerbated by persistent droughts and floods (Khisro et al., 2025). Women experience the risk of these places, especially since they are supposed to gather water, and in most instances, they are the ones who have to walk long distances in order to get clean water. Lack of water and poor hygiene have led to water-borne diseases, primarily among women and children. Furthermore, inefficient sanitation care and hygiene also mean that people will be exposed to degraded health risks over which they cannot gain fair access (Ahmad et al., 2025).

Governance related to water resources and WASH services in the rural settings of Pakistan is not well coordinated since the local, provincial, and federal governments do not align. In Khyber Pakhtunkhwa (KP) and Punjab, the absence of good governance and weak governmental institutions has acted as a barrier to effective disaster management and the adoption of climate-resistant WASH practices. This has been escalated by corruption, misappropriation, and poor investment in infrastructure in the rural areas. As a consequence, communities living in climate-sensitive areas like Swat and Chitral still face the inability to deliver water and sanitation in a stable manner (Mumtaz et al., 2025).

Consequences of water scarcity are gendered, more particularly in rural Pakistan. Providing water and sanitation facilities to women is a significant challenge in such areas with good agricultural practices, such as Multan and Faisalabad (Waqar et al., 2025). The time taken to fetch water from distances denies them time to pursue education and other economic opportunities, further skewing the gender gap. It also raises the issues of dignity, health, and safety because of the inaccessible sanitation systems, particularly to women and girls. The situation demands particular action to address the necessities of women and their involvement in the handling of water and sanitation (Perveen et al., 2023).

The effectiveness of the WASH systems in Pakistan, particularly those linked to climate adaptation, has been improved through multiple efforts that are being undertaken at both the national and international levels (Malik et al., 2024). Such interventions are still, in most cases, insufficient, and failure to cater to the demands of a complete climate-resilient WASH system predisposes many households in rural areas to the dangers of climate-related disasters. The example of small-scale rainwater harvesting and solar-powered water pumps developed in flood-prone areas, like Chitral, will suffice (Mustafa et al., 2024). However, such initiatives need to be spread throughout the country. To support the plight of women and the marginalized groups amidst climate change, it becomes crucial that gender-sensitive policies are provided in the WASH programs (Iqbal et al., 2025).

In Pakistan, and especially in its rural disaster regions, access to sustainable and equitable WASH is a significant dilemma. All these characteristics of water resource vulnerability to climate change, together with the vulnerabilities related to governance and gender inequity, intensify the plight of such communities (Abdi et al., 2025). Adaptability to climate change, such as gender-sensitive WASH infrastructure, is a vital component in ensuring more people get access to safe water and sanitation infrastructure, particularly in the most vulnerable regions of the country. The gravity of these problems underscores the significance of this investigation, titled "Strengthening Climate-Resilient WASH systems in Rural Communities: Addressing Water Scarcity, Governance, and Gender Vulnerabilities in Disaster-Prone Areas of Pakistan." This study focuses on an approach that combines several issues to address the challenges of shrinking WASH facilities and policies in those areas.

Objectives of the Study

- Assess the existing WASH situation and practices in a disaster-prone rural area, specifically the effects of climate change.
- Examine gender disparities in access to and control over water and sanitation services, and evaluate how these inequalities are exacerbated by climate change.
- Propose integrated strategies for strengthening climate-resilient, gender-inclusive WASH systems, focusing on improving governance and service delivery in vulnerable rural communities.

Materials and Methods

This paper gives an in-depth description of the Water, Sanitation, and Hygiene (WASH) challenges and opportunities in rural Pakistan. Under the qualitative research, this study aimed to depict the informational facts of social interactions, the network of governors, and the effects of gender-related influences on WASH services in the targeted localities. The scope of the study was rural communities in disaster-prone

environments in Pakistan, which were affected by a shortage of water and other climate-related disasters, e.g., floods and droughts. The research concentrated particularly on Tharparkar district in Sindh, Chitral district in Khyber Pakhtunkhwa, and Dera Ismail Khan district in Khyber Pakhtunkhwa, which are most prone to climate change and have been perpetually struggling with challenges of WASH services.

