A Comprehensive Assessment of Migration Associated with Climate and Related Risks: A Literature Based Research in Pakistan

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Climate change is increasingly recognized as a primary factor driving migration globally, and Pakistan is particularly susceptible to its impacts. This review investigates the relationship concerning climate and migration in Pakistan, relying over how environmental stressors such as flooding, droughts, and rising temperatures contribute to socio-economic vulnerabilities. Utilizing a literature review approach from different sources including Google Scholar, Web of Science, Scopus, Science Direct and Different websites investigate migration trends, associated risks, dislocations caused by flood, gender disparities and gaps in policy frameworks. The findings indicate that climate-induced migration exacerbates challenges such as poverty, resource scarcity, gender disparities, and urban congestion. Existing policies are inadequate in addressing the complex links between climate-related events, environmental degradation, and population displacement. This research emphasizes the need for a holistic approach that combines immediate assistance with long-term strategies to support affected communities, enhance resilience, and improve climate risk management.

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Introduction

Pakistan possesses an extraordinarily varied topographical landscape and a climate spectrum that ranges from the warm, tropical zones to the more temperate regions. The nation of Pakistan is home to an estimated populace of approximately 208 million individuals and encompasses a vast expanse of land measuring a total of 796,000 square kilometers. The climatic conditions across this region exhibit considerable variation, transitioning from semi-arid environments to those characterized by humidity within the majestic high mountain ranges, while further extending to arid and semi-arid conditions within the fertile plains of the Indus River, the hyper-arid Balochistan Plateau, and the arid expanses of the deserts

including Thar and Cholistan, along with the Indus delta that gracefully borders the Sea, (Khushi et al., 2024). A historical analysis reveals that the annual mean temperature in Pakistan has experienced an increase of 0.57°C since the year 1900, as supported by reports from the Government of Pakistan in 2010, along with scholarly contributions from Khoso et al., 2024), with the most significant warming trends being observed during the winter months across the southwestern territories, southern and northern, of the nation, (Khoso et al., 2024). Furthermore, it has been observed that precipitation during the monsoon season has risen by an impressive 15 to 25 percent in the northern regions of Pakistan, while experiencing a slight decline in the southern areas, (Khan et al., 2019). In addition to these changes, there has been a notable increase in both the frequency and intensity of extreme weather events (Iqbal et al., 2016). Current projections suggest that, under the most severe climate change scenarios, the average annual temperature is expected to rise by approximately 1.2°C during the 2020s, by 2.5°C in the 2050s, and by a staggering 4.5°C in the 2080 (Jahangir et al., 2016). In the northern glaciated regions, a significant increase in annual mean temperature ranging from 3°C to 4°C is to be expected, while the southern parts of Pakistan are projected to witness a more modest increase of between 2°C and 3°C (IPCC, 2013). It is anticipated that the winter months will undergo a more pronounced increase in temperature compared to the summer months, with a potential rise in overall precipitation levels, possibly attributable to heightened interannual variability, particularly observed in the southern regions of Pakistan (Khoso et al., 2022). While incidence of thrilling rainfall measures is projected to escalate, particularly in the northern regions of Pakistan (Khushi et al., 2024). Furthermore, there is an escalating concern regarding the increasing frequency of consecutive dry days in Sindh and South Punjab, which may exacerbate the prevailing drought conditions (Abdul et al., 2024). Research indicates an upsurge in both average and extreme rainfall levels, alongside augmented spatial and temporal variability, particularly in the dynamics of summer monsoon rainfall (Fang et al., 2014). Migration patterns within Pakistan are profoundly influenced by the nation's diverse geographical characteristics, which can be broadly delineated into four principal areas encompassing its own sub-regions (Atanga & Tanpka, 2021).

The scholarly examination of migration in Pakistan frequently neglects the complex interplay between climate change and migration, particularly concerning migration as an adaptive mechanism. Existing literature has predominantly concentrated on migration as an economic construct, scrutinizing the determinants of migration, the demographic characteristics of migrants, and the ramifications of remittances. Theoretical frameworks pertaining to human capital and macroeconomic indicators have been utilized to investigate the influence of individual-level human capital. These investigations have also assessed how remittances facilitate asset accumulation, savings, consumption, and their impacts on poverty and income disparity, particularly within rural contexts. Although research in Pakistan has illustrated that climate change has precipitated a decline in agricultural productivity, heightened food insecurity, and exacerbated inequality, particularly among disadvantaged rural demographics, there has been insufficient emphasis on the direct correlation between climate change and migration. This research concentrates on areas most susceptible to the repercussions of climate change, including flooding, erratic rainfall, unpredictable drought occurrences, and elevated temperatures.

