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MINISTRY OF EDUCATION AND SCIENCE

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THE IMPACT OF CLIMATE CHANGE ON EDUCATION

IN MONGOLIA

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EXECUTIVE SUMMARY

Climate change is a risk multiplier, threatening to undermine the progress achieved in promoting development over the last few decades. The education sector, however, has been underrepresented in global climate change discussions. Indeed, no single National Adaptation Programme of Action (or the subsequent National Adaptation Plans) in the East Asia and Pacific region highlights the education sector as being at risk. However, in the 2018 climate change negotiations, delegates recognized the importance of including education in the Nationally Determined Contributions of countries, highlighting the increasing significance of exploring the links between education and climate change (UNFCCC, 2018).

The current study was launched by UNICEF with the overall aim of gathering evidence on impacts of climate change on education sector, enhancing awareness and understanding among key stakeholders, enabling cross-country comparison of climate change actions in education, and facilitating sharing of good practices and lessons learned in the region.

The study indicates that climate trends, including more extreme winter conditions (leading to more severe *dzuds* and greater use of coal which in turn leads to air pollution), heavier summer precipitation (leading to flash floods), and more extreme summers (leading to both more severe droughts and more severe *dzuds*), all have a significant impact on Mongolia's education sector. The main impacts include reduced access to education – especially in the harsh, cold winters when roads are impassable or too dangerous, and after flash floods when roads are destroyed – as well as missing school or dropping out of school due to health complications (particularly in winter). These trends result in lower attendance rate, and potentially impact learning outcomes. Livelihood concerns are also widespread with herding families being particularly dependent on favourable weather conditions to make a living and obtain sufficient income to send children to school. In addition to these concerns, schools have also reported insufficient access to water and sanitation facilities, food insecurity and access to energy as important issues that affect students' well-being during climate-related disasters.

Given the potential for climate change to hamper progress in education, education authorities need to prioritize efforts to ensure universal education through four inter-related 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) and developing analysis plans to inform climate resilience planning.

b. Conducting education-specific **vulnerability assessments** on climate change risks and air pollution and carrying out further field consultations in other regions of the country in order to get a comprehensive overview of potential effect of climate change on education.

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.** Developing guidelines and standards that take climate change issues into consideration is an essential starting point for better planning. Such guidelines should be incorporated into the recently adopted school safety standards.

b. **Alternative education** modalities such as mobile ger schools and distance learning should be explored and systematically integrated into planning processes, especially in remote rural areas.

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 – 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 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. Climate change sensitive **education planning** and greater **intersectoral 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.

LIST OF ABBREVIATIONS

EAPRO	UNICEF East Asia and Pacific Regional Office
ESIS	Education Sector Information System
GGGI	Global Green Growth Institute
MECSS	Ministry of Education, Culture, Science and Sports
MET	Ministry of Environment and Tourism
NAMEM	National Agency of Meteorology and Environment Monitoring
NAPCC	National Action Plan on Climate Change
NCC	National Climate Committee
NEMA	National Emergency Management Authority
PAGE	UN Partnership for Action on Green Economy
UNICEF	United Nations Children's Fund

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1. INTRODUCTION

There is increasing consensus that climate change will exacerbate current and future inequalities by disproportionately affecting the most vulnerable communities around the world – particularly children who are often less able to manage climate-related risks and least represented in decision-making processes (Barros et al., 2014; UNICEF, 2015).

The realization that climate change threatens development outcomes has led to increased analysis linking climate change science to health (McMichael et al., 2003), poverty (Abeygunawardena et al., 2014), gender (UNDP, 2013), water (Vorosmarty et al., 2010) and food security (WFP and UK Met Office Hadley Center, 2010).

Analyses of climate impacts on education have traditionally focused primarily on impacts on schools and the built environment (Hoornweg et al., 2011) as well as the role of education in advancing awareness of climate change (UNESCO and UNEP, 2012). Recognizing that impacts are broader, more recent research has been conducted to evaluate various effects such as reduced access to schools during floods, reduced nutritional outcomes during droughts, and mortality of children during storms (e.g., Randell and Grey, 2016; Pettengell, 2016; UNDP, 2017).

As climate change exacerbates the magnitude of disasters (such as floods, droughts and storms), and introduces new risks such as sea-level rise, there is an increasing need to understand how these events may affect education – and also what strategies may be implemented to reduce these risks. Recognizing the threats associated with climate change and climate-related events, UNICEF East Asia and the Pacific (EAPRO) launched a regional research study to examine the impact of climate change on education and learning in 4 countries in the region including Mongolia.

OBJECTIVE

With this background, the purpose of the present study is:

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

The results will provide an evidence base for education stakeholders in Mongolia to engage with climate change adaptation stakeholders. It is also hoped that the analysis will help provide the foundation to open new partnership opportunities and funding streams, such as the Green Climate Fund or bilateral funding.

METHOD

The method for this analysis consisted of two approaches.

1. A literature review was conducted to gather documented evidence of climate impacts on education as well as data gaps.
2. Consultations were carried out to enhance the understanding of the situation and – to the extent possible – fill in the gaps identified through the literature. These steps are described in greater detail below.

REVIEW OF EXISTING EVIDENCE

The first part of the exercise consisted of reviewing peer-reviewed journals and technical reports to compile and synthesize evidence of the impact of climate change on education. A comprehensive search of relevant peer-reviewed articles was conducted on Google Scholar and SCOPUS using the following keywords: climate OR *dzud** OR flood OR drought AND impact* AND education OR schools OR children AND Mongolia. Only papers published after 2000 were selected, to ensure that findings are recent and relevant. Abstracts were screened for relevance – key papers identified through this process are indicated in the References section.

In addition to peer-reviewed publications, technical reports and disaster assessment reports from 2000 onwards were also evaluated. Reports from the Ministry of Education as well as international organizations (Save the Children, World Vision, UNICEF) were reviewed.

COUNTRY- AND FIELD-LEVEL CONSULTATIONS

As a next step, consultations were carried out with the ministries of education and environment as well as the National Emergency Management Authority to gather information on the perceived roles of the various government agencies related to climate change and the education sector.

To deepen the analysis, field consultations also carried out. Given temporal and financial limitations, the field visits were limited to Nalaikh district (1 day) and Bayankhongor province (2 days). Both locations were selected because they are former or current UNICEF priority areas. In Nalaikh district, consultations were carried out only with education authorities, while in Bayankhongor province education authorities, school staff, teachers, students and parents were consulted. Schools in Nalaikh district (primary school), in Bayankhongor aimag center (one primary school and an education complex for primary and secondary education) and in soum centers (two primary and secondary schools) were visited to collect further information.

2. MONGOLIA: COUNTRY CONTEXT

Mongolia is a case landlocked country in Northeastern Asia, with extremely diverse landscapes ranging from high mountain alpine systems in the north to the vast deserts in the south. Mongolia has embraced economic modernization with unprecedented growth in the last two decades, reaching the status of high human development according to the United Nations Human Development Index (UN HDR, 2018). Part of this growth has been the result of rapid industrialization following the collapse of the Soviet Union and increasing trading relationships with China; indeed, China alone accounts for over 80% of total exports from Mongolia (WITS, 2018). Migration from rural to urban areas has also been a prominent demographic feature of Mongolia: in the last two decades, the capital city of Ulaanbaatar expanded more than 30 times in area and its population grew by more than 70 percent (Long, 2017).

However, climate change threatens to undermine some of the development progress achieved by Mongolia in recent decades. On the one hand, urban and peri-urban areas are becoming increasingly vulnerable to the effects of climate change: drought risk exacerbates water scarcities, and the burning of coal to withstand increasingly longer, harsh winters exacerbates respiratory problems (USAID, 2017). On the other hand, rural areas are also vulnerable to climate change. The nomadic traditions of Mongolia are prevalent, with nearly 40 percent of the population depending on livestock rearing and small-scale rainfed agriculture 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. The major climate risks in Mongolia include droughts and *dzuds* – a multi-causal disaster triggered by a combination of summer droughts

followed by heavy snowfall and lower-than-average winter temperatures. Such events cause large losses of livestock and crops (MONET and UNEP, 2010). In addition, changing seasonal patterns – with winters becoming milder but the colder period becoming prolonged, and summers becoming shorter but more extreme – are likely to place additional stress on the already climate-sensitive livelihoods.