The population to be targeted in this research was the rural households, local authorities, WASH practitioners, gender experts, and community leaders. An appropriate sample size of about 90 participants was adopted in five categories. The highest number of respondents, 50 in total (15 per district), belonged to rural households, since they were the major group of people that the WASH challenges affected. Each of the local authorities and WASH practitioners contributed about 10 participants presenting the insights in governance, policy, and service delivery. Gender experts consisted of 5 participants and contributed to the gender lopsidedness in the management of water. Finally, five community leaders were valuable sources of socio-cultural and governance information. Such consistency achieved proper coverage of the key topics of the research and led to data saturation and diversity of perspectives.

Table 1

Category	Tharparkar (Sindh)	Chitral (KPK)	Dera Ismail Khan (KPK)	Total
Rural Households	15	15	20	50
Local Authorities	5	5	5	15
WASH Practitioners	5	5	5	15
Gender Experts	1	2	2	5
Community Leaders	2	2	1	5
Total	28	29	33	90

A purposive sampling approach was used to ensure that the sample could reflect the experiences of the subjects relating to WASH matters in the chosen areas, given their expertise in these areas. A purposive sample was identified using rural communities, community leaders, local officials, and WASH professionals who had experience in water management and sanitation in disaster-prone areas. The sampling allowed a closer inspection into the matter of climate resilience and gender equity in WASH services and their opportunities.

Profiling a vulnerable community within sampled districts on water scarcity and climate-related disasters was used to jump-start the sampling process. Together with its local authorities and other community bodies, a list of potential participants was drawn. Interviews and focus groups were carried out across a broad spectrum of people, not only with members of households in rural areas, but also with local authorities, WASH practitioners, and gender experts. This was given the fact that the research covered a broad base of experiences, views, and opinions on matters regarding the areas of study. To answer these questions, the study utilized qualitative data collection methods (semi-structured interviews and in-depth interviews among members of the community, authorities, and practitioners of WASH at the local level, including both genders). The interview guidelines were designed to target and discuss privacy to water, gender implications of water supply, concerns of governance, the role of climate change in the WASH system, and the most appropriate way of addressing inequality's impact on women and girls in terms of water and sanitation service delivery.

In addition, Focus Group Discussions (FGDs) were conducted with community members in order to create collective knowledge on issues facing the rural population in terms of accessing and managing water and sanitation services. Such talks were helpful to the perception of collective groups and the everyday experiences of vulnerability to climate change. The data was collected in June 2024, within three months. This period provided enough time to liaise with the participants, such as interviews and focus groups, in the chosen districts. The timing was also a pre-monsoon season, and this season is of great importance for water availability and preparing against the outcomes of climate-related disasters in the study regions.

All the data obtained was kept in digital format in encrypted devices to guarantee confidentiality. The consent forms and the interview transcripts were stored in a locked cabinet, in hard copy form, and identifying information was anonymized. Verbatim transcripts were organized by qualitative analysis software and coded. Thematic data analysis has been applied to identify patterns, themes, and insights related to the research goal.

The researcher used the Institutional Review Board (IRB) of the affiliated institution to provide ethical approval of the study. Data collection was performed after informing the participants of the nature of the study, their right to withdraw from the study at any time without any fault, and ensuring they did not participate under duress. The participants were also assured of the confidentiality of their identities, and all information given would only be utilized in the research. Particular attention was paid to ensure women, a significant target of the study, could safely participate without coercion, since there is a gender gap in access to WASH. The ethics of the research emphasized respect, openness, and anonymity during the study.

Results and Major Findings

In the chapter, the researcher indicates the effects of untimely weather conditions and water shortage, and the financial costs of collecting and sanitation water in disaster-affected areas. It also discussed the governance failures that hampered the provision of successful WASH services, as well as the significance of the climate-resilient infrastructure in enhancing access to safe water and efficient sanitation.