Disease associated with climate

Climate change has become an unavoidable global challenge, causing devastating impacts on human life and societal structures. Its direct link to migration is increasingly evident (Al-Amin et al., 2019). The term "climate-induced migration" refers to all forms of human

movement driven by climate change, including both gradual and sudden environmental changes. While "displacement" typically describes the temporary relocation of people due to flooding or other disasters, it can also extend to permanent resettlement. Broadly, migration encompasses all climate-related movements, highlighting the gravity of this issue (Islamic Relief, 2021). Rural communities in developing nations are particularly vulnerable, as climate change threatens global sustainability. In Pakistan, climate-related impacts have intensified in recent years. Catastrophic flooding along the Indus River system, recurrent droughts, and heat waves have become more common, underscoring the nation's vulnerability (Manzoor and Adesola, 2022). Climate-induced migration has amplified existing migration patterns, including:

Permanent migration: Long-term relocation of individuals or families to new areas for sustained residence.

Temporary migration: Short-term movement to safer locations, with eventual return home, such as during Pakistan's floods between 2010 and 2014.

Seasonal migration: Regular, cyclical relocation based on changing weather conditions. This is particularly common in Pakistan, where residents of regions like Skardu, Chitral, and Gilgit relocate to urban centers during harsh climatic periods. In Sindh and Balochistan, rural inhabitants often displace to another cities including Karachi for the betterment of life and economic opportunities.

The Global Climate Risk Index ranks Pakistan among the ten most climate-vulnerable nations, placing it fifth in 2020 (Eckstein, 2022). Rising temperatures, frequent extreme weather events, glacier melt in the northern regions, and changing monsoon patterns contribute to this vulnerability. Between 1999 and 2018, Pakistan experienced 152 extreme weather incidents (Chan et al., 2022). Climate-induced migration affects all regions of Pakistan (Ali, 2021). Annually, natural disasters impact nearly three million Pakistanis, representing 1.6% of the population (Ebrahim, 2020). In South Asia, Pakistan leads in urbanization, with estimates suggesting that 50% of its population will reside in urban areas by 2025 (UNDP, 2019). Projections indicate that climate change could displace between 25 million and 1 billion people globally by 2050, with Pakistan already witnessing significant migration due to floods and droughts. In 2022 alone, 30 million individuals worldwide were displaced by climate-driven disasters, with approximately 700,000 Pakistanis moving annually from rural to urban areas (See et al, 2017). Research from the (SDPI) (CANSA) shows that rural populations in Pakistan face significant challenges from floods and droughts (Jury et al., 2007). These disasters are not isolated; heat waves, rising sea levels, and other climate-induced hazards also force people to migrate to protect their families or improve economic conditions. However, urban migration presents new difficulties, including competition for limited resources and space, worsening pre-existing inequalities (Charupoonphol, 2014). Pakistan also has a history of voluntary migration, with workers moving to the UAE, Dubai, Europe, and the United States. The Pakistani diaspora, one of the largest globally, contributes significantly to the economy, sending approximately $12 billion in remittances annually.

Research Methodology

This study employs a literature based review method to synthesize and analyze existing research on climate-induced migration and its associated risks in Pakistan. The review critically examines scholarly works, policy reports, and statistical data, focusing on key areas: climate change trends, migration patterns (permanent, temporary, and seasonal) triggered by

climatic stressors, socio-economic impacts of migration, and adaptive strategies adopted by vulnerable populations. Secondary sources include peer-reviewed journals (Web of Science, Scopus, Science Direct and other data base), books, and reports from international organizations (e.g., UNDP, IPCC, IOM) and national entities like the Sustainable Development Policy Institute and the Ministry of Climate Change. Government records and case studies, such as the 2010 floods and recent heatwaves, provide additional context. Keywords like "climate-induced migration," "flooding and migration," and "urbanization and climate risks" guide the search process. The review includes sources from the last 15 years that focus on South Asia or Pakistan, prioritizing empirical studies with socio-economic insights, while excluding irrelevant or outdated materials. Data is analyzed using thematic synthesis, categorizing findings into climatic drivers of migration, migration patterns, socio-economic impacts, and policy gaps. This framework enables a critical evaluation of existing strategies and identifies areas for improved adaptive responses.

