Resilience through Education: Equipping Schools and Students to Face Climate Change Challenges in Punjab

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ARTICLE INFO	ABSTRACT
	Globally, education systems are under pressure due to climate change, with developing countries like Pakistan mainly affected. These countries are experiencing significant disruptions in Education. This study aimed to support adaptation to climate change by addressing areas such as gender, teacher preparedness, and school facilities. It also explored the urgent need to integrate climate change mitigation measures into the educational context in Punjab and emphasized recognizing schools as both educational institutions and community support hubs. The research methodology employed a descriptive research approach. Quantitative surveys were conducted among educators and students from rural and urban schools. A questionnaire was used as the research tool for data collection. The data analysis revealed significant gaps in raising awareness about climate change, weaknesses in school infrastructure, and inadequate resource availability, particularly in rural regions. The study recommended increasing awareness about climate change, incorporating climate resilience into the curriculum, upgrading school facilities, and fostering a stronger appreciation for climate change issues among communities.

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INTRODUCTION

Climate change is now a continual and increasing threat to humanity across the globe, with consequences affecting human populations and the environment. Punjab, a rapidly growing region in Pakistan, is one of the areas most affected by low- and middle-class economic affectation, agrarian economy, and socio-environmental vulnerability (Grigorieva et al., 2023). In such regions, the education sector appears to be the only framework within which the development of the ability to cope with such challenges can be achieved. Punjab is a leading food crop producer famously known as the "Granary of Pakistan". However, the state is confronted with the stresses of irregular rainfall, escalating temperatures, decreasing water tables, and more frequent disasters like floods and heat waves (Kumari et al., 2020). They endangered millions of farmers' incomes and stressed out social and economic systems, particularly Education (Ali & Erenstein, 2017).

Therefore, the Punjab education system cuts across its urban and rural areas; it enrolls children from different social and economic backgrounds. The overall literacy rates in the state are still lower than the average in other countries in this region; however, despite having an adequate number of school-going children, large inequalities exist in the qualitative aspects of Education and schooling infrastructure. This has been especially apparent in rural schools, whereby climate impacts, as defined by school damage and functional closure resulting from weather vagaries, affect learning outcomes, leading to educational inequality (Abbass et al., 2022). Therefore, it can be seen that efforts to understand how climate change and Education are connected in Punjab are not an endeavor of the nature of the scholarly investigation but a major need in terms of development (Abdullah & Chaudhry, 2018).

Furthermore, Education is one of the main factors in climate resilience since it improves people's capacity to address climate issues (UNESCO, 2020). It can help develop insight and consciousness, build advocacy for environmental conservation, and prepare individuals and societies to respond to unlikely climate scenarios. Punjab, in particular, individuals are fully involved in climate-sensitive livelihoods, and integrating climate change education in schools would go a long way in closing the knowledge-practice divide.

Moreover, an effective system of Education that addresses specific climatic and socio-economic proximate factors has the potential to produce students as agents of change and bring appropriate alterations to the behavior of their families and communities on the matter. For example, interventions in educating learners on water saving, planting different crops that adapt to changing climate conditions, and using renewable energy sources focus on the climate risks in Punjab (Grigorieva et al., 2023). In addition, new and improved climate-responsive schools, built to withstand some form of climate stress, can act as community centers to provide and receive both preparedness and disaster relief.

Including climate education in the Punjab school curriculum has certain challenges. First, the current curriculum fails to provide climate context within learning concepts, offering generic environment concepts different from the existing regional threats of climate change (Winter et al., 2022). Second, climate education can also be limited in its impact because teachers are likely not trained or armed with the proper resources to teach climate education adequately. Moreover, due to poor infrastructural facilities, many schools in rural areas have weak facilities in terms of learning, such as poor or no classrooms, no educational facilities such as computers, poor or no access to clean water, and no or irregular electricity supplies to enable full provision of Education and other basic needs.

