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BRIDGING A GAP: ASSESSING CLIMATE CHANGE IMPACTS ON GIRLS' EDUCATION AND DEVELOPING A RESILIENT LEARNING SYSTEM

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Abstract

Climate change poses significant and widespread threats to girls' education globally. It impacts the continuity, quality, and accessibility of education. This research examines the effects of climate-induced disasters, including floods, droughts, and heat waves, in four districts of Balochistan. The study employed a mixed-methods approach to gather both qualitative and quantitative data using questionnaires, interviews, and focus group discussions. A sample of 330 participants, comprising female students, teachers, school administrators, parents, community members, and NGO representatives, was selected using simple random and purposive sampling techniques. The primary indicators of attendance rate, dropout rate, learning outcomes, teacher availability, infrastructure damage, and delays in school reopening were examined to evaluate the effects of climate change on education. The findings of the study reveal that climatic disasters severely affected school attendance and continuity of education, as evidenced by a 35% drop in attendance in flood-affected areas. The dropout rate among girls significantly increased due to displacement, financial constraints, and safety concerns. Moreover, the quality of education also decreased due to teachers' absenteeism and deteriorated classroom conditions, leading to a 20% drop in average student performance. Access to education was further restricted due to road destruction and school closure for an extended period, affecting enrollment and attendance after climate disasters. To establish a resilient learning system in Baochistan, the study recommends constructing flood and drought-resistant school buildings, incorporating climate change education into national curricula, and implementing community-based learning programs wherein educated individuals assist students during climate emergencies that disrupt formal schooling. Policy reforms, increased government funding, and improved coordination between educational and disaster management authorities can establish a sustainable learning system in climate-affected regions. By implementing these initiatives, Balochistan can build a resilient education system to ensure the future of girls' education despite severe ongoing climatic challenges.

Keywords: Climate change, Girls' Education, Climate-Resilient Learning

Introduction

Climate change is the most pressing issue of our generation, critically affecting the vulnerable populations globally, particularly women and girls in climate-sensitive regions (UNDP, 2017). Balochistan, the most vulnerable region in Pakistan, faces climate disturbances such as floods, droughts, and rising temperatures (Hussain et al., 2022). These climate disasters affect critical sectors, including education, health, and livestock, affecting socio-economic conditions and threatening the well-being of future generations.

Climate change significantly impacts the education sector, especially girls' education. Studies reflect that climate-related disturbances, such as floods, droughts, and heatwaves, exacerbate barriers to girls' education, which is already compromised by poverty, cultural constraints, and inadequate educational facilities. Families often sacrifice girls' education when faced with the effects of the climate crisis. Girls are forced to leave school to support their families, find food and water, or care for their siblings (UNICEF, 2021). Climatic changes in Balochistan impact the continuity, quality, and accessibility of education. Frequent floods destroy educational infrastructure, displace communities, and interrupt the continuity of education, whereas droughts severely impact economic conditions, compelling families to

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involve girls in labor, resulting in high dropout rates among female students. These climate disasters not only disrupt learning in the affected regions but also undermine the quality of education.

These issues have a profound and enduring impact in Balochistan due to its widespread economic and geographic marginalization. Girls are underrepresented in the province's literacy rate of 40%, much below the national average (Pakistan Bureau of Statistics, 2021). This study is carried out in four districts of Balochistan: Nushki and Chaghi, which have prolonged droughts, and Jaffarabad and Sohbatpur, which face frequent flooding and extreme heat waves. The province of Balochistan encounters distinct and region-specific climatic challenges, as illustrated by these districts. Frequent floods in Sohbatpur and Jaffarabad displace entire communities and destroy school facilities, consequently interrupting the learning process (ADB, 2023). Conversely, in Nushki and Changhi, prolonged drought conditions intensify water scarcity and economic difficulties, forcing families to prioritize survival over girls' education (FAQ, 2023).