Results and Discussions

The research highlights that Pakistan is disproportionately affected by the adverse consequences of global climate practices, which not only harm the environment but also jeopardize the well-being of its citizens. For over two decades, Pakistan has ranked among the top ten countries most vulnerable to climate change. The climate crisis is closely tied to issues of poverty and security, significantly hindering the country's development progress and creating a sense of instability among its population. These challenges heavily influence governmental and institutional capacities to respond effectively. Climate-related crises have led to severe consequences, including malnutrition and physical weakness, as communities wait for essential supplies, often delivered under extreme circumstances. Flood-induced displacement has forced families into areas lacking basic necessities such as adequate shelter and sanitation. In these dire situations, at least one male family member often migrates to rural or urban areas to seek employment opportunities. This study underscores the strong link between climate change and migration, emphasizing that this relationship must be addressed. Climate impacts, whether immediate or long-term, are intensified by various factors such as social, economic, political, and cultural dynamics, which can compel individuals to migrate. The movement of people due to climate-related causes places additional strain on destination areas, further aggravating Pakistan's climate vulnerabilities. The findings of this review categorize the risks associated with climate-induced migration and assess the scale of the resulting costs and consequences.

Figure-1 Rainfalls in Pakistan 2022 demonstrating (mm).
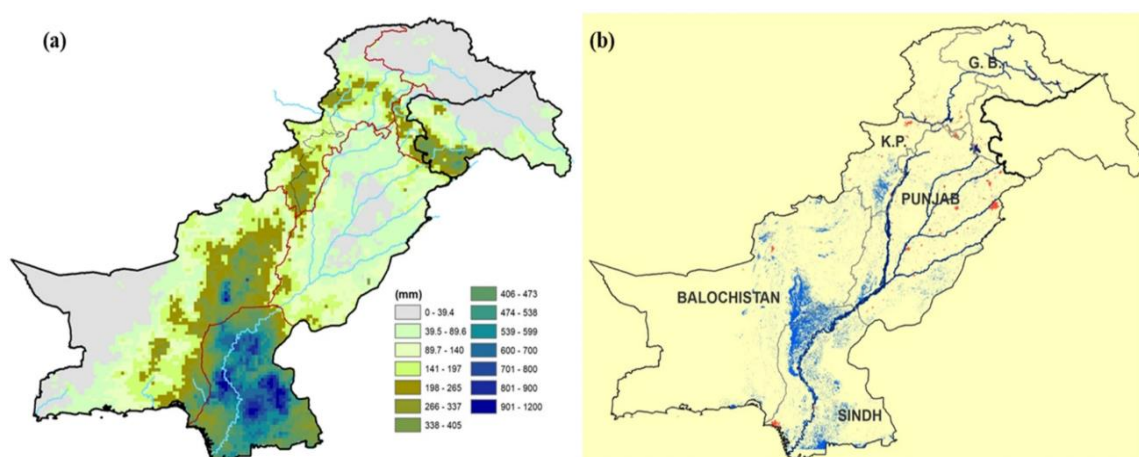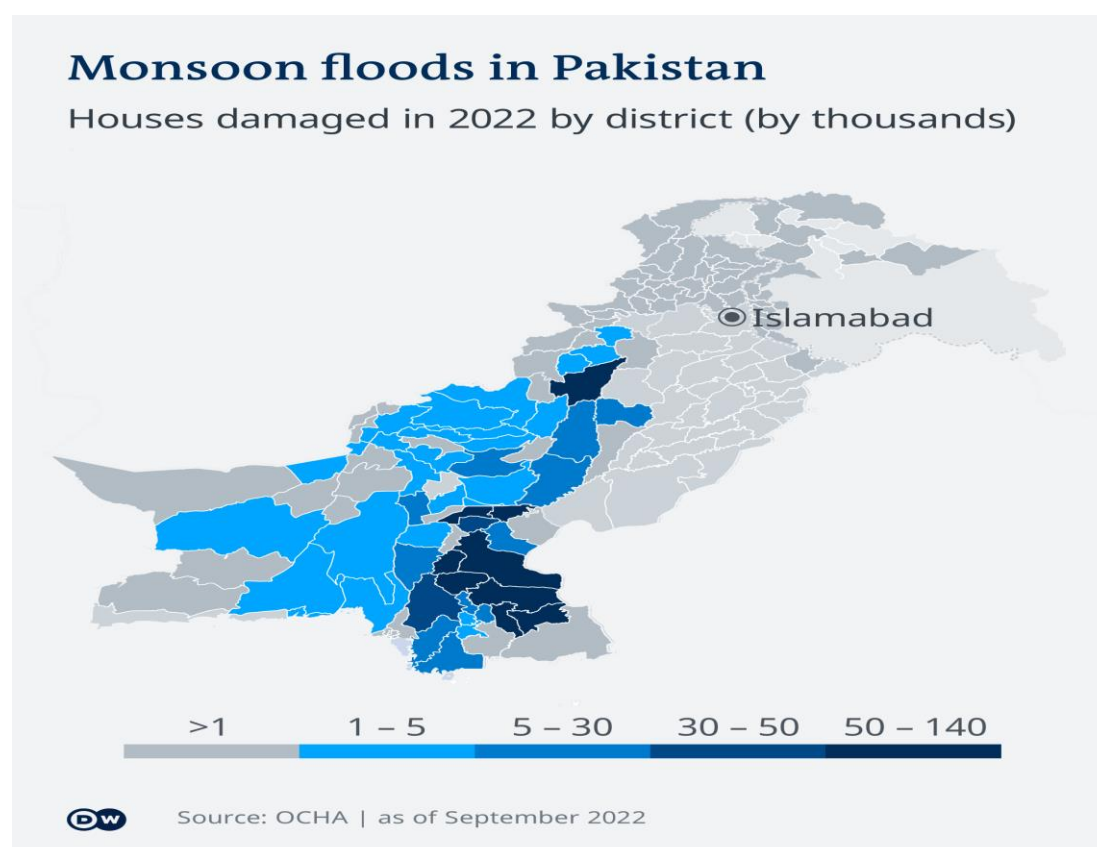

