



# Protecting Children's Learning Futures: Quantifying Climate Related Loss and Damage in Eastern and Southern Africa

TECHNICAL ANALYSIS REPORT

*Presented in slide deck format*

# Acknowledgments

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The report was developed by Dalberg in close collaboration with Carolin Wäldchen and Nadia Zaidi, Policy Specialist (Loss and