Due to growing vulnerabilities, the link between climate change and girls' education is particularly critical in these districts. Cultural norms, for example, often limit girls' mobility and educational opportunities, which become worse during climate-related crises. Displacement interrupts educational activities in flood-affected areas, and children usually work to help generate household income in drought-prone areas (Haque et al., 2022). Moreover, the lack of climate-resilient infrastructure results in school closures in these areas, thereby increasing the marginalization of females. Most schools in the province lack adaptive strategies that disrupt the learning process during climatic emergency. Moreover, insufficient resources undermine the quality of education, and access to school is hindered by considerable distances and unsafe facilities.

To address these challenges properly, a comprehensive approach that goes beyond immediate disaster response is necessary. To ensure that girls' education is not merely preserved but also improved during climate challenges, it is essential to establish a learning system that is resilient and tailored to the unique climatic, cultural, and economic conditions of Balochistan. This research aims to address this significant gap by examining the various ways climate change may impact the continuity, quality, and accessibility of girls' education while also proposing innovative approaches to enhance resilience capacity.

This study examines the intersection of education, gender, and climate change through a mixed-methods approach, highlighting the systemic barriers that hinder girls from accessing school. By integrating input from educators, policymakers, and community stakeholders, the study aims to develop practical frameworks for a climate-resilient educational system in Balochistan. This initiative aligns with Pakistan's commitments to the Sustainable Development Goals (SDGs), particularly Goal 4 (Quality Education) and Goal 13 (Climate Action), as inclusive and equitable education is essential for sustainable development.

This study focuses on crucial aspects of gender equity, climate adaptation, and human capital development in climate-vulnerable areas, aiming to contribute to the broader debate on these issues. The findings will support evidence-based policy reforms to foster resilience and inclusivity in educational systems and facilitate targeted investments in community mobilization, teacher training, and infrastructure.

Objectives of the Study

1. To examine climate change impacts on the continuity of girls' education
2. To assess the influence of climate change on the quality of education for girls
3. To analyze barriers girls face in accessing education in the context of climate change

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Literature Review

Low and lower-middle-income countries are most affected, and women and girls are especially at risk as climate change increases the frequency and severity of weather-related disasters. Girls' education is affected directly and indirectly by climate-related disturbances, such as heat waves, drought, floods, tropical cyclones, and heavy rainfall. These impacts probably affect girls in crisis-affected environments (INEE, 2022). An estimated 37 million children worldwide experience interrupted learning every year due to a humanitarian catastrophe or natural disaster (Save the Children, 2021). According to the Malala Fund (2021), at least four million girls in low- and lower-middle-income countries could not complete their education in 2021 due to climate-related disasters. At least 12.5 million girls will not be able to complete their education annually by 2025 due to climate change if current trends continue. Disadvantaged students, particularly girls, suffer more than other students.

The climate crisis has detrimental repercussions on teenage girls, hindering their access to primary and secondary education. They further intensify gender discrimination and harmful practices such as child marriage and early pregnancy, which yield enduring consequences. Food insecurity disproportionately affects girls' education. The current global hunger crisis significantly undermines educational opportunities, especially in regions severely affected by drought, such as the Sahel, Haiti, and East Africa. Consequently, there is usually an increase in forced and early marriages, premature or unintended pregnancies, and school dropout rates (Plan International, 2023).

Climate change disproportionately affects women and girls due to existing gender disparities (Atkinson & Bruce, 2015; Chigwanda, 2016; Kwauk & Braga, 2017; Le Masson et al., 2016; Malala Fund, 2021a; Rao et al., 2019; Terry, 2009; UNDP, 2016). Girls have a greater possibility of dying in natural disasters (Neumayer & Plummer, 2007). Climate change increases girls' household responsibilities, detracting from their pursuit of education (Peek et al., 2018). It affects family income, creating a substantial obstacle to girls' education (Sims, 2021), and may result in early marriage (Alston et al., 2014).