On the education front, Mongolia has made impressive progress in recent years to ensure universal education. There are nearly one million children (33 percent of the national population) under the age of 15 – the age at which education is no longer compulsory. Net enrollment rates in primary school are relatively high at 97.88 percent though gender inequalities exist: to illustrate, primary enrollment rates are 97.1 percent for girls and 98.63 for boys (World Bank, 2018). 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. Recognizing these challenges, the education sector masterplan 2006-2015 (which is currently being updated) highlights the need for (1) improving gross enrollment rates for preschool education; (2) develop preschool education services in accordance with the needs of child development; (3) improve policies and the regulatory framework for the provision of preschool education services; (4) improve access to quality education at the primary and secondary levels; (5) enhance the learning and teaching environment at all levels; (6) improve management capacity of schools; and (7) improve access to quality non-formal, adult, and vocational education.

Climate change threatens to hinder progress in most of these areas, jeopardizing the global objective of achieving universal education by 2030. For instance, if climate change reduces pasture carrying capacity and agricultural output, as climate models suggest, and household income is affected, some children may opt to find employment to support their families rather than attend school. Additional stressors like health complications could also increase the risk of absenteeism and dropouts, while malnutrition and water stress could affect learning outcomes. The new risks introduced by climate change – such as more frequent and intense extreme heat events and changing seasonal patterns will require updating teaching materials more frequently so that teachers and students are equipped with the latest scientific information and knowledge on how to deal with these risks. And the additional costs of climate-related hazards and risks – both direct and indirect – on the education sector will require additional financing to manage impacts appropriately.

REGULATORY FRAMEWORK

Since the transition to a democratic government in the 1990s, the Parliament of Mongolia has passed several important environmental laws including specific laws on environmental protection (1995, amended in 2007), water (2004, amended in 2012[1]), forests (2013), and disaster prevention (2003). The key piece of legislation governing climate change policy is the National Action Plan on Climate Change (NAPCC), approved by Parliament in 2011 and designed to meet obligations under the UN climate change convention. The NAPCC is designed to be implemented in two phases: the first phase (2011-2016) is centered around strengthening the government structures required to address climate change, while the second phase (2017-2021) is focused on implementation of mitigation and adaptation strategies. Mongolia's climate change objectives are further articulated in its Intended Nationally Determined Contributions, which focus on reducing the impacts of climate change and related disasters on livestock, farming, water resources, forestry, as well as on reducing greenhouse gas emissions from industrial activities. A related regulation is the GDP which sets a roadmap for transitioning towards green development through 2030. All climate change activities are managed by the inter-disciplinary and inter-sectoral National Climate Committee (NCC), currently led by the Ministry of Environment and Tourism (MET).

From the education perspective, the Ministry of Education, Culture, Science and Sports (MECSS) is responsible for implementing national education such as Education Sector Master Plan 2006-2015 (currently being revised) as well as education policies linked to the Green Development Policy (GDP) of Mongolia. There is limited coordination and collaboration between the MECSS and the MET with respect to climate change activities other than through the inter-sectoral NCC, and indeed most climate change-related activities in the education sector have focused on developing curricula that address climate change and disaster issues (Tugjamba et al., 2018). Through the GDP, there has also been impetus for developing green public buildings, and a series of demonstration kindergartens have been prepared by the MET in collaboration with international partners – though such projects are still in their infancy. Another initiative related to environmental education builds on the Swiss Development Cooperation (SDC)-funded initiative Education for Sustainable Development through which the MET and MECSS have approved a national programme for education for sustainable development (2018).

The MECSS, however, does have some experience dealing with broader environmental problems – which might offer a framework for managing climate change. Through collaboration with the Ministry of Health, MECSS has proposed temporary shutdowns of schools when over 15 percent of school children fall ill – in order to prevent diseases from

1 https://www.legalinfo.mn/law/details/8683

spreading. Most recently, this directive was implemented in the winter of 2018/2019 when schools were shut down for 4 weeks due to the extremely high pollution levels which contributed to widespread respiratory problems. MECSS also collaborates with the National Emergency Management Agency (NEMA) on disaster risk reduction efforts. The work has so far focused on earthquakes (identifying schools that are most at-risk of collapse, drills, training teachers for search and rescue operations), and some work on flood risk management has initiated – but there is substantial scope for including schools as key actors during *dzud* events. These experiences offer an opportunity to expand the scope of MECSS and engage more actively in climate change adaptation and mitigation practices.

INITIATIVES

On-the-ground initiatives

Recognizing the challenges of climate change, the Government of Mongolia has developed various policies and regulations. However, these policies do not articulate strategies to address the unique vulnerabilities of children, and do not yet feature the education sector in an explicit manner. To address this critical gap, a few initiatives have been implemented.

Climate education through the Children's Solutions on Climate Change program: In collaboration with the Swiss Committee for UNICEF, UNICEF Mongolia has worked with communities to ensure that young people are able to demonstrate leadership in climate change and environmental issues, and that young people are represented in national and international climate change fora. The project included four components. The first component included establishing national climate ambassadors (one child and one adult for each of the thirty *aimags* and districts) who would be responsible for developing child-led environmental solutions. The second component was focused on mobile entertaining education to deliver knowledge of environmental issues. The third aspect was the Eco Passport program, whereby participants assessed their local area and identified possible impacts and solutions that could be implemented with small grants of 50,000 MNT (approximately 19 USD). 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. The education component of the program was very much focused on environmental education and awareness raising.

Children-led eco-clubs: A number of schools have implemented environmental (eco) clubs, either through their own initiative or as part of their participation in the UNESCO and SDC-led Education for Sustainable Development project. The children-led eco-clubs have varying levels of engagement, with some meeting rarely and others meeting regularly to identify

problems and come up with solutions to local environmental problems. In Bayankhongor province, for instance, the eco-club at Erdem school has identified desertification as a key problem and the children have planted several dozens of trees to prevent (and ideally revert) desertification trends. A similar initiative – the "Green passport" campaign – has been implemented by MET. The main purpose of the Green passport is to promote eco clubs at secondary schools and encourage children to contribute to natural conservation and improve their habits and attitude to "how to live green."

Greening education buildings: As part of the GDP, the Government of Mongolia has set an ambitious goal of ensuring all of the country's public buildings are environmentally friendly by 2030. In this regard, the Global Green Growth Institute (GGGI) supported MET, 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 construction of green kindergartens is 26% more expensive than construction of regular schools, there is a substantial reduction in utility costs of 20-99 percent per year, which results in longer-term savings (GGGI, 2018). Other initiatives related to infrastructure include the UN Partnership for Action on Green Economy (PAGE), through which a green school building was designed for School No. 122 in Songinokhairkhan district, Ulaanbaatar. The school features a source heat pump to reduce greenhouse gas emissions and air pollution. GIZ and SDC have also supported efforts to retrofit school buildings against climate-related disasters in Tuv *aimag.*

3. MAIN FINDINGS

CLIMATE IMPACTS ON EDUCATION: THE EVIDENCE

Climate change acts as a risk multiplier, interacting with environmental, socioeconomic and demographic pressures to exacerbate existing challenges. For instance, one of the most dominant features of recent demographic trends in Mongolia is the rapid migration from rural areas to provincial *(aimag)* centers and the capital city of Ulaanbaatar. Migration patterns are driven by a number of factors, but communities report that the decision to migrate is driven by both the search for better economic opportunities near mining operations and the capital city, as well as the failure to maintain a large herd size to ensure profitability. Climate patterns contribute to the challenges of livestock rearing through more intense summer and winter conditions, which limit access to food and water resources for livestock. To deal with these and other potential risks, it is important to first evaluate the potential climate challenges that Mongolia faces, and how they are projected to change over time.

Various climate change assessments have been conducted for Mongolia, including the Assessment Reports on Climate Change (MONET et al., 2009; MEGD, 2014), the Japanese Ministry of Environment's analysis of general circulation model outputs for Mongolia (MoE, 2015) and the USAID-funded Climate Risk Profile (2017). Such studies have tended to focus on impacts at the ecosystem level, on agricultural outputs, health, or on livelihoods. But specific impacts on education and learning have been relatively understudied. Though there has been limited work to link climate trends with education, an increasing body of research suggests that climatic conditions can have significant effects

on education and learning – which could ultimately have a compounding effect on underdevelopment. The pathways through which climate can impact on the education sector can be both direct and indirect (Figure 1).