Table 2

Distribution of Participants According to their Gender

Category	Tharparkar (Sindh)	Chitral (KPK)	Dera Ismail Khan (KPK)	Total
Rural Households	M: 10, F: 5	M: 8, F: 7	M: 12, F: 8	M: 30, F: 20
Local Authorities	M: 4, F: 1	M: 3, F: 2	M: 4, F: 1	M: 11, F: 4
WASH Practitioners	M: 4, F: 1	M: 3, F: 2	M: 4, F: 1	M: 11, F: 4
Gender Experts	M: 0, F: 1	M: 1, F: 1	M: 1, F: 1	M: 2, F: 3
Community Leaders	M: 2, F: 0	M: 2, F: 0	M: 1, F: 0	M: 5, F: 0
Total	M: 20, F: 8	M: 17, F:12	M: 22, F: 11	M: 59, F: 31

Table 2 provides a gender breakdown of 90 participants across five categories in three districts: Tharparkar, Chitral, and Dera Ismail Khan. Among the Rural Households, there were 30 males and 20 females, with a higher number of males in each district. The Local Authorities category had 11 males and four females, reflecting a predominance of male participants in governance roles. In WASH Practitioners, 11 males and four females participated, again showing a higher male representation. The Gender Experts category included two males and three females, with a slight majority of females. Lastly, Community Leaders consisted entirely of 5 males, with no female representation. Overall, the study included 59 males and 31 females, highlighting a greater male participation across most categories.

Table 3

Major findings, impacts, and suitable recommendations

Key Factors	Description	Impact	Recommendations
Water Scarcity	Over 70% of participants reported inadequate access to clean drinking water, exacerbated by climate change.	Seasonal variations, erratic weather, and frequent droughts disrupt local water sources, leading to shortages.	Implement reliable water storage systems and climate-resilient water management practices.
Gender Disparities	Women in rural Pakistan spend an average of 2.5 hours daily collecting water.	Time-consuming tasks limit women's participation in education and economic activities and increase vulnerability.	Develop gender-sensitive water and sanitation policies, and improve access to safer sanitation facilities.
Governance Challenges	40% of participants reported active community participation in decision-making related to WASH services.	Poor governance and coordination result in inefficiencies and delays in implementing WASH interventions.	Foster inclusive, transparent, and accountable governance frameworks. Increase local community engagement.
Climate Resilience	Communities with climate-resilient WASH systems, such as rainwater harvesting, report better preparedness.	Access to alternative water sources during climate-induced disasters improves recovery, but many communities lack such infrastructure.	Scale up climate-resilient solutions, integrate them into national WASH policies, and improve adoption rates.

Hygiene (WASH) in rural settings, which includes climate change, gender imbalance, the lack of governance, and climate resilience. More than 70 percent of the respondents complained of insufficient supply of clean drinking water, exacerbated by a variable weather pattern and seasonal fluctuations due to climate change. This has caused a shortage in water, putting many families at the mercy of contaminated water that can encourage waterborne diseases. Gender inequalities were also indicated, whereby women were spending an average of 2.5 hours a day fetching water, thus having less time to study or work. Moreover, 65 percent of respondents confirmed a lack of proper sanitation, especially among women during menstruation, which poses health risks and loss of dignity to them. Governance problems, including limited community

involvement and a lack of effective coordination between local authorities and service providers, also compromise WASH service delivery.

The research indicates the need to factor in climate resilience in WASH systems. Investments made in climate-resilient systems, such as rainwater harvesting and flood-proof sanitation, were well prepared to face the disasters caused by climate change. However, lots of rural areas are kept on the previous infrastructure, according to which they continue to be exposed to the vulnerabilities of climate pressures in the future. The study proposes respective recommendations to respond to these challenges, including formulating gender-sensitive policies, enhancing community participation in decision-making, and expanding the provision of solutions that are climate resilient to prevent any inequitable access to safe water and sanitation. Inclusion of a wider governance system and investments in strengthening the infrastructure are important to alleviate any adverse effects of climate change and improve the welfare of people in rural areas.

Thematic Analysis

Water Scarcity and Climate Vulnerability

Severe water shortages, coupled with climate vulnerability, were a significant factor in the selected rural communities. Trends in seasonal change, rainfall disparities, and an ever-changing weather pattern drastically affected water availability. Households in areas like Tharparkar and Dera Ismail Khan complained of extreme difficulty in accessing water during the dry spell, with many of them using the temporary sources, which in many cases were contaminated.

This exposed them to the risk of water shortage, particularly during droughts. Analysis indicated that these weaknesses were exacerbated by a lack of sustainable water management mechanisms, i.e., water storage or irrigation methods. The theme highlights the importance of a climate-resistant water system that will be able to support water scarcity and provide clean drinking water with equitable distribution to everyone. Specific sustainable technologies like rainwater harvesting, effective irrigation systems, and the application of water-efficient technologies will be critical to mitigate the effects of climate change.

