

# Understanding the impact of climate change on Bhutanese school communities: Challenges and responses

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## ABSTRACT

Climate change is intensifying the risks faced by children's lives, as well as impacting their learning and education. How school communities in Bhutan are dealing with issues related to climate change is largely uncharted. This study examined how Bhutanese schools have been affected by the changing climate and how they were responding to it. The data sources included interviews with school principals, teachers, and district education officers, as well as observations, and document analysis. The global comprehensive school safety framework, along with a whole school approach to climate action framed the results of this study. Findings included that schools experienced multiple climate impacts and shocks affecting their children's health, education, and the school system itself. Adaptation and mitigation measures including climate change education have yet to gain traction at the sector and school's level. Schools, however, have attempted some actions such as through disaster management, and participatory environmental conservation and green school initiatives. Social capital was critical in filling the resource gap for initiating environmental and climate change actions, carried out through collective school, community, and student-based activities. Human capacities, policy and institutional structures, technical capacities, and capital (cultural and economic) constraints as well as slow mainstreaming into local development processes impeded efforts to build climate-resilient schools, including practices to contribute to greenhouse gases reduction. This study not only shed light on how climate change was affecting schools and children but also provided strong evidence for policymakers and relevant agencies to scale up interventions to enhance adaptation and mitigation practices.

**Keywords:** climate change, schools, adaptation, mitigation, climate action education

## INTRODUCTION

The earth has now warmed around 1.1 °C since pre-industrial time, and likely reach the critical threshold of 1.5 °C by 2040 at current warming rates (Intergovernmental Panel on Climate Change [IPCC], 2021). Many observed impacts are proceeding at an unprecedented rate across regions, including the Himalayas, where Bhutan is situated, the most sensitive hotspot to climate change (IPCC, 2021). Despite being a few net carbon-negative countries in the world (Climate Council, 2017) climate change impacts are apparent in Bhutan. Reports indicate steady rising temperatures, changes in precipitation and weather, ecological degradation, and increased threats of climate hazards and extreme events (Ministry of Agriculture and Forests [MoAF], 2016; National Environment Commission [NEC], 2020). The rugged mountain terrain, fragile geological conditions, and vulnerable ecosystems make Bhutan particularly susceptible to impacts (NEC, 2020). As a result, climate change poses a serious risk to country's development

efforts, including progress in education. Schools face increased risks to their operations, infrastructures, and health and safety from climate impacts and disruptions. To ensure continued education for Bhutanese children in various climate change scenarios, it is critical to protect the entire education system, including key school stakeholders such as students, teachers, staff, and families, and ensure that access to and quality of education is not undermined. This requires adapting to climate impacts and creating social and system resilience (United Nations International Children's Emergency Fund [UNICEF], 2019a). Moreover, schools and educational institutions, as learning centers, have an important role to play in improving the knowledge and skills needed to address the challenges of the climate crisis. Education has long been recognized as integral to achieving increased climate change resilience (Bonifacio et al., 2010; Lutz et al., 2014). It is not only ethical but also a cost-effective approach to tackling climate change and promoting sustainable development (Mochizuki & Bryan, 2015). Therefore, it is imperative to identify strategies and approaches that could be implemented

to reduce the school sector's own carbon footprint and contribute to climate mitigation efforts. At the same time, the education sector must also strengthen its own capacities to gain a deeper understanding of the climate crisis, contribute to policy formulations, and initiate practices. While the significance of school education in tackling issues of climate change is being acknowledged in Bhutan, the capacity to respond to impacts, adaptation and mitigation measures, and climate change education (CCE) is yet to be fully explored. To address this gap, this paper examines how Bhutanese schools are being affected by the changing climate and how they are responding. Utilizing a qualitative case study approach, the data sources include interviews with school principals, teachers, and district education officers (DEOs), as well as observations and document analysis from a comprehensive school safety framework (CSSF) and Whole school approach to climate action perspectives. The study explored the nature of the impacts and risks on schools and children and the institutional structures, strategies, and practices that have emerged to respond to climate change.

### Responding to Climate Change in Education Sector

While threats of climate change are established, how it needs to be addressed remains ambiguous, particularly in the education sector. Climate change is a source of hazards, impacts, vulnerabilities, and risks to schools and their operations. It is a "direct threat to a child's ability to survive, grow, and thrive" (UNICEF, 2019b, p. 1). Understanding the exposure and vulnerabilities of schools to climate impacts is indispensable to assessing the consequences of potential hazards and gaining knowledge of risks to schools and children. IPCC (2014) maintains that climate-change risks result from the interaction of hazards, exposure, and vulnerabilities, where hazards are influenced by anthropogenic and natural climate variability. Exposure is associated with the existence of humans, assets, and ecosystems in a place that could be adversely affected, while vulnerability represents the tendency to be adversely affected by damages and lack of capacity to manage future changes. Risk analysis remains critical for developing interventions for school climate risk management, particularly coping with inevitable destructions, losses, and other risk drivers.

While the number of studies examining climate impacts on schools and their engagement in response is increasing, there is still a scarcity of research in this area. Climate implications on school systems are multifaceted, making it difficult to develop a single strategy that addresses all aspects of impacts and threats. The whole school approach to climate action that aims at building a culture of collective action to engage in responses such as through reinforcing *teaching and learning, facilities and operation, community partnerships*, and *school governance* are becoming relevant (Gibb, 2016; Kyle Jr, 2020). Such an approach is considered a feasible and effective strategy to promote sustainability within school culture as it emphasizes how schools and communities can benefit from a greater sense of belonging, hands-on learning opportunities, and professional learning prospects, and contribute to ecological footprint reductions (Gibb, 2016, p. 3). This way, it facilitates effective resource management, promoting environmental greenery, access to expert knowledge, teaching

resources, and financial support. Similarly, CSSF developed in response to Sendai framework for disaster risk reduction (DRR) 2015-2030 (United Nations International Strategy for Disaster Reduction [UNISDR], 2015), takes a holistic approach to building resilience in schools addressing three pillars of school safety; *safe learning facilities, school disaster management, and risk reduction and resilience education*, all built within the enabling environment of the education sector's policies. CSSF aspires to protect students and teachers, ensure educational continuity during hazards, safeguard educational investments, and strengthen risk reduction and resilience through education (United Nations Office for Disaster Risk Reduction [UNDRR] & Global Alliance for Disaster Risk Reduction & Resilience in Education Sector [GADRRRES], 2017, p. 2). This study utilized key components of the 'whole school approach to climate action' and CSSF as a framework for research design and data generation, to better understand how schools are being affected and respond to emerging climate change impacts and risks, within the climate change adaptation and mitigation context. Drawing on CSSF, this research investigated disaster and emergency management practices that have emerged to address climate-induced disasters and threats including risk reduction education integration in schools, as well as the school's capacity in terms of knowledge, resources, and facilities to reduce vulnerability and build resilience.