(Source: GPM -IMERG satellite data), (**b**) Fig. 1: Flood extent in Pakistan on 28 August 2022 based on Sentinel-satellite data (Source: Sentinel-1 satellite data, the maps were produced using the ArcGIS 10.7 (www.esri.com).

Economic Downfall and Disasters

Pakistan bears the disproportionate consequences of environmental negligence by other nations (WHO, 2022). Since its establishment, the country has faced numerous natural disasters, including floods, earthquakes, windstorms, and droughts, which have devastated infrastructure, claimed lives, and disrupted livelihoods. These catastrophes have significantly impacted agriculture, animal husbandry, fishing, health, education, and businesses (Rana et al 2021). Approximately fifty percent of Pakistan's demographic is dependent on agricultural activities and associated sectors for their subsistence, rendering the repercussions of global warming particularly acute. The prevalence of poverty exacerbates susceptibility to climate change, serving as a predominant factor influencing displacement (World Bank, 2022). The nation endures annual economic detriments surpassing $4 billion attributable to climate change, culminating in a cumulative total of $80 billion in losses from 1996 through 2016 (Ministry of Climate Change). Migration induced by climatic changes constitutes a pervasive national concern, impacting all provinces, inclusive of the northern region of Gilgit-Baltistan (Rana et al, 2021). It was also noted that, climate change has suffered different lives in terms of economic burden, health issues and conflicts. There is further main factor affecting human life is migration that not only consequences the population but also become the main cause of epidemics. Pakistan has undergone a multitude of disasters, including the 2005 seismic event, the Hunza landslide, and various cyclonic storms, all of which have resulted in considerable casualties and destruction of property. These adversities are further exacerbated by persistent challenges such as terrorism and political turbulence, which hinder the government's capacity to respond effectively. In August 2022, unprecedented rainfall and subsequent flooding precipitated the displacement of roughly 33 million individuals, incurring an estimated $40 billion in damages (Mahmood et al, 2021).

Fig-2 Monsoon floods in Pakistan

Monsoon floods in Pakistan
Houses damaged in 2022 by district (by thousands)

>1 | 1 – 5 | 5 – 30 | 30 – 50 | 50 – 140

Source: OCHA | as of September 2022

The figure-2 shows the monsoon floods indicating the household damages in Pakistan. Floodwaters destroyed shops, livestock, poultry shelters, and other assets. Many people, unable to sustain their livestock due to the lack of fodder, were forced to sell them at significantly reduced prices. Mismanagement and delays in aid distribution led to severe hardship, with some families suffering from malnutrition while waiting for food supplies to reach their areas. Displaced families relocated to areas with inadequate shelter and sanitation, and in most cases, one male member migrated to urban or rural areas to earn and send money home (Salik et al., 2020). Natural disasters such as floods, storms, and heavy rainfall disrupt education, with children often forced to drop out of school, and increase neonatal mortality rates (Mahmood et al, 2021). Additionally, neighboring countries like Bangladesh and India have experienced severe health crises, such as outbreaks of diarrhea and AIDS, following major floods (Rahman et al., 2012). Pakistan's susceptibility to climate change stems from several factors, including widespread rural poverty, urban unrest, degraded land, and food production deficits. Rapid urbanization and industrialization further strain limited water resources already impacted by climate change (Climate and Migration Coalition). While major polluters like China and the United States accelerate global climate change, countries like Pakistan face the critical consequences of this escalating crisis (Rana et al, 2021; Shah et al., 2021).

Population Dislocations caused by Floods

Flooding and thermal stress represent significant determinants of climate-induced migration within the context of Pakistan, necessitating the relocation of individuals on either a temporary or permanent basis. Throughout the years, a considerable number of Pakistani citizens have experienced displacement as a consequence of natural calamities, particularly floods. (Shah et al, 2020). Regions like Gilgit-Baltistan have experienced increasingly unpredictable weather patterns in recent times, including heavy rainfall, flash floods, and landslides, which have forced many to migrate. Shifts in the timing of monsoons and precipitation, attributed to rising temperatures, have further worsened these conditions. For instance, the summer monsoon now occurs later in the season, while winter rains have shifted to late February and March. Similarly, snowfall, previously limited to November and December, now extends into March (Shah et al., 2018).