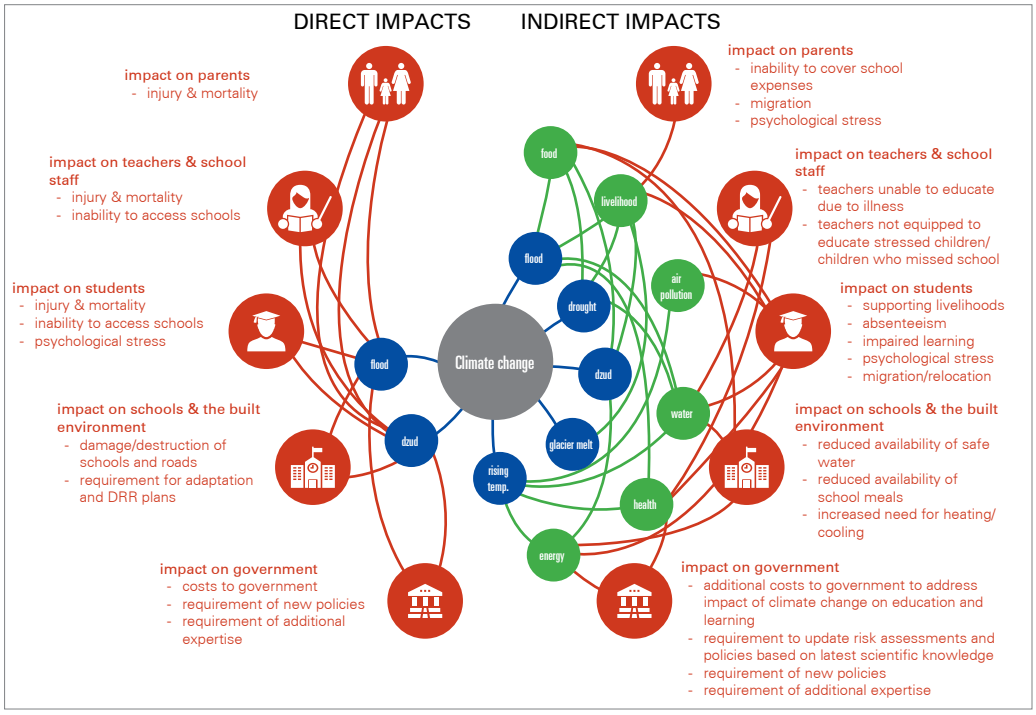


FIGURE 1 **The pathways through which climate change can impact the education sector are diverse.** Some impacts are more direct – such as floods destroying schools, while others are indirect – such as reduced agricultural output resulting in parents being unable to afford school expenses.

DIRECT IMPACTS

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 major climate risks (floods and *dzud*s) 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 impacts are listed alongside each of the stakeholders.

Dzuds

Dzuds have been historically some of the most destructive climate-related disasters in Mongolia, being implicated in mass livestock mortality which threatens the livelihood of pastoralist communities who inhabit the remote steppes as the 2015 event tragically showed. A *dzud* is a phenomenon that is unique to Mongolia; it occurs when a severe drought (typically in the summer months of June, July and August) is followed by heavy snowfall and extremely cold temperatures in the winter months (typically between December and February). The combination of these events leads to lower water availability and pastures, due to unfavorable conditions during the growing months of summer, and lack of access to pastures in other areas of the country, due to heavy snowfall and/or cold temperatures. Livestock mortality, in turn, has severe livelihood impact as communities lose their main source of food and income.

Herders identify five types of *dzud: (1) white dzud*, deep heavy snow and cold temperatures; (2) *black dzud,* freezing temperatures and the absence of surface water and forage; (3) *combined dzud,* deep snow with a sudden drop in temperature; (4) *iron dzud,* impenetrable ice cover over the forage area; and (5) *storm dzud,* high blizzard-like winds and heavy snow – however, differentiating between these is often challenging because of limited historical climate data (Rao et al., 2015). In addition to these *dzuds,* during field consultations in Bayakhongor, communities reported a recent trend which is resulting in *dzud-like* conditions: namely, the delay of the rainy season until end of July or early August followed by colder-than-normal conditions in September leading to freezing conditions which do not allow for growth of sufficient forage.

In Mongolia, such events have been historically linked to higher dropout rates, primarily due to livelihood and health effects, including nutrition outcomes. From the livelihoods perspective, *dzuds* increase livestock mortality which in turn reduces household income, including the ability to cover school expenses. From the health side, drought conditions and harsh winters exacerbate scarcity of water and nutritious food, leading to a range of health problems. A study of the impacts of *two dzuds* between 1999-2002 and 2009-2010 demonstrated that in the Western parts of Mongolia the occurrence of *dzuds* lowers the probability of basic schooling enrollment among herding communities, while this impact is not seen among non-herding families. This impact is most severe among pre-school children (Groppo and Kraehnert, 2017).

Among the most direct impacts of *dzuds i*s the ability of children to access schools. Heavy snowfall and extremely cold temperatures (sometimes reaching -40°C) make it extremely difficult for children and school staff to reach schools. As a result, older children tend to stay with the family (to help with household chores) rather than in centers (for schooling). If children do stay in the *soum* center, and are unsupervised, they might become the head of household – child-headed households tend to lack food and other means to stay in the *soum* center as they are disconnected from their

herding parents. During the 2009/2010 *dzud,* over 40 percent of schools and 50 percent of kidergartens reported lower attendance rates, with the majority of dropouts and absenteeism reported in the most severely affected provinces (Lawrie and Dandii, 2010). In part, dropouts and absenteeism were linked to difficult travel conditions from rural homes.

Exposure to *dzuds* has been quantitatively linked with a reduced likelihood of being enrolled in mandatory schooling, and this effect lasts up to three years after the shock (Groppo and Kraehnert, 2017). The trend is more significant among younger children: those aged 6-10 were between 6.3 and 7.8 percent less likely to be enrolled than those aged 11-15 (Groppo and Kraehnert, 2017). Long-term effects have also been identified: even eleven years after the 1999-2002 multi-year *dzuds*, children who lived in heavily affected areas were between 26.5 and 31.2 percent less likely to complete education. Both of these trends are seen among herding communities, but not in urban settings.

The direct impact of *dzuds* on education can be described through the following rationale. Harsh winters can affect the quality of schooling infrastructure. Heavy snowfall can damage roofs and walls, while also making transportation to and from schools extremely challenging (United Nations, 2000). At the same time, extremely cold temperatures may provide exceptional challenges for providing adequate heating and food supplies to schools and dormitories as demonstrated by the 2009-2010 event (Lawrie and Dandii, 2010). The uncomfortable environment created by cold winters can reduce the ability of students to concentrate during class and create stress for students.

School closures are also common during *dzud* events. For instance, during the 2009/2010 event, 35 percent of schools reported closures of between 1 and 5 days, whilst 12 percent of the schools reported closing for more than 6 days due to the heavy snowfall (Lawrie and Dandii, 2010). In addition, more than two thirds of schools closed up to eight classrooms as they were deemed unusable (blizzards and strong winds had blown off roofs, stoves had broken, and pipes had frozen due to the freezing water) *(ibid.).*

From a financial perspective, longer winters pose a substantial stress on public spending. In 2004, 18 percent of the national education budget was spent on heating schools and dormitories (World Bank, 2006). During the exceptional winter of 2009/2010 school authorities reporting a large proportion of their school budget on fuel for heating, severely restricting funding for other essential education needs like school textbooks and updating infrastructure (Lawrie and Dandii, 2010). More frequent harsh winters and longer cold seasons (as reported by communities and suggested by some climate models), will likely place an additional burden on financial resources.

Projecting future risks associated with *dzuds* is challenging because these occur over seasons and years, and depend on a number of conditions. The first requirement for a *dzud* to occur is a dry summer. By and large, climate models suggest a continuation of the drying trend seen in the first part of the 21st

century extending until the middle of the century, after which more regular precipitation will help reverse the trend (see Hessl et al., 2018). However, even after precipitation increases, the timing of rainfall is of concern. Projections suggest a delay in the onset of the rainy season, which will prevent regular pasture growth. The second condition that must be met is heavy snowfall or extremely cold temperatures in the winter months. Though annual temperatures are projected to increase, and winters could become milder, models suggest that winters will be more extreme with more heavy snowfall events (MEGD, 2010). The combination of these conditions suggests that *dzud* risk is likely to increase in the coming decades, though there are large uncertainties with how these risks will materialize in the latter half of the century.