Climate-resilient school infrastructure is fundamental to children's safety and wellbeing as they spend a significant amount of their waking hours in school (Bangay & Blum, 2010; Organization for Economic Co-Operation and Development [OECD], 2018). Therefore, careful risk assessment, resilient designs, retrofitting, maintenance, and inclusivity are imperative (UNDRR & GADRRRES, 2017). Safe and climate-resilient school infrastructure can also serve as a shelter for displaced populations during disasters (Shaw & Kobayashi, 2001). In this study, the learning environment to which teachers and students were exposed and how climatic conditions influenced teaching and learning were explored. It also examined schools' preparedness for climate change consequences through investment in resilient infrastructure, safety assessment, and climate mitigation measures.

Schools must strengthen their organizational capacity to re-evaluate operations and educational experiences for their learners (Gough & Sharpley, 2005). Effective governance and leadership in schools are essential to foster a more collaborative and cohesive culture, develop a greater working partnership with broader communities and be highly adaptive to train new generations to deal with the rapidly changing world. School governance for climate action could include involving all key school stakeholders (principals, teachers, students, and community) in decision-making, accountability, quality assurance, maintaining school-community linkages, proposing action, assessing practices, and supporting initiatives to fulfill school-community's needs (OECD, 2016; Yuner & Burgaz, 2019). Good governance is vital for schools as it enables making the best use of their human and material resources in an economically, socially, and environmentally sustainable approach (Gough & Sharpley, 2005). This study was keen to understand approaches the school management and leadership in Bhutanese schools adopted to CCE and

action. This included teachers' and staff's concerns about climate change, existing policies and strategies, leadership and management initiatives, the school's support for climate action, and management and leadership challenges.

Effective curriculum development and organization are decisive for addressing climate change and promoting sustainable development (Boon, 2016; United Nations Educational, Scientific and Cultural Organization [UNESCO], 2015). Pedagogical shifts are found necessary to enhance learning through several modes, including experiences and practices, critical and creative thinking, inquiry-based, reflexive, and participatory, to foster environmental, climate change, and sustainability literacy (Braun & Dierkes, 2017; Leicht et al., 2018; Lugg, 2007). Learning must encompass scientific, technological, behavioral, ethical, emotive, and practical components (Mochizuki & Bryan, 2015). Teachers must also be skillful with access to reliable resources, community partnerships, and professional development opportunities (Alberta Council for Environmental Education [ACEE], 2017). It is critical teachers and students understand climate change, acquire essential knowledge and skills, make informed decisions, take suitable actions, and contribute to sustainable lifestyles, green economies, and sustainable and climate-resilient societies (Gibb, 2016; Leicht et al., 2018; Monroe et al., 2019). The ingenuity of teachers and students can be harnessed to devise and implement climate mitigation solutions in schools and communities (Kwauk & Winthrop, 2021).

However, in Bhutan, it was unclear how climate change, disaster, and sustainability education were structured in the school's teaching and learning system and broader policy and operational level, despite recognizing its significance in climate change policy (NEC, 2020). This study examines how CCE is being viewed and integrated into the school's teaching and learning system and broader policy and operational level. It explored teaching, learning, and educational programs on climate change that can support increased student engagement, meaningful learning, and practical learning experiences.

Schools and local communities play a crucial role in addressing climate change and sustainability issues, while also providing students with transformative learning experiences in their local environment (Flowers & Chodkiewicz, 2009). Most climate change and sustainability actions require an integrative approach, which can only be accomplished in partnership with other community groups, agencies, and networks (Gough & Sharpley, 2005).

Burton (2016) argues that a lack of collaboration might result in maladaptation and malpractices and that the scales of climate risks and interventions may not be coordinated efficiently. This study looked into how schools were connected to a wider community (parents, schools, non-governmental organizations [NGOs], government agencies, community org., and academia] to act on climate change.

By understanding the dynamics of these partnerships, the study sought to capture insights into best practices and potential areas for improvement to enhance the effectiveness of these collaborations in addressing climate change and sustainability issues.

## MATERIALS & METHODS

This study employed a qualitative case study design as this strategy was suitable for accounting culture and context in understanding and interpreting thoughts, experiences, and actions (Kim, 2001; Shkedi, 2005) of the school agents. This study focusing on schools and educational communities in Bhutan as the subject of the case analysis, provided a prospect to carry out a country-specific, intensive examination of the impacts of climate change on schools. This approach also enabled being more reflexive and obtaining in-depth responses.

The key participants were school principals, teachers, and Dzongkhag education officers. Four levels of high, middle, lower, and primary schools located in different parts of the country were included. A convenience sampling design was adopted for data collection since this technique is not only flexible, but also cost-effective, and enables selection of participants who are readily available, accessible, and willing (Etikan et al., 2016).

The interviews, observations, and document analysis were the key data-gathering tools. In total, 69 semi-structured interviews (24 principals, 32 teachers, and three DEOs) were conducted in the month of December 2019. The interview questions were developed under eight thematic categories, consisting of climate change and causes, impacts and risks, DRR and management, safe school facilities, teaching and learning, community support and network, school leadership and management responses/governance, and school adaptation and mitigation activities. After the interview data were transcribed, the data were then clustered as principals' interviews (PI), teachers' interviews (TI), and district education officers' interviews (DEOI). They were provided with unique codes or pseudonyms to protect participants' confidentiality (e.g., PI1 as principal interview one). The transcribed text data was then transferred into NVivo 12 for data management, triangulation, and analysis.