REVIEW OF LITERATURE

Climate change is not a problem for specific areas, but it is also a problem for many areas around the globe. Punjab, a key food-producing region in Pakistan, is on the receiving end. The impacts of climate change, which range from climate variability and more dramatic calamities, productivity volatility in agriculture, and shortages in water, all bore deep consequences on social and economic structures in the region (Grigorieva et al., 2023). This literature review will also identify how Education fosters resilience to climate-related challenges among students and schools in Punjab. Drawing from the literature and recommended interventions, this study reveals how Education has the ability to bring change by providing the younger generation with the knowledge, skills, and personal dispositions to address, mitigate, and adapt to climate change (Abbass et al., 2022; Hasan et al., 2024a).

Education and Climate Change Awareness

Awareness can be defined as the use of Education as a tool to undertake public sensitization of the effects of climate change. A study shows that incorporating climate change education aspects into teaching and learning practices can improve environmental literacy amongst school-going children and increase concern towards sustainable practices (Anderson, 2012). In Punjab, where agriculture is the mainstay of the economy, embarking on educating students about climate change can socially proliferate throughout the family and the community. Other research works have revealed that students who have knowledge of climate change testified and practiced on the climate change policies (Leiserowitz, 2006).

Additionally, integrating climate education into schools would wipe out misconceptions and myths about climate change. A study by Shepardson et al. (2012) discovered that students have different prior conceptions that may interfere with learning about climate change. Thus, a correctly designed climate education program provides students with scientific understanding to correctly navigate and correctly evaluate climate-related information.

Resilience and Adaptive Capacity through Education

Education increases awareness and helps build resilience and adaptive capacity among students and specific communities. Climate resilience can be defined as the capacity to adapt, without suffering negative consequences, to events that disrupt the provision of schooling with regard to climate. Among the most significant key role that schools could effectively perform is to be aware and prepare the individuals to cope effectively with the changing environmental conditions. For example, activities that show and teach how people adapt to societal practices such as water conservation, agriculture, and disaster management prepare the learners to develop raw implementation solutions in societies.

The problem of water deficit, especially in Punjab, and persistent floods and droughts also crop up regularly, so teaching the students about sustainable water use is very important. Ahmad (2011) discovered in his study that educating students on the conventional methods of water harvesting and the use of modern irrigation systems to solve water scarcity crises is effective. Through such knowledge incorporation, schools can build up students' and their families' adaptive capacity, which benefits the whole community.

Role of Teachers and Educational Institutions

Teachers and schools are essential in delivering climate knowledge and building resistance. Monroe et al. (2015) pointed out that teachers with climate change knowledge deliver effective climate education, which leads students

to take proper action. Teachers' professional development increases the quality of climate education as programs that help teachers improve their knowledge of climate change and developed practices help improve climate education in school. In addition, schools and colleges should also set a positive model for sustainable practice and learning climate. Education institutions in Punjab include rainwater harvesting, solar energy utilization, and waste management programs. Such initiatives save the school environment and are effective learning models for the students as they apply what has been taught in class (Gough, 2005).

Community Engagement and Collaborative Efforts

Schools, communities, or policymakers cannot independently address climate change impacts for sustainable development. However, the school can serve as a focal point for creating awareness through different campaigns, workshops, and tree-planting exercises. For example, Tilbury (2011) pointed out that such attempts may help build collective responsibility and result in common efforts to enhance climate responsiveness across the community. The authorities should increase their funding of efforts in climate change education and invest in structures that would create climate education's curriculum as well as climate change teachers' training. Here, the fiscal and technical support of non-governmental organizations and international agencies may support climate education enhancement programs. Moreover, there are increased cases of use of technology, like the learning management system and mobile applications, to increase the course reach and offer flexibility (Anderson, 2012; Hasan et al., 2024b; Nasreen et al., 2024). Hence, Education enables us to prepare a generation of knowledgeable people who are willing and capable of extending their hands for a change in society and the world, in general, to be more stable and resistant to future disasters and vices.