Women and girls spend more time walking long distances and waiting for extended periods of time to collect water during droughts, which puts them at higher risk of sexual violence and causes them to miss school or show up too tired to learn (Saqlain & Shahid, 2024b). In situations where sending girls to school is already difficult due to gender norms, poor academic performance by girls is likely to increase caregivers' reluctance to let them return to school, which increases the likelihood of pulling girls out of school (Kwauk & Steer, 2023). Climate change is not gender-neutral; it worsens existing gender inequalities, disproportionately affecting the most vulnerable populations. Girls' educational access is restricted by household responsibilities and the distance to school under increasingly challenging circumstances. The reproductive health of girls and teenage girls may be affected by inadequate access to water and sanitation services, which could have a detrimental effect on their psychological and general well-being (UNICEF, 2023).

Pakistan is one of the top ten nations in the world where climate change has affected all sectors (David et al., 2021). Variations in temperature and precipitation, more frequent and intense tropical storms and coastal rains, melting glaciers, rising sea levels, desertification, droughts, biodiversity loss, and glacial lake outburst flooding are all examples of the changing weather patterns that Pakistan has observed (Government of Pakistan, 2021). Pakistan's educational system faces multiple challenges, such as a lack of funding, high dropout rates, and gender inequality (Saqlain & Shahid, 2024a). The infrastructure and accessibility of schools, especially for females, are also impacted by climate change, which compounds these issues. In addition to poverty, cultural customs, and early marriages,

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climate change makes it even more difficult for girls to get education (Muhammad Bakhsh, 2023).

The 2022 floods in Pakistan severely interrupted educational activity and destroyed almost 27,000 government schools. During that period, around 2 million students in Pakistan lacked access to educational opportunities. A 2023 research conducted by the International Rescue Committee (IRC) in four districts of Sindh aimed to assess the impact of the 2022 floods on education. The results indicated that, on average, 25% of students experienced a negative impact on their learning due to the floods. The findings further revealed that in the Dadu and Sanghar districts, 34% of students faced a direct effect on their education, while the percentages in Umerkot (20%) and Badin (12%) were slightly lower. All four districts experienced a significant decrease in student attendance. Despite the government's notification allowing schools to resume regular operations, attendance during the initial days remained significantly low. Moreover, the study revealed that floods negatively affected learning outcomes and reduced students' motivation for their education.

The importance of girls' education in building resilience and reducing the effects of climate change is becoming more apparent (INEE, 2022). Education increases girls' resilience, adaptive capacity, and disaster preparedness by reducing their vulnerability to the effects of climate change (Mutarak & Lutz, 2014). This advantage not only helps girls but also their families, communities, and future generations (Stryssnig et al., 2013). Female students who receive education develop essential critical thinking abilities to comprehend and react to weather forecasts, enabling them to mitigate climate-related adversities (Muttarak & Lutz, 2014). Nations that have invested in girls' education have experienced a substantial reduction in deaths resulting from floods and droughts, in contrast to those with fewer educational opportunities for females (Saqlain, Gao Xiaoling, & Hussain). Moreover, by the end of this century, total emissions from fossil fuels might decrease by 37% to 41% if all girls had access to modern contraception and could exercise their sexual and reproductive health rights through high-quality education (Neil et al., 2010).

To assist their families and communities in coping with the severe effects of climate change, girls who complete 12 years of high-quality education are better equipped to withstand and reduce the impact of extreme weather events and changing climatic patterns (Price, 2024). Facilitating girls' access to education is a sustainable and economical method to enhance societal resilience to climate change (Saqlain, 2021). Countries that have prioritized investment in girls' education are more effective in mitigating the impacts of droughts and floods than those with lower levels of girls' education (Brain et al., 2010).

