IT IS GETTING HOT

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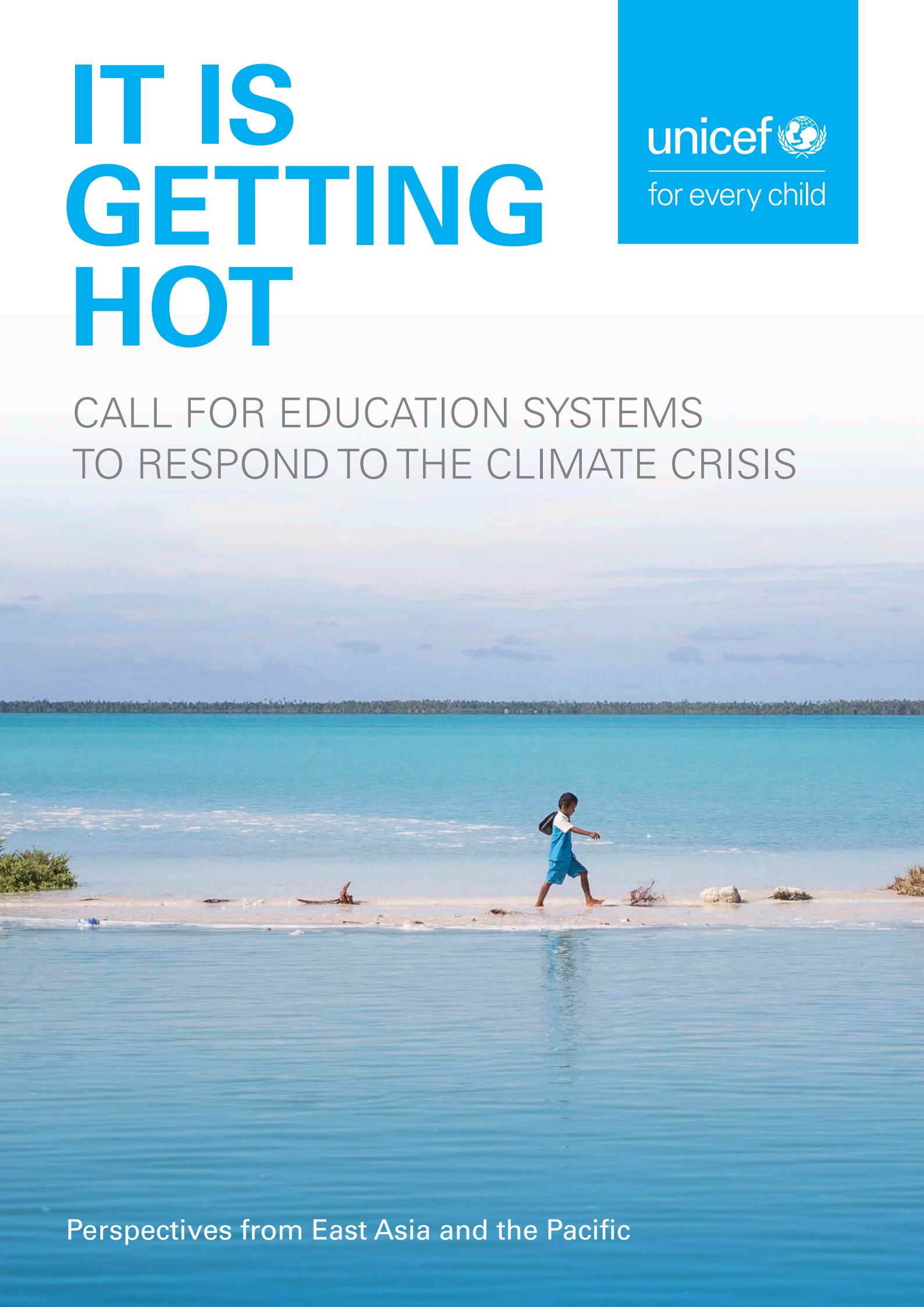
CALL FOR EDUCATION SYSTEMS TO RESPOND TO THE CLIMATE CRISIS



Perspectives from East Asia and the Pacific

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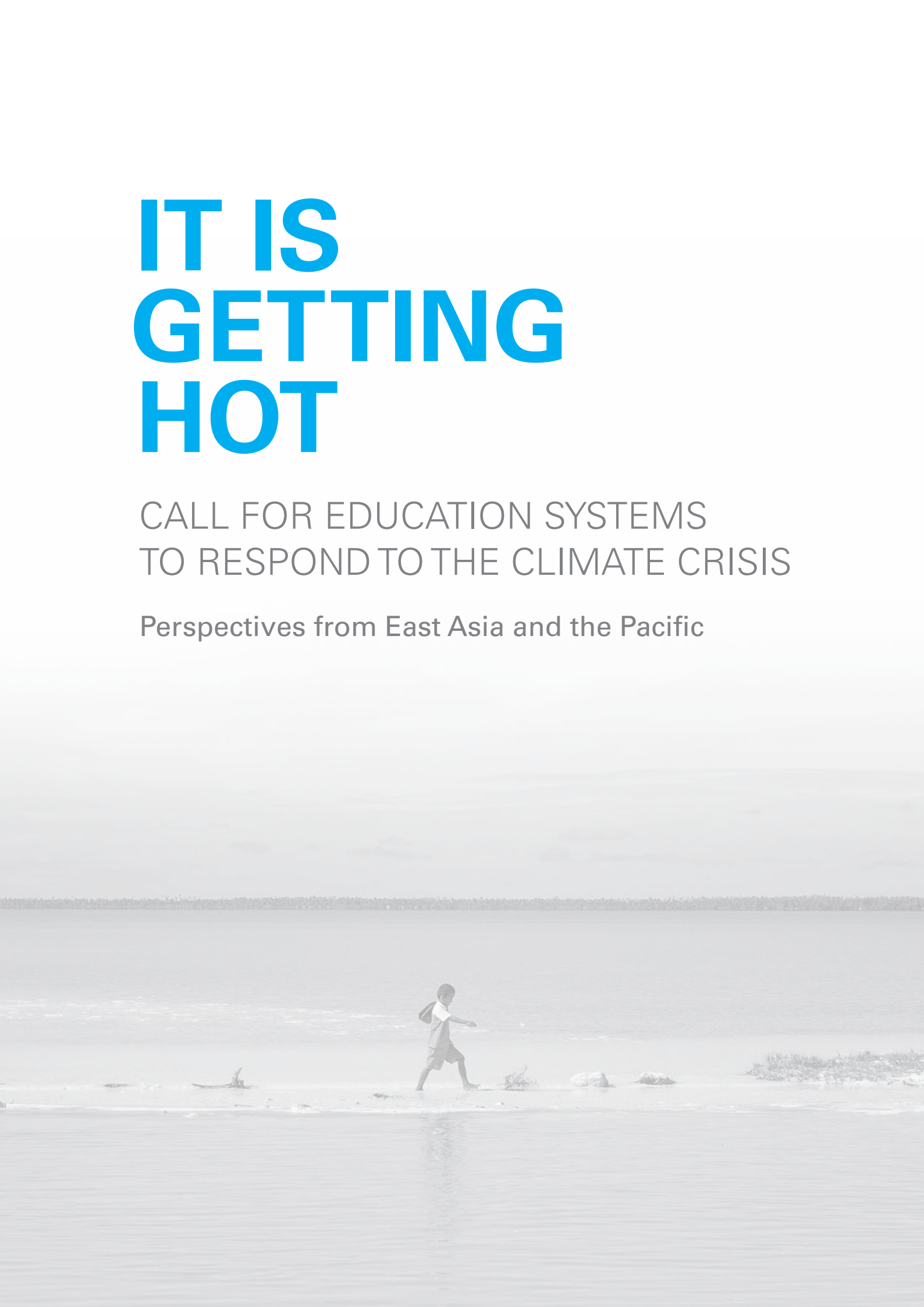

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FOREWORD

Climate change is both a reality and a crisis. Children and adolescents around the world are aware of it and are desperately calling for action. School strikes are now becoming a common phenomenon in many countries, with students not attending classes on Fridays as an act of protest. They are concerned that governments and adults are failing them to the extent that they have filed serious legal complaints to the United Nations Committee on the Rights of the Child to protest against the lack of government action on the climate crisis.

These young activists are right! Their future, our future, is jeopardized! The effects of the climate crisis are already being felt across the globe and especially in East Asia and the Pacific. The region is one of the most vulnerable to the impacts of climate change, with 1 billion people affected by floods, droughts and storms every year. The scientific evidence is clear: the frequency, intensity and duration of climate-related extreme events and the slow onset of changes will only escalate if the current path of inaction continues, affecting in particular the most vulnerable and marginalized of the region's children. This will exacerbate current inequalities and threatens to undermine the progress achieved in promoting education over the last years.

The region is also particularly susceptible to climate change due to the trend of rapid urbanization. Most of this population growth is projected to occur in coastal areas, which are highly vulnerable to the impacts of floods, tropical storms and sea level rise. Governments are already taking action, with some governments having moved or planning to move their capital cities away from their current locations.

As we mark 30 years of the Convention on the Rights of the Child, UNICEF in East Asia and the Pacific is committed to supporting children, governments, communities, families and schools to act and be ready to manage climate change-related risks, and to ensure children continue their education and learning process.

Education is a crucial component of climate change mitigation and adaptation. Increasing environmental awareness and education on the climate crisis can contribute to the effective reduction of greenhouse gas emissions and in adapting to a changing climate in both the short- and long-term. Education systems need to acquire the knowledge, skills, tools and adequate financing to prevent and manage risks associated with climate change. Thus, education systems urgently require a strong voice and presence in climate change discussions, as well as need to be prepared to respond to current and future challenges associated with the climate crisis.

Against this background, the UNICEF East Asia and the Pacific Regional Office (EAPRO) has undertaken this regional analysis *It is Getting Hot: Call for education systems to respond to the climate crisis* to gather available evidence on the impacts of climate change on the education sector. The report aims to help improve national and regional stakeholders' understanding on the links between climate change and education systems. The study also aims to promote the sharing of good practices and lessons learned on the integration of climate change actions into the education sector and preparing education stakeholders to be climate-ready, making a case for greater investment in climate-resilient education systems.

UNICEF strongly believes that every girl and boy has the right to thrive and to pursue a high-quality education. In the East Asia-Pacific region, UNICEF will do its best to make this a reality by addressing the challenges that the climate crisis creates for education systems. Children and adolescents cannot miss school; they cannot miss their future. It is getting hot, we need responses, we need to change. Let's learn how and act together now!

Karin Hulshof

Regional Director
UNICEF East Asia and the Pacific

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Furthermore, the work draws on consultations with the ministries of education, disaster management and climate change authorities, development partners, non-governmental organizations, as well as education authorities, teachers, students and parents in Cambodia, Mongolia and Viet Nam.

EXECUTIVE SUMMARY

The climate crisis is a reality in East Asia and the Pacific. The region is already one of the most vulnerable to climate-related disasters, with half of the population directly affected every year by floods, droughts and storms (UNISDR, 2019). Increasing temperatures, changing rainfall patterns and rising sea levels will add to current vulnerabilities. Scientific evidence shows that the frequency, intensity and duration of extreme events will increase – it will, therefore, be important to 'climate-proof' the education sector to ensure that it can adapt to a changing climate and protect its hard-earned gains in children's education and learning.

Urbanization will intensify climate risks. The rapid movement from rural to urban areas is increasing vulnerabilities in the region. By 2040, population projections suggest that urban areas will house an additional 1 billion people (GFDRR, 2019). In the region, most of this population growth is projected to occur in coastal areas, which are highly vulnerable to the impacts of floods, tropical storms and sea level rise.

The climate crisis will affect the most vulnerable children and adolescents, exacerbating current inequalities and undermining the progress achieved in promoting development over the last few decades. Particularly vulnerable populations, such as those under the poverty level in both urban and rural settlements, children or adolescents with disabilities, young girls or boys, or minority and migrant groups, are often less able to manage climate-related risks and are least represented in decision-making processes (Barros et al., 2014; UNICEF, 2015). Governments need to identify these groups and prioritize support for them.

Education is part of the answer. Increasing environmental awareness and education on climate change can contribute to effective adaptation and mitigation. The UN Framework Convention on Climate Change (UNFCCC) Article 6 on education, training and public awareness states that countries shall develop and implement educational and public awareness programmes on climate change and its effects. The Paris Climate Agreement (UNFCCC COP 21, 2015) Article 12 also reiterates the importance of the role of education in enhancing climate actions. Governments and

communities need to acquire the knowledge and tools to both understand the climate crisis (and its causes) as well as possible approaches to manage risks associated with climate change.

However, education needs are invisible in most key climate change discussions; and the voice of education is almost silent. Countries are not including educational issues in national priorities for climate mitigation and adaptation actions through the Nationally Determined Contributions (NDC), which are a core element of the Paris Agreement. Out of the 196 Parties to the UNFCCC, only 32 per cent of the Parties mention education (YOUNGO, 2018). Education systems' participation in climate change discussion is usually marginal.

Urgent actions are needed to 'climate-proof' the education sector and to accelerate climate-resilient and climate-smart education investments and actions. In this regard, the present study contributes to understanding how climate change may affect education; likewise, it helps to identify strategies that can be implemented to manage climate risks to education systems. The objectives of the present study are:

- To gather evidence on the impacts of climate change on the education sector
- To improve national and regional stakeholders' understanding of the relationship between climate change and education
- To enable cross-country comparison and tracking of climate change actions in education
- To promote the sharing of good practices and lessons learned on the integration of climate change actions into the education sector
- To integrate climate change risks and climate action priorities into the education sector planning and budgeting systems
- To make a case for greater investment in climate-resilient education systems for regional and national climate change and education policy-makers.