**Fig-3: Dislocations by the flood- 2022**

The figure-3 shows the displacements of the people due to the flood. These evolving climate conditions often leave individuals with no choice but to directly shifting, either for providing security to their livings or to seek better livelihood opportunities. However, migration to urban areas presents additional challenges. Migrants often face competition for limited resources and space, which exacerbates the inequalities that made them vulnerable in the first place (Mahmood et al, 2021). In recent years, nearly one-third of Pakistan was submerged by floods, displacing vast numbers of people. These events caused severe human and economic losses. Addressing the needs of displaced individuals becomes a government responsibility, but financial constraints often hinder effective support without assistance from non-governmental organizations and international donors. Neglecting these needs could lead to frustration among affected communities, potentially escalating into conflicts. Their primary concern remains survival, and the lack of adequate resources may heighten grievances. Urban migration is particularly concentrated in Pakistan's largest cities. If basic necessities remain unmet, this could lead to increased crime rates (Rana et al, 2021). Patterns of coerced migration are discernible throughout all provinces, albeit the underlying causes differ. For instance, in Khyber Pakhtunkhwa and Gilgit-Baltistan, both seasonal and permanent dislocation frequently occurs as a consequence of Glacial Lake Outburst Floods (GLOFs). In Northern areas of Sindh, in 2022, the reason for dislocation of population were deemed to be because of the floods, where each and every person was involved to transfer themselves from one to another area. As, the houses were completely damaged and the sources of income were also hindered. That not only caused the dislocations but also infected the human health and life. The catastrophic 2010 floods, one of the worst climate-related disasters in Pakistan's history, displaced more than 20 million individuals, who were classified as climate refugees. In coastal regions of Sindh, sea intrusion and deforestation have contributed to significant land loss, displacing entire communities (Ali et al., 2022). Urban migration is particularly directed toward Pakistan's largest cities. If basic needs remain unmet, the risk of rising crime rates also increases (Seyyed, 2022). The catastrophic floods of 2010, among the worst climate-related disasters in Pakistan's history, displaced over 20 million people, categorizing them as climate refugees. Meanwhile, coastal areas in Sindh are experiencing land loss due to sea intrusion and deforestation, which has displaced local communities (Ali et al., 2022).

Shortage of water

Temporary migration has historically functioned as a strategy for alleviating seasonal water deficiencies, whereas enduring water scarcity frequently compels individuals to undertake permanent migration. Scholarly discourse regarding the influence of migration on water resources predominantly accentuates the adverse consequences, particularly the heightened demand for water in regions where migrants establish residence. The interrelationship between water management and climate-induced migration is profoundly significant (Environmental Migration Portal, 2022).

In agrarian economies such as Pakistan, the issue of water security is of paramount importance, as it has direct implications for agricultural production and energy availability. The agricultural sector constitutes more than 23% of Pakistan's Gross Domestic Product, supports the livelihoods of in excess of 40 million individuals, and is vital for the preservation of the nation's food security.