Research Methodology

The study employed a mixed methods approach to investigate the impact of climate change on the continuity, quality, and accessibility of education for girls. This methodology integrates quantitative and qualitative techniques to ensure a comprehensive understanding of the effects of climate change on girls' education. This study aims to provide actionable insights for developing a climate-resilient learning system in Balochistan using various data collection and analysis techniques.

Research Design

The study used a mixed-methods exploratory design, integrating qualitative and quantitative approaches to examine the complex relationship among climate change, education, and gender. This research design is useful since it validates the findings by considering the lived experiences of people with the broader statistical trends that prevail.

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Study Area

The study was conducted in four districts of Balochistan: Nushki and Changhi, which experience prolonged drought and water scarcity that negatively impact the economic conditions of the population, thereby increasing barriers to girls' education; and Sohbatpur and Jaffarabad, which experience frequent flooding and extreme heat waves that damage school infrastructure and reduce student attendance. These districts were chosen because of the diverse climate challenges affecting the educational system in the province.

Population and Sampling

The population of the study comprised female students aged 10 to 16 years, parents and guardians, teachers and school administrators, community members, NGO representatives, and education department officials. The simple random sample approach is used to choose 100 female students and 100 teachers and school administrators. Furthermore, purposive sampling is used to select 50 parents/guardians, 50 community members, 20 NGO representatives, and 10 education department officials. The total sample comprises 330 respondents from various fields to collect diverse perspectives on climate change impacts on education.

Data Collection Methods

Structured questionnaires were administered to collect statistical insights from teachers, school administrators, and students on the impact of climate change on the continuity, quality, and accessibility of education. Additionally, focus group discussions were conducted with parents/ guardians, community members, and NGO representatives to examine their opinions of the effects of climate change on education. Furthermore, in-depth interviews were held with policymakers and officials to gain a detailed knowledge of institutional responses and gaps in addressing the implications of climate change on education. Moreover, observation was a continuous strategy employed during on-site visits to schools to document infrastructure damage, classroom conditions, and measures taken to mitigate the effects of climate change.

Data Analysis

Data collected through structured questionnaires is analyzed using frequency distribution, percentage analysis, and T-test analysis. Moreover, thematic analysis is used to analyze data collected through Focus Groups Discussions (FDGs) and Key Informant Interviews (KIIs).

Table 1: Climate change impact on attendance, dropout rates and school reopening delays

District	Pre-disaster Attendance (%)	Post-disaster Attendance %	Dropout Rate %	School Reopening Delays (Days)
Jaffarabad	80	50	30	46
Sohbatpur	75	40	42	55
Chaghi	76	58	25	41
Nushki	78	55	23	38

Source: Field Survey, 2025

The impact of climate change on the continuity of girls' education was assessed using important indicators such as student attendance, dropout rates, and delays in school reopening. The table indicates a substantial decline in student attendance across all four districts. Jaffarabad and Sohbatpur had the most significant drop in attendance, decreasing from 80% to 50% and 75% to 40%, respectively. Moreover, the results reveal a significant correlation between climate change and dropout rates, with Sohbatpur experiencing the highest drop rate of 42%, followed by Jaffarabad at 30%. In addition, the data reveals that after the climatic event, schools in four districts observed reopening delays ranging from 38

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days to 55 days, with Sohbatpur district observing the most prolonged delay of 55 days. The prolonged delay in resuming educational activities disrupts the learning process and could increase the likelihood of permanent dropout rates.

Table 2: Climate change impact on teachers' attendance, test score, and functional classrooms

District	Pre-disaster Teachers' attendance (%)	Post-disaster Teachers' attendance %	Pre-disaster Test score (%)	Post-disaster Test score (%)	Pre-disaster functional classrooms (%)	Post-disaster functional classrooms (%)
Jaffarabad	80	55	80	54	90	75
Sohbatpur	84	45	76	46	87	52
Chaghi	81	62	73	55	90	78
Chaghi	85	63	72	50	85	85

Source: Field Survey, 2025

The impact of climate change on the quality of education was assessed by comparing pre-and post-disaster teachers' attendance, students' test scores, and classroom functionality. The table indicates that the quality of education in all four districts deteriorated, as we observed a marked decrease in teachers' attendance, students' test scores, and the percentage of functional classrooms after the disaster.