THE CLIMATE CRISIS HAS COMPLEX IMPACTS ON CHILDREN'S EDUCATION

Direct effects due to infrastructure damages and possible injury can disrupt the learning process for a long time. In the most direct way, climate-related disasters can interrupt children's and adolescents' education by damaging or even destroying schools and relevant infrastructure, like bridges and roads that connect communities to schools. Such destruction can disrupt education for days and even weeks – and in countries with limited alternative education modalities during disasters, this can lead to missed classes and lower academic performance compared to other schools in the country. Events can also result in losses of learning materials. Climate disasters can also cause injury to parents, students and teachers – resulting in absenteeism. In more severe cases, mortalities could have devastating consequences for long-term education.

Indirect effects not only increase absenteeism, dropouts and threaten learning, but also negatively impacts the wellbeing and security of children and adolescents. In addition, the climate crisis affects the *social and environmental determinants of health* – clean air, safe drinking water, sufficient nutritious food and secure shelter. Children and adolescents are now expected to bear the additional burden of disease related to climate change, compromising their physical and physiological development (for example, evidence links the detrimental effects of *air pollution* on health to lower academic performance). The *availability of water* is another challenge in a changing climate. The scarce water supply comprises a risk of contracting food-borne diseases which can generate long-term health problems and increase absenteeism. *Food security and nutrition* is also threatened as children and adolescents may not be able to obtain sufficient and nutritious food either at home or at school, which is proven to have compounding effects on their academic wellbeing. Another indirect but key impact of climate change on children's education is a risk in *livelihood security and income.* Across much of the region, livelihoods are predominantly dependent on rain-fed agriculture and livestock rearing, making them particularly susceptible to the climate crisis (Morton, 2007). This situation reduces household income and purchasing power. Parents may not be able to afford school costs (transport, school materials) and children, especially adolescents, may be expected by parents to miss school and support livelihood or household activities. In more extreme cases, households may decide to *migrate.* Evidence suggests that relocation and attending classes in a different school generally translates to dropouts or lower academic performance.

Education systems need to adapt to be more protective, particularly for the most vulnerable. All of these impacts, direct or indirect, need to account for differences in consequences by gender, urban/rural, ethnicity, minority and migrant populations, children or adolescents with disabilities, or socioeconomic status. Thus, the education sector needs to provide effective and preventive actions to protect the most vulnerable children from the impacts of climate change.

Quantifying the economic cost of the climate crisis on education is a challenging task as the links between climate change and education are not always straightforward (such as health and livelihood impacts). They manifest instead over different timescales through multiple pathways. Indirect impacts could be more long-lasting and potentially even more costly than direct impacts. It is important to highlight that costs need to include the particular needs of different populations by gender, urban/rural, minority, children or adolescents with disabilities, and socioeconomic status.

But preliminary data indicate exponential costs. When considering all of these issues, a rough estimate of the total cost of climate change on education is likely to be in the scale of trillions of dollars. Moving forward, there is a need to develop systematic frameworks to assess these multiples costs. Nowadays, estimated economic costs include infrastructure (including damage to schools and school materials) and costs associated with forgone education (comprising of lost lifetime productivity and earnings); for instance, global analyses of missed education show that limited educational opportunities for girls and barriers to completing 12 years of education cost countries between US$15 trillion and US$30 trillion dollars (World Bank, 2018).

PREPARING FOR THE NEW NORMAL: 'CLIMATE-PROOFING' THE EDUCATION SECTOR

Education stakeholders in East Asia and the Pacific have made some progress in integrating climate change into education planning, but substantial work remains to be done. The following four areas are proposed for urgent actions to ensure children's education and learning are not undermined by the negative impacts of climate change, and to help education stakeholders play a proactive role in tackling the climate crisis in the region.

I. Improve learning and skills in schools to address climate crisis challenges.

Education is essential to prepare societies to prevent and manage risks associated with the climate crisis. Children and adolescents across the region have demonstrated significant interest in engaging in climate change adaptation and mitigation action. However, limited knowledge and capacity on climate change issues hamper such action. Here, Ministries of Education and schools can play a major role in ensuring that students have access to relevant education on climate change. There is scope to ensure that *the latest knowledge on climate change science and local impacts and solutions are integrated into the national curricula accompanied with other key topics such as gender and inclusion.* Furthermore, it is necessary to *ensure skills-based learning,* through action-oriented pedagogies, where there is significant potential to encourage children and adolescents (as well as teachers and communities) to participate in climate mitigation and adaptation programmes, and to become part of the solution.

II. Enhancing data and improving the evidence base to inform climate and education policies and develop sustainable financing mechanisms for climate-resilient education systems.

A systematic understanding of both direct and indirect impacts of climate change is necessary. First, *developing specific evidence on how climate change affects education enables education stakeholders to actively participate in climate change discussions, monitor progress and identify solutions.* Second, systematic collection and use of climate impact data on education provides a clear climate rationale for education authorities and stakeholders to access and deliver climate finance. There are opportunities for the education sector to promote *an integrated data and information system on the impact of climate on education and climate-resilient education actions* with existing databases, such as environmental, health, nutrition, housing, water, etc. (disaggregating data by gender, urban/rural, ethnicity, children or adolescents with disabilities, socioeconomic status, etc.), to measure the impact of climate change and inform policy decision.

III. Ensure continued education and support of all children and adolescents, teachers, and families under different climate change scenarios. Specific initiatives to climate-proof schools and relevant infrastructure necessary for access to and quality of education are needed.

To reduce duplication of efforts, strategies for climate-proofing education infrastructure should build on existing safe school guidelines (which are generally available in most of the countries in East Asia and the Pacific). However, even heavy infrastructure investments cannot withstand the impacts of climate change; on occasion, extreme events can wreak havoc on schools, community services and livelihoods. In such instances, increasing access to education under climate change will also require *developing innovative alternative education modalities.* Beyond mortality and injury, one of the most severe, but also less well-understood, impacts of climate change on education is the psychological stress that follows after major disasters. This can severely affect educational communities and actors, especially for vulnerable groups, such as those under the poverty level, children or adolescents with disabilities, girls or boys, rural or urban populations, or minority or migrant groups. Therefore, it is crucial to *implement measures to identify and protect the most vulnerable and at risk children, adolescents, teachers and families who have been affected by the climate crisis.*

IV. The education sector's leadership in tackling the climate crisis is critical. For this, education stakeholders will need to strengthen their capacity in understanding and acting on the climate crisis and proactively participating in relevant climate change policy-making and financing processes at international, national and sub-national levels.

Within the countries, education ministries and stakeholders will also need to promote cross-sectoral collaboration with other ministries and agencies to systematically understand the implications of climate change on education systems and to enable cross-sectoral actions for making climate-resilient education a reality. Ministries of education in the region often have limited engagement with ministries of environment, and therefore lack opportunities to exchange expertise and ideas on climate change issues. Collaboration is also needed across other sectors, especially given that the impacts of climate change on the education sector are cross-sectoral. For example, one of the key ways through which climate change affects education and learning outcomes in the region is through impacts on health and child poverty, which translate to increased dropouts and absenteeism.

Finally, there is also a need to *incorporate climate change issues into education planning, as well as to include education system priorities and climate action needs into climate change policy and financing.* Climate finance requirements for the education sector are rarely met. There is significant scope for expanding the availability of contingency funds for the education sector during climate-related disasters. At present, only a fraction of contingency funds is allocated to education ministries (and education authorities report that most funds go to agriculture and infrastructure). The climate investment needs for the education sector could also include mitigation needs, such as, the provision of reliable, affordable and sustainable clean energy services for schools or energy efficiency measures of education infrastructure. Again, greater cross-sectoral collaboration – particularly with disaster management and energy authorities, and with climate finance focal agencies – is crucial.

CONTENTS

Introduction

Impacts of climate change on education, direct or indirect, need to account for differences in consequences by gender, urban/rural, ethnicity, minority populations, children with disabilities, or socioeconomic status to ensure that the response of the education sector is adequate.

Climate change is a reality. Its effects are already being felt in East Asia and the Pacific – a region that is highly vulnerable due to its unique exposure and sensitivity to the impacts of climate change. More frequent and severe typhoons, floods and droughts are already occurring, and many of the countries in the region are reporting record temperatures. These impacts, together with gradual phenomena like sea level rise and changes in the seasonality of rainfall will have a profound impact on societies in the region.

The education sector is particularly vulnerable to the impacts of climate change. Evidence suggests that climate change can impact the education sector directly (through effects related to the damage of education infrastructure; loss of education material; injury/mortality of students, teachers and parents; and psychosocial stress resulting from exposure to extreme weather events). Furthermore, there are also less well-understood indirect impacts associated with climate effects on food security, livelihoods, air pollution, access to water, health and energy. Despite this emerging evidence, the needs of education stakeholders have been invisible in climate change discussions. Indeed, there is generally a lack of acknowledgement and integration of education and youth in climate priority settings. Out of the 196 Parties to the UNFCCC, only 32 per cent mention education (YOUNGO, 2018). Even this limited inclusion of education priorities in the climate change policies of countries is often limited to school curriculum and public awareness issues and does not reflect the serious impacts of climate change on children's education and learning over the short- and long-term.

This report is an initial step by UNICEF East Asia and the Pacific towards filling this gap in the East Asia-Pacific region. After highlighting the unique geography and challenges associated with the region, the report highlights the key education stakeholders and the ways in which they might be affected by climate change. In so doing, the report highlights that climate change does not only affect students (and out-of-school children and adolescents) – it also affects teachers and education staff, parents and communities, schools and education infrastructure, and ministries of education. Next, the report offers a framework for understanding direct and indirect impacts of climate change on education, highlighting the pathways in which climate change may affect the education stakeholders highlighted earlier. It then highlights some of the key challenges in quantifying the economic costs associated with climate change on the economic sector, highlighting that the true costs on education are likely to be in the scale of trillions of dollars. Finally, it recommends priority actions for climate-resilient education systems.

Due to financial and time limitations, the work focused on three case studies from across the region: Cambodia, Mongolia and Viet Nam. The work is based on a thorough review of the literature – both academic and grey – as well as consultations with education and climate-related authorities and development partners, school staff, students and parents. The report is based on consultations carried out in one region from each of these countries, and while additional analysis in other regions would enhance the rigour of this work, the results presented here offer the first regional overview of challenges and opportunities associated with the climate crisis for the education sector. This work is not meant as a comprehensive analysis but rather as a tool to initiate discussions about education stakeholder needs in climate change discussions.

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Background and context

Climate change is a risk multiplier

Climate change has increased the vulnerability of communities and systems.
It threatens to undermine the gains we have made in child survival, health, education and wellbeing over the last few decades. Climate change is already exacerbating current inequalities by disproportionately affecting the most vulnerable communities around the world (including rural areas, households with limited financial resources, minority groups, and children and adolescents with disabilities) – particularly for children and adolescents who are often less able to manage climate-related risks and who are least represented in decision-making processes (Barros et al., 2014; UNICEF, 2015).

All children and adolescents in and out of schools are affected, and their risk will increase.
Children will bear the brunt of climate change effects. As the magnitude of extreme weather events and slow-onset changes intensifies under climate change, so will the impacts experienced by children. Understanding climate impacts is complex because there are both slow-onset and rapid-onset risks, which can exacerbate each other and are intricately linked to non-climatic factors affecting children and adolescents. On the one hand, slow-onset phenomena like gradually increasing temperatures, changing rainfall patterns, sea level rise and salinization are already affecting the nutrition of children and infectious disease patterns, such as increasing incidences of serious diseases like malaria and dengue among children. On the other hand, abrupt events like floods and storms that are intensified by climate change disproportionately affect children and adolescents, especially the poorest and most vulnerable who are already suffering from multiple deprivations.

Climate change threatens to exacerbate current and future hurdles to the global objective of providing universal education to all children and adolescents as articulated by Sustainable Development Goal 4. The mechanisms through which climate change may impact the education sector are complex. Some connections are more direct: floods and tropical storms, for instance, can severely damage or destroy schools which can lead to delayed or reduced learning time. Other impacts are indirect: for instance, changing weather patterns will also affect the viability of agricultural livelihoods, adding financial stress to vulnerable families who may not be able to afford school expenses and may decide to involve their children in farm labour and other livelihood needs – time that could be spent at school.

Climate change has immense costs on the education sector.
Global analyses of missed education show that limited educational opportunities for girls and barriers to completing 12 years of education cost countries between US$15 trillion and US$30 trillion dollars in lost lifetime productivity and earnings (World Bank, 2018).

Climate change is likely to add to these costs – both through direct losses and damages (e.g., on education infrastructure and on mortality of students) as well as indirectly (e.g., through missed school). When combining these impacts, the total cost of climate change on education is likely to be in the scale of trillions of dollars because of the potential impacts occurring at various timescales and through multiple pathways

Education systems have a key role to play in mitigating and adapting to climate change.
Nonetheless, education is also an important part of the answer to tackle the climate crisis we are facing now. Increasing environmental awareness and education on climate change can contribute to effective adaptation and mitigation. By providing vulnerable communities with the knowledge and tools to understand climate change and its causes, as well as the possible approaches to manage risks associated with climate change, it is possible to empower communities and reduce the adverse effects of climate change. Secondary education reforms aim at improving adolescents' skills to face community and development challenges, and contribute creatively to the "green" 21st century economy. Education should therefore be an integral part of international and national efforts to address the impacts of climate change on children and adolescents, as well as poor and disadvantaged communities, and to accelerate climate mitigation actions. The education sector is highly vulnerable to the impacts of climate change and, at the same time, it also has a fundamental role to play in accelerating climate actions and implementing the Paris Climate Agreement, Sendai Framework for Disaster Risk Reduction and Sustainable Development Goals.