Figure-4 Water crisis due to floods
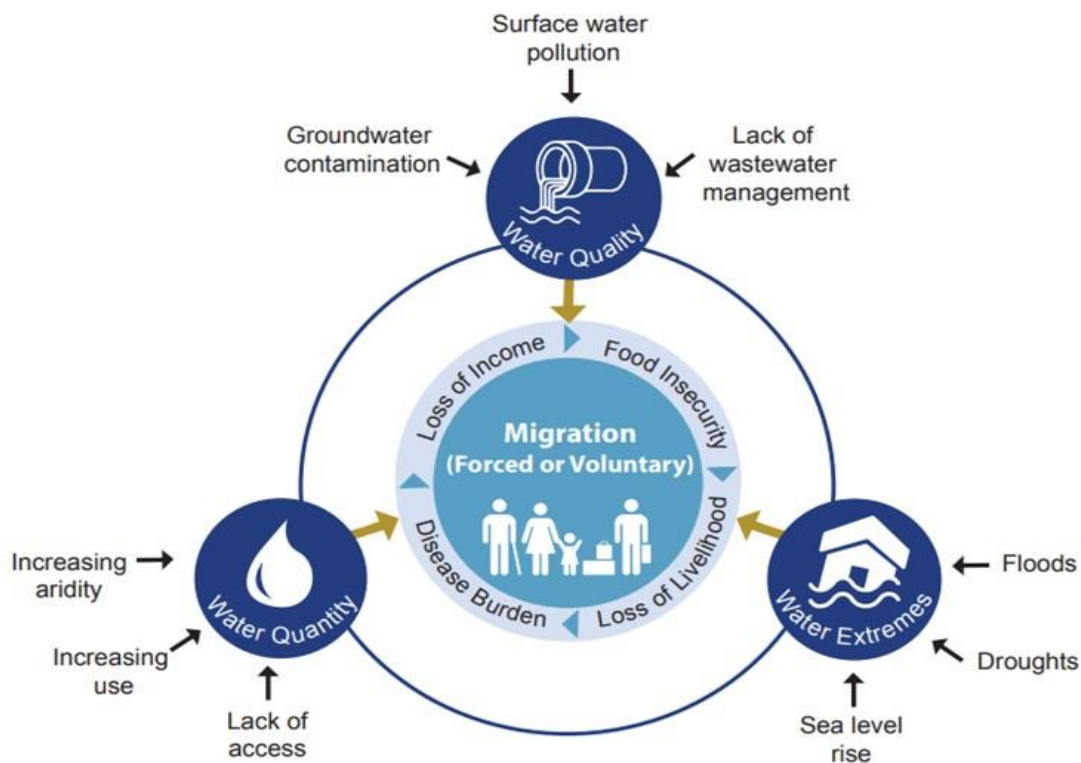
The figure-4 highlights the water crisis due to the floods, as, it's observed that water has always been the major cause in various areas. Where people are lacking the pure drinking water. Historically, the depletion of critical river systems has precipitated the demise of entire civilizations. Currently, Pakistan is experiencing a shift from water stress to water scarcity, with per capita access to potable water diminishing below 1,800 cubic meters annually and projected to further decline to 800 cubic meters by 2026 as a consequence of population growth. This escalating water crisis is aggravated by Pakistan's reliance on natural water sources and Transboundary Rivers governed by neighboring countries. The construction of over 50 dams by India on rivers that flow into Pakistan has strained diplomatic relations and adversely impacted Pakistan's water and energy security. In a similar vein, Afghanistan's proposed infrastructure initiatives on the Kabul River are anticipated to create further complications. Moreover, Pakistan's principal reservoirs, including Tarbela and Mangla— erected in the 1960s and 1970s—have experienced diminished storage capacity owing to sedimentation. The political debate surrounding the construction of new dams has further delayed action, worsening water availability issues. Reduced water resources could exacerbate food shortages and potentially spark conflicts between provinces and the federal government. Climate change adds another layer of complexity, accelerating glacier melting and altering rainfall patterns, which can lead to both droughts and floods, as demonstrated by the devastating floods in 2022.

Gender-Based Disparities in Climate-Driven Migration

While climate change exerts its influence on populations uniformly, its repercussions are frequently intensified by prevailing socio-political and economic frameworks, which further aggravate gender inequities (Islamic Relief, 2021). Scholarly investigations have elucidated the gender-specific ramifications of climate change, identifying migration as a domain wherein the roles, obligations, and adversities encountered by men and women markedly

diverge (Sultana et al., 2024). Women, particularly those possessing limited resources and fewer alternatives for relocation, exhibit heightened vulnerability to the compounded impacts of climate change, migration, and systemic inequalities.

In developing countries, rural women who depend on agriculture are particularly susceptible to these risks. Environmental alterations, such as droughts and cyclones, jeopardize their livelihoods as they frequently oversee vital resources, including water, forests, and crops. Households reliant on women's agricultural income encounter severe economic and social challenges in the wake of environmental calamities (Afzal et al., 2024). Acknowledging the interconnectedness of gender and migration is essential for comprehending the dynamics of displacement. Social inequalities, encompassing unequal access to resources, further influence migration trends and decision-making processes (Cardarelli, & Pomper, 2024). Although the ramifications of climate change on women have been extensively investigated, the nexus between these effects and migration remains insufficiently examined. Migration frequently functions as an adaptive mechanism to address extreme weather phenomena; however, the experiences of men and women are distinct, thereby emphasizing the necessity of integrating gender perspectives into migration policies. The international community, as evidenced by frameworks such as the 2015 Paris Agreement, has recognized the imperative for gender-sensitive methodologies in tackling climate-induced migration (Oyilieze et al., 2022). In Pakistan, women are disproportionately impacted by climate-induced migration. They confront heightened health risks, increased domestic responsibilities, restricted mobility, and reduced income prospects—challenges that are particularly pronounced in rural agricultural contexts. Research focusing on climate-induced migration within Sindh illustrates the daily adversities encountered by women migrants, including vulnerability to diseases, threats from wildlife, harassment, lack of privacy, and psychological trauma stemming from displacement (Bari et al., 2024). Addressing these concerns necessitates the formulation of targeted policies that acknowledge gender disparities and cater to the distinct needs of women affected by climate migration.