The study employed thematic analysis as the analytical approach as this technique enabled identifying themes, patterns, and meanings in the data, to gain insights from participants' beliefs, attitudes, and experiences. This strategy provided flexibility to adapt to a range of research questions and contexts, capture the complexity of the data by identifying multiple themes and sub-themes, and acquire multiple perspectives on specific subject matter. It also facilitated the generation of new insights, hypotheses, and unanticipated themes and patterns in the data.

In NVivo, the process of coding was initiated using nodes (major themes) and child nodes (sub-themes). This involved initially reading through the entire text, then dividing the text into segments of information considering research questions, next labelling the segments of information with codes and finally collapsing the codes into major themes. In the final coding, the data was thematically reduced into two major parent nodes:

- (a) exposure, vulnerabilities, and impacts, and
- (b) school adaptation and mitigation responses.

## OBSERVED & FUTURE CLIMATE CHANGE IMPACTS & RISKS ON SCHOOLS

### Schools' Exposure to Hazards & Their Vulnerability

School leaders and teachers in Bhutan perceived rising incidences and intensity of climate hazards affecting schools. Floods, windstorms, landslides, torrential rain, and lightning were common hazards that schools were recently exposed to. Schools in various regions experienced different impacts and threats. The critical factors that determined schools' vulnerability to climate risks and impacts were their physical location, old school structures, irresponsive constructions and designs to geographical needs, inadequate facilities, and socio-economic circumstances. Schools are generally located on slopes, hilltops, near and between rivers, exposing them to a range of hazards and making it difficult to create safer zones to manage and limit impacts and disasters. For instance,

“since our school is on the slope, there is a high risk of landslides, and like during the recent years we had landslides just near the school boundary” (PI24).

Consistent with reports of rapid glacier retreat in Bhutan (Fujita et al., 2012; Gurung et al., 2017), schools in glacial lake outburst flood prone locations showed higher sensitivity to climate variability and extremes. A principal stated,

“my school campus falls into a red zone, which means at our source we have got glacial lakes like Thorthormi and Luggye Tsho and if there is continuous melting like this, one day very soon if this lake blasts I think this valley is going to have a serious impact and it is a serious concern for the school” (PI13).

Similarly, steep slopes, rugged topography, and river systems remained sources of hazards, compounded by the changing climate for numerous schools. Thus, this complex nature of the ecological and topographical system and the land use patterns left schools and children vulnerable to a wide range of climate disasters and hazards. Schools in remote regions and those with poor infrastructures and social support were most affected. Another important aspect of the schools' vulnerability to impacts from climate change is that many school buildings, structures, and infrastructures were not only old but still in use in many instances. Common problems in schools included poor drainage and pavements, exposed electrical wires, plumbing leakages, spalling of walls, and worn-out wooden rudiments. In addition, schools lacked emergency access, fire alarms, and fire hydrants. Findings also revealed that constructions and school designs were not always suitable for their geographical locations/weather and climate (i.e., school buildings adaptable for hot/cold climates and weather). The findings indicate that schools in Bhutan are not only directly exposed to the effects of various hazards, but they also exhibit increased sensitivity to the effects of these hazards. The rising incidence of climatic hazards is consistent with IPCC's (2021, 2022) predictions of increases in temperature, monsoon precipitation, and cyclones in the South Asian Region. The risk of damages and losses in schools was determined by a variety of underlying factors, including

the frequency and intensity of hazards, geographical locations, exposure of teachers, students, and school assets, the vulnerability of teachers, students, and school assets, and other long-term repercussions of the instant damages and losses sustained. Consistent with previous observations (UNDRR, 2020), this research observed that currently there is an absence of adequate disaster information management systems that contribute to proper risk assessment, hazard mapping, or estimating future climate change consequences in the education sector in Bhutan. By maintaining adequate hazards, exposures, vulnerabilities, and loss data, risk assessment accuracies can be strengthened. Such data would also contribute to devising more viable strategies to prepare for, prevent, and manage disaster risk resourcefully.

### Climate Change Implications on Health, Teaching-Learning, & Education

Schools and children experienced multiple climate change impacts and shocks affecting their well-being and health, education, and social-cultural life. Warmer temperatures and changes in weather patterns not only caused physical discomfort for teachers and students but also impeded their meaningful engagement and performance in teaching, learning, and other school activities in already overcrowded classrooms. It limited learners' time for social, cultural, and outdoor events such as physical exercises, games, co-curricular activities, and outdoor education. A participant reflects “we experience severe windstorms and children cannot go outside. Sometimes, there is very heavy rainfall and there are lots of floods. When it is sunny it is extremely hot” (TI15). Worsening monsoons and disasters, particularly in the southern districts, have had a substantial influence on children's regular attendance in schools.

“There is a lot of absenteeism in school when it comes to teachers and students. Some teachers stay far away from the school, and some students are traveling two to three hours walk. So, on the way, there are many streams, which are very vulnerable to flash floods whenever there is heavy rainfall, we have had so many experiences, the students came late for school or sometimes it even extends to stay, staying on leave for three or four days. It even includes teachers, and it is affecting a lot, of attendance in school, and difficulty in covering the syllabus” (PI11).