But the education sector's climate action needs are almost invisible in climate change discussions.
The UN Framework Convention on Climate Change (UNFCCC) Article 6 on education, training and public awareness states that countries shall develop and implement educational and public awareness programmes on climate change and its effects. The Paris Climate Agreement (UNFCCC COP 21, 2015) Article 12 also reiterates the importance of the role of education in enhancing climate actions. All Member States of the UN have committed to working towards ensuring inclusive quality education and improving education for sustainable development, as well as improving life in cities and tackling climate change through adopting SDG 4 on education, SDG 11 on urban settings, and SDG 13 on climate change. In particular, SDG target 4.7 (by 2030, ensure all learners acquire knowledge and skills needed to promote sustainable development, including among others through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship, and appreciation of cultural diversity and of culture's contribution to sustainable development) is an important target in terms of linkages with other SDG targets such as climate change, but which requires further clarification, operationalization, localization and monitoring in the region, together with climate-related targets of SDGs. Countries are laying out national priorities for climate mitigation and adaptation actions through the Nationally Determined Contributions (NDC), which are a core element of the Paris Agreement. However, as noted by YOUNGO (the official youth constituency of the UNFCCC), there is generally a lack of acknowledgement and integration of education and youth in the climate priority setting of countries. Out of the 196 Parties to the UNFCCC, only 32 per cent of the Parties mention education.

Urgent actions are needed to 'climate-proof' the education sector and be more effective in climate change-related actions and decisions.
Children's education opportunities and learning outcomes are already critically threatened by the climate crisis. Climate change is a reality. Its effects are already being felt in East Asia and the Pacific – a region that is highly vulnerable due to its unique exposure and sensitivity to the impacts of climate change. Countries in Northeast Asia and Southeast Asia are also becoming large emitters of greenhouse gases, aggravating the climate crisis further. Urgent actions are needed to 'climate-proof' the education sector to ensure that the gains we have made in advancing children's education and learning are not lost, as well as to safeguard children's rights to education.

As children's education is significantly affected by climate change, there is an increasing need to better understand how climate change affects education, and also what strategies may be implemented to climate-proof and increase the resiliency of the education sector and its contribution to climate mitigation efforts through reducing the sector's own carbon footprint. In this context, UNICEF EAPRO has launched this initiative:

- To gather evidence on the impacts of climate change on the education sector
- To improve national and regional stakeholders' understanding of the relationship between climate change and education
- To enable cross-country comparison and tracking of climate change actions in education
- To promote sharing of good practices and lessons learned on the integration of climate change actions into the education sector
- To make the case for greater investment in climate resilient education systems for regional and national policymakers in education and climate change.

East Asia and the Pacific is a diverse region

The East Asia-Pacific region is one of the most diverse and dynamic areas in world – with landscapes as diverse as the steppes of Mongolia, global mega-cities such as Beijing and Manila, the tropical rainforests of Indonesia, and the atolls of the Pacific Islands.

The East Asia-Pacific region has extremely diverse geographic features and climates. Asia itself has some of the highest peaks in the world (in the Tibetan Plateau) as well as several low-lying coastal areas and islands. This also influences the differences in climate: from arid deserts to wet and humid tropical regions, and hot and warm climates to cold continental climates in the northern regions.

Some of the key river basins in the continent include the Yangtze River Basin and the Mekong River Basin, which are an important source of water and livelihoods in the region but are critically affected by climate change.

The region hosts approximately 2 billion people, roughly 30 per cent of the world's population. As such, the region has some of the densest parts of the world, and includes some of the world's largest mega-cities, such as Shanghai, Beijing, Jakarta, Manila and Bangkok, many of which are located in coastal areas. Similarly, there are regions with very low population densities – particularly in the remote areas of Mongolia, the Tibetan Plateau and western China.

The complexity of the continent is also reflected in the diversity of development levels: while some Asian economies rank among the most developed according to the Human Development Index (e.g., Malaysia and Singapore), others rank towards the bottom of the index (e.g., Timor-Leste, Papua New Guinea) (UNDP, 2014).

This diversity in geography, climates, demographic trends and economic circumstances provides the background for understanding the challenges the region faces in terms of education and climate change.

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The role of education stakeholders and their vulnerability to climate change

The impacts of climate change on education and learning are far-reaching, impacting at least five groups of stakeholders and systems: students, out-of-school children and adolescents; teachers and school staff; parents and communities; schools and the built environment; and education authorities. Each of these are impacted differently by climate-related threats.

Climate change threatens to affect various stakeholders in the education sector. Children will bear the brunt of climate change effects. As the magnitude of extreme weather events and slow-onset changes intensifies under climate change, so will the impacts experienced by children. The mechanisms through which climate change may impact students are complex. Some connections are more direct: floods and tropical storms, for example, can injure students and prevent them from going to school. Other impacts are indirect: for example, increasing temperatures will affect the distribution of vector-borne diseases and increase exposure of children to dengue and other illnesses, reducing time spent at school.

But it is not only students who will be affected. Parents and communities will also experience challenges related to injury and mortality, inability to cover school expenses when livelihoods are damaged by extreme weather events, and potential relocation due to heavy damage to shelter or livelihoods. Teachers and school staff may be unable to offer education services if they fall ill or if the main roads and bridges connecting to schools are damaged.

In addition to people, schools and the built environment are susceptible to climate change impacts. There is ample evidence suggesting that extreme weather events can destroy or heavily damage education infrastructure and disrupt education. Other challenges include water scarcity with increasing temperatures, reduced availability of quality school meals, and increased costs associated with heating and cooling.

Finally, education authorities are also affected. Ministries of education will require additional funds to implement new policies, train staff, recruit and train qualified teachers and integrate climate change considerations into education sector planning processes.

Climate change poses significant threats to these five essential stakeholders and systems in education. These threats are summarized below.

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ROLE OF STAKEHOLDER/SYSTEM	VULNERABILITY/CLIMATE IMPACTS
Parents and communities have a key role in ensuring that children feel supported in their education and that household conditions are conducive to learning. This means that children should feel safe at home and that they receive support from their families to engage in homework and extracurricular activities. 	▪ Mortality and injury due to extreme weather events ▪ Psychological stress ▪ Inability to cover school expenses as climate events affect livelihoods ▪ Relocation due to heavy damage to shelter or failing livelihoods
Teachers and school staff should ensure that the material being taught to students and extra-curricular activities are relevant and of good quality. Teachers and school staff are also responsible for creating a safe environment at school where children feel encouraged to participate and interact. Additionally, teachers and school staff should mentor and nurture the interests and learning needs of individual students. 	▪ Mortality and injury due to extreme weather events ▪ Difficulty accessing schools if roads/bridges are damaged ▪ Teachers unable to educate due to illness ▪ Teachers unequipped to teach students who experience post-traumatic stress disorder after a disaster
Students are the main recipients of education and the benefits this accrues. In addition to the responsibilities of attending classes, being respectful and completing assignments, students can also play major roles in improving the education system they belong to by defining and actively participating in school events that are relevant to their local concerns. 	▪ Mortality and injury due to extreme weather events ▪ Difficulty to access schools if roads/bridges are damaged ▪ Psychological stress ▪ Migration resulting in disrupted education ▪ Absenteeism due to illness ▪ Impaired learning due to air pollution, lack of nutritious food or extreme temperatures in classroom ▪ Absenteeism as children support household livelihoods during climate events
Schools and the built environment should create an atmosphere that will help students feel safe and comfortable to learn. High-quality infrastructure facilitates better instruction, improves student outcomes and reduces dropout rates. 	▪ Damage/destruction of schools and key infrastructure like roads and bridges connecting remote villages to schools ▪ Water scarcity ▪ Reduced availability of school meals ▪ Increased costs associated with heating and cooling
Education authorities should identify emerging issues that need to be addressed to ensure students have access to good quality education – including developing policies and strategies to reduce barriers to education, updating the curriculum to include relevant material, and ensuring that teachers receive adequate training to impart good quality education. 	▪ Additional costs to governments to address impacts of climate change on education and learning ▪ Requirement to update risk assessments and policies based on latest scientific knowledge ▪ Requirement of new policies ▪ Requirement of additional expertise

Within these stakeholders, it is key to state that certain groups are more vulnerable and exposed to these climate threats depending on whether their geographic location is prone to climate disasters and also on their socio-economic situations, particularly poorer children or adolescents with disabilities, and minority or migrant groups. Governments need to identify these groups and include them in their priority actions.

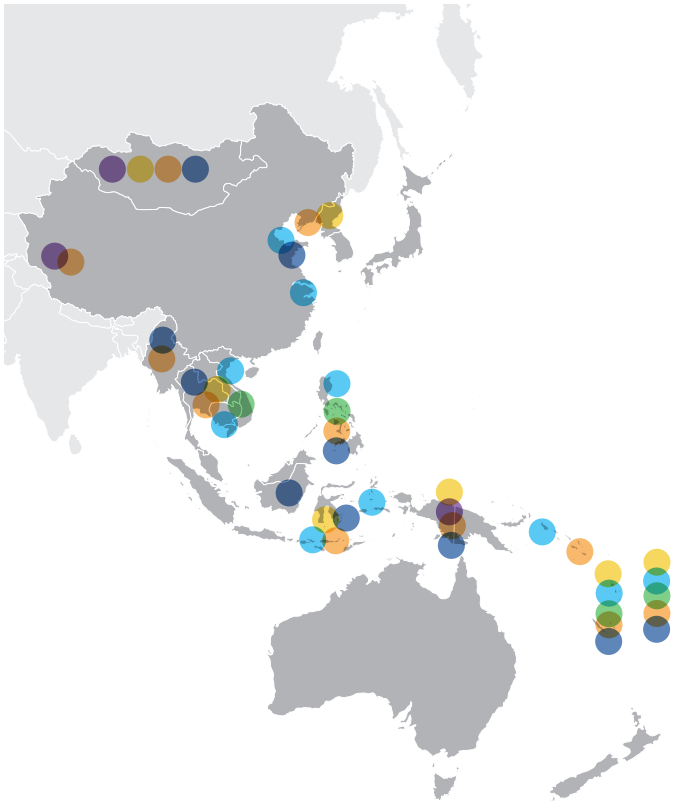
3

Climate change risks in East Asia and the Pacific

The East Asia-Pacific region is already one of the most vulnerable to climate-related extreme weather events and slow-onset changes. Increasing temperatures, changing rainfall patterns, rising sea levels and more intense climate disasters are adding to existing vulnerabilities of children.

Already today, the East Asia-Pacific region is among the most vulnerable to climate-related disasters, with more than 1 billion people affected by floods, droughts and storms every year (UNISDR, 2019). This means that one person out of two is directly affected by climate change. Under climate change, the magnitude of these climate disasters is projected to increase: floods are projected to become more frequent as the monsoons become shorter but more intense, droughts are projected to become more severe as temperatures in the dry season increase, and storms are projected to become less frequent but more intense (Hijioka et al., 2014) with significant variation across different locations. In addition, climate change will introduce new risks to the region, such as more frequent heatwaves resulting from more extreme temperatures, changing seasonality due to changing rainfall patterns, sea level rise and, to a lesser extent, glacier melt (ibid.)

CLIMATE CHANGE IMPACTS



The circles represent the approximate locations of climate change-related risks projected for the region. The colours are associated with a specific risk (described on the text on the right-hand side of the chart). Rising temperatures are not shown as these are projected all over the region.

Rising temperatures are projected over all of East Asia and the Pacific, with increases in temperature of 2°C by 2050 (compared to present temperature). Larger warming trends are projected for Southeast Asia (3°C increase by 2050).

Heavy precipitation events and floods are projected throughout the region. Though there will be high inter-annual variability, monsoons are generally projected to become shorter but more intense.

Sea-level rise is projected at up to 82 cm by the mid-21st century, and up to 98 cm by the end of the century without mitigation efforts. The greatest impacts will be felt in low-lying coastal zones with high population densities, as well as in small island states which genarally consist of low elevation atolls.

Droughts are projected to become more frequent and severe, primarily as a result of hotter temperatures, which will increase water stress in the months before the rainy season.

Tropical storms are a source of uncertainty in climate models, and global models do not resolve regional patterns adequately. However, a majorty of model outputs suggest that the frequncy of storms forming in the Western Pacific will decrease but their intensity will increase.

Changing climatic patterns are expected over large parts of Asia, including the Mekong Basin and parts of South Asia. Such shifts may render traditional, climate-sensitive livelihoods such as farming and fishing unsustainable.

Glacier melt will inevitably occur at an accelerated rate due to warming trends. In the short- to medium-term, melting glaciers can lead to excess water (flood), while in the long-run they can exacerbate drought risk.

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But climate change is only one of several factors contributing to vulnerability, as climate patterns interact with demographic and environmental trends to determine overall risk. The rapid movement from rural to urban areas will increase vulnerabilities in the region: between 1980 and 2012, the number of people living in cities in the region increased by more than 1 billion, and by 2040 population projections suggest that urban areas will house an additional 1 billion people (GFDRR, 2019). Most of this population growth is projected to occur in coastal areas, which are highly vulnerable to the impacts of floods, tropical storms and sea level rise. Poor urban planning, combined with increasing concentrations of people and assets in cities, creates disaster hotspots.

On top of this, environmental degradation, like deforestation, land degradation and environmental pollution, will exacerbate the risk of climate disasters. For example, deforestation is associated with lower soil quality (and therefore lower nutrient cycling capacity, water retention and structural stability) which can increase flood and landslide risks.

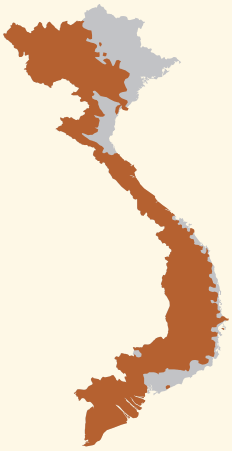
The East Asia-Pacific region is vast, and impacts are not uniform: for example, countries like the Philippines and Viet Nam are located in the typhoon belt and are vulnerable to the increasing intensity of typhoons, while small island states are particularly prone to the impacts of rising sea levels. An overview of key climate impacts projected for the region is shown below (based on Hijioka et al., 2014).

BOX 1

Examples of projected climate change-related risks in Viet Nam and Cambodia. Among the various impacts of climate change, one of the most visible is the increased magnitude of extreme weather events such as floods and droughts, as well as slow-onset disasters brought about by rising sea-levels.

FLOOD

Projections of flood risk are uncertain due to the complexity of projecting rainfall patterns. However, models suggest that heavy rainfall events will become more frequent leading to more floods.



DROUGHT

Drought risk is projected to increase in much of East Asia-Pacific due to increasing temperatures and more intense dry seasons.