Conclusion

 In addition to the risks already discussed, climate-induced migration poses significant security concerns for indigenous communities in areas where migrants resettle. The arrival of people from diverse ethnic and cultural backgrounds may lead to feelings of insecurity among local residents, particularly when migrants enter the local job market. This competition for limited resources can often spark tensions and conflicts between migrants and host communities, especially in densely populated regions. The rapid population growth resulting from climate migration further intensifies challenges such as food shortages, water scarcity, displacement, gender inequality, and economic instability. These issues are often compounded by poor governance and ineffective management by responsible authorities. While some forms of migration can serve as adaptive strategies to cope with climate change, others may highlight an inability to adapt to changing environmental conditions. This review examines the policy discussions surrounding natural disasters and migration, emphasizing the importance of strong governance systems in establishing national and international disaster risk management frameworks. Effective governance plays a crucial role in addressing and mitigating the impacts of climate-induced migration. The study suggests that well-planned relocation strategies can offer a practical solution for adaptation. Successfully addressing climate adaptation challenges requires advanced research, dedicated political will, substantial investments, and the modernization of outdated infrastructure and policies across critical sectors like agriculture, water management, and energy systems.

Recommendations

Floods have always been the serious concerns of Pakistan either 2010 or 2022. There are several major issue that causes damage to human life include inappropriate infrastructure, lack of planning, and absence of good governance. As, shown in literature that, china has tackled the issue at greater extent with their ability to control and manage the flood prone areas. Therefore, the research recommends that, the better Planning, Functional governance and strategies to face and tackle those floods. For the purpose different policies should be implemented to lessen the floods with updated infrastructure.

References

1. Abdul Rasool Khoso, Shahnaz Bhutto, Kainat Vighio, & Tehmina Solangi. (2024). To Study The Medical Waste Management In District Hyderabad: A Sociological Investigation. *Journal of Population Therapeutics and Clinical Pharmacology*, *31*(6), 3495-3505. https://doi.org/10.53555/f22kwg72
2. Afzal, F., Das, A., & Chatterjee, S. (2024). Drawing the Linkage Between Women's Reproductive Health, Climate Change, Natural Disaster, and Climate-driven Migration: Focusing on Low-and Middle-income Countries-A Systematic Overview. *Indian Journal of Community Medicine*, *49*(1), 28-38.
3. Al-Amin, A. Q., Nagy, G. J., Masud, M. M., Leal Filho, W., & Doberstein, B. (2019). Evaluating the impacts of climate disasters and the integration of adaptive flood risk management. *International journal of disaster risk reduction*, *39*, 101241.
4. Ali, M., Mohammed, Z. M. M., & Al-Shaghdari, F. M. O. (2022). A comprehensive analysis of recent flood disaster & their economic impact on Pakistan Economy & its causes. International Journal of Finance and Management (IJFM), 1(1).
5. Atanga, R. A., & Tankpa, V. (2021). Climate change, flood disaster risk and food security nexus in Northern Ghana. *Frontiers in Sustainable Food Systems*, *5*, 706721.
6. Cardarelli, R., & Pomper, H. (2024). Climate-Driven Migration–Africa (Case Studies of Malawi and Kenya). In *Children and the Climate Migration Crisis: A Casebook for Global Climate Action in Practice and Policy* (pp. 41-57). Emerald Publishing Limited.
7. Chan, E. Y. Y., Liu, S., Wong, C. S., & Shaw, R. (2022). Health, climate change and disaster risks. In *Handbook on Climate Change and Disasters* (pp. 392-406). Edward Elgar Publishing.
8. Charupoonphol, P. (2014). Public health roles in response to the 2011 Thailand flooding. In *Routledge handbook of global public health in Asia* (pp. 381-402). Routledge.
9. Environmental Migration Portal. (2022). Climate Change, Water Security and Migration in Central Asia: A Dialogue with Stakeholders and Partners. Retrieved from, https://environmentalmigration.iom.int/events/climate-change-water-security-and-migration-centralasia-dialogue-stakeholders-and-partners
10. Fang, J., Du Juan, X. W., Shi, P., & Kong, F. (2014). Advances in the study of climate change impacts on flood disaster. *Advances in Earth Science*, *29*(9), 1085.
11. Intergovernmental Panel on Climate Change (IPCC), (2013). Climate change 2013: the physical science basis. In: Stocker, T.F., Qin, D., Plattner, G.-K., Tignor, M., Allen, S.K., Boschung, J., Nauels, A., Xia, Y., Bex, V., Midgley, P.M. (Eds.), Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

12. Iqbal, M. A., Penas, A., Cano-Ortiz, A., Kersebaum, K. C., Herrero, L., & del Río, S. (2016). Analysis of recent changes in maximum and minimum temperatures in Pakistan. *Atmospheric Research*, *168*, 234-249.