Gender Inequality and WASH Access

The research has found that there are severe gender gaps in WASH access, mainly in rural communities. *Women had to receive the disproportionately large share of the burden of water collection, preventing women from engaging in other productive activities such as education, employment, and development.* This disproportionate labor burden had a significant impact on the health, finances, and social status of women.

Poor sanitation facilities were also *a problem for women in most rural communities since they did not help them to isolate themselves, especially when on their monthly periods, a factor that adversely affected their dignity and well-being. Their vulnerability was exacerbated by the lack of gender-sensitive WASH infrastructure, particularly in situations of climate-related crises, where there is an even greater lack of clean water sources.* This requires the integration of gender-responsive policies on WASH planning, and women/girls should not be viewed as recipients of protection. However, they should be empowered to engage in both water management and decision-making.

Governance and Institutional Weaknesses

One of the major themes during the study was governance failures. *Low participation in the community, coupled with weak governance and coordination among service providers and the local authorities, significantly compromised the effective delivery of WASH services.* The lack of involvement of the community members in the decision-making related to WASH led to interventions that were poorly targeted and not focused on the needs of the local community.

Moreover, the coordination between different stakeholders, including the local governments and non-governmental organizations, was nil; this led to poor integrated action and redundancy. These weaknesses of governance become particularly harmful in the case of climate change because resilience and swiftness of action are critical aspects. Supporting the local administration system and locally led outreaches, as well as increased coordination with other actors, is essential to improving WASH outcomes in rural locations and areas most affected by climate change.

Resilience and Adaptation

The theme of resilience and adaptation translated to the fact that more resilient or climate-resilient WASH systems exhibited better coping strategies when hit by climatic and related induced shocks and disasters such as floods and droughts. These villages already invested in infrastructures that would enable them to live through the worst weather conditions, e.g., flood-proof latrines and rainwater collection systems. The measurements also offered an alternative source of water in times of drought and relieved the current over-exploitation of other local sources of water.

However, the study also confirmed that the availability of most of the rural populations to such systems was pathetic, putting them at the mercy of the climatic pressure. *As the research indicates, incorporating climate-resilient WASH systems into local planning is a fundamental prerequisite for enhancing long-term sustainability.* Through expansion of such systems and making them available to every community, Pakistan could increase its climate resilience and limit the vulnerability of rural inhabitants to subsequent climate-related disasters.

Critical Gaps in Existing WASH Interventions

Important gaps also exist in the current WASH interventions, particularly in terms of sustainability, inclusivity, and governance, which were identified by the thematic analysis. The research illustrates the high priority that is accorded to incorporating climate resilience in WASH policies and interventions on a local and national level. It brings attention to the need for gender inclusion strategies to ensure that the needs and contributions of women are not overlooked in water management and sanitation activities. The study also suggests improving the governance models to enhance greater community and stakeholder involvement. By taking these themes, the water scarcity, gender inequality, governance issues, and climate resilience, this research suggests the necessity to contemplate an integrated comprehensive way of complexity to ensure WASH in the local communities of Pakistan.

Discussion

The need to enhance climate-resilient and gender-responsive WASH systems in rural Pakistan is critical due to the current water crisis, poor sanitation, and the impact of climate-induced calamities. It is shown in this

paper that climate change, gender inequality, and governance issues are interconnected in their destructiveness to the delivery of adequate water and sanitation systems and services as described by Qamar et al. (2024), Mansour et al. (2024), and Sultan et al. (2025). The findings show that over 70 percent of rural communities are victims of water shortages, which are aggravated by the unpredictable climatic conditions. In the meantime, the worst victims include women who have to work hard walking long distances in search of water. Besides, it can also be seen that, as proposed by Shah et al. (2024) and Tufail et al. (2024), the findings reflect on governance failure, specifically, the absence of community participation and community failure to effectively incorporate stakeholders, which contributes to the escalation of such problems, leaving rural populations most vulnerable to novel climate shocks.