SEA-LEVEL RISE

Sea levels are projected to rise by up to 80 cm by the end of the century, affecting over 300 million people living in coastal areas in the region.

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Climate change can impact the education sector in various ways

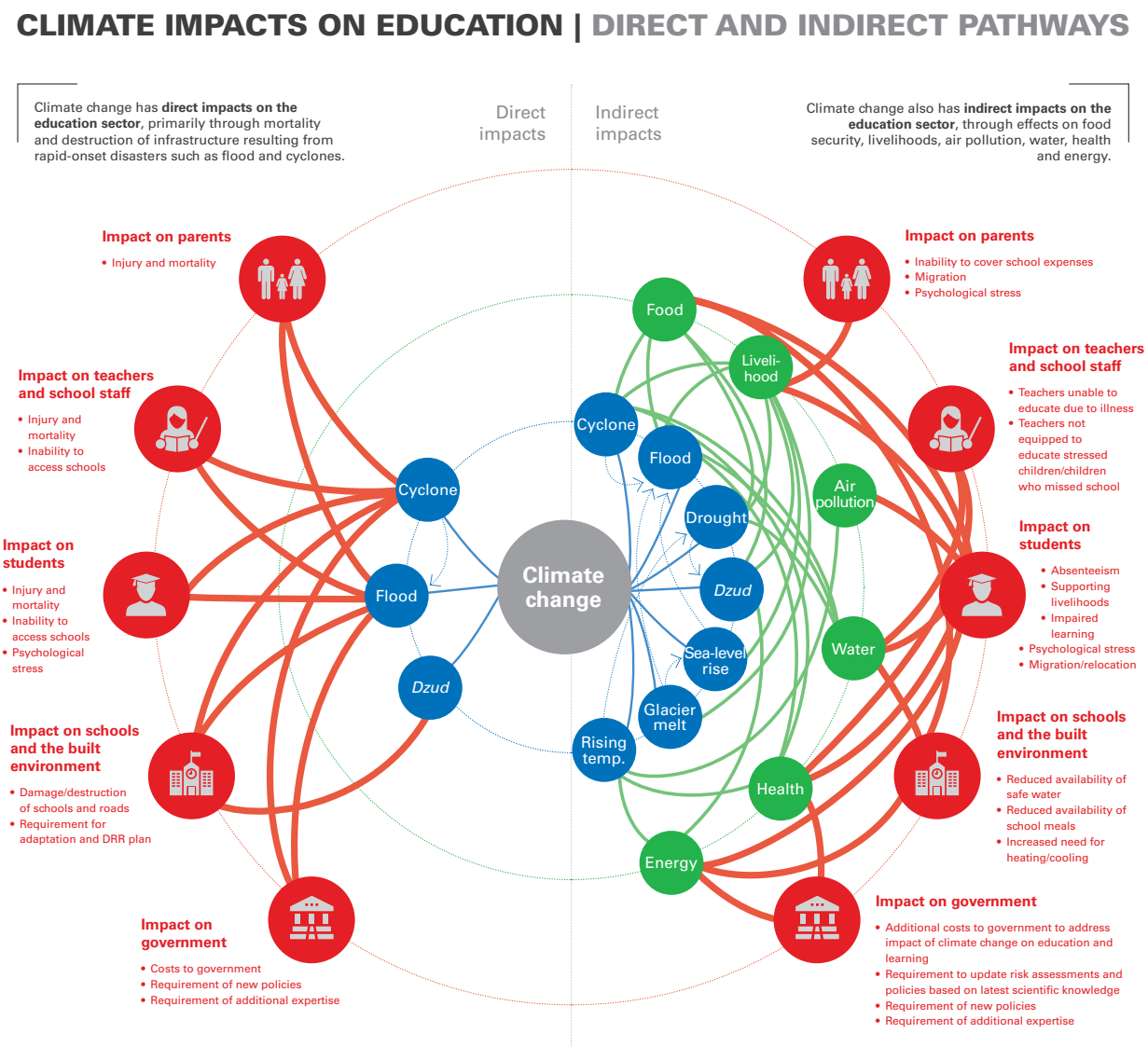
Increasing evidence suggests that climatic conditions can have significant effects on education and learning – which could ultimately have a compounding effect on children's wellbeing and development throughout their lifetime. The pathways through which climate can impact on the education sector can be both direct and indirect (Figure 1).

Direct impacts on the education sector

The left-hand side of Figure 1 shows the direct pathways through which climate change and climate-related disasters can impact access to education. The blue circles illustrate three major climate risks (cyclones, floods and dzuds) with smaller arrows showing the links between them. The red circles on the outermost portion of the diagram illustrate the different stakeholders that may be impacted: (1) parents, (2) teachers, (3) students, (4) schools and the built environment, and (5) education authorities and the public sector in general. The red lines connecting the blue circles and the red circles indicate the direct pathways through which each of the stakeholders may be affected, and the impacts are listed alongside each of the stakeholders.

FIGURE 1

Climate impacts on education: direct and indirect pathways



Note: Some impacts are more direct, such as floods destroying schools, while others are indirect, such as reduced agricultural output resulting in parents being unable to afford school expenses.

In the most direct way, climate-related disasters can interrupt children's and adolescents' education by damaging or even destroying schools and relevant infrastructure, like bridges and roads, that connect remote communities to schools: floods, strong winds and rains associated with cyclones, landslides and heavy snowfall events can all damage education infrastructure (cf. Kousky, 2016; Benson, 1997; Arndt et al., 2015). Such destruction can disrupt education for days and even weeks – and in countries with limited alternative education modalities during disasters, this can lead to missed classes and lower academic performance compared to other schools in the country. Infrastructure impacts are among the best documented examples of climate impacts on education, with data being collected primarily through disaster and needs assessments. Table 1 illustrates a few well-documented cases of impacts on education infrastructure in selected countries in the region. Here, however, it is important to reiterate that these data are not comprehensive – and better data collection is required to show historical trends in loss and damage in the education sector, as well as to better understand how future climate change might affect education if no action is taken.

Floods and typhoons do not merely damage schools and the built environment, they can also result in losses of textbooks and classroom materials such as desks and chairs. For example, over 40,000 textbooks were lost in the aftermath of the 2000 floods in Cambodia (NDMC, 2000).

TABLE 1

There are several documented cases of climate-related disasters damaging or destroying education infrastructure across East Asia and the Pacific.

CAMBODIA

155 schools, mainly located near the Tonle Sap Basin, closed for up to nine weeks after the destructive 2000 floods (ADPC, 2004)

INDONESIA

351 schools were submerged and closed for 3-14 days in northern Jakarta after the 2015 floods (Save the Children, 2015)

MONGOLIA

Over 50 schools in rural areas reported heavy damage to roofs and schools during the multi-year 1999-2002 *dzuds* (United Nations, 2000)

MYANMAR

4,116 schools were damaged and 608 were completely destroyed in the aftermath of Cyclone Komen in 2015 (Save the Children, 2015)

PHILIPPINES

803 schools closed for around 14 days due to heavy damage in Region III after Typhoon Koppu struck the Philippines (Save the Children, 2015)

VANUATU

Over 50% of primary and secondary schools closed for nearly a month due to heavy damage caused by Cyclone Pam in 2015 (Save the Children, 2015)

VIET NAM

Over 325 schools in four provinces closed for nine days due to destruction wrought by Cyclone Damrey in 2017 (VDMA and UNDP, 2017)

In addition, climate disasters can result in injury of parents (who would be unable to take young children to school), students and teachers – resulting in absenteeism. In more severe cases, however, mortality might be caused with devastating consequences for long-term education. Evidence at the global level has shown that children and adolescents who lose a classmate, a teacher or a parent after a major disaster are more likely to be traumatized and are less able to concentrate during class, thereby compromising their academic performance (McMillen et al., 2002).

And beyond the impact on parents, teachers, students and schools, the consequences for education authorities and the public sector can be significant too. Additional finances are required to support affected communities, teachers and students, as well as repairing infrastructure damaged by climate disasters. Beyond immediate disaster response needs, skills and resources are also needed to develop policies and guidelines to better manage climate-related risks over the long-term, and appropriate expertise is needed to implement these guidelines.

Losses and damages in the education sector, whether they are quantified in terms of infrastructure or human impact, tend to be associated with rapid-onset disasters – floods, cyclones – though multi-causal disasters like *dzuds*[1] can also have serious impacts on infrastructure and access to education due to heavy snowfall.

[1] *Dzuds* are multi-causal disasters, endemic to Mongolia, that occur when a severe drought (in the summer months) is followed by a cold winter with heavy snowfall. *Dzud* events not only have devastating effects on livestock, who succumb to the lack of water and fodder, but more recently attention has been paid to its other impacts on areas such as infrastructure and social wellbeing.

Indirect impacts on the education sector

The right-hand side of Figure 1 shows the indirect pathways through which climate change and climate-related disasters can impact education. The blue circles illustrate seven major climate risks relevant to East Asia and the Pacific, including rapid-onset disasters (cyclones, floods), multi-causal disasters (dzuds) and slow-onset events (droughts, sea level rise, glacier melt and rising temperatures) with smaller arrows showing the links between them. The green circles illustrate socioeconomic and environmental effects resulting from these climatic conditions, which can ultimately impact the various stakeholders of the education sector, shown in the outermost red: (1) parents, (2) teachers, (3) students, (4) schools and the built environment, and (5) education authorities and the public sector in general. The diagram shows the complex ways in which climate-related extreme events and slow-onset changes can affect education and learning indirectly through intermediate socioeconomic and environmental effects.

The link between climate events and damage to education infrastructure and mortality/injury has been relatively well-captured in disaster risk reduction, loss and damage literature because data are easier to collect (e.g., Gupta et al., 2004; Chinowsky et al., 2015; Mochizuki et al., 2015). However, emerging literature has begun to examine the indirect pathways through which climate can affect socioeconomic conditions (for example, livelihoods and income) and ultimately education outcomes (e.g., Randell and Grey, 2019). Here we identify six socioeconomic and environmental conditions that are affected under current and future climate change, and which have an indirect impact on education and learning: food security and nutrition, livelihood and income, air pollution, water quality and availability, climate-sensitive diseases and health effects, and energy security.

Food security and nutrition

Among the most detrimental effects of climate change is the potential for reduced availability of food, as yields of major crops are projected to decrease significantly in the tropics due to increasing temperatures and shifting rainfall patterns (e.g., Fischer et al., 2002; Parry et al., 2004; Lobell and Field, 2008). In particular, climate models agree that the productivity of rice, wheat and maize will be compromised by the end of the 21st century in Southeast Asian countries, which are currently large suppliers of rice in the global markets (Gustafson et al., 2018). Furthermore, impacts could go beyond changes in agricultural yields and translate to under-nutrition, overweight and obesity among children: rising temperatures and elevated CO2 levels have been associated with reduced quality of micro-nutrients, protein and vitamins in key cereals – particularly rice and maize – as plant physiology is altered in warmer environments and by rising levels of carbon dioxide in the atmosphere (e.g., Brouder and Volenec, 2008; Zhu et al., 2018; Loladze, 2014).

Climate change can affect access to education and learning outcomes for children and adolescents through its impacts on nutrition. Children and adolescents may not be able to obtain sufficient nutritious food. Global evidence shows that the consumption of insufficient or less-nutritious food items is linked with lower academic performance, possibly as children are less able to concentrate during lessons (Behrmann, 1996; Alderman et al., 2006). In addition, lower food availability at the local level can also reduce the quantity and quality of meals at school and at home. As school meals are often a major meal, particularly for vulnerable and marginalized children, reduced access to school meals can have compounding effects on their academic wellbeing (cf. Florence et al., 2008).

The effects of food and nutritional insecurity arising from climate-related disasters and long-term changes in the climate, and the concomitant results on learning, are understudied. Evidence from across the region shows that crop failures after severe flood and drought events are associated with reduced food consumption. For example, during the 2015-2016 El Niño event, over 25 per cent of families living in the most affected districts reported serious food shortages, leading to a reduction of meals and lower quantities of preferred foods (WFP, 2016). The eventual outcome on

education and learning has not been documented. Though several studies at the global level have shown that children and adolescents who experience food insecurity are less likely to complete their education (Mutisya et al., 2016) and tend to perform worse in exams than their peers (Jyoti et al., 2005), the focus of these studies has been on chronic food security problems rather than on food shortages triggered by climatic events. Therefore, quantifying the effects of climate-related extreme events and slow-onset changes on education through food and nutritional security impacts is therefore an area of future work.

Livelihood security and incomes

Across much of East Asia and the Pacific, livelihoods are predominantly dependent on rain-fed agriculture and livestock rearing, making them particularly susceptible to climate variability and climate change (Morton, 2007). Climate events like floods, cyclones, droughts, dzuds, sea level rise and glacier melt can all affect agriculture and pastoralism through multiple mechanisms (cf. Krishnamurthy et al., 2015). As climate change compromises livelihoods, household income is reduced. This also has an indirect effect on education.

With lower income and purchasing power, parents may not be able to afford direct and indirect school costs (transport, school materials) and may prefer to keep their children at home to reduce expenses (cf. Chevalier et al., 2013). For example, in Mongolia, it is common for teenage boys in rural areas to miss school days or drop out when there is insufficient income (UNICEF, 2014). Reduced incomes may also have other indirect consequences: households may purchase less preferred and nutritious foods to make ends meet (Krishnamurthy et al., 2015), and, as highlighted earlier, this may also affect academic performance.

When livelihoods are compromised, children and particularly adolescents may be expected by parents to miss school and support livelihood or household activities while their parents find alternative income sources. Anecdotal evidence from Viet Nam suggests that this trend is particularly prominent among secondary school students (aged 10 years and older). Activities may include taking care of livestock, supporting farm activities and taking care of younger siblings – all of which limit the ability of students to focus on education. Indeed, in Viet Nam, children and adolescents who miss school days to support livelihoods tend to perform worse than their peers in end-of-year exams.