13. Islamic Relief. (2021). Climate-Induced Migration in Pakistan: Global Discourse, local realities, and Governance.

14. Jahangir, M., Ali, S. M., & Khalid, B. (2016). Annual minimum temperature variations in early 21st century in Punjab, Pakistan. *Journal of Atmospheric and Solar-Terrestrial Physics*, *137*, 1-9.

15. Janjua, S. (2009). Climate change impacts: Adaptation challenges for Pakistan. *The International Journal of Climate Change: Impacts and Responses*, *1*(4), 1.

16. Khoso, A. R., Akhtar, F., Narejo, A. A., Mallah, S. A., Vighio, K., & Sanjrani, D. K. (2022). Comparative Analysis of Service Quality between Public and Private Hospitals, Using SERVQUAL Model: A Case Study of Peshawar, Pakistan. *MEDFARM: Jurnal Farmasi dan Kesehatan*, *11*(2), 240-252.

17. Khoso, A. R., Bhutto, S., Jintu, G., & Suyuhan, W. (2024). The Impact of Smoking on Public Health and Economic Stability in Sindh Province, Pakistan. *Zakariya Journal of Social Science*, *3*(2), 15-25.

18. Khoso, A. R., Gu, J., Bhutto, S., Muhammad Javed Sheikh, Vighio, K., & Arshad Ali Narejo. (2024). Climate change and its impacts in rural areas of Pakistan: a Literature review. Journal of Environmental Science and Economics, 3(1), 18–26. https://doi.org/10.56556/jescae.v3i1.731

19. Khushi, S. R., Khoso, A. R., Bhutto, S., & Narejo, A. A. (2024). The long-term health impacts of repeated flood events: A Review. *Journal of Environmental and Energy Economics*, 11-19.

20. Mahmood, S., Sajjad, A., & Rahman, A. U. (2021). Cause and damage analysis of 2010 flood disaster in district Muzaffar Garh, Pakistan. *Natural hazards*, *107*(2), 1681-1692.

21. Manzoor, A., & Adesola, R. O. (2022). Disaster in public health due to flood in Pakistan in 2022. *Health science reports*, *5*(6).

22. Oyilieze, A. A., Joe-Ikechebelu, N. N., Okedo-Alex, I. N., Okafor, K. J., Omoruyi, F. A., Okeke, J., ... & Echendu, S. T. (2022). Climate-Driven Temporary Displacement of Women and Children in Anambra State, Nigeria: The Causes and Consequences. *Climate Change in Asia and Africa-Examining the Biophysical and Social Consequences, and Society's Responses*.

23. Rana, I. A., Asim, M., Aslam, A. B., & Jamshed, A. (2021). Disaster management cycle and its application for flood risk reduction in urban areas of Pakistan. *Urban Climate*, *38*, 100893.

24. Shah, A. A., Gong, Z., Ali, M., Jamshed, A., Naqvi, S. A. A., & Naz, S. (2020). Measuring education sector resilience in the face of flood disasters in Pakistan: an index-based approach. *Environmental Science and Pollution Research*, *27*, 44106-44122.

25. Shah, A. A., Ye, J., Abid, M., Khan, J., & Amir, S. M. (2018). Flood hazards: household vulnerability and resilience in disaster-prone districts of Khyber Pakhtunkhwa province, Pakistan. *Natural hazards*, *93*, 147-165.

26. Shah, S. Z. A., Farooq, F., Chaudhry, I. S., & Asghar, M. M. (2021). The role of internal and external migration on rural poverty alleviation in Pakistan: a case study of Multan district. *Review of Education, Administration & Law*, *4*(2), 495-502.

27. Sultana, N., Sarkar, J., & Meurs, M. (2024). Climate Change Induced Migration: A Gendered Conceptual Framework. *Migration and Diversity*, *3*(2), 215-233.

28. UNDP. (2019). Development Advocate Pakistan. Sustainable Urbanization, 5(4).

29. United Nations Climate Change. (2016). Climate Change Is a Key Driver of Migration and Food Insecurity. Assessed from: https://unfccc.int/news/climate-change-is-a-key-driver-of-migration-and-food-insecurity.

30. World Bank Blogs, 2022. Flood risk already affects 1.81 billion people. Climate change and unplanned urbanization could worsen exposure. https://blogs.worldbank.org/en/climatechange/flood-risk-already-affects-181-billion-people-climate-change-and-unplanned

31. World Health Organization, 2022. Floods. https://www.who.int/health-topics/floods#tab=tab_1