Table 3: T- test Results for Students' Test Score

District	Pre-disaster Test score (%)	Post-disaster Test score (%)	Mean Difference (%)	t- value	p-value
Jaffarabad	80	58	-26	-4.64	0.001
Sohbatpur	76	46	-30	-4.36	0.001
Chaghi	74	55	-21	-3.51	0.004
Nushki	72	50	-22	-3.22	0.005

Source: Field Survey, 2025

The t-test results indicate a substantial decrease in students' test results across all four districts, with Sohbatpur experiencing the most significant reduction of 30%, followed by Jaffarabad at 26%.

Table 4: Climate change impact on school accessibility, average travel distance, alternative learning options

District	School Accessible Pre-disaster (%)	School accessible Post-disaster (%)	Average Travel Distance Pre-Disaster (%)	Average Travel Distance Post-Disaster (%)	Alternative Learning Options (%)
Jaffarabad	91	65	3	8	0
Sohbatpur	84	54	4	10	0
Chaghi	87	71	2	3	0
Nushki	92	83	3	4	0

Source: Field Survey, 2025

Survey data reveals that climatic disasters substantially impacted access to educational institutions. Jaffarabad and Sohbatpur show a significant reduction in accessible schools (40%). Furthermore, the travel distance post-disaster notably increased in Sohbatpur (6 km) and Jaffarabad (5 km). Similarly, none of the schools in the four districts provided alternate

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learning opportunities. This indicates that students lacked the resources to continue their studies outside traditional settings during the climatic disaster.

Discussion

Globally, climate change has seriously affected educational systems, especially for girls in the most vulnerable regions like Balochistan. The findings of this study show that climate-induced disasters such as floods in Jaffarabad and Sohbatpur and droughts in Chaghi and Nushki significantly disrupted learning environments in educational institutions. Climate change affected not only the infrastructure of schools but also worsened socio-economic, cultural, and institutional problems that widened gender gaps in education, especially for girls. Understanding these effects is essential to create focused interventions that can assist Balochistan in developing a climate-resilient education system.

Impact of Climate Change on the Continuity of Education

Along with the likelihood of co-occurring events, the frequency and severity of severe climate-induced disasters such as floods, droughts, and heat waves are increasing due to climate change. These extreme weather events disrupt education, leading to students dropping out of school, learning loss, and other long-term effects.

The findings of this study reveal a considerable decline in attendance rates after the disaster, which is alarming. Jaffarabd and Sohbatpur observed a 30% and 35% drop in attendance, respectively. A significant increase in post-disaster dropout rates demonstrates that climate-induced disasters, including floods, droughts, and heatwaves, severely limit students' ability to continue their education. Furthermore, the prolonged delays in the reopening of schools after a climatic disaster result in long-lasting educational setbacks that impede students' academic progress. The failure to resume educational activities on time after a disaster increases the likelihood of permanent school dropouts in the affected regions.

Impact of Climate Change on the Quality of Education

Climate change significantly impacts the quality of education. Climate-induced disasters, such as floods, damage school infrastructure, making classrooms unsafe and the learning environment uncomfortable. Furthermore, severe heat affects students' concentration, decreasing their academic performance. The findings of this study reveal a significant decline in teacher attendance, student test scores, and instructional time across all four districts, which suggests that climatic disasters interrupt the learning environment. In Jaffarabad and Sohbatpur, teachers' attendance decreased by 35% and 39%, respectively, resulting in students being unattended. In addition, students' test scores significantly declined in Jaffarabad by 34% and in Sohbatpur by 30% due to deteriorated learning quality. The infrastructural destruction, including the destruction of classrooms and school buildings, exacerbated the issue. Moreover, after the disaster, the absence of educational facilities hindered students' ability to continue learning and achieve academic advancement.