In more extreme cases, households may decide to relocate when livelihoods are no longer feasible. Evidence suggests that relocation and attending classes in a different school generally translates to lower academic performance as students may not be familiar with the material or the pace of education at the new school (Battistella and Conaco, 1998; Kandel and Kao, 2001). Anecdotal evidence in Viet Nam notes that communities were temporarily relocated from rural provinces in the Mekong River Delta to the cities to cope with increased salinity and drought during the 2015-2016 El Niño event – though the impact on education has not yet been fully quantified.

Air pollution

Air pollution is both a source and a consequence of climate change. In East Asia and the Pacific, carbon dioxide emissions from industrial activity, transportation and land use are among the largest contributors to overall greenhouse gas concentrations (IPCC AR5 WGI, 2014). Associated increases in temperature can accelerate reactions, leading to increasing ground-level concentrations of harmful allergens and pollutants like lead, ozone and aerosols. This problem is more prominent in urban environments, but children in rural areas are already suffering from indoor air pollution caused by the use of unclean fuels and technologies for cooking and heating, and ambient air pollution from agriculture and waste burning as well as forest and peatland fires.

Evidence has linked higher pollution levels to lower academic performance through health effects – particularly higher incidence of asthma and respiratory problems. Children's respiratory health, neurocognitive development, immune system response, learning comprehension and school performance are all influenced by their school environment. Poor indoor or outdoor air quality can cause or worsen respiratory illnesses and is associated with difficulty concentrating, which can compound learning challenges for students with underlying neurocognitive disorders. Poor air quality and other related exposures can lead to sickness and missed schools days, and frequent absenteeism leads to increased risks of dropping out of school (Sheffield et al., 2017). The majority of the work linking air pollution to education outcomes has been conducted in the United States (Sanders, 2002) or in European countries (e.g., Sheffield et al., 2017). Additional work is needed to quantify the effect of increased air pollution due to climate change on education outcomes in East Asia and the Pacific.

Water and sanitation

The availability of water is projected to change dramatically under climate change. Changes in the quantity and timing of rainfall and increases in temperature are likely to reduce the availability of clean water for personal hygiene and consumption in the region, with children being particularly vulnerable (Bates et al., 2008). Dry spells and droughts, both of which are projected to become more frequent under climate change, can significantly deteriorate the quality and quantity of water in schools and households.

Access to clean water contributes significantly to education through three key mechanisms (conversely, lack of access affects education outcomes negatively): (1) clean drinking water is essential for avoiding dehydration and water-borne diseases, which can increase the risk of infection while also reducing physical and mental capacities; (2) water for handwashing reduces the risk of contracting food-borne diseases which can generate long-term health problems and increase absenteeism; and (3) water for sanitation is also important, with growing evidence linking the quality of sanitation facilities to higher academic performance. Sanitation facilities are becoming increasingly affected by climate related extreme events such as floods and global studies now suggest that absenteeism during menses increases significantly when there is limited access to sanitation (Jasper et al., 2012).

Water scarcities could also lead to increased absenteeism as children and adolescents fetch water. For example, in Mongolia, about 35 per cent of rural households living in gers (traditional mobile houses) collect water from open sources like rivers and ponds. For most families, the primary responsibility to fetch water lies with children who typically spend 3-4 hours a day collecting water in the winter months (UNICEF, 2014). With changing water availability and potential water shortages, the burden on children and their education could increase drastically and could even lead to local conflict over scare water resources undermining children's safety.

Health

Climate change affects the social and environmental determinants of health – clean air, safe and sufficient drinking water, food and shelter – and estimates suggest that by 2050, projected climate change will result in 250,000 additional deaths (WHO, 2018).

Children and adolescents are projected to bear the brunt of the additional burden of disease due to climate change due to their heightened vulnerabilities, owing to their level of physiological development, metabolism and higher exposures per unit of body weight. Documented health effects include changing ranges of vector-borne diseases, such as malaria and dengue; increased diarrheal and respiratory disease; increased morbidity and mortality from extreme weather; and changed exposures to toxic chemicals (Sheffield and Landrigan, 2010). Additional health impacts on children from projected increases in frequency and severity of extreme storm events and sea level rise include acute injuries, chronic mental illness, malnutrition and infectious diseases (e.g., Shea, 2007).

Health is one of the most significant contributors to a successful education and, conversely, exposure to climate-sensitive diseases can compromise education and learning. Numerous studies highlight that health-related problems result in increased absenteeism and lower academic performance (Zimmerman et al., 2015). Anecdotal evidence from Viet Nam suggests that younger children are more susceptible to health-related problems (particularly colds and fevers) which are more prominent in the transition between the rainy and dry seasons, resulting in children missing one or two days of school. In more extreme cases, children can miss up to one week of classes. Health problems might also affect parents (who in turn may be unable to take young children to school) and teachers (who may be unable to teach until they recover). These impacts may also affect students' academic performance.

Rising temperatures will place additional stress on children's and adolescents' physiology (Sheffield and Landrigan, 2010). During extremely hot days, children are particularly vulnerable to dehydration and heat stress (ibid.), and are less able to focus during class as a consequence. With the frequency of extremely hot days projected to increase under climate change across much of East Asia and the Pacific, the impacts of heat on students' health (and ultimately their academic performance) should be prioritized.

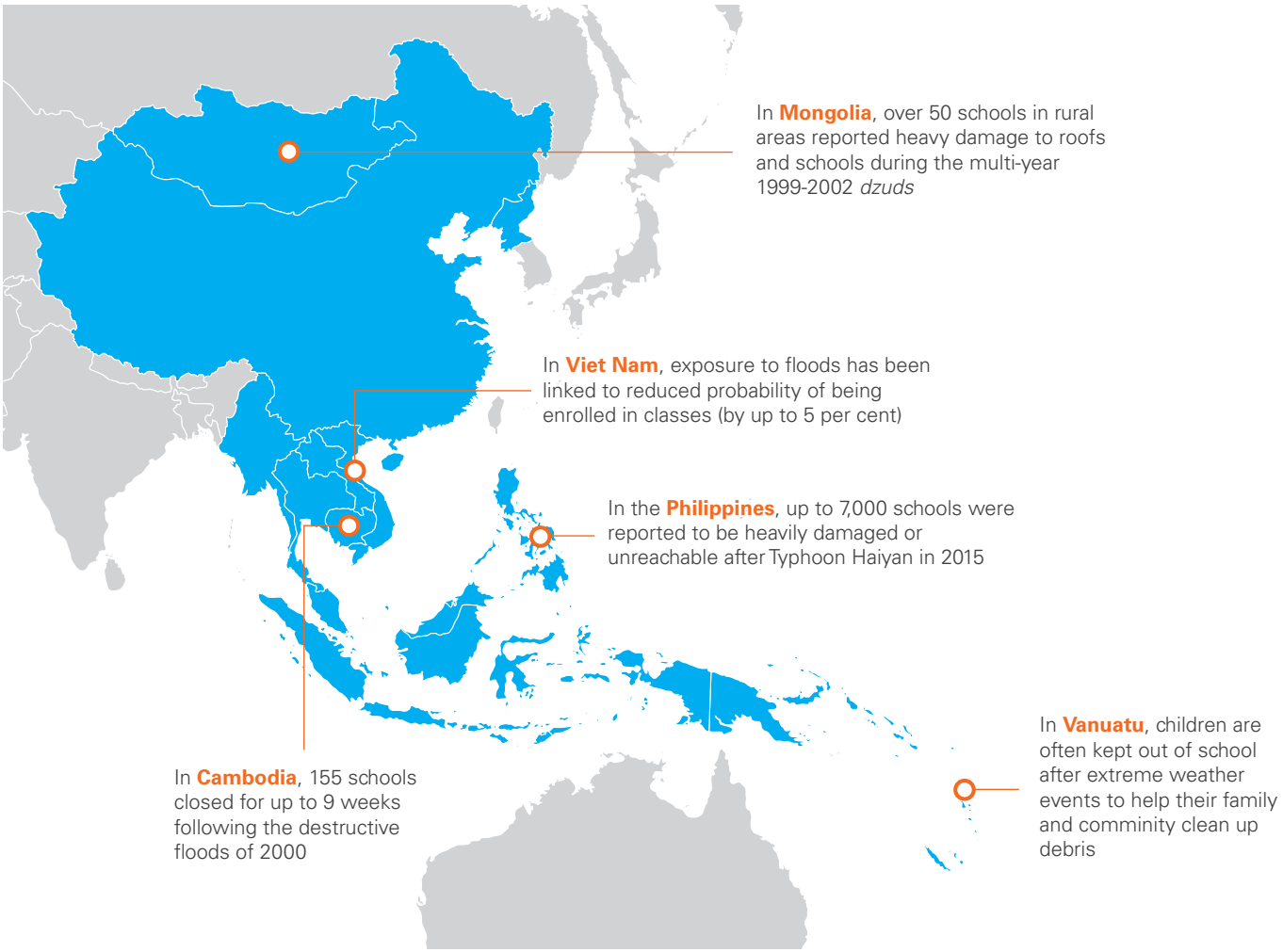
Energy

Over 1 billion people lack access to electricity and 2 billion do not have access to modern fuels for cooking. This trend means that nearly 3 billion people cook and heat their homes with solid fuels such as dung, wood and crop waste (UNICEF, 2015). Ensuring access to cleaner sources of energy such as biogas or solar power yields two benefits for education: first, it reduces indoor air pollution and its related health problems which can increase absenteeism, and second, it reduces the burden on children and adolescents, especially on girls, to fetch wood or other biomass fuels.

Energy demand, as it relates to education, is likely to increase under future climate change. On the one hand, rising temperatures will increase the demand for air conditioning. Evidence shows that heat during school days reduces the productivity of instruction, with disadvantaged communities and minorities being particularly affected. Access to air conditioning offsets all negative effects of temperature on educational outcomes (Goodman et al., 2018) but if air conditioning uses fossil fuel energy sources, greenhouse gas emission rates will increase, further aggravating the climate crisis, so it is important to invest in clean energy services for cooling air together with energy-efficient measures for school infrastructure. On the other extreme, cold winters can present significant challenges. In Mongolia, dzud conditions are associated with increased financial burden: in normal years, around one fifth of the national education budget is spent on providing heating to education facilities and dormitories (World Bank, 2006), and additional demand for heating may prove to be too expensive. Evidence also shows that the uncomfortable environment created by cold winters can reduce the ability of students to concentrate during class and can create stress for students, though the effect on academic performance is yet to be quantified (Lawrie and Dandii, 2010).

FIGURE 2

Impact of climate-related disasters and events on education



Note: Selected examples of impacts on education and learning reveal that multiple weather events (typhoons, floods and multi-causal disasters) can have a range of impacts on education – from destruction of infrastructure to absenteeism and increased dropout rates.

5

Quantifying the economic cost of climate change on education and learning

As the links between climate change and education are so diverse and can manifest over different timescales and through multiple pathways, quantifying the economic costs are challenging. A number of approaches, however, have begun to quantify some elements of climate-related loss and damage associated with the education sector.

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Economic losses associated with climate change and related risks have been the subject of analysis for various sectors: agriculture (crop losses, yield reductions, loss of livelihood assets, loss of income), infrastructure (damaged roads and buildings) and health (number of work days lost due to heatwaves, additional financial burden on the health sector due to increased incidence of diseases) – all of which have clear economic value in the market. In terms of education and learning however, there is a comparative dearth of analytical approaches.

The growing realization that climate change and climate-related events could have immediate, serious and long-lasting effects on education has led to increasing interest in quantifying these impacts. The big challenge is that the relationships between climate change and education are not always straightforward, with potential intermediate steps (such as health impacts). Another complication is that costs can be actual – such as in the case of lost infrastructure – and future – such as in the case of lost development due to reduced education. Moving forward, there is a need to develop a systematic framework to assess these multiples costs occurring over various timescales through multiple pathways such as health, livelihoods and migration. In what follows, key approaches to assess the economic costs of climate change are summarized and evaluated.

Economic costs associated with infrastructure losses

Costs linked with loss and damage to infrastructure have been routinely assessed in post-disaster needs assessments and similar exercises – partly in order to estimate the financial resources needed to bring back a location to at least its pre-disaster state (cf. World Bank et al., 2018). Analytically, the focus of these studies tends to be on quantifying physical damages, economic losses and the costs of meeting recovery needs. The estimates typically include damage to schools (which are considered key infrastructure) and school materials.

Using such approaches, the Cambodian Ministry of Education, Youth and Sports (MOEYS) estimated the total damage of the 2013 floods in the education sector to be in the excess of US$15 million. After these events, over 1,200 schools in the floodplain were affected, with 155 schools being so severely damaged that they had to close for up to nine weeks; 40,000 textbooks were lost; and more than 450,000 students were unable to access schools during the floods. As a result, the 2013-2014 academic year saw an increase in dropout rates and grade repetition, but the costs associated with absenteeism and dropout were not quantified, although the latter would arguably have more far-reaching impacts on the economy as a whole.

Economic costs associated with forgone education

Various studies have shown the economic benefits of enrolling in basic and higher education; for example, estimates suggest that individuals who graduate from a first degree earn, on average, 40 per cent more than high school graduates, who in turn earn 30 per cent more than students who have not completed mandatory education, though this trend is more extreme in developing economies (e.g., OECD, 2018).

Global analyses of missed education show that limited educational opportunities for girls and barriers to completing 12 years of education cost countries between US$15 trillion and US$30 trillion dollars in lost lifetime productivity and earnings (World Bank, 2018). The costs are the result of lost earnings (girls who complete secondary education earn twice as much as those that only complete primary education), higher incidence of health problems (particularly HIV/AIDS) and foregone labour (girls who only complete primary education are more likely to marry early and never participate in the labour market than those who complete secondary education). Clearly the costs of missed education can be serious. An analytical approach is now needed to evaluate the potential additional losses in education that could be incurred due to climate change.

Integrating indirect costs on education

Approaches focusing on physical losses of infrastructure and school materials tend to focus solely on the direct impacts of climate change (see Figure 1). However, the indirect impacts could be more long-lasting and potentially even more costly.