The research provides the foundation for a coherent policy on the WASH crisis that touches both environmental and socio-economic areas of concern. Rainwater harvesting and flooding-proof sanitation facilities that would ensure long-term climate resilience of the infrastructure would be important (Yasmin et al., 2023; Yousaf et al., 2025). In addition, the policy must also be gender sensitive, such that the voice of females is heard during the decision-making process and their needs are met. Empowering local authorities and participatory communities is also a key ingredient to the sustainability and efficiency of the WASH interventions. Integrating the answers to these complex problems in a comprehensive approach, Pakistan would effectively be able to reinforce climate-proofing, reduce gender inequalities, and give a boost to the well-being of people living in rural areas.

Recommendations

To ensure that in the future we have strong climate-resilient and gender-responsive WASH systems in rural Pakistan, the following are some of the important recommendations that could be put into consideration, and through these recommendations, Pakistan is likely to achieve more climate change-resilient, inclusive, and sustainable WASH systems, leaving its social-economic barriers behind.

- Devise policies that reconcile climate resilience and gender inclusivity to WASH planning, emphasizing long-term strategies of water management such as rainwater harvesting and groundwater recharge.
- Encourage and support community-based water management initiatives and ensure that particularly women and marginalized groups have a voice and are included in the decision-making process and as leaders.
- To improve the capacity of the locally existing institutions and service providers to handle climate-resilient infrastructure and offer fair WASH services.
- Invest in climate-resilient and gender sensitive WASH infrastructure, such as flood-resistant latrines and water storage, taking into consideration the needs of women for privacy and safety.
- Implement quality monitoring and evaluation measures to monitor the effects of WASH interventions, to hold each other accountable, and include the community with perspectives.

References

Abdi, A. A., & Geremew, A. (2025). Wash implementation in a climate change induced emergency. https://doi.org/10.20944/preprints202501.0742.v1

Ahmad, M., & Munir, M. (2025). Linking Climate Change and Sustainable Development Goals: Evidence from Pakistan. *Dialogue Social Science Review (DSSR)*, *3*(4), 982-995. https://dialoguessr.com/index.php/2/article/view/834

Ashraf, M., Shahzad, S., Sequeria, P., Bashir, A., & Azmat, S. K. (2024). Understanding challenges women face in flood-affected areas to access sexual and reproductive health services: A rapid assessment from a disaster-torn Pakistan. *BioMed Research International*, *2024*, 1-13. https://doi.org/10.1155/2024/1113634

Iqbal, M. A., Bhatti, A. D. O. S., & Khan, F. (2025). Climate-Resilient Solutions: The Anticipated Role of Reed Bed Technology in Transforming Rural Hygiene and Waste Treatment in Pakistan. *Dialogue Social Science Review (DSSR)*, *3*(3), 664-675. https://dialoguessr.com/index.php/2/article/view/403

Khalid, S., Hafeez, M., Junaid, N., & Aeman, H. (2024). Navigating climate change, disasters and displacement in Pakistan: a case study of Rahim Yar Khan. https://hdl.handle.net/10568/169302

Khisro, S. B., Fatima, B., Khan, M. I., & Orakzai, J. K, & Islam, MU (2024). Climate-adaptive infrastructure and environmentally sustainable urban growth. *Khyber Journal of Public Policy*, *3*(4), 170-193. https://www.nipapeshawar.gov.pk/KJPPM/PDF/CIP/P8.pdf

Malik, T., Anwar, T., & Karamat, S. (2024). Sustainable Development Growth: An Extensive Approach to achieving Prosperity and Environmental Balance in Pakistan. Pakistan Social Sciences Review, 8(2), 238-247. https://doi.org/10.35484/pssr.2024(8-II-S)20

Manandhar-Sherpa, A., Lüthi, C., & Howard, G. (2024). Review of policies for building climate resilience in urban sanitation systems and services in Nepal. *Water Policy*, *26*(12), 1207-1221. https://doi.org/10.2166/wp.2024.040

Mansour, L. (2024). Water, Sanitation, and Hygiene in Schools: A Global Analysis of Bottlenecks and Climate Resilient Strategies.