Flood risk

In Mongolia, floods have typically occurred in the transition between spring and summer as the winter snow melts. In years with particularly heavy snowfall, or abnormally warm springs, conditions lead to flash flood events. In recent years, however, communities have noted a shift in the timing of the rainy season – from early May to late July or early August – accompanied by a more concentrated rainy season, ultimately resulting in floods.

Recent years have seen an increase in the frequency of flash floods during the spring months in Mongolia, largely resulting from accelerated melt of glaciers, permafrost and snow (Nenova-Knight, 2011). Flash floods can have a detrimental impact on education through two main pathways: first, they can destroy critical education infrastructure and limit access to education; and second, they can lead to water shortages and concomitant health problems. Flash floods threaten to damage key sources of freshwater, thereby exacerbating water scarcities for both urban and rural communities. Flash floods have also occurred in the latter part of the Mongolian summer (most recently in July 2018). Such events are linked to a delay in the onset of the rains, which normally occur in May.

As floods are less common than *dzuds,* their impact on education is less well-documented. But anecdotal evidence suggests that the timing of floods is critical. If the event takes place in the spring months (during the livestock birthing season), a flood can limit the ability of children to reach their home to support their family – or get back to school after visiting their families. If the flood coincides with the beginning of the academic year, and roads and bridges connecting remote locations with provincial and district centers are destroyed, this would hamper access to schools. During community consultations, families reported difficulty in accessing schools due to heavy damage to roads resulting from flash floods in September in Bayankhongor province. Due to safety concerns, some families decided not to take their children to school until the floods receded 10 days after the beginning of the academic year, leading to potential fallback in learning.

And finally, even if the flood occurs during the summer break, damage to school infrastructure can be problematic. Losses associated with floods can be significant, as demonstrated by the June-July 2018 floods which affected parts of northern and western Mongolia. In all, economic losses were estimated to exceed 17 billion MNT (equivalent to approximately US$ 6.4 million) but no sector-specific damages are available (MECSS et al., 2018). The floods resulted in severe damage to several school and kindergarten facilities, with some schools in Bayan-Ulgii experiencing heavy damage to roofs, beds, and toys. In a school serving 320 children in Arhangai province, a roof was destroyed beyond repair causing an estimated damage of 5.7 million MNT (MECSS et al., 2018). In addition to damages reported in schools, the 2018 floods also destroyed school dormitories. For instance, in the province of Bulgan, a boys' dormitory was severely cracked due to flooding. Education staff were also affected, with over 50 teachers and non-school staff reporting damage to their homes in Bayan-Ulgii and Arhangai provinces. The impact of such losses experienced by school staff is understudied, but it is likely that the stress felt by teachers and other school staff can affect their performance at work (MECSS et al., 2018).

Under climate change, models indicate an increase in spring and summer temperatures which will likely accelerate glacier and snow melt – which will ultimately result in more frequent and intense flash floods (MEGD, 2010; UNICEF, 2018). Climate models disagree on the duration and timing of rains, but there is general agreement among CMIP5[2] projections that the onset of the rainy season will likely be delayed under future climate – highlighting the heightened risk of potential flash floods later in the year. This trend is likely to continue throughout the entire century. The severity of flash floods, however, will also depend on snowfall and snow cover during the winter months. Models generally project more extreme cold winter conditions until the middle of the century but disagree on the direction of change during the latter half of the century (MoE, 2015).

2 CMIP5 (the Coupled Model Intercomparison Project Phase 5) is a collaborative framework designed to improve knowledge on climate science. The fifth phase represents the most recent completed version of the project and includes the most up-to-date climate outputs used in the climate change community. Phase six of the project is currently ongoing.

INDIRECT IMPACTS

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 major climate risks including rapid-onset disasters (floods), multi-causal disasters (*dzud*s) and slow-onset disasters (droughts, 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 events and disasters can affect education and learning indirectly through intermediate socioeconomic and environmental effects.

Dzuds

In addition to direct impacts on education infrastructure, school children and school staff, *dzuds* have serious effects on health, nutrition, child protection and livelihoods that can ultimately have a detrimental effect on education and learning outcomes. Indeed, the indirect impacts of *dzuds* on education are possibly more significant than the direct impacts. A recent study on short- and long-term effects of *dzuds* on education concluded that children from herding families were more likely (by up to 31.2 percent) to drop out of school than children from non-herding families – suggesting that supply of education services (e.g., provision of heating during classes) is less problematic than indirect individual- and household-level impacts (NSO and DIW, 2015). The ways in which *dzuds* can have indirect effects on education are multi-faceted.

First, school authorities report that, together with difficult school access conditions, the most serious impact *dzuds* on education is related to health. Extremely cold temperatures exacerbate respiratory illnesses. During the 2009/2010 dzud, for instance, school staff from over 20 schools reported that absenteeism had increased, especially in the western provinces. The primary cause of absenteeism was linked to unusually high numbers of sick children, with some children missing over 10 days of school as they were being hospitalized (Lawrie and Dandii, 2010).

Second, *dzuds* have been associated with long-term impacts on nutrition. Large-scale climate shocks, such as the 2010 *dzud*, result in increased stunting (i.e., low height-for-age) rates among children from herding communities. This effect is not replicated for urban communities, highlighting the vulnerability of children in rural areas to climate-related nutrition problems (Schindler and Groppo, 2014). Children who were exposed to the

2009/2010 *dzud* and who lived in the most severely affected regions showed height-for-age z-scores 1.26 standard deviations lower than those of children of the same age in non-affected areas. Malnutrition in the aftermath of the 2009/2010 *dzuds* was particularly high in the western regions of Mongolia (28.7 percent) compared to the national average (16 percent) *(ibid.)*. Higher prevalence of stunting is likely due to reduced availability of nutritious food (resulting from the loss of the primary source of food) and lower purchasing power to buy nutritious food (resulting from the loss of the primary source of income). Therefore, the effects of the *dzud* on stunting were less severe among households who have multiple sources of income, and among households who received food assistance in the aftermath of the event. Indirectly, these effects can have severe impacts on education: at the global level, stunting has been linked to lower ability to concentrate in school and lower academic performance (Jukes et al., 2007).

Third, *dzuds* are a major contributor to rural poverty (World Bank, 2006). *Dzuds* destroy livelihood assets (for instance, the 2009-2010 *dzud* resulted in losses of around 23% of all livestock) and by reducing the households' asset base they contribute to a lower income level, which limits the ability of parents to afford school expenses. Consequently, some children drop out of school to help with household and herding activities. Children also report higher stress levels during major *dzud* events, as a result of livelihood losses experienced by their families. During the 2009/2010 event, children reported experiencing unhappiness and distress caused by witnessing the difficulties their families were facing. The frequent exposure to television news also generated further distress for children – though the effect on learning outcomes has not been quantified (Lawrie and Dandii, 2010).

The lack of insurance systems during the multi-year 1999-2002 and 2009-2010 *dzuds* and the limited aid provided in the aftermath of these events led several households to relocate to Ulaanbaatar in search of employment after losing their herds (indeed, survey data indicate that after the 2009-2010 *dzud* more than 40 percent of households reported losing over half of their herds; UNDP and NEMA, 2010). Such migration patterns can also disrupt education, especially in urban areas where exisiting school capacities may not be sufficient to take on additional children. For instance, in Nalaikh district, school authorities reported the need for three shifts in some schools to accommodate the high number of students (mostly from migrating families).

In addition, migration to Ulaanbaatar and provincial centers, partly driven by *dzud*-related livelihood losses, also contributes to air pollution – as low-income families move to urban areas they depend on low-cost fuel (particularly coal) to heat homes during the winter months. The heavy pollution resulting from burning coal can exacerbate respiratory problems during the winter months. With students missing classes due to illness, there is a strong possibility for falling behind with the curriculum. During community consultations, children also report low visibility in the winter months due to the

combination of limited daylight hours and dark smoke being produced by burning coal. Low visibility, in turn, can affect child safety.