In the context of nutrition, for example, global analyses suggest that the annual costs of malnutrition are US$3.5 trillion (higher than the GDP of India as of 2018), calculated by comparing foregone economic growth, lost investments in human capital, premature deaths, impaired learning potential, increased care costs and lower labour productivity (Global Panel on Agriculture and Food Systems for Nutrition, 2016). At the national level in other regions, research has linked malnutrition and the resulting losses in educational outcomes to reduced economic output (SUN and WFP, 2017) – in an economic analysis of the costs of malnutrition impacts in Pakistan, it was estimated that stunting, anemia and iodine deficiencies translate to deficits in mental and physical development, and consequently lower school performance, costing the country US$3.7 billion annually (equivalent to one per cent of the national gross domestic product).

The missing step in this type of analysis is the link to climate change impacts. In other words, the key question that remains unanswered is how climate change and related environmental changes affect education and learning indirectly through effects on: food security and nutrition, livelihoods, air pollution, water stress, health, and energy. When considering all of these issues, the total cost of climate change on education is likely to be in the scale of trillions of dollars because of the potential impacts occurring at various timescales and through these multiple pathways.

6

Preparing for the new normal: 'Climate-proofing' the education sector

Education stakeholders in East Asia and the Pacific have made progress in integrating disaster risk reduction and related climate change issues into education planning, but substantial work remains to be done.

Four key areas require investment in order to ensure that the education sector will withstand the effects of climate change and help tackle the climate crisis: improving the evidence base, ensuring access to education and completion in a changing climate, improving learning without leaving any student behind, and strengthening climate-resilient education systems.

Significant work has been done across East Asia and the Pacific to address the impacts of climate change and climate-related risks on education and learning. For example, recognizing that the flood season in Cambodia occasionally coincided with the beginning of the academic year, the Ministry of Education, Youth and Sports has ordered the academic year to start and end one month later in order to prevent disruption of education. Governments have also explored the possibility of using alternative education modalities to deal with severe disasters – in Cambodia, temporary learning spaces are set up during particularly destructive floods in some of the most affected areas to ensure that education can continue even if access to schools is compromised; and in Mongolia, distance learning approaches have been piloted with varying levels of success. At the policy level too, ministries of education across the region have started to recognize the importance of incorporating climate change planning into their own sector plans and are increasingly including climate action into their own processes.

But progress across the region is patchy and much work remains to be done in order to ensure that education stakeholders in East Asia and the Pacific are prepared to manage the impacts of climate change. Across most of the countries in the region, ministries of education still perceive their role in climate change to be limited to curriculum development or emergency response. While incorporating climate change science and management is an integral part of 21st century education, the role of education ministries should extend to active engagement in climate change adaptation and mitigation.

Some stakeholders have also advocated for the development of safe school guidelines that take into account climate change risks. This is an important step forward, but 'climate-proofing' the education sector goes far beyond simply improving the quality of infrastructure to ensure resilience to floods, storms, droughts and sea level rise – it means targeting the sector as a whole by building an entire education system that identifies immediate and long-term key climate risks; assesses vulnerabilities and exposure of children and education systems; and prioritizes and implements climate adaptation actions, as well as monitors and evaluates the effectiveness of these actions engaging children. To ensure climate resilience in the education sector, additional investment of human and financial resources are needed in four essential priority areas:

1. Improve learning and skills in schools to address climate crisis challenges
2. Enhance data and improve the evidence base to identify solutions and acquire funds
3. Increase strategies to ensure continued education of all children and adolescents under a climate change scenario, and
4. Work across sectors to strengthen education systems and their voices in order to provide a better response with climate-smart planning and financing.

BOX 2

Current climate action in the education sector

Recognizing the increasing impacts of climate change on children's education, a number of governments and education stakeholders have implemented initiatives to address climate change. Such initiatives have tended to focus on current climate-related disaster risks (e.g., by training teachers and students on the appropriate course of action during major disasters), but a number of initiatives specifically designed to address climate change are emerging.

A number of initiatives centred on **retrofitting infrastructure** have been implemented in the region. For example, schools in the central region of Viet Nam, with support from IrishAid, have incorporated storm-resistant roofing; replaced old doors, windows, hinges and glass; and re-painted indoor and outdoor surfaces as well as doors and windows.

Meanwhile, in Mongolia, efforts are currently underway to develop a prototype for energy-efficient infrastructure in kindergartens. In response to the Green Development Policy, which sets an ambitious goal of ensuring all of the country's public buildings are environmentally friendly by 2030, the Global Green Growth Institute (GGGI) supported the Ministry of Environment and Tourism and the Municipal Government of Ulaanbaatar in their efforts to design a demonstration green kindergarten fitted with solar roofs, water catchment technologies, roof gardens, and insulated walls and windows. A cost-benefit analysis of the project revealed that though the construction of a green kindergartens is 26 per cent more expensive than construction of regular schools, there is a substantial reduction in utility costs of 20-99 per cent per year, which results in longer-term savings (GGGI, 2018).

Such initiatives offer an opportunity to test best practices in developing climate-resilient safe school guidelines, but government commitment to require this type of infrastructure is required.

Some countries in the region have explored **alternative education modalities**: for example, Cambodia has implemented temporary learning spaces – structures designed to temporarily replace schools affected by floods with the intention of reducing disruptions in students' education; and in Mongolia, mobile ger kindergartens follow nomadic families and ensure that vulnerable young children who are unable to attend regular kindergarten have access to school. Such mobile gers are more suitable and cost-effective for temporary use and can replace school buildings damaged by floods or heavy snowfall. But across the region, alternative education modalities are limited and students who miss classes due to disasters often rely on remedial education or catch-up classes. Importantly, as climate change will introduce new risks like extreme heat, alternative education modalities for these types of events must be explored. With increasing access to telecommunications, especially in the most remote areas that are often cut off after major disasters, remote education should be tested.

Finally, a number of projects have focused on improving **environmental education and promoting child-led climate adaptation**. In Mongolia, the Children's Solutions on Climate Change programme included a mobile edutainment system to deliver knowledge of environmental issues. In addition, it implemented an Eco Passport programme, whereby students assessed their local area and identified possible impacts and solutions that could be implemented with small grants of 50,000 MNT (approximately US$19). The final component included the development of the Children's Report on Climate Change, which highlighted several strategies for climate change mitigation and adaptation that could be led by young people.

A similar approach exists in Cambodia through eco-schools. In eco-schools, students lead the committee and recruit fellow students as members. The committees of the eco-schools manage a modest budget of US$400 to run the club and fund small-scale activities such as bio-gardens, resilient farming, installing water containers, renovating toilets, planting trees, creating small forest demonstrations and recycling waste, among others. The project has been implemented in four provinces: Kampot, Kampong Chhnang, Stung Treng and Svay Rieng, each representing a different geographic region (coastal, Tonle Sap, floodplain, and plateau respectively).

These initiatives are extremely important and provide an avenue for children to become agents of change. However, several of these initiatives tend to be project-based and are not continued once the funding is terminated. Government engagement and financial commitment are needed to ensure that these initiatives can become sustainable and system changes take place for the long-term climate resiliency of children's education.

7

Priority Climate Action Areas to climate-proof the education sector

I. Improve learning and skills in schools to tackle the climate crisis

Recommendation 1.1: Improve learning on Climate Change in schools

Education is essential in preparing societies to manage risks associated with climate change. It helps increase the climate change mitigation and adaptive capacity of communities by enabling individuals to make informed decisions. Children and adolescents across the region have demonstrated significant interest in engaging in climate change adaptation and mitigation action, even if at the local level, but limited knowledge and capacity on climate change issues hampers such action. Ministries of education can play a major role in ensuring that students have access to relevant education on climate change, as well as on gender and equity.

The status of climate change education varies across the region. In Viet Nam, the Ministry of Education and Training has committed to promoting education on environmental issues (including climate change) to the extent that environmental issues will cover 30 per cent of the new curriculum, while in other countries like Mongolia, climate change features as a small component of the geography and biology curricula. As such, there is scope to ensure that the latest knowledge on climate change science and local impacts are integrated into the national curricula of all countries in the region and delivered effectively using innovative education technologies and practices.

Recommendation 1.2: Take action-oriented pedagogies to ensure skills-based learning

There is significant scope to encourage children, teachers and communities to participate in adaptation programmes. This could be done by integrating climate change to project-based learning in schools. The advantage of such an approach is that it can provide a multiple-subject platform to implement skills-based learning. For this, alignment in the curricula and teacher training are needed.

Already, several school systems in the region are exploring ways in which students can implement solutions at both the school level and beyond to tackle environmental degradation problems like desertification, deforestation and air pollution. An example from Viet Nam is the recent workshop co-organized by UNICEF and Clean Air Asia in Ho Chi Minh City, in which targeted school students participated in a workshop to develop innovative solutions to air pollution. Selected ideas will be further supported for implementation. In Mongolia, the SDC and UNICEF-supported Eco Passport programme encouraged participating students and teachers to assess their local area and identify possible impacts and solutions that could be implemented with small grants of 50,000 MNT (approximately US$19). Such capacity building support and education enables student to become agents of change in their communities. However, across the region such initiatives tend to be project-based and are not kept up once the project is over – mainly due to financial limitations. Climate finance for the education sector should therefore also focus on initiatives that can encourage students and school staff to engage in climate action.

II. Enhancing data and improving the evidence base to identify, fund and implement climate-resilient education solutions

Intuitively there is an understanding that climate change and climate-related disasters have an impact on education and learning – but evidence remains mostly anecdotal and undocumented. What limited data are available are collected through disaster and needs assessments and therefore tend to focus only on immediate damage to schools, textbooks and education material, or on injuries to students and teachers. But climate change can also have long-term impacts on education indirectly through effects on food and nutrition security, livelihoods and income, air pollution, water access and sanitation, health, and energy. These indirect effects are often understudied but can have a far more significant effect on education than direct impacts like destruction of infrastructure.

Recommendation 2.1: Systematically collect and use data from education systems and other sectors

Systematically collecting and using data on both direct and indirect impacts of climate change on education is a necessity. First, having specific evidence on the ways in which climate change affects education enables education stakeholders to actively participate in climate change discussions and identify solutions. Second, collecting these data provides a stronger justification for education authorities and stakeholders to access and deliver climate finance for making education systems resilient to climate change.

There are opportunities to routinely collect data on the ways in which climate-related risks affect education in a cost-effective manner through major integration with different government databases, such as environment, health, nutrition, housing and water, while disaggregating the data by gender, urban/rural, ethnicity, children with disabilities and socioeconomic status in order to accurately measure the impact of climate change and inform policy decision. In this regard, there is scope for integrating education data into climate and disaster data platforms, such as those typically maintained by national meteorological services, disaster management agencies and ministries of environment.

Furthermore, to strengthen educational data, it is important to enhance Education Management Information Systems (EMIS) across all countries in East Asia and the Pacific. The scope of EMIS varies across the region. Few EMIS collect data on a daily basis (providing near real-time information on basic statistics), while others only report on essential statistics at the end of the academic year (providing a snapshot of the education situation). Some systems are comprehensive and include dozens of indicators on the attendance and performance of students, number of teachers, and school infrastructure quality, among others – while other indicators are more limited. There is an opportunity for EMIS cover basic indicators such as the reason for absences (including difficulty accessing school during climate-related disasters, government-mandated shutdowns due to extreme weather, inability to afford school expenses, and illness) and damage to schools due to climate disasters.

In addition to quantitative data, there is an opportunity to collect qualitative information through discussions with education authorities, school staff, students and communities. Field consultations can provide useful insight regarding impacts that may be difficult to quantify, as well as information about the context in which climate change impacts education, taking into account gender and equity. For this work, an approach to collecting data through consultations and student participation could be replicated to develop a more robust database for various countries.

Ultimately, governments should mandate the collection of data for climate change issues. Without such regulations, education and other authorities – particularly at the subnational level – are unlikely to push for the collection and use of data due to a lack of financial and human resources to do so. In Viet Nam for example, provincial authorities highlighted that the central government is responsible for determining the types of data that need to be collected.

Recommendation 2.2: Improve monitoring and data analysis to improve policies and investments

But data collection should not be the final outcome: results must be analysed and interpreted in terms of policy recommendations. Such information should be used to monitor progress towards reducing or altogether eliminating the negative impacts of climate change on education – such as planning for large-scale climate-related migrations and meeting the educational needs of displaced children. Across various countries in East Asia and the Pacific, ministries of education report that one of the key limitations of existing education databases is that data are simply reported and not analysed. Before overwhelming education authorities with requirements for additional climate data collection, especially in a field that is traditionally not their area of expertise, it will be essential to train staff on education-sector relevant climate data analysis and interpretation for education planning and

budgeting. Furthermore, developing regular climate and environmental vulnerability and adaptation analysis in the education sector will provide a basis for adequately using the additional information.

III. Increase strategies to ensure the continued education of all children, adolescents, boys and girls under a climate change scenario

Recommendation 3.1: Invest in climate-resilient education infrastructure

One of the key and most visible impacts of climate change on the education sector remains the impact on schools and school infrastructure. At present however, there is limited funding to improve the quality of schools (and roads near schools) to withstand the effects of climate change over the short- and long-term. There is limited funding available under ministries of education focused on rebuilding schools after a major disaster has stricken. Specific initiatives to climate-proof schools and relevant infrastructure are therefore needed. To reduce duplication of efforts, strategies for climate-proofing education infrastructure should build on existing safe-school guidelines (which are generally available in most of the countries in East Asia and the Pacific); the added value of 'climate change-specific guidelines' is to include future climate change projections into infrastructure planning beyond immediate disaster-response needs. For example, climate change projections provide information about areas which are likely to become more susceptible to flood or typhoon risks and are therefore unsuitable for school construction.