Many schools experienced increasing water scarcity, which impacts students' health and hygiene. Evidence suggests lack of access to safe drinking water increases the risk of stunting, wasting, and anemia in children, as well as affects cognitive development and educational attainment (Cameron et al., 2021; Getaneh et al., 2019). Thus, the provision of safe drinking water will be key for the health and wellbeing of Bhutanese students. Participants commented that low agriculture yields in family households in some communities had an impact on the children's nutrition, as many families grappled with the issues of unproductive seasons and human and wildlife conflict. Studies report climate change affecting family livelihoods has a great influence on children's schooling and nutritional security (Fuller et al., 2018; Urbano et al., 2011). The projections indicate that it may impede future

endeavors to lower child malnutrition in regions such as South Asia and sub-Saharan Africa, despite economic growth (Lloyd et al., 2011). Therefore, this might aggravate the situation in Bhutan, which is already reliant on food imports from other nations. While Bhutan maintains more than 70% (NEC, 2016) of its land under forest cover, which could significantly contribute to carbon sequestration, wildlife threats surfaced as another yet unique challenge owing to changing climate. Due to disturbances in the habitat, wildlife posed another serious threat to children, especially those attending rural schools. Participants reported that animals and reptiles are now found migrating unseasonably.

“High altitude animals like snow leopards and bears, if we look at their movement, during winter they descend and in summer they move up but if we look today they are seen everywhere” (PI23).

Currently, studies on wildlife impacts and threats to schools and children due to climate change are underreported in Bhutan and globally. Thus, the safety of children who have hours of walking distance to access the nearest schools continues to be a challenge in many schools, especially for children attending as day scholars. Similarly, transport and communication disruptions during flash floods and landslides affecting students' commutation to schools and school operations were noted.

The emergence of diseases and other health effects of climate change were the most dominant themes reported in this study, which is consistent with global projections (IPCC, 2021, 2022) and studies that have found an increase in the incidences of vector-borne diseases in the region (Dhimal et al., 2021). The participants reported increasing cases of students suffering from numerous diseases in schools and attributed these to changes in weather and climate conditions. Dengue fever (in the south) and chilblains (in the north) have particularly affected the staff and students in schools.

“We really actually do not study all these things but this year we had a problem with dengue fever, that a lot of our teachers and the children got affected by this, I think, this could be also because of climate change” (PI19).

Epidemiological analyses of the dengue epidemic in Bhutan have attributed the underlying causes climate change and environmental factors and called for strengthening national preparedness strategies for efficient detection, control, and timely responses, with a focus on high-risk areas (Tsheten et al., 2020, 2021). Participants in affected schools also noted that children exposed to and those who experienced extreme weather and disasters displayed signs of trauma and emotional disturbances, including one incident of a direct physical health injury to a student during extreme windstorms. However, many minor injuries and out-of-school incidents would have gone unreported.

“A few years ago, there was a very strong wind windstorm, many roofs were blown off and when the roofs were blown off children were being traumatized, so their minds were disturbed” (PI20).

Research on the psychological impact of climate change on children in Bhutan is limited. An aftermath assessment of the 2011 earthquake however has reported that children experienced psychological effects such as anxiety, shock, worries, nervousness, and other mental disturbances (Royal Government of Bhutan, United Nations, & GFDRR, 2011). Similarly, global evidence suggests that weather and climate-related disasters have resulted in a range of psychological health issues such as anxiety, depression, post-disaster trauma, and other emotional disorders in children (Burke et al., 2018). The findings in this study captured a glimpse of children's quality of life and how climate change is beginning to impact their health and well-being.

Climate change also posed significant financial implications for the school authorities to maintain school infrastructure and services. Numerous schools sustained damage to their infrastructures and teaching and learning assets during extreme weather events. In addition, schools reported disruptions to their daily routines and school operations. Schools constructed in the past lacked built-in amenities and services to adapt to changing temperatures and weather conditions. For example, schools lacked basic equipment such as fans, air conditioners, water dispensers, and first-aid equipment. The school management also observed that emerging climate change impacts were influencing school decision-making processes such as the formulation and changes of new school policies. As a result, the schools recognized the need for the latest knowledge and information to manage the impacts and risks as well as device policies to apply in school.

## SCHOOL CLIMATE CHANGE ADAPTATION CHALLENGES & OPPORTUNITIES

### Investment in Climate-Resilient Infrastructures/Safe School Facilities

In schools in Bhutan, low-quality construction, untimely maintenance, unavailability of funds, and a lack of rigorous monitoring and assessment were often cited as the problems. Similarly, there was inadequate and a lack of provision for retrofitting infrastructure and building assets to adapt to climate change impacts and risks.

“This structure was built during the year 1982 or 1983. So, I do not think this is strong enough and it was built by the local people. There was no engineer as such, so to my understanding, I think this building may not be that safe if there are very strong earthquakes or other disasters” (TI5).

While the participating school principals and teachers acknowledged the need for advancement in green infrastructures and technologies, there was very little investment indicated. There was a great need for additional utilities and facilities in schools. Locally built shades and canopies were not weather and climate extremes resistant and often became a threat to students and staff.

“I think if the storm is very strong, then there is a possibility, during school hours, if they blow away the roofing or something like that then there is a chance of hitting the students” (PI4).

The study also observed safety negligence in several schools in terms of identifying and addressing potential threats caused by weak infrastructures that required immediate action.

While schools could only do a little to ensure the safety of the infrastructure and assets, investment in climate-resilient infrastructure is not only capital intensive, but also takes a longer time to process, plan, and implement (IPCC, 2014; OECD, 2018). Nonetheless, the major obstacle to adopting new practices was the lack of economic capital. Furthermore, they were constrained by education and training needed to manage infrastructures and assets as schools are usually responsible for managing their own assets. As climate extreme events and impacts intensify, repairing school infrastructures and properties will become more difficult, hindering the provision of educational services (Mochizuki & Bryan, 2015; UNICEF, 2019a). This will result not only in greater maintenance and repair expenses, but also increased learning interruptions, health and safety risks, learning delays, reduced opportunities and involvement in physical activities, and poorer learning outcomes for the learners (State of Victoria Department of Education and Training [SVDET], 2021). It will be critical for Bhutanese school education to ensure that climate change adaptation mechanisms are integrated into the design and construction of school infrastructure and assets so that such facilities not only provide more safer and comfortable learning environments for students but also lessen the requirement for maintenance and repair due to severe weather effects. Disaster-resistant schools are equally critical for promoting disaster resilience education and preparing children for disasters (Luetz, 2020). There are prospects for schools and education sectors to use risk assessments, designs, and construction directives that have been practiced and proven successful across the world. In addition to improved climate-resilient infrastructures, provisions of policies that regulate operations and activities will be critical for Bhutanese schools. While climate-resilient infrastructure is capital-intensive and requires extensive planning (IPCC, 2014; OECD, 2018), improvements in the quality of educational infrastructure and exposure to different climatic conditions can significantly impact children's learning outcomes (Barrett et al., 2019; Cho, 2017; Park et al., 2020).