Drought risk

Drought is a significant threat to Mongolia's population, and is a precursor to the highly destructive *dzuds.* However, even if the droughts are not followed by heavy snowfall or cold winters, they can have devastating impacts on their own. Mongolia experienced the most severe consecutive drought events in its history between 1999 and 2002, which led to the degradation of 70 percent of grassland (cf. Marin, 2010). In addition, as a result of these drought events, more than 3,000 water sources including 680 rivers and 760 lakes were completely dry – exacerbating water scarcity problems in rural areas.

Reduced availability of livestock feed and water can translate to livelihood impacts, with major losses of livestock. As with *dzuds*, the consequences for education can be severe: some children from herding families drop out of school either because parents are unable to afford school expenses, or because they support household and livelihood activities. This effect is not fully quantified in the context of Mongolia but studies focusing on *dzuds* can give an indication of the extent of this problem (see, for instance, Groppo and Kraehnert, 2017).

Drought conditions can also exacerbate health problems. In areas that already have low access to safe water, children are particularly prone to water-borne infections and diseases (Nenova-Knight, 2011). Salmonella and dysentery rates have also been found to increase with intense drought events (Batima et al., 2011). Indirectly, these health effects can affect the ability of children to focus during school – and global studies have shown that children suffering from water-borne diseases are more likely to miss classes or drop out of school altogether (Glewwe and Miguel, 2007).

Finally, droughts have also been associated with family separation. In Sukhbaatar province, for instance, families reported having to relocate in search of better pastureland for their livestock during severe droughts. In turn, migration patterns can lead to family separation as children are forced to stay in dormitories without parental care and supervision (UNICEF, n.d.).

Flood risk

The indirect effects of floods on education are not fully quantified in Mongolia – though anecdotal evidence suggests that floods can contaminate critical water sources (such as wells) limiting the availability of safe drinking water in schools. In the aftermath of the July 2018 floods, for example, a number of kindergartens reported the presence of mud in their wells (MECSS et al., 2018). As floods become a more common occurrence, their impact on education needs to be better understood.

Glacier melt

Glaciers are an important source of water in Mongolia, contributing to 10 percent of the country's freshwater (Myagmarjav and Davaa, 1999). Up to 50 glaciers have been identified in the country, with the majority located in the northwestern region (Kamp et al., 2013). Rapid glacier melt has been associated with floods though in the long run the disappearance of glaciers can exacerbate drought risk. Additional work is needed to evaluate the impact of glacier melt on education.

Extreme temperatures

Mongolia's climate is very harsh, with extreme temperatures both in winter and in summer. Because children do not attend classes during the peak summer months (July and August), extremely hot temperatures are only likely to have indirect effects by contributing to water scarcity and health problems – though these effects have not been quantified.

Extremely cold temperatures in the winter months, on the other hand, are a common problem for education. Such weather creates an uncomfortable environment in the classroom. The problem is exacerbated by ageing school infrastructure and poor insultation in modern buildings, which allow heat to escape from the classroom. During the winter of 2009/2010, directors from 41 percent of schools and 33 percent of kindergartens reported that temperatures in classrooms were not acceptable for teaching and learning (Lawrie and Dandii, 2010).

Indoor and Outdoor Air Pollution

Pollution is both a source and a consequence of climate change. Pollution is a source in the sense that households typically burn coal contributing to greenhouse gas emissions. But it is also a consequence of climate trends which have been associated with increasingly harsher winters. Mongolia's capital city, Ulaanbaatar, is among the most polluted in the world ranking as the fifth most polluted capital city in the world with an average of 58.5 μg/m³ of dangerous particulate matter 2.5 (PM2.5) – compared to the international standard of 10 μg/m³ (WHO, 2019). In the winter, PM2.5 levels reach 200 μg/m³ (IQAir, 2018). The extent of pollution in Ulaanbaatar is such that for children under five, per capita deaths attributable to ambient air pollution is several times higher than in neighboring countries (MONET, 2010). The problem of air pollution is more prominent in urban and peri-urban settings around Ulaanbaatar, but rural communities are not immune to higher pollution levels. In rural areas, the use of indoor stoves contributes to pollution and potential respiratory problems, particularly among younger children.

The links between climate change and air pollution in Mongolia are not straightforward. The source of pollution in Ulaanbaatar and provincial *(aimag)* centers is the increased use of coal by families living in *ger* districts on the periphery of urban areas – and in Ulaanbaatar, the problem is exacerbated by the geography of the city (the city is located in a valley and is surrounded by mountains, preventing the dilution of smoke). Increasing migration to urban areas is driven by two factors: on the one hand, families seek a better quality of life (better services) and more economic opportunities – but on the other hand, families also migrate as livestock rearing becomes increasingly challenging. The second issue, in particular, is partly driven by climatic conditions: more severe summer and winter conditions make it increasingly challenging to provide sufficient fodder and water for livestock, leading to large-scale mortality and, in extreme cases, a collapse of livelihood options for families. The combination of these factors contributes to migration. As coal remains the cheapest and most readily available source of energy for families in the so-called *ger* districts, is the most widely used fuel for cooking and heating.

Evidence has linked higher pollution levels to lower academic performance (Miller and Vela, 2013). Beyond increased mortality and morbidity, air pollution also has severe consequences on health – particularly higher incidence of asthma and respiratory problems – which can translate to education impacts. High concentrations of pollutants

can affect children's learning process by exacerbating respiratory illnesses, fatigue, absenteeism and attention problems (cf. Miller and Vela, 2013). As winters are projected to become harsher, the severity of the problem under climate change will depend on the greenhouse gas reduction strategies and policies to transition away from coal for heating. Even with aggressive mitigation goals, the climate change that the world is committed to will result in increases in temperature. In the absence of a comprehensive strategy to limit both the source of pollution and exposure to it, this trend is likely to exacerbate pollution levels and ultimately affect children's performance in schools.

The government's sudden political decision to shut down school for a month in the winter of 2018/2019 due to air pollution had a negative impact on quality of educational service as it affected school's normal function. In addition, it reduced time available for teachers to cover the entire curricula content within the academic year and resulted in teachers not being able to teach specific or certain content and/or requiring students to study some content on their own. Also, such prolonged school closures can have a financial cost on the education sector due to change or extension in academic year schedule. Moreover, although schools are closed, the heating system still incurs costs which are borne by education authorities.

Here it is important that outdoor air pollution is not solely linked to increase coal use in the winter. Indeed, increasing *summer* temperatures have been associated with more frequent and intense forest fires (Shuman et al., 2017). This trend contributes to higher carbon dioxide emissions being released from carbon stored in trees as well as otherwise frozen peatlands. And the pollution resulting from forest fires has the potential to travel long distances, reaching Mongolia (and even locations in Canada and the United States). In July 2019, sustained periods of above-average summer temperatures triggered fires in 2.4 million hectares of forest in eastern Siberia. The difficulty of reaching the area has meant that controlling and altogether stopping the fires is extremely complicated and expensive (AFP, 2019). Though the consequences for education in Mongolia are yet to be evaluated the foregoing discussion highlights that climate change will introduce new risks that could translate to education impact. This is especially true given that projections suggest this kind of forest fires will become more frequent under rising temperatures.

CASE STUDY: IMPACTS OF CLIMATE CHANGE ON EDUCATION AND LEARNING IN BAYANKHONGOR PROVINCE

Bayankhongor is a province *(aimag)* in southwestern Mongolia consisting of three diverse landscapes: the northern mountainous region, the central steppes, and the southern arid Gobi desert. The province is prone to droughts, *dzuds* and flash floods – all of which pose significant problems both to the education sector.

DIRECT IMPACTS

One of the key climate-related challenges for the education sector is access to schools – especially for smaller schools located in district *(soum)* centers. During the winter months, a heavy snowfall event can limit access to schools. In a country with limited roads, snow can make the few existing roads impassable; and even if snow melts, cold conditions mean that roads are icy and too dangerous for walking or driving. This is especially problematic if the heavy snowfall events coincide with the winter breaks as children, especially those who reside in dormitories, will likely delay their return to classes. Community consultations reveal that winters have become warmer in recent years (though still with sub-zero temperatures) but that the cold season has also been extended, meaning that the challenge of accessing schools lasts longer – even extending to the birthing season in March when children in secondary school are traditionally expected to support households. Indeed, communities report that even though transportation options and conditions have improved drastically over the years, access to schools is challenging because climatic conditions have changed.