Recommendation 3.2: Establish alternative climate-resilient education pathways

Even with heavy investments in infrastructure that can withstand the current impacts of climate change, extreme events and other compound events can wreak havoc on schools and access to quality education. In such instances, increasing access to education under climate change will also require developing innovative alternative education modalities that are adapted to different climate scenarios. Some countries in the region have explored alternative education modalities: Cambodia has implemented temporary learning spaces – structures designed to temporarily replace schools affected by floods with the intention of reducing disruptions in students' education; and in Mongolia, mobile ger kindergartens follow nomadic families and ensure that vulnerable young children who are unable to attend regular kindergarten have access to school – and there is scope to apply this concept to serve children affected by climate-related disasters. But across the region, alternative education modalities are limited and students who miss classes due to disasters often rely on remedial education or catch-up classes. With increasing access to telecommunications, especially in the most remote areas that are often cut off after major climate disasters, governments are increasingly exploring the option of remote education. For example, during the recent 2018-2019 four-week shutdown of schools in Mongolia for winter, the Ministry of Education, Culture, Science and Sports promoted TV and Internet-based classes, but not all families and students had sufficient knowledge about the schedule of specific classes and often missed them. Temporary learning spaces, mobile education centres and remote education all have significant potential for reducing disruptions to education after climate disasters. Despite this, more work is needed to identify what works best and in which contexts.

Recommendation 3.3: Protect children, adolescents, teachers and their families affected by the climate crisis

Investments should be made in measures to protect children, adolescents, teachers and families who have been affected by climate change impacts. Beyond mortality and injury, one of the most severe, but also less well-understood, impacts of climate change on education is the psychological stress that follows after major disasters. Stress from losing relatives, teachers or classmates, or household-level stress resulting from financial losses, can severely affect all, including the ability of children and adolescents to learn, which could in turn lead to severe long-term consequences for their

Young child crossing a sand bank in Kiribati on the way to school. Such sand banks are extremely vulnerable to rising sea levels.

development and realization in life, especially for vulnerable groups such as rural populations under the poverty level, children or adolescents with disabilities, girls or boys, or minority groups. Although governments of the region acknowledge that stress and trauma resulting from climate-related shocks is a serious risk to learning and academic performance, this is not well documented at the school level. Additional work is needed to (1) assess the level of psychosocial stress incurred after a climate-related disaster; and (2) develop guidelines to ensure children's learning is not compromised by stress.

IV. Cross-sectoral work to strengthen education systems and their voice to provide a better response with sound planning and financing

Recommendation 4.1: Strengthen the education sector's leadership in climate change and raise the voice of the education sector in climate policies, finance and actions

Addressing climate change in a meaningful way will require closer collaboration with staff from various ministries and agencies. Ministries of education in the region often have limited engagement with ministries of environment, and therefore lack opportunities to exchange expertise and ideas on climate change issues. Indeed, only 12 of the 27 NDCs[2] submitted by countries in the East Asia-Pacific region explicitly mention education (or related terms) – and even then, mentions of education are superficial and often tend to only focus on climate awareness raising without considering the education sector's urgent climate adaptation needs. This is partly because ministries of environment, which are traditionally responsible for climate change strategies, generally lack evidence about the vulnerabilities of the education sector with respect to climate change. Greater collaboration between education and environment, climate, and planning and finance authorities is therefore needed to fill this gap.

[2] The 12 countries that mention education in their NDCs are: China, DPR Korea, Indonesia, Kiribati, Lao PDR, Marshall Islands, Myanmar, Nauru, Solomon Islands, Tuvalu, Vanuatu and Viet Nam.

Recommendation 4.2: Improve cross-sectorial collaboration and programming

Collaboration is also needed across other sectors, especially given that impacts of climate change on the education sector are cross-sectoral. For example, one of the key ways through which climate change affects education and learning outcomes in the region is through impacts on health, which translate to increased absenteeism. Enhancing collaboration with ministries of health on climate change issues can ensure that schools and education authorities are better equipped to deal with health risks that may become more frequent under climate change.

Recommendation 4.3: Incorporate climate change in education planning and financing

There is also a need to incorporate climate change issues into the education planning and education sector's mitigation and adaptation needs into climate finance. Guaranteeing that climate change issues are incorporated into education planning requires financing. However, climate finance requirements for the education sector are rarely met: for example, in Cambodia only 3 per cent of required funds have been allocated (solely for curriculum development). In part, the lack of funding can be attributed to insufficient data on impacts in the education sector – other than anecdotal evidence and ad-hoc disaster needs assessments – as well as the lack of vulnerability assessments to quantify the education sector's climate adaptation and mitigation needs. Investing in data systems, as highlighted earlier, can therefore provide a robust climate rationale for supporting the education sector's needs. But as data become increasingly available, and governments become increasingly aware of the ways in which climate change impacts on education and learning, ministries of planning, finance and investment should allocate climate funds and help others access international climate funds that specifically focus on education sector needs – in addition to curriculum development, training for teachers and students on climate change adaptation actions, retrofitting infrastructure to withstand the effects of projected climate changes over the long-term, and development/improvement of alternative education modalities in the context of increasingly variable and more unpredictable weather patterns. At present, the funding allocated to ministries of education in the region is mainstreamed into the budget and it is difficult to ascertain what percentage of the total budget is specific to climate change – but it is often a small percentage of total funds focusing on immediate emergency relief purposes. Moving forward, setting aside a specific budget code for climate action in the education sector may be beneficial for tracking how climate funds are used for education sector-specific needs.

There is also significant scope for expanding the availability of contingent funds for the education sector during climate-related disasters. At present, only a fraction of contingency funds goes to education ministries (and education authorities report that most funds go to agriculture and infrastructure). In part, this is because ministries tend to work independently to carry out impact and needs assessments and only coordinate activities during major disasters, so the scale of financial requirements for the education sector is not always known. Here, again, greater cross-sectoral collaboration – particularly with disaster management authorities – is beneficial.

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Conclusions

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The East Asia-Pacific region is one of the most vulnerable to the impacts of climate change. Devastating storms such as Typhoon Haiyan in 2013 (the most destructive in the region's history), heavy rainfall events linked to floods and drought conditions such as those experienced during the 2015-2016 El Niño event are all projected to become a common occurrence under future climate change. In addition, climate change will expose the region to new risks such as extreme temperatures (which were already experienced in April and May of 2019), melting glaciers and rising sea levels which threaten to destroy huge portions of land both in low-lying island states of the Pacific and in the agricultural plains of Southeast Asia.

But climate change is not the entire story. Climate patterns interact with other socioeconomic and demographic trends to exacerbate children's vulnerabilities in the region. For example, rapid deforestation rates in Southeast Asia affect the quality of soil and the hydrological cycle, compromising the stability of soil and increasing the risk of landslides. Rapid rural-to-urban migration (partly driven by climate trends in places where climatic conditions are rendering traditional livelihoods unfeasible) is leading to increasing pollution and scarcity of resources such as water.

Against this background, climate change poses a serious risk to the education sector in various countries across East Asia and the Pacific. Today, children and adolescents are already experiencing severe difficulties in accessing school due to floods or to icy conditions in the winter months, especially for particularly vulnerable populations such as those under the poverty level, children or adolescents with disabilities, girls or boys, urban/rural, or minority or migrant groups. As these disasters become more frequent and severe, the education sector needs to adapt in order to ensure universal education continues. Beyond the direct impacts on access to education, climate change also has indirect effects through impacts on food security, livelihoods and income, access to water and sanitation, health, and energy – all of which have a knock-on effect on education and learning outcomes.

Given the large geographic diversity between countries (from landlocked countries like Mongolia, to small island states like Tonga) as well as differing levels of economic development, the range of challenges for the education sector is varied. So too is the level of awareness regarding climate impacts on education and learning, as well as responses.

Recognizing the impacts of climate-related risks on education, governments have already begun work to enhance disaster risk management efforts among schools. There is scope to build on these initiatives and experience to ensure climate change adaptation, specifically by enhancing the national environmental education curriculum to include relevant climate change information, training teachers on climate change topics, and retrofitting schools and associated infrastructure to withstand the impacts of climate change and climate-related risks using the best available local and scientific knowledge on climate change solutions.

Much work remains to be done. This report outlines four areas of work that will bring the education sector closer to being resilient to the impacts of climate change:

1. Improve learning and skills in schools to address climate crisis challenges
2. Enhance data and improve the evidence base to identify solutions and acquire funds
3. Increase strategies to ensure continued education of all children and adolescents under a climate change scenario, and
4. Work across sectors to strengthen education systems and their voices in order to provide a better response with climate-smart planning and financing.

It is hoped that this report will help initiate the discussion by providing an initial evidence base to illustrate the ways in which climate change affects the education sector with examples from across the region. It is also hoped that the recommendations outlined here will trigger further actions to ensure the education sector is both well-represented in the climate change policy-making and financing processes, and is prepared for a changing climate.

Stories from the ground:
Case studies from across the region

CAMBODIA

OVERVIEW

Cambodia has achieved significant progress in primary education, where 8.7 out of 10 children transit from primary to lower secondary education. However, for lower secondary only 4 out of 10 complete this level.[3] Children in Cambodia are still failing to reach learning standards appropriate for their age. At the primary level, nearly 25 per cent of children in Grade 3 cannot write a single word in a dictation test. Only 27 per cent of 3- to 5-year-olds are developmentally on track in literacy and numeracy, and by the time they are 17 years old, 55 per cent of adolescents will have dropped out of school. Moreover, only about 38 per cent of the students in lower secondary education achieved a minimum proficiency in reading and only 17 per cent in mathematics. Children from rural households, and especially in the north-eastern parts of the country, are particularly vulnerable.

Considered among the most vulnerable to the impacts of climate change, Cambodia is regularly affected by floods and droughts – which severely impact on its primary economic activities, including rain-fed paddy farming and fishing (GermanWatch, 2016). In recent years, rapid deforestation has also led to increased risk of land degradation and landslides, while increasing temperatures have led to more extreme heat events and freak storms, highlighting the continued climate vulnerability of the country. Indeed, estimates of the costs of climate change on the economy suggest that climate change could reduce GDP by 2.5 per cent by 2030 and by almost 10 per cent by 2050.

SUMMARY OF KEY CLIMATE RISKS

Temperature	Rainfall	Droughts	Floods	Heatwaves	Storms
Increase of 1-2.6°C by 2050	Erratic rainfall, more frequent heavy rainfall	More frequent drought	More intense floods	More extreme heatwaves	More intense typhoons

[3] UIS data, 2018.

MOST VULNERABLE CHILDREN AND ADOLESCENTS

- Children and adolescents who attend floating schools, typically from poorer households
- Children and adolescents in remote areas, especially in the northeast of Cambodia, who are typically from ethnic minorities and from poorer households
- Younger children (pre-primary and primary school students) are more vulnerable to health impact
- Adolescents (secondary school) are more likely to miss school to support livelihood activities

KEY CLIMATE IMPACTS ON EDUCATION AND LEARNING

CLIMATE RISK	DIRECT IMPACTS	INDIRECT IMPACTS
Floods	• Injury or mortality of students, teachers and education staff, and family members. • Damage or destruction of key education infrastructure.	• Health impact (diarrhea is linked with absenteeism) • Livelihood impact (damage to crops and livestock affects purchasing power of families)
Droughts		• Reduced access to safe water (increased consumption of contaminated water). • Health impact (contraction of diarrhea increases risk of absenteeism) • Livelihood impact (damage to crops and livestock affects purchasing power of rural families).
Tropical storms	• Injury or mortality of students, teachers and education staff, and family members. • Damage or destruction of key education infrastructure.	• Livelihood impact (damage to crops and livestock affects purchasing power of families)
Heatwaves		• Uncomfortable learning environment (inability to concentrate) • Health impact (heat stress can result in dehydration)
Sea-level rise	• Damage or destruction of key education infrastructure.	

OPPORTUNITIES FOR ACTION

Given the potential for climate change to hamper progress in education, education authorities need to prioritize adaptation efforts to ensure universal education through four interrelated activities:

1. **Enhancing data and improving the evidence base.** Evidence on climate impacts on education tends to be anecdotal.
   a. Linking data systems to the education management information system (EMIS) and climate data platforms to ensure sustainability of data collection.
   b. Carrying out in-depth climate risk and vulnerability assessments.
2. **Increase access to education under a climate change scenario.** Access to education is one of the key challenges during major climate-related disasters.
   a. Developing adaptation guidelines for schools to ensure that education infrastructure can withstand the effects of climate risks.
   b. Expand alternative modalities for education.
3. **Improve learning to address climate change impacts.** Children and adolescents acknowledge the significance of climate change but often lack the knowledge and skills to implement effective solutions.
   a. Enabling children, adolescents, and communities to become agents of change through curriculum enhancement and skills-based learning strategies.
4. **Systems strengthening.** Ensuring universal education under climate change will also require school staff and education authorities to be capable of dealing with climate risks.
   a. A review of climate adaptation needs and potential measures specific to the context of the education sector in Cambodia.
   b. Greater cross-sectoral collaboration with relevant agencies.
   c. Greater access to climate finance and contingent financing specific to the education sector.

The table below indicates progress achieved thus far and areas for potential improvement to ensure climate-resilience in the education sector.