THEORETICAL FRAMEWORK

This research study was linked to the social-ecological resilience theory, which posits the ability of a system to adapt, learn, and evolve in response to stimulus stressors. It is also related to the transformative learning theory, which suggests that Education brings transformation and, therefore, gets people to reflect on their behaviors and reconsider them to fit new challenges. By integrating the above-mentioned frameworks, the study aimed to understand how educational interventions support the development of schools' adaptive capacity and long-term resilience against climate change.

RESEARCH METHODOLOGY

A quantitative research method was adopted in order to meet the research objectives. The descriptive research design was employed in this study. The self-developed questionnaire was used to gather the quantitative data. The study sample was selected through a purposive sampling technique, comprising 206 students, teachers, and school officials from the areas most affected by climate change in Punjab.

DATA ANALYSIS AND INTERPRETATION

The data was analyzed in the context of climate resilience, gender, teacher-relevance knowledge, and infrastructural development or school facilities in Punjab.

Linear Regression Analysis

In this study, the Linear Regression Analysis was used to predict the value of the dependent variable (climate change resilience) based on the predictor variable (school facilities). The regression equation which was applied is given below:

H1: There is no impact of climate change resilience on school facilities.

Equation 1

$Y = \alpha + \beta_1 X_1 + \varepsilon$
Climate change resilience = $\alpha + \beta_1$(school facilities) + ε
Climate change resilience = intercept + coefficient (school facilities) + error

Table 1: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.796[a]	.787	.789	8.978

Table 1 reflects the model summary, which revealed that climate change resilience explained 78.7% of the variance in school facilities.

Table 2: Coefficients regression

Model	Un-standardized Coefficients		Standardized Coefficients	t	P
	B	Std. Error	Beta		
(Constant)	19.576	3.985		3.671	.000
School facilities	1.199	.042	.784	27.432	.000

It is evident from Table 2 that climate change resilience has a strong positive impact on school facilities ($p < 0.05$), with an unstandardized coefficient of 1.199 and a standardized coefficient of 0.784. Consequently, the null hypothesis ("there is no impact of climate change resilience on school facilities") was rejected.

Multiple Regression Analysis

However, the Multiple Regression Analysis was employed to predict the dependent variable (climate change resilience) using the predictor variables (gender, teacher preparedness, and school facilities). The regression equation which was applied is as follows:

H2: Climate change resilience does not impact school facilities, gender, or teacher preparedness.

Equation 2

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon$$

Climate change resilience = $\alpha + \beta_1$(school facilities) + β_2(gender) + β_3(teacher preparedness) + ε

Table 3: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.899[a]	.785	.778	8.09600

Table 3 shows that the predictor variables (school facilities, gender, and teacher preparedness) explained 78.5% of the variance in climate change resilience.

Table 4: Regression Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	P
	B	Std. Error	Beta		
(Constant)	17.859	3.380		3.599	.000
Gender	-.378	.398	-.049	-.874	.531
School facilities	1.674	.396	.198	3.980	.000
Teacher preparedness	1.099	.299	.274	4.926	.000

The results indicated in Table 4 revealed that school facilities ($\beta = 0.198$, $p < 0.05$) and teacher preparedness ($\beta = 0.274$, $p < 0.05$) had significant positive impacts on climate change resilience. In contrast, gender ($\beta = -0.049$, $p = 0.531$) did not significantly impact. The null hypothesis, i.e., "there is no impact of climate change resilience on school facilities, gender, and teacher preparedness", was rejected for school facilities and teacher preparedness, while it was retained for gender. The findings demonstrate that climate change resilience positively impacts school facilities and teacher preparedness.