Beyond harsh winters and heavy snowfall events, flash floods during the summer can also contribute to the difficulty of accessing schools. Typically the rains fall in May but localized heavy rainfall can also occur in August or September, coinciding with the beginning of the academic year. Indeed, during community consultations in Bayankhongor province, families reported that flash floods in 2018 destroyed bridges, making it impossible for some families to reach the soum center on time for the beginning of the academic year.

Currently there are no formal alternative education modalities or remedial/catch-up classes exist for students who miss school due to impassable roads. Some teachers provide remedial classes, but this is not a formal requirement in all schools. With changing seasonal patterns, and an increasing likelihood of heavy snowfall and rainfall events, ensuring access to schools should be a priority – both in terms of infrastructure (road and bridge access) as well as alternative education modalities for children who live in remote areas.

An additional problem linked to heavy snowfall and rainfall is damage to school infrastructure. Especially in schools designed with a flat roof, snow tends to accumulate on the rooftop and eventually leaks into the walls of classrooms, generating moisture and even mold. Damage to textbooks, stationery and desks is common and can affect learning outcomes as children do not have sufficient access to education material.

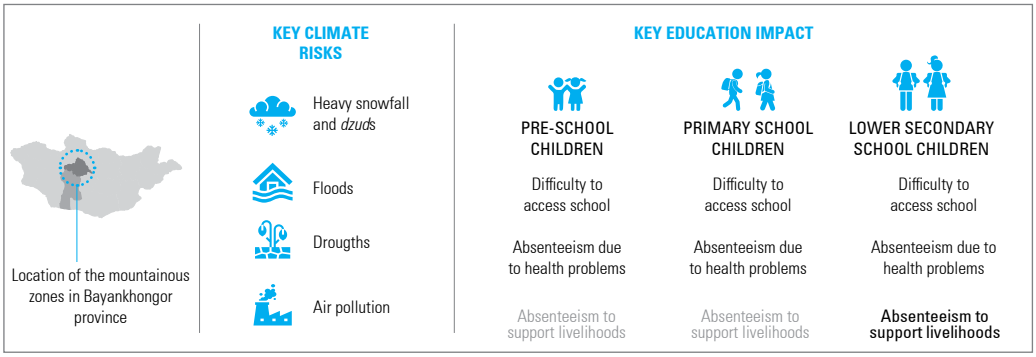


Figure 2 | **Summary of climate risks and impacts on education reported in Bayankhongor province, Mongolia.**

INDIRECT IMPACTS

During the community consultations, indirect climate-related effects were also identified that could exacerbate risks for a successful education.

Food and nutrition security. There are two food security challenges associated with climate change. First, communities report a delay in the onset of spring/summer rains (which traditionally occur in May, allowing for grasses to grow during the summer months) limiting the availability of food while at the same time increasing food prices. As a result, communities have to rely on fodder imported from other areas in the province or from other provinces altogether. If fodder is not available, the quality of meat is severely diminished. Communities have reported thinner animals – and they even report finding rocks in the stomachs of their livestock due to sand storms/desertification – which contributes to lower availability of nutritious food for children.

In addition, schools and dormitories rely on vendors for their meat. Some schools have reported that in recent years, icy conditions make it difficult for the vendors to access schools. Under such circumstances, schools depend on their food stocks or even on nearby herding families to supply meat. While this has not yet been a serious problem, the prolongation of the cold season under climate change can contribute to the lack of sufficient, nutritious food in the winter months.

Livelihoods. Livestock rearing is the dominant livelihood in the province, with yaks, sheep and goats being the preferred animals in the northern mountainous regions; cattle, sheep and goats in the central steppes; and camels in the Gobi desert. Typically, during *dzud* events children in secondary school (particularly boys) are expected to support their families. In major *dzud* events (such as those of 2000 and 2010), children missed school for up to eight weeks. School children are also culturally expected to support their household during the birthing season (in March). Activities include, among others, fetching water for

the household and livestock; household chores; taking care of younger siblings; and taking care of livestock. Typically these activities are carried out during short one- to two-week school breaks, so education is not disrupted. However, as highlighted earlier, the prolongation of the cold season has slowed down the melting of snow/ice, creating a serious risk for accessing schools. In addition, teachers have reported that during particularly severe winters, children return to school tired due to the heavy workload at home – thereby affecting their learning.

Health. Among the various indirect pathways through which climate affects education, health impacts are reported as the most serious for Mongolian children. Absenteeism increases due to health-related problems during the cold months, with children missing between 7 and 10 days due to respiratory illnesses. Teachers have reported an increased incidence of health-related absenteeism in recent years – partly due to the extension of the cold months, and partly due to the prolonged use of coal in *aimag* and *soum* centers as a result of the extension of the colder months. As per recommendations by the Ministry of Health, the MECSS requires schools to temporarily close down if 15 percent of the students in the province experience an illness in order to prevent the disease from spreading. In some of the schools visited, between 30 and 40 percent of students fall ill during the peak winter months of December and January. Moreover, after major *dzuds* parents and family members exhibit stress (for example, due to financial loss) which impacts children's mental health, and consequently their ability to concentrate during class. In extreme cases, some family members show suicidal tendencies.

Water. Schools reported limited access to drinking water facilities and access to safe sanitation facilities is a challenge. Access to water is key for children's wellbeing and ability to perform in school. A lack of safe drinking water can exacerbate health problems. During cold winters, access to water and sanitation facilities is especially challenging. As water freezes, children are unable to use showers and sinks. In some areas, icy conditions also make it unsafe for children to access toilet facilities which are located outside of schools or dormitories to the extent that young children experience injuries trying to reach sanitation facilities.

Air pollution. Outdoor air pollution is a major problem in Mongolia. Increasing migration to aimag centers has led to higher population density. Coal is the cheapest (and therefore the preferred) source of energy among communities living in ger districts. Pollution from coal therefore spikes in the winter months as families try to maintain a pleasant temperature in their household. As highlighted earlier, in recent years, the cold season has extended – thereby increasing reliance on coal for a longer period. Air quality affects the health of children and teachers, and therefore negatively affects learning. Another indirect effect of air pollution on education, reported by children, is that the smoke generated by burning coal exacerbates winter darkness making it difficult for children to find their path to school. Some children suffer from accidents as a result of this trend.

Energy. Energy issues are significant, especially during the colder months. Energy is required to keep classrooms warm (and therefore comfortable for learning) during the winter and early spring. However, heat leaks due to poor insulation or ageing infrastructure are extremely common. In one of the schools visited during the field consultations, children and teachers monitored classroom temperatures and reported that the average temperature in the classroom is 5°C – consequently children shiver even with heavy winter clothing. The problem is not endemic to school buildings; it's also found in dormitories where broken and cracked windows are common, affecting children's wellbeing and ability to study in the broader school environment. During extreme wind events, electric poles can be damaged, disconnecting provinces from the central grid system for days or even weeks.

Additional consultations in different regions of the country, particularly in the steppes, the taigas, and the desert would provide a more comprehensive picture of the potential impacts of climate change on education and learning.