### **School Disaster Management Response & Preparedness**

DRR and management are critical elements of climate change adaptation strategies (IPCC, 2022). In general, schools in Bhutan have implemented disaster management plans. However, these were mostly earthquake driven and the evidence suggests inadequate and slow signs of progress within the context of adaptation to changing climate. At most, mock drills were carried out for earthquakes, and in a few cases, fire or a flood. Although school leaders and teachers often questioned whether every individual took such preparedness seriously and how effective it would be in actual emergencies, drills have been enacted as a school policy. Schools were yet to implement cross-sectoral and community-

linked simulation drills and disaster preparedness needed to enhance and develop effective response preparedness. Contrary to expectations, schools were also poorly equipped with disaster response tools, kits, early warning systems, and resources.

“Should disaster strike for real, I am not sure if we are ready because other than DRR educational part, no materials are ready. For example, even I as a chief DEO in Dzongkhag I do not know, where the stockpile is, should something go wrong. Of course, we have attended so many disaster management workshops and drills and we do ensure mock drills take place, but our disaster response is driven by earthquake, it is earthquake responses only. Other than that, we were not sure if our schools are ready” (DEOI3).

It became evident that schools in Bhutan still must pay greater attention to the identification and mitigation of non-structural impacts and hazards as the existence of weak infrastructures and disaster-prone school environments remained a major source of threats and hazards. Schools in general also lacked formulation and implementation of staff and students' safety protocols. For instance, safety rules, standard operating procedures, using personal protective equipment, and safe family reunification processes were non-existent in many schools in this study. The literature strongly highlights, efforts to reduce disaster risks through awareness, education and training, and response preparedness to create safer communities cannot be realized unless a safety culture is established (Davis et al., 2003; Marshall, 2020). Thus, fostering a culture of safety and strict adherence among children, including the public, will be crucial for Bhutanese schools. Building a safety culture in Bhutanese schools will be crucial for creating pathways to climate and disaster resilience. Every school in Bhutan had a trained disaster focal teacher who carried out disaster awareness and advocacy, risk assessments, and response preparedness with the help of a school disaster management committee. Ministry of Education also developed and distributed a teacher handbook for disaster management for use by teachers in schools. Despite efforts to enhance disaster education, school leaders and teachers asserted that education and training on disaster management are still inadequate. The training was often conducted on an ad hoc basis and as one-off training. Except for the focal person, only a few individuals had the opportunity to attend. The participants held a strong belief that regarding disaster management, it may not be a good idea to rely solely on a single focal person because he/she could be absent on any given day. Thus, all teachers and staff in schools must receive education and training for risk reduction and management.

“We are ready, but I am skeptical, if a real disaster strikes, what will be our situation because we ourselves might be in trouble. So, at that moment, probably there will be sudden like miscommunication, and then like lots of disorder, and chaos in the school” (TI1).

One of the critical highlights of the findings was that most schools lacked strategies and plans for ensuring educational continuity in the face of impending and immediate disasters. The most important aspect of school safety efforts is ensuring

educational continuity in the face of all expected threats and hazards (UNDRR & GADRRRES, 2017). Communication and coordination linkages between schools, disaster management sectors, local communities, agencies, and relevant stakeholders have still not been fully established. Thus, the lack of formal partnership among these stakeholders often created confusion during times of actual emergencies although informal communication and consent always occurred. The formulation of community-based adaptation strategies within the context of climate impacts and risks has not been scaled up within the disaster plans. Similarly, when it came to capacity building, children and youth-centered participation in disaster prevention, response, communication, and climate change adaptation remained minimal. It has also been found that at present, there is low education and training on disasters, including health-related disasters such as diseases. While disaster management policies have been put in place, there are still significant policy and operational gaps. Social capital has been essential in supporting one another during times of crisis, with Dessups now playing a larger coordinating role nationally.

The results show that the need for resources for disaster and emergency management, response and recovery, and mitigation preparedness has grown and that this demand will only increase as the impact of climate change escalates. It may also put additional pressure on teachers and staff to extend learners with health and wellness support, teaching and learning, and psychological assistance. Thus, this might lead to an increase in teacher demand in schools, while teacher retention and recruitment are already a major concern in Bhutan (Dolkar, 2022; Pem, 2021; Wangchuk & Dorji, 2020). It becomes apparent that schools in Bhutan must integrate climate change threats into the school emergency and disaster management programs emphasizing the health and wellbeing of the students. As observed, often schools with weak infrastructures and with fewer safety nets were most vulnerable to a range of climate hazards.

### Climate Change & Risk Reduction Education

When it comes to teaching and learning about DRR in schools, there was no separate curriculum, nor was it integrated into the formal curriculum at all levels. At the secondary level, a brief lesson on disaster and risk reduction was integrated into environmental sciences subject as part of the teaching and learning of climate change. However, it is only an optional subject. Similarly, when it came to CCE, participants held a strong belief in the need for the inclusion of CCE into the curriculum. Perceptions were mixed on whether it should be integrated into all subjects or just offered through a single curriculum.

“Best could be integrated mode because climate change and disasters are something that can be incorporated in any kind of subject depending on which topic they are in. Should we leave these topics to subjects like science and geography, I think the education part will be minimal, and when it comes to levels I think this kind of education, in the varying degree of difficulty, should be given to almost all children” (DEOI5).

In addition, opinions were divided about whether to offer it only at the higher grade level or offer it from the lower grades. However, participants maintained that it needs to be implemented effectively.

“I do not know whether it has to be integrated in all the subjects or it should be there in science or environmental science or geography. But it is required. It is important” (PI9).