Impact of Climate Change on Access to Education

The destruction of educational infrastructure and learning materials by climate change directly affects access to education, making it difficult for students to continue their education. In addition, schools are used as emergency shelters during climatic disasters, which further disrupts the learning process for an extended period. Floods result in the displacement of entire communities and the necessity for families to relocate to areas with safer living conditions. This often leads children to drop out of school or struggle to succeed in unfamiliar environments.

The findings of this study reveal that in Jaffarabad and Sohbatpur, the percentage of accessible schools dropped by 26% and 30%, respectively. The primary reason is the destruction of road infrastructure due to floods. Most households, especially in rural areas,

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lacked financial resources for transportation, leading to higher absenteeism in schools. Climate-induced disasters, such as floods and droughts, displaced entire communities and destroyed their livelihoods, forcing families to prioritize survival over girls' education. The lack of alternative educational opportunities, such as community-based educational programs and mobile schools, exacerbated the problem, leaving students without viable options for education.

Conclusion

Climate change significantly and extensively threatens education by affecting access, continuity, and quality, particularly for girls. The financial strain caused by climate-related disasters, the disruption of learning due to displacement, and the destruction of school infrastructure all pose significant barriers to education. Millions of students experience prolonged interruptions in their learning during climatic emergencies, as families are compelled to migrate to survive and schools are used as emergency shelters. Climate change worsens the cycle of poverty by limiting educational opportunities, particularly for underprivileged groups, as financial constraints force children into labor instead of learning. Dealing with these challenges requires immediate investment in disaster-preparedness programs, climate-resilient educational infrastructure, and policies that ensure continuity of learning through digital platforms and other learning options.

Climate change will continue to deprive a large number of children of their fundamental right to education, which will ultimately result in poor socio-economic development if focused and effective interventions are not made. Therefore, to protect education in a world that is becoming increasingly influenced by climate change, we need to take a holistic strategy that combines policy reforms, financial support for affected communities, and measures for sustainable development.

Recommendations for Building a Resilient Learning System in Balochistan

Given these findings, it is clear that climate change poses a significant threat to girls' education in Balochistan. To effectively address these challenges, a comprehensive and multi-sectoral strategy is required. The following initiatives are important to developing a resilient education system in Balochistan.

- Integrating disaster risk reduction into education is imperative for the government to form a climate-resilient education policy. Strengthening collaboration between educational and disaster management authorities is also critical to ensuring a prompt response after climate disasters.
- Education policies and plans must be reformed to build a climate-resilient learning system. Integrating climate change education into national curricula will help students comprehend and develop strategies to mitigate climate change challenges.
- Additionally, it is imperative to construct school infrastructure using materials that are resistant to drought and floods and to elevate schools in flood-prone areas.
- Investing in roads and infrastructure to facilitate student access to schools during climatic disasters is also essential to improving school accessibility.
- Implementing financial incentives, such as scholarships and stipends, for families affected by climate change will help students continue their education after climate-induced disasters.
- It is vital to provide teachers with training in disaster risk management and emergency response strategies to ensure learning during a climatic emergency. Distance learning will also benefit from providing online tools and resources, which will greatly help in situations when physical attendance is not feasible.

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- Improving the water supply and sanitation in drought-affected areas like Chaghi and Nushki is imperative to ensure basic hygienic facilities. The government must also start awareness programs to educate communities about the significance of girls' education in the context of climate change.
- It is crucial to engage communities to continue education during climate disruption. Launching awareness programs for families to prioritize girls' education even after a climate disaster will help reduce the dropout rate. Similarly, community-based learning initiatives, where educated individuals support students during crises, can help continue learning when formal schooling is disrupted.

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