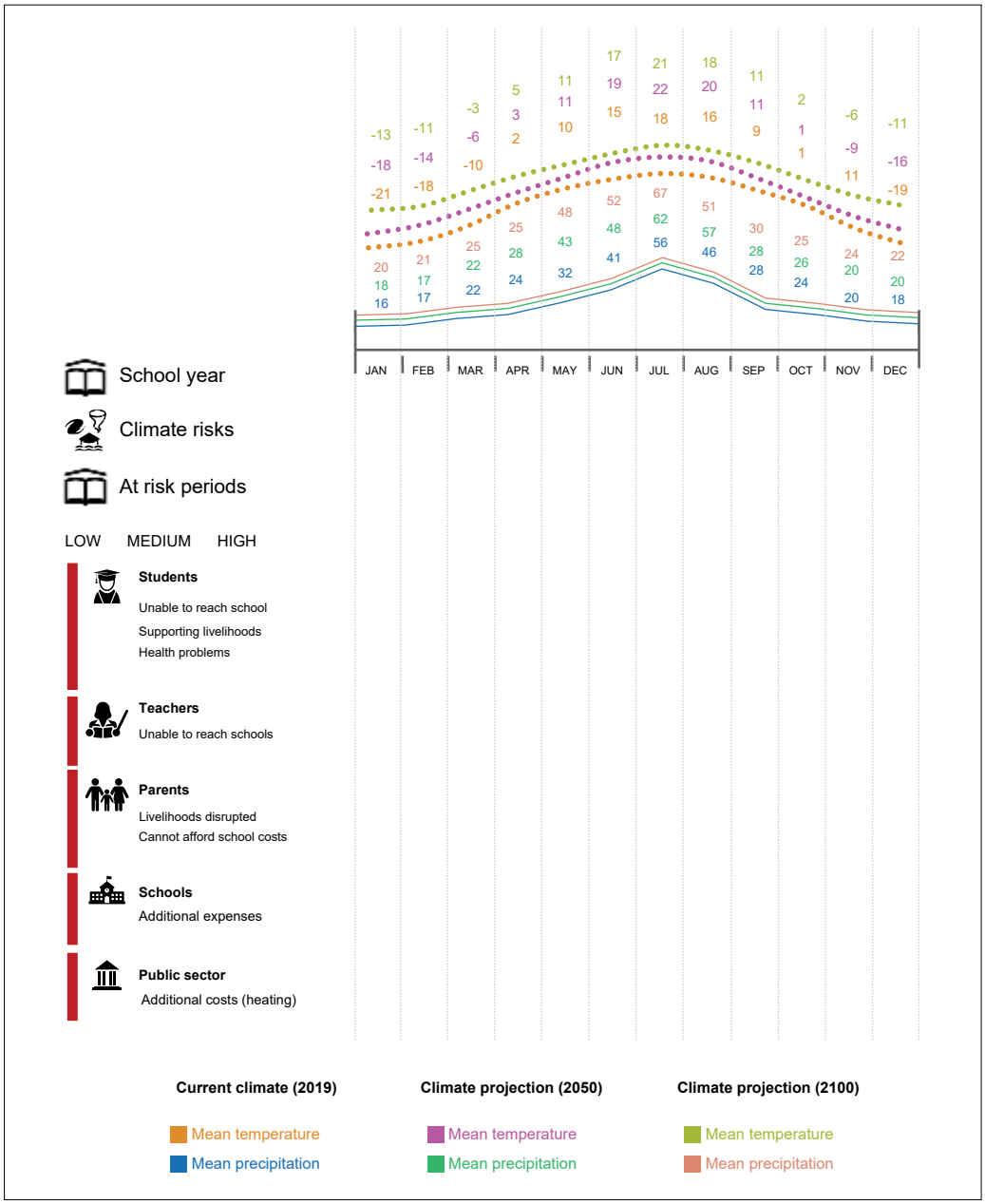
PROJECTING FOR THE FUTURE: HOW FUTURE CLIMATE CHANGE MAY AFFECT THE EDUCATION SECTOR

As the forgoing discussion highlights, *dzuds* are perhaps the greatest climate-related hazard that can disrupt education in Mongolia. Under climate change scenarios, two conditions may increase the potential for destructive *dzuds:* more extreme summer temperatures which can lead to more intense and severe droughts, and more intense snowfall in the winter months accompanied by a prolongation of the cold season. In addition, the delay of the onset of the rainy season can also contribute to education access challenges.

The chart below page illustrate the periods during which the education sector is potentially affected. For each of the five main stakeholder groups in the education sector (students, teachers and school staff, parents, the built environment, and the government), the key risks and their timing is identified. For instance, for students, access to schools is likely to be hampered by *dzuds* between December and February, and they could miss classes or drop out of school between January and March as they support livelihood activities at home.

Additional vulnerabilities that could be faced under future climate change due to greater intensity, duration or severity of disasters are shown in dark red.

Graphic 1. How future climate change may affect the education sector



CONCLUSIONS

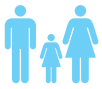
Climate change is a serious challenge to the education sector in Mongolia. Already today, children experience severe difficulties in accessing school due to icy conditions in the winter months or after a flash flood. Morover, pollution problems, linked to the rapid rural-to-urban migration partly driven by climate trends, are also posing a major challenge to children's well-being. As these disasters become more frequent and severe under climate change, the education sector needs to adapt in order to ensure universal education.

Part of the solution requires improving access to education under climate change. This means ensuring that education infrastructure is resilient to climate patterns which are likely to become more frequent under climate change, such as heavier snowfall and more severe flash floods. In addition, alternative education modalities should also be explored as a way to prevent disruption of classes in case of extreme climate-related events.

Improving the quality of education is also an essential part of the solution. Children recognize climate change as an important challenge to their education, and more broadly, to their well-being. However, they often report insufficient knowledge and skills to address climate change and related risks. Climate change education is needed to ensure that children can be effective agents of change.

Finally, there is a need to strengthen education systems to address climate change. Such efforts inevitably require greater collaboration among various agencies and ministries (including MET and the NEMA) and greater access to climate finance – which has historically been limited for the education sector.

Substantial work has been done to enhance disaster risk management efforts (particularly in the context of earthquakes and floods) among schools, and there is scope to build on these initiatives and experience to ensure climate change adaptation. **The table below** indicates progress achieved thus far as well as areas for potential improvement to ensure climate-resilience in the education sector. Moving forward, efforts should focus on enhancing the national education masterplan (currently ongoing), the disaster risk reduction framework for the education sectors, training teachers on climate change topics, and retrofitting schools and associated infrastructure to withstand the impacts of climate change and climate-related risks.

 GOVERNMENT (national/subnational)	Government has a climate change strategy embedded in the education sector plan with M&E indicators Government agencies 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)	2/4 score
 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	1/4 score
 TEACHERS & 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/emergency preparedness and alternative education modalities Teachers have sufficient materials to provide climate change education School staff develop climate resilience strategies across the school	2/4 score
 PARENTS & 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	2/4 score
 STUDENTS	Students learn about climate change issues and develop problem solving critical thinking skills Students have access to climate change education materials During extreme weather events, students can access alternative education from a secure place or accelerated programs afterwards Students engage in climate resilience activities at school and at home	2/4 score

 SCHOOLS & 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 retrofitted against future climate risks	1/4 score

4. RECOMMENDATIONS

ENHANCING DATA AND IMPROVING THE EVIDENCE BASE

Integrating climate change and environmental information into the Education Sector Information System (ESIS).

There is recognition within the MECSS that climate change poses a significant challenge to education objectives but the evidence base is still dominated by anecdotal examples and *soum* level assessment reports rather than comprehensive work at the national level. Doing more systematic analysis of climate impacts on education requires investment in data systems. Yet the benefits can be significant: generating a robust evidence base quantifying the impacts of climate change on education can help attract climate funds from sources such as the Green Climate Fund or bilateral donors, while also offering an opportunity to strengthen the argument of the Ministry of Education when requesting contingency funds.

Integrating indicators on climate-related impacts in the Education Sector Information System (ESIS) offers an opportunity to enhance data that are collected routinely anyways and provide a database for understanding how climate impacts on education. The ESIS currently collects indicators on numbers of schools, numbers of students, numbers of teaching staff, enrollment rates, students' performance, and student flow/completion rates. A key challenge identified by MECSS, however, is that data are not being analyzed and utilized for planning purposes. From a climate risk perspective, adding indicators to the ESIS on (1) whether the school was damaged by climate-related disasters in the academic year, 2) number of school days missed and (3) reasons for missing classes/dropping out of school could provide a powerful database for systematically analyzing impact trends. For instance, together with meteorological information from the NAMEM and disaster-related information from the NEMA, education data from the ESIS can provide useful insights regarding the impacts of climate- (and other) related hazards.

Within the framework of expanding the scope of the ESIS, a limitation identified by MECSS is the software capacity of the existing structure. Investment towards enhancing the capabilities of ESIS could enable addition of simple indicators and enable thorough analysis of various issues.

Vulnerability assessments on climate change risks and air pollution, and expansion of the analysis to other regions of the country.