DISCUSSION

This study aimed to support adaptation to climate change by addressing areas such as gender, teacher preparedness, and school facilities. It also explored the urgent need to integrate climate change mitigation measures into the educational context in Punjab and emphasized recognizing schools as both educational institutions and community support hubs. The results of this study pointed out the importance of the educational sector in enhancing climate resilience among students in Punjab, as well as the impact of key predictors such as teacher training and school infrastructure. This study revealed that males have values of resilience equal to those of their counterparts. This is in accordance with earlier work that reported similar resilience values among males and females in the prevailing environment and developed a coping mechanism (Grigorieva et al., 2023). This could be due to the cultural beliefs that are canalized to caregiving and management of resources apart from being associated with sustainability. Furthermore, teacher preparedness was again found to be a factor, thus corroborating the assertions that well-prepared teachers can enhance the application of the knowledge they impart about climate change to students. In the same way, positive school infrastructure supports UNESCO, 2020, stating that climate-resilient education infrastructure is important for reducing disruptions and developing adequate abilities. On the other hand, some existing studies come with a contrary view. According to Winter et al. (2022),

climate education integration may not be enough to bring systemic equity change as socio-economic factors and policy gaps appear to be more dominant in compromising operational resilience. Likewise, Kumari et al. (2020) also specified that such infrastructure improvements require a better approach to engaging the broader community to attain the best results. This study raises awareness of Education, gender, and systemic approaches to resilience and calls for integrated and complex approaches that are required in the socio environment of Punjab. The resilience against climatic changes can be addressed through Education effectively in the Punjab.

CONCLUSION

This study examined the role of Education in building climatic resilience among schools and students in Punjab, addressing gaps in policy, infrastructure, and teaching capacity while emphasizing gender-specific dynamics. The findings demonstrated that Education plays a pivotal role in enhancing adaptive capacities, with gender, teacher preparedness, and school infrastructure emerging as key determinants of resilience. It was found that no gender-wise differences existed regarding resilience scores, underscoring the need for gender-sensitive approaches to climate education that leverage existing strengths while addressing disparities in access and participation. It was also concluded that teacher preparedness significantly influenced resilience, affirming the importance of capacity-building programs that equip educators to integrate climate concepts effectively into their teaching practices. Furthermore, the impact of school infrastructure highlights the necessity for climate-resilient educational facilities that minimize disruptions and foster a conducive learning environment. These results were aligned with the study's objectives of identifying gaps, assessing the effects of climate challenges on Education, and proposing actionable strategies for resilience-building. Moreover, it was concluded that systemic factors such as socio-economic disparities and policy implementation gaps remain significant barriers. The study also concluded that a multifaceted approach combining curriculum reform, teacher training, infrastructure investment, and community engagement is essential to address these challenges. By prioritizing Education as a cornerstone of resilience, Punjab can equip its schools and students to adapt to climate challenges, contributing to sustainable development and environmental stewardship in the region.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations are proposed to enhance climate resilience among schools and students in Punjab.

It is recommended that climate change localization and adaptive messaging be made available to schools so that they can update all curricula as necessary. The issues should include water saving, utilizing green energy, responding to emergencies, and using sustainable farming techniques suitable for Punjab conditions. It is also recommended that the teacher design interventions that might build on the identified vulnerabilities female students demonstrate and the challenges male students encounter. It is also recommended that workshops be arranged to create awareness regarding climate change. Moreover, it is also recommended that capacity development initiatives that help educators possess the right skills and facilities to influence climate change knowledge impartation should be ensured. In this regard, teachers could be prepared through daily and weekly workshops, online modules, and accessing teaching aids. Furthermore, it is also recommended that the school infrastructure should be improved to better accommodate climate adversity, including heat waves, floods, etc. This requires proper airing, construction of structures in low-risk areas, and proper water and electricity provision to support learning. Social collaboration with either local or community-based agencies is also recommended to enhance the extension of educational interventions. It is also recommended that sufficient resources and good practices for building school resilience programs should be initiated.

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