 **GOVERNMENT** (national/subnational)	• **Government has a climate change strategy embedded in the education sector plan with monitoring and evaluation (M&E) indicators** • **Governments have sufficient funding to implement climate change strategy, re-build infrastructure and support families during disasters** • **Government analyses vulnerability of schools, creates a plan and relocates schools in high-risk zones** • **Ministry of Education collaborates with other ministries (environment, disaster management)**
 **CURRICULUM**	• **Government includes climate change in the national curricula** • Government develops national guidelines for environmental curricula including climate change • **Government updates curricula with the latest climate science and knowledge** • Government provides training in climate change for teachers, schools directors and school staff
 **TEACHER AND SCHOOL STAFF**	• Relevant teachers receive training in CC education including how to integrate the topic in their class sessions and how to develop active pedagogies (problem/inquiry-based learning) • **All school staff receive training in disaster risk reduction (DRR)/emergencies preparedness and alternative education modalities** • Teachers have sufficient materials to provide climate change education • **School staff develop climate resilience strategies across the school**
 **PARENTS AND COMMUNITIES**	• Communities develop a resilient source of income not only depending on climate-sensitive activities • **Parents receive assistance during extreme events** • Parents engage in climate resilience activities at school and at home • **Communities engage in climate resilience activities at school**
 **STUDENTS**	• **Students learn about climate change issues and develop problem-solving critical thinking skills** • **Students have access to climate change education materials (only at secondary level)** • **During extreme weather events, students can access alternative education from a secure place or accelerated programmes afterwards** • Students engage in climate resilience activities at school and at home
 **SCHOOLS AND BUILT ENVIRONMENT**	• **Schools are mandated to engage in climate resilience** • Schools have sufficient funds to retrofit infrastructure against future climate risks • **Roads/access to schools are accessible at all times, even during extreme weather events. During extreme weather events there is a school plan for accessibility or alternative education modalities** • Areas surrounding schools are refitted against future climate risks

MONGOLIA

OVERVIEW

Mongolia sustains high rates of basic education enrolment, at 97.88 per cent. Transition rate from primary to lower secondary education is 99.08 per cent, and lower secondary education completion rate is 90.3 per cent. However, gender inequalities exist: to illustrate, primary enrolment rates are 97.1 per cent for girls and 98.63 for boys. Regarding learning outcomes, comparable data are not available.[4]

A key challenge for providing universal education is the fact that herding communities follow nomadic traditions, contributing to low population densities outside of the capital. As a result, children have to travel long distances. To address this challenge, the government has provided housing facilities near schools. However, additional challenges remain: inadequate teaching qualifications and skills, a lack of consistent education standards, and weak learning and teaching environments in schools all present a challenge for addressing educational needs, particularly in rural areas.

Mongolia is a landlocked country in Northeast Asia, with extremely diverse landscapes ranging from high mountain alpine systems in the north to vast deserts in the south. Mongolia has embraced economic modernization with unprecedented growth in the last two decades. Climate change threatens to undermine some of the development progress achieved by Mongolia in recent decades. Urban and peri-urban areas are becoming increasingly vulnerable to the effects of climate change: drought risk exacerbates water scarcities (USAID, 2017). Rural areas are also vulnerable to climate change. The nomadic traditions of Mongolia are prevalent, with nearly 40 per cent of the population depending on livestock rearing for their livelihoods in the vast steppes of the country (USAID, 2017). Weather is an integral part of pastoral livelihoods and climate shocks can seriously impact households.

SUMMARY OF KEY CLIMATE RISKS

Heavy snowfall/*dzuds*

Potential for more frequent and longer *dzuds*

Floods

More frequent flash floods

Droughts

More frequent drought events

Air pollution

No clear link to climate change, but more serious pollution episodes likely due to growing urban population

[4] UIS data, 2018.

MOST VULNERABLE CHILDREN AND ADOLESCENTS

- Younger children (aged 10 years or younger) are more vulnerable than those aged 11-15.
- Children and adolescents from herding communities in remote areas, especially from the poorest households.
- Children and adolescents living in ger districts in Ulaanbaatar and provincial centres.
- Migrant children and adolescents who live in ger districts.

KEY CLIMATE IMPACTS ON EDUCATION AND LEARNING

CLIMATE RISK	DIRECT IMPACTS	INDIRECT IMPACTS
Heavy snowfall/*dzuds*	• Injury and mortality of students, teachers and education staff • Reduced access to education services linked to a lack of sufficient alternative education modalities	• Reduction in enrollment rates, particularly for children aged 10 or younger • Livelihood impacts (damage to livestock) • Health impacts (respiratory problems and malnutrition)
Floods	• Damage or destruction of key education infrastructure	• Reduced access to safe drinking water (contraction of water-borne diseases leads to absenteeism)
Droughts		• Livelihood impact (children miss class to support household activities) • Reduced access to safe drinking water (contraction of water-borne diseases leads to absenteeism)
Air pollution	• Shutdown of education services due to health problems	• Respiratory problems and increased rates of absenteeism due to smoke • Shutdown of education services due to health problems • Increasing evidence of air pollution's effects on children's cognitive capacity, immune system, inflammatory diseases and endocrine functions, as well as pre-term birth and low birth weight

OPPORTUNITIES FOR ACTION

Given the potential for climate change to hamper progress in education, education authorities need to prioritize adaptation efforts to ensure universal education through four interrelated activities:

1. **Enhancing data and improving the evidence base.** Evidence on climate impacts on education is not systematically collected and tends to be anecdotal – especially for less frequent risks like droughts and flash floods. More work is needed to systematically evaluate climate impacts on education and learning by:
   - **a.** Incorporating environmental and climate indicators into the education sector information system (ESIS), as well as analysing and using these for climate resilient educational service planning.
   - **b.** Conducting education-specific vulnerability assessments, including analyses of pollution impacts and carrying out further field consultations in other regions of the country.
2. **Increase strategies to ensure continued education under a climate change scenario.** Access to education is one of the key challenges during major climate-related disasters.
   - **a.** Climate-related risks should be taken into account in the planning and construction of any educational facilities to ensure continued education, even during and after extreme weather events.
   - **b.** Alternative education modalities such as mobile ger schools and remote education should be explored and systematically integrated into planning processes, especially in remote rural areas.
3. **Improve learning to address climate change impacts.** Children and adolescents acknowledge the significance of climate change but often lack the knowledge and skills to implement effective solutions – despite their strong desire to engage in climate action.
   - **a.** Updating the national curriculum to reflect the latest knowledge in climate science and policy actions is an essential first step towards ensuring children and adolescents can be agents of change.
4. **Systems strengthening.** Ensuring universal education under climate change will also require school staff and education authorities to be knowledgeable and capable to deal with climate risks.
   - **a.** Prepare teachers, school staff and education authorities to respond to the changes in curricula and align assessments relevant to climate change science and management.
   - **b.** Greater inter-sectoral collaboration with relevant agencies (the Ministry of Environment and Tourism, the National Emergency Management Authority, the Ministry of Health, national and sub-national education stakeholders) to ensure a holistic response.
   - **c.** Greater access to climate finance and contingent financing specific to the education sector to deal with climate-related disasters and integrate climate change adaptation into education sector planning.

The table below indicates progress achieved thus far and areas for potential improvement to ensure climate-resilience in the education sector.

 **GOVERNMENT** (national/subnational)	• Government has a climate change strategy embedded in the education sector plan with M&E indicators • **Governments have sufficient funding to implement climate change strategy, re-build infrastructure and support families during disasters** • Government analyses vulnerability of schools, creates a plan and relocates schools in high-risk zones • **Ministry of Education collaborates with other ministries (environment, disaster management)**
 **CURRICULUM**	• **Government includes climate change in the national curricula** • Government develops national guidelines for environmental curricula including climate change • Government updates curricula with the latest climate science and knowledge • Government provides training in climate change for teachers, school directors and school staff
 **TEACHER AND SCHOOL STAFF**	• Relevant teachers receive training in CC education including how to integrate the topic in their class sessions and how to develop active pedagogies (problem/inquiry-based learning) • **All school staff receive training in DRR/emergencies preparedness and alternative education modalities** • Teachers have sufficient materials to provide climate change education • **School staff develop climate resilience strategies across the school**
 **PARENTS AND COMMUNITIES**	• Communities develop a resilient source of income not only depending on climate-sensitive activities • **Parents receive assistance during extreme events** • **Parents engage in climate resilience activities at school and at home** • Communities engage in climate resilience activities at school
 **STUDENTS**	• **Students learn about climate change issues and develop problem-solving critical thinking skills** • Students have access to climate change education materials *(only at secondary level)* • **During extreme weather events, students can access alternative education from a secure place or accelerated programmes afterwards** • Students engage in climate resilience activities at school and at home
 **SCHOOLS AND BUILT ENVIRONMENT**	• **Schools are mandated to engage in climate resilience *(only in the context of flood risk management)*** • Schools have sufficient funds to retrofit infrastructure against future climate risks • Roads/access to schools are accessible at all times, even during extreme weather events. During extreme weather events there is a school plan for accessibility or alternative education modalities • Areas surrounding schools are refitted against future climate risks

VIET NAM

OVERVIEW

Significant progress has been made towards realizing basic quality education for all in the country. Almost every child starts secondary education, with a transition rate of 99.79 per cent. Furthermore, the lower secondary completion rate is more than 83 per cent.[5]

Vietnam has considerably improved learning outcomes, where 86.16 per cent of the students in lower secondary education achieved the minimum proficiency in reading and 80.9 per cent in mathematics.

However, major obstacles to accessing quality, inclusive and sustainable education remain for the most vulnerable children, especially ones living with disabilities, who are disadvantaged and ethnic minorities. Within the context of Viet Nam's rapid socio-economic development, children who fail to access quality education also deprive the country from a source of dynamic growth. On top of this, climate change threatens to exacerbate these inequalities

As a coastal country located in the typhoon belt, Viet Nam is regularly affected by various climate-related disasters, including tropical storms, floods, droughts, landslides and sea level rise. According to the National Climate Change Strategy (2011), between 2001 and 2010, damages caused by such disasters resulted in 9,500 deaths and missing persons, as well as the loss of approximately 1.5 per cent of annual GDP, highlighting the extent of current vulnerability. Education is one of the national priorities of the country, and in recognition of these challenges, the Government of Viet Nam has prioritized increasing access to education for disadvantaged communities, as well as enhancing the quality of education. However, climate change threatens to both hinder progress made in the education sector and exacerbate current inequalities. Increasing magnitudes of floods, droughts, tropical storms, air pollution and hazards related to sea level rise all may ultimately damage the ability of children from disadvantaged groups to access education and perform well in school.

[5] UIS data, 2018.

SUMMARY OF KEY CLIMATE RISKS

Temperature	Rainfall	Droughts	Floods	Sea-level rise	Storms
Increase of 1-2°C by 2050	Erratic rainfall, more frequent heavy rainfall	More frequent drought	More intense floods	Sea-level rise of 28-33 cm by 2050	More intense typhoons

MOST VULNERABLE CHILDREN AND ADOLESCENTS

- Children and adolescents who attend satellite school sites in remote areas, typically from poorer households.
- Younger children (pre-primary and primary school students) are more vulnerable to health impacts.
- Adolescents (secondary school) are more likely to miss school to support livelihood activities.

KEY CLIMATE IMPACTS ON EDUCATION AND LEARNING

CLIMATE RISK	DIRECT IMPACTS	INDIRECT IMPACTS
Floods	• Injury or mortality of students, teachers and education staff, and family members • Damage or destruction of key education infrastructure	• Reduced enrolment (evidence shows that flood events have a negative impact on enrollment rates and performance of students) • Health impact (increased risk of water-borne diseases leads to absenteeism) • Livelihood impact (damage to crops and livestock affects purchasing power of families)
Droughts		• Reduced access to safe water (increased consumption of contaminated water) • Livelihood impact (damage to crops and livestock affects purchasing power of rural families)
Tropical storms	• Injury or mortality of students, teachers and education staff, and family members • Damage or destruction of key education infrastructure	• Livelihood impact (damage to crops and livestock affects purchasing power of families)
Heatwaves		• Uncomfortable learning environment (inability to concentrate) • Health impact (heat stress can result in dehydration)
Sea level rise	• Damage or destruction of key education infrastructure	• Water and health impact (salt water intrusion affecting drinking water and livelihood options, linked to internal migration in the Mekong Delta region)

OPPORTUNITIES FOR ACTION

Given the potential for climate change to hamper progress in education, education authorities need to prioritize adaptation efforts to ensure universal education through four inter-related activities:

1. **Enhancing data and improving the evidence base.** Evidence on climate impacts on education tends to be anecdotal.
   - **a.** Developing a more robust data system to analyse climate impacts on education and learning.
   - **b.** Linking data systems to the education management information system (EMIS) and climate data platforms to ensure sustainability of data collection.
   - **c.** Developing thematic reports on climate change, education and learning to examine the ways in which specific climate risks impact education and learning.
   - **d.** Carrying out in-depth climate risk and vulnerability assessments that can inform appropriate locations and strategies for establishing schools.
   - **e.** Carrying out further field consultations in other regions of the country, including climate and education calendars,
2. **Increase access to education under a climate change scenario.** Access to education is one of the key challenges during major climate-related disasters.
   - **a.** Improving the quality of infrastructure to ensure it can withstand the effects of climate risks will help reduce negative impacts associated with climate change.
   - **b.** Alternative education modalities such as remote education should be explored and systematically integrated into planning processes, especially in remote rural areas.
   - **c.** Measures to protect children and adolescents who have been affected by climate change impacts, including provision of psychosocial support to children affected by disasters.
3. **Improve learning to address climate change impacts.** Children acknowledge the significance of climate change but often lack the knowledge and skills to implement effective solutions.
   - **a.** Enabling children, adolescents and communities to become agents of change through curriculum enhancement and skills-based learning strategies.
4. **Systems strengthening.** Ensuring universal education under climate change will also require school staff and education authorities to be capable to deal with climate risks.
   - **a.** Greater cross-sectoral collaboration with relevant agencies
   - **b.** Greater access to climate finance and contingent financing specific to the education sector

The table below indicates progress achieved thus far and areas for potential improvement to ensure climate-resilience in the education sector.

 **GOVERNMENT** (national/subnational)	• **Government has a climate change strategy embedded in the education sector plan with M&E indicators** • **Governments have sufficient funding to implement climate change strategy, re-build infrastructure and support families during disasters** • Government analyses vulnerability of schools, creates a plan and relocates schools in high-risk zones • **Ministry of Education collaborates with other ministries (environment, disaster management)**
 **CURRICULUM**	• **Government includes climate change in the national curricula** • **Government develops national guidelines for environmental curricula including climate change** • **Government updates curricula with the latest climate science and knowledge** • **Government provides training in climate change for teachers, school directors and school staff**
 **TEACHER AND SCHOOL STAFF**	• **Relevant teachers receive training in CC education including how to integrate the topic in their class sessions and how to develop active pedagogies (problem/inquiry-based learning)** • **All school staff receive training in DRR/emergencies preparedness and alternative education modalities** • **Teachers have sufficient materials to provide climate change education** • School staff develop climate resilience strategies across the school
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