Intuitively there is an understanding that some schools are more vulnerable to the impacts of climate change than others – there is scope for using this information for planning and budgeting purposes. The MECSS has already conducted analysis of the locations of at-risk schools (including the number of students they serve and the number of teachers and education staff working at those schools) in the context of earthquake risk and some initial work has been done to evaluate flood-related risks. There is scope for improving these existing efforts to include *dzud* risks and integrate climate change projections into this analysis to prepare for climate change. Such analysis will also provide insights on new risks that will be introduced under climate change, such as rising temperatures (and more frequent extreme heat events) and glacier melt. In addition, given the severe impact that air pollution is already having on children's health and education, additional work researching impacts associated with pollution on education and learning is needed.

The work conducted for this analysis was based on findings from various secondary sources, including peer-reviewed journals and disaster assessment reports, as well as field consultations in Nalaikh (in the outskirts of Ulaanbaatar) and the mountainous zone of Bayankhongor province. Given that the country is vast, with very diverse landscapes ranging from the taigas in the north, to steppes in the east, high mountains in the west, and the Gobi Desert in the south, field consultations in these various zones should also be conducted. Such analysis would provide a more comprehensive overview of risks and climate trends felt by communities.

INCREASE ACCESS TO EDUCATION UNDER A CLIMATE CHANGE SCENARIO

Climate-change sensitive education infrastructure planning.

Climate-related risks should be taken into account in the planning and construction of any educational facilities. Developing guidelines and standards that take climate change issues into consideration is an essential starting point for better planning. Such guidelines should be incorporated into the recently published school safety standards.

A key concern for the education sector in Mongolia is the ageing infrastructure. Some schools were built over 60 years ago, and some require significant repairs to minimize heat loss during the winter months (indeed, some schools have major cracks in windows and walls, and do not maintain a comfortable room temperature for teaching and learning). Poor insulation in walls and windows exacerbate this problem. On the other hand, newer

buildings are built with flat roofs which can accumulate snowfall and can get severely damaged during heavy snowfall events. Energy access is occasionally a challenge, and can be relatively expensive, so identifying alternative sources of energy (such as solar panels) can help reduce the financial burden on schools – though additional work is needed to explore the feasibility and scalability of alternative energy sources. Such efforts will need closer intersectoral and interministerial collaboration to ensure that the latest knowledge on climate science is well-integrated to address the needs of the education sector.

Beyond schools themselves, the dormitories visited do not provide a comfortable environment during the winter months. Education authorities report that this is a widespread problem as there is limited investment on dormitories. Problems vary from building to building, but common issues include broken windows, insufficient heating inside the dormitories, frozen water during the winter (and therefore an inability to use the sink), and icy conditions near outdoor sanitation facilities.

On top of this, roads tend to be covered by heavy snow or ice during cold months. With increasingly longer cold periods, snow and ice melt is likely to be delayed providing additional challenges for access to schools. Directors from schools report that small investments, such as placing rocks on the roads can help melt the snow faster and thereby increase access to schools.

There are a number of climate challenges, both at the school-level but also in dormitories and infrastructure around schools. Developing guidelines to design climate-resilient and energy-efficient infrastructure can help prevent access and safety problems in the winter months, which will likely become more commonplace under climate change. Additional work in collaboration with various ministries and engineers is required to develop such guidelines.

Alternative education modalities to address climate change-related risks

A number of initiatives have already been implemented to explore alternative education. With UNICEF support, the MECSS has implemented the *ger* kindergarten programme to increase access to pre-primary education among herding families. The *ger* kindergartens follow the nomadic patterns of herding families during the summer months and thereby ensure that children are near their parents' home. The *ger* kingergarten model was not meant as an alternative education modality in case of occurrence of climate related disasters, but the approach could be tested for areas that have been particularly affected by climate-related risks and where children have been unable to attend classes.

During the recent four-week shutdown in the winter months, the MECSS organized TV lessons and also distributed the syllabus material through online media. Access to these, however, varied significantly by region. For instance, field consultations revealed that not all parents in the *aimag* center and the soums of Bayankhongor received information about these alternative education modalities.

As climate change-related risks (and air pollution in winter) will increase the likelihood of access challenges, alternative education modalities should be further explored. There is already a wealth of experience with mobile education facilities for pre-primary children, and TV-based education – but additional work is needed to systematically integrate these into school planning for all levels of education to ensure that education services are not disrupted.

IMPROVE LEARNING TO ADDRESS CLIMATE CHANGE IMPACTS

Improve the quality of climate change education

Environmental education remains limited, though initiatives such as Education for Sustainable Development have provided the impetus to improve the environmental component of the national curriculum. The updated curriculum, too, includes climate change as a theme in the geography and biology courses. The scope, however, is limited to climate change processes and impacts on water resources (taught in Grade 7). There is therefore an opportunity to include additional climate change content – including basic science, climate change impacts, and perhaps more importantly, mitigation and adaptation solutions. Approaches such as project-based learning offers an opportunity to make climate change issues more relatable and thereby improve climate change education.

Building on an improved curriculum, children should also be encouraged to explore climate change solutions that are relevant to their local environment. Within the framework of skills-based learning, there is significant scope promoting

the participation of children (as well as teachers and communities) in small-scale adaptation programmes can generate significant benefits. Such initiatives have been implemented in the past, such as through the SDC and UNICEF-supported Eco Passport program, whereby participants assessed their local area and identified possible impacts and solutions that could be implemented with small grants of 50,000 MNT (approximately 19 USD). These initiatives, however, tend to be project-based and are not kept up once the project is terminated. Funding for such activities should therefore be integrated into the education sector's financial plan.

SYSTEMS STRENGTHENING

Capacity development for teachers, school staff and education authorities on climate change issues and disaster management

There is a need to enhance knowledge and understanding of education stakeholders at all level on climate change and its potential impact on education sector. Enhancing the quality of climate change education will require training teachers and education staff. In many schools, especially at the provincial or soum¬-level, there is a lack of teachers qualified to teach science subjects and often teachers specialized in other subjects end up teaching science, raising questions on the quality of education. Greater focus on training educators in climate change science should therefore be a priority and appropriate investments should be made.

On the disaster management side, the NEMA has begun investing resources to train teachers and school staff on disaster response. The focus has, thus far, been on imparting safety life skills for earthquakes through extracurricular activities. Work has initiated to educate school staff on flood management – but training could be expanded to include *dzud* risks and hazards associated with extreme winters.

Planning and increasing collaboration with other ministries

Under a scenario of increasing climate-related risks, and significant impacts on the education sector it is essential for the sector policy and planning (e.g., Master Plan) to incorporate these risks in a more systematic manner. Also, given that climate change impacts on education and learning materialize through indirect effects, addressing climate change in a meaningful way will require closer collaboration with experts from various ministries and agencies. For instance, one of the key ways through which climate change affects education and learning outcomes is through impacts on health, which translate to increased absenteeism. There is scope for enhancing collaboration with the Ministry of Health to ensure that schools and education authorities are better equipped to deal with health risks

that may become more frequent under climate change.

Further, the MECSS has had limited collaboration with environmental stakeholders such as the MET, other than through national committees on air pollution and climate change. There is, however, significant potential for linking climate change information into education sector planning. In the most basic form, such collaboration can lead to the enhancement of climate change-related content in the national curriculum. In more advanced forms, technical collaboration can lead to the development of adaptation guidelines for schools.

There is also an opportunity to strengthen collaboration with the National Agency of Meteorology and Environment Monitoring (NAMEM) to integrate seasonal forecasts into the academic plan. Through such collaboration, MECSS could develop flexible academic plans relevant to each province. For instance, if seasonal forecasts from the NAMEM suggest a high risk of *dzud* in certain areas of the country, education authorities might consider starting the academic year a few weeks earlier (or ending a few weeks later) – or they may consider investing in alternative education modalities earlier on in the year – to ensure that disruptions to education are minimal. The feasibility of these approaches requires further examination.

Increasing access to climate finance in the education sector

School staff and education authorities report serious deficiencies in accessing climate-related finance. What limited resources are available for emergency management are typically allocated for livestock-related activities. There is therefore a need for specific funds to be allocated to address education needs, including in addition to curriculum development, training for teachers and students on climate change adaptation actions, retrofitting infrastructure to withstand the effects of projected climate change, and improvement of alternative education modalities in the context of increasingly variable and more unpredictable weather patterns.

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 needs. Investing in data systems, as highlighted earlier, can therefore provide a robust climate rationale for supporting the education sector needs.

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