Currently, CCE is integrated into environmental science curriculum offered at the secondary level as an optional subject. The findings indicate that the depth of inclusion of both CCE and DRR into the curriculum is marginal. In terms of transferring education to the learners, the participants posited that teaching and learning should be experiential learning with a more updated curriculum, resources, climate experts’ support, and active leadership roles.

“Our teachings are always in isolation because when things are taught in isolation, is very difficult to understand things that might look abstract such as climate change, so maybe, field experience, some real-time videos, then some such things might help otherwise, unless we experience ourselves, many a time people are not able to relate in their everyday life” (PI20).

Non-subject teachers were not directly involved in the teaching of climate change in their classrooms, except for creating awareness and discussing relevant topics in their lessons. Teachers acknowledged that the present curriculum had not achieved noticeable changes in learners’ pro-environmental and climate change behaviors, particularly at the individual level. As observed in other studies (Howard-Jones et al., 2021; UNESCO, 2021), teachers in Bhutan expected CCE to encompass action-oriented teaching and learning. In brief, the findings revealed that schools in Bhutan have yet to comprehensively embed disaster resilience and CCE in the curriculum. Nonetheless, Bhutan has recently instituted a national climate change policy that recognizes the need for developing a curriculum on the environment and climate change and imparting knowledge at various levels of the education system (NEC, 2020).

### Teachers’ Knowledge & Capacities

Although all school leaders and teachers in this study had a basic understanding of climate change causes, impacts, and the need for action, they claimed that they were not appropriately trained or adequately equipped with climate change knowledge. Subject teachers (e.g., science, geography, social studies, and environmental science) demonstrated more exposure and confidence in climate-related knowledge and information than other teachers. The findings demonstrated that school leaders’ and teachers’ lack of climate change knowledge and skills to initiate climate-resilient adaptive and mitigative practices, including classroom teaching in the field they occupied was a major setback. Teachers who engaged in teaching about climate change claimed they could not practice what they preached due to the absence of appropriate capital and structural constraints.

“I talk to my students, I always tell them, minimize the use of resources, go for renewable resources, at the same time I drive 17×2=34 kms, I feel guilty because I am preaching something, which I am not practicing myself” (TI27).

This appears to be a concern for teachers worldwide. For instance, in a survey of teachers (n=58,280 teachers) from 144 countries, only around 40% felt confident in teaching about climate change (cognitive dimensions), and only one-fifth comprehended well how to act or reduce their own carbon footprint (behavioral dimension) (UNESCO, 2021). Thus, increased efforts are needed to provide sufficient education and skills to teachers in order for them to be more encouraged and supported as they navigate the field of disaster resilience and CCE. In this way, knowledge accumulation could enable the teachers to further acquire climate change knowledge and skills that are not present in their current experiences in schools. This study further supports the integration of CCE into pre-service and in-service teacher training across all disciplines and education levels (Anderson, 2012; Boon, 2016; UNESCO, 2021). The results observed that teachers' academic and socio-demographic attributes had an influence on their perceptions and knowledge of climate change. As recommended by Chopin et al. (2018) in their Canadian research, a teacher's manual for embedding climate change in all disciplines would be useful for Bhutanese schools. The results showed that teachers need to be supported with the required material capital (teaching-learning materials, guides, funds, etc.), education, and structures, to enable them to deliver the curriculum through climate change and disaster management paradigms and to devise programs that develop individual resilience. To achieve this, structures and frameworks for promoting and implementing CCE, disaster management, and education for sustainable development must be scaled up. Learners need appropriate knowledge, skills, and capacities to not only adapt to climate impacts but also understand the consequences of their actions, promote behavior to mitigate those consequences and empower them to contribute to tackling this global crisis. Schools can support communities in understanding climate change impacts and risks and build knowledge to help reduce emissions as well as develop communities' resilience against climate impacts by supporting adaptation practices (Gibb, 2016; UNESCO, 2020). As a result, schools play a larger role in transferring social and educational capital that brings about the desired social transformation.

### **Schools' Adaptive Structures & Capacities**

As highlighted above, climate change has begun posing considerable challenges to school education. While the sense of urgency in combatting climate change in schools and school actors was deemed less apparent, participants acknowledged devastating consequences on schools and children. Their responses indicated a significant gap in applying various adaptation measures and evolving into practice to make schools a safe place for children's education. IPCC (2022) underscores the importance of robust institutional governance for embedding adaptation in planning and decision-making and facilitating a successful transition into implementation. For this, multi-level institutional coordination between the

government, sectors, and actors, and mainstreamed with the national adaptation plans and operational frameworks is required, which is currently a major shortcoming in Bhutan. Consistent with the literature, this study argues that Bhutanese schools' (education systems') ability to address, cope, and overcome adverse effects or to respond to consequences will be defined by their adaptive capacity (Anderson, 2010; Feinstein & Mach, 2020; SVDET, 2021). Many of the adaptation challenges are ascribed to the absence of policy frameworks and strategic objectives that enable local-level interventions. Furthermore, significant gaps exist in knowledge and technical skills, resources and tools, and cross-sectoral and stakeholder engagement and collaboration. Luetz (2018) found that, in the context of emerging nations, the absence of livelihood security, education, and services provisions and planning was often the most significant obstacle to adaptation preparedness. Several analyses (IPCC, 2022; SVDET, 2021) caution that failure to incorporate climate trends and projections when designing programs or initiatives may result in not only delayed or inadequate preparedness but also adaptation malpractices. Given the region's worsening climate projections and the already widespread impacts, strengthening schools' adaptive capacities at the earliest will be critical.