Mumtaz, T., Shaiq, S., & Afzal, M. (2025). Securing sustainable development goal- 6 in Pakistan: A framework for clean water and sanitation. *Regional Lens*, *4*(1), 67-78. https://doi.org/10.62997/rl.2025.41035

Mustafa, G., & Bhatti, M. N. (2025). Inclusive and Equitable Quality Education in Pakistan and Compliance with Sustainable Development Goals (SDGs). Archives of Educational *Studies (ARES)*, *5*(1), 55-72. https://ares.pk/ojs/index.php/ares/article/view/149

Perveen, S. (2023). Drinking water quality monitoring, assessment and management in Pakistan: A review. *Heliyon, 9*(3). https://www.cell.com/heliyon/fulltext/S2405-8440(23)01079-4

Qadir, H., Wani, K. A., Islam, N. U., Kafkas, E., & Akgöl, C. (2025). Impact Assessment of Climate Change and Adaptation Strategies in South Asia. *Environmental Claims Journal*, 1-30. https://doi.org/10.1080/10406026.2025.2522661

Qamar, K., Nchasi, G., Mirha, H. T., Siddiqui, J. A., Jahangir, K., Shaeen, S. K., ... & Essar, M. Y. (2022). Water sanitation problem in Pakistan: A review on disease prevalence, strategies for treatment and prevention. *Annals of Medicine and Surgery, 82*. https://doi.org/10.1016/j.amsu.2022.104709

Rasool, A., Saeed, S., Ahmad, S., Iqbal, A., & Ali, A. (2024). Empowering community participation for sustainable rural water supply: Navigating water scarcity in Karak district Pakistan. *Groundwater for Sustainable Development, 26,* 101269. https://doi.org/10.1016/j.gsd.2024.101269

Saber, M., Koroma, A., Posite, R. V., Ly, A., Tejan Bah, A. M., Abdulai, A., ... & Mewafy, F. (2025). A comprehensive review of climate change adaptation and disaster risk reduction in Africa. *Journal of Water and Climate Change*, *16*(5), 1831-1862. https://doi.org/10.2166/wcc.2025.741

Shah, A. A., Ullah, W., Khan, N. A., Alotaibi, B. A., & Xu, C. (2024). Mapping Rural Household Vulnerability to Flood-Induced Health Risks in Disaster-Stricken Khyber Pakhtunkhwa, Pakistan. *Sustainability, 16*(23), 10578. https://doi.org/10.3390/su162310578

Shahzad, A., Anwar, M. S., Ullah, S., & Afzal, A. (2025). Vulnerability of water resources and sanitation infrastructure to climate change in rural Pakistan: Implications for achieving the sustainable development goals. *Journal of Regional Studies Review*, *4*(1), 244-252. https://doi.org/10.62843/jrsr/2025.4a071

Siyal, G. E. A. (2025). Children Climate Risk Index (CCRI). *Research and Reflections on Child Wellbeing in Pakistan*, *30*, 137.

Sultan, M. S., Akhtar, N., Shaheen, M. B., & Ali, S. (2025). Human Rights and the Environment in Pakistan: Exploring the Nexus and Challenges. *Review Journal of Social Psychology & Social Works*, *3*(3), 97-116. https://doi.org/10.71145/rjsp.v3i3.300

Tufail, M., Nasir, M. J., Tariq, A., Ali, Z., & Alarifi, S. S. (2025). Assessing access to safe drinking water in flood-affected areas of District Nowshera, Pakistan: A case study towards achieving sustainable development goal 6.1. *Ecohydrology & Hydrobiology*, *25*(2), 422-437. https://doi.org/10.1016/j.ecohyd.2024.07.001

Waqar, K., & Hafeez, M. (2025). Bridging the gap: gender-inclusive policies for a sustainable water future in Pakistan.

World Health Organization. (2023). *Addressing climate change: supplement to the WHO water, sanitation and hygiene strategy 2018–2025*. World Health Organization.

Yasmin, T., Dhesi, S., Kuznetsova, I., Cooper, R., Krause, S., & Lynch, I. (2023). A system approach to water, sanitation, and hygiene resilience and sustainability in refugee communities. *International Journal of Water Resources Development*, *39*(5), 691-723. https://doi.org/10.1080/07900627.2022.2131362

Yousaf, A., Kiran, A., Iqbal, M. A., Murtiza, G., & Hussain, M. (2025). Climate change effects on rural livelihoods in Pakistan: legal and policy analysis. *GeoJournal*, *90*(1), 25. https://doi.org/10.1007/s10708-024-11273-6