An appropriate institutional and regulatory framework, as well as operational policies supported by a range of social, material, and technical capital, is vital for enhancing schools' adaptive capacities (IPCC, 2022; SVDET, 2021). In Bhutan, aligning adaptation strategies to gross national happiness (GNH) indicators will be key as the nation continues to prioritize happiness over economic growth to achieve social and environmental progress. To build adaptive capacities, the first step would be to disseminate adequate knowledge and information about climate change impacts and risks, as well as integrate trends and projections into decision-making. Next, the education sector must prioritize the protection and deployment of educational infrastructure, the provision of knowledge and skills for climate change adaptation, and the improvement of general education through curricular and pedagogical reinforcement (Feinstein & Mach, 2020). Furthermore, supporting school leadership and management with appropriate knowledge and skills is critical. Given sustainable development, climate change adaptation, and disaster management have common features, schools need to pay attention to overlapping strategic objectives, policies, and plans to ensure effectiveness, minimize duplications, and optimize resources (UNDRR, 2020). Limited provision of economic capital for schools was by far the most significant challenge in schools' efforts to employ adaptation measures to climate impacts. Despite challenges, schools must strive to address existing and future climate change impacts by reducing barriers to adaptation as well as creating foundations for transformative adaptation changes.

## **SCHOOL CLIMATE CHANGE MITIGATION CHALLENGES & OPPORTUNITIES**

Studies reveal that schools can significantly reduce their carbon footprint through technological adoption,



maintenance, and whole-school low-carbon initiatives (Gamarrá et al., 2018; Hanus et al., 2019; Odell et al., 2020). Furthermore, community groups, projects, organizations, associations, and student-led activities are beneficial in taking an active role in climate change adaptations and mitigation actions (Godfrey & Tunhuma, 2020; Hargis et al., 2018). The formal mitigation strategies and plans had not yet been mainstreamed in schools' actions for climate change. However, various schools, teachers, and student-led activities contributed to adaptation and mitigation action through green school initiatives of the Ministry. Some of these examples include:

- a. advocacy & awareness,
- b. afforestation & reforestation,
- c. reduction of firewood use in school kitchens,
- d. recycling of waste,
- e. rainwater harvesting,
- f. waste management,
- g. educational initiatives: essays, quizzes, exhibitions, & dramas,
- h. observing international days,
- i. car-pooling,
- j. student clubs/associations
- k. water resource conservation
- l. conservation of endangered plant species,
- m. school agriculture program,
- n. mass cleaning campaign,
- o. practicing indigenous & sustainable development activities,
- p. emergency communication system,
- q. improvement of school facilities, and
- r. creating a safe school zone.

Most of these environmental and climate-related programs were designed and implemented through the support of groups and networks of people. Social capital was the only available resource for undertaking these interventions. One could wonder if schools and student-level activities, which often appear insignificant, are sufficient to address greenhouse gas reduction. It can be argued that an important and expected outcome of education will be that young generations understand the urgency of climate change, that they are prepared to adapt, and that they are empowered to pursue more sustainable lifestyles (Leicht et al., 2018; Stevenson et al., 2017). In a recent study, Cordero et al. (2020) estimate that if only 16% of high school students (in high-income and upper-middle-income countries) received CCE, carbon dioxide levels could be reduced by approximately 19 gigatons by 2050. As a result, empowering the personal agency of all students in the universe would have a significant impact on their everyday decision-making and behavior, lowering the overall carbon footprint of their lifespan (Kwauk & Winthrop, 2021). Schools and student-based climate-focused models and programs have been effective in many countries across the world, benefiting not just in learning and adaptation to consequences, but also in contributing to green measures for mitigation (see Godfrey & Tunhuma, 2020; Hargis et al., 2018; Tanner, 2010; UNICEF

& PI, 2010; United Nations Joint Framework Initiative on Children, Youth and Climate Change [UNJFICYCC], 2013). However, there is still little research on how schools and students may participate in climate change mitigation. Pickering et al. (2020) in their study found that student youth showed low confidence in how effectively their schooling had prepared them for taking mitigation action, although most believed their activities and lifestyle choices could help in climate change mitigation. This highlights the significance of skill-based education for accelerating mitigation actions and solutions or what Bourdieu describes as grounding "scientific practice in social action" (Robbins, 2008, p. 32).

In terms of school and community relations, the findings indicated a culture of strong community support services and education rendered by the schools. The schools and communities collaborate to protect the environment. However, the emphasis to date has been mostly on waste and other environmental management issues, climate change has yet to be prioritized on their action agenda. A teacher reflects,

"below the football ground, we have planted there, we have involved the community and then in collaboration with the community and schools, we have planted the saplings all the way from the school to the main road" (TI18).

In Canada, in an evaluation of the whole-school approach to the climate action pilot project, Chopin et al. (2018) found that schools and children participated well in climate activities when there was a strong collaborative network and diverse actors engaging in it. They observed that climate activities were more effective when they were local, relevant, and achievable, and suggested expanding it to community-level solutions and considering integration of indigenous knowledge. Using information technologies creatively contributed significantly to their positive outcome. Chopin et al. (2018) also suggest that for climate action in schools, a readily accessible platform, where the school and the individual agency could easily share ideas, concerns, challenges, and resources is very necessary. Thus, community and stakeholder cooperation to address such needs will be indispensable. The present study revealed that institutional involvement in climate discourse, research, and other innovative programs with relevant partners and organizations was minimal. The school leaders and teachers wanted stronger parental involvement in CCE and climate action. Climate action calls for a cooperative approach due to the requirement of wide-ranging expertise, community and stakeholder consultation, finances, local concerns, planning and prioritizing, developing knowledge, broadening opportunities, protecting social and cultural, and assuring outcomes (Gibb, 2016; Gough & Sharpley, 2005). Burton (2016) argues that the absence of collaborations could lead to maladaptation and malpractices and the scales of responses and threats may not be effectively aligned. The school actors' dispositions as "ways of acting, feeling, thinking and being" (Maton, 2008, p.51) were evident from their commitment to social action projects and services in relation to environment conservation and climate change. While there was a strong sense of social and community unity in school, this study suggests that a mechanism to sustain this form of positive social capital-

through supportive community groups, associations, school clubs, NGOs, ministerial sectors, and external parties—is essential to continue to rigorously participate in climate change-related activities. The experience of schools across the countries indicates that climate action in schools was effective when there is commitment and diligence of school leaders; trained teachers and engagement with external expertise; devoted facilitators managing the process; relevant materials and resources; and sufficient long-term financing (Gibb, 2016). Using participatory programs, school leaders and teachers did everything they could to instill values and change the behavior of future generations to help protect the natural system, but they also experienced challenges. Some school and leadership challenges included a lack of economic capital, time-tabled curriculum, willingness and readiness of teachers and students, and low access to and attainment of cultural capital.

### Policy Approaches & Capacities for Mitigation Response

Mitigation responses need policies and collaboration at all scales and reinforced and integrated in tandem with other societal goals (IPCC, 2014, 2021). The enabling factors for mitigation responses include efficient governance structures, investment in environmentally friendly infrastructures, technology and innovations, behavioral and lifestyle choices, and sustainable livelihoods (Havukainen et al., 2022; IPCC, 2021). Although the notion of a green school was promoted in schools for students' learning and skills, no broader mitigation strategies for large-scale actions at the sectoral and school level are currently in place. Climate change issues have not yet been fully mainstreamed into the education sector's policies, planning, financing, and priority targets.

“No as such particular strategies and policies to climate change at school level, but just the normal things that we do, something related to disaster and cleanliness of the surrounding, water resources, other than that nothing serious” (TI, 32).

This study indicates there is a need to place emphasis on the field of mitigation for a greater understanding of schools' engagement in climate responses. Havukainen et al. (2022) found that most of the least developed countries' nationally determined contributions to implementing the Paris Agreement did not focus on national political decision-making and did not demonstrate significant efforts to reform institutions to facilitate mitigation. Well-designed and systemic sectoral mitigation strategies that contribute to structural and institutional changes through instruments such as education, finance, and cross-sectoral cooperation will be critical for Bhutan, but as found in this study, these do not yet exist. According to the findings, not all schools have been able to take measures towards equipping themselves with energy-efficient infrastructures. Schools were still using firewood for cooking the students' meals. In addition, schools in many locations are still burning waste due to a lack of effective waste management facilities. However, this is understandable given the socio-economic situation of the country. In most Bhutanese public schools, prospects for schools and institutions to engage in mitigation actions depend largely on the strategic objectives of the government and sector.

Research suggests that school education has abundant opportunities to contribute to reducing the carbon footprint. For instance, a study in the USA estimates that rooftop solar power supplies from educational institutions alone could reduce environmental, health, and climate change losses by around \$4 billion annually (Hanus et al., 2019). Similarly, in Australia, Odell et al. (2020) report that by taking a behavioral and whole-school approach to low-carbon initiatives, participating schools could cut their utility costs, resource consumption, and carbon emissions, and nearly 70% of their outlined school actions involved little to no investment. Gamarra et al. (2018) reported similar findings in which lighting technologies, renewable heating solutions, thermal insulation, maintenance and operations in school buildings significantly reduced fossil fuel and energy demands, contributing to a lower carbon footprint. In this study, the most significant barrier to investing in less carbon-intensive school infrastructure was the lack of economic capital, particularly for the initial sets up. Current school climate initiatives are of a smaller scale and often focused on environmental and waste management. Regarding the government's efforts for climate action, participants believed that the government is concerned about climate change challenges. However, there are currently no clear structures in place to coordinate attempts to operationalize actions at the local, regional, and national levels. While the school leaders and teachers who participated in this study might be aware of what and how they should be involved in climate action, this may not always translate into practice because of the disjuncture between the dispositions, capital, and structures. For schools to be part of the climate mitigation strategy, viable policy instruments backed by various forms of economic and cultural capital will be crucial.

### Limitations

The data in this study were generated only from school leaders, teachers, and DEOs in some schools and districts in Bhutan. Incorporating other key stakeholders such as the secretariat, education departments, students, parents, and relevant agencies would have provided comprehensive perspectives on the effects of climate change on the school system and children, along with insights into the corresponding responses. Similarly, schools from remote and other disadvantaged regions and locations were not included. Furthermore, observations of CCE and DRR-related teachings in schools were not conducted. Likewise, the investigation did not delve into how the needs of pre-school and out-of-school children, and children with special needs were addressed through the current disaster management plans or climate change adaptation strategies.

## CONCLUSIONS

Climate change impacts were being observed in the school sector in Bhutan, affecting not just the learners but the entire school system, including its amenities. Structures for adaptation and mitigation have yet to be established as a field of practice. Climate change concerns have not become part of the decisions of many decision-making cultures of the schools. Schools are yet to integrate current climate change trends and

future projections as the foundation of school development programs and activities, as a result of which no proper response strategies have so far been implemented. The slow progress in response demonstrates the limits of individual and collective school agency due to systemic and resource constraints. Opportunities for action were constrained by education and economic capital, limited impacts and risk assessment, policy and institutional structures, and technical and human capacities. While awareness, education, and engagement in responding to climate change were gradually gaining traction in the school sector, further ambition is required. It remains crucial to implement comprehensive climate change plans in schools and the education sector, aligned with national and international goals. This involves numerous key actions: enhancing understanding of climate risks, establishing effective risk assessment systems, integrating climate adaptation into policies and decision-making, strengthening emergency management plans, and protecting vulnerable groups. Schools must also focus on building resilience of the school infrastructure through technology adoption and training. Developing carbon footprint reduction plans and allocating funds for climate adaptation and mitigation are critical. Similarly, the education sector needs to address disparities by focusing on high-risk and disadvantaged students, integrating climate education into formal education and teacher training, fostering cross-sector partnerships, and involving school leadership and children in climate action. Additionally, prioritizing local and participatory programs, supporting climate research, and alignment with the national vision of GNH are important considerations. It became apparent that schools and systems must be capable of not just recognizing, adapting to, surviving, and recovering from climate-induced impacts and hazards, but also of improving welfare and health. The escalating climate change consequences call for well-organized risk management, accelerate adaptation practices, and scaling up carbon reduction in Bhutan and globally. When supported adequately, schools can become an essential part of society preparing for climate change adaptation and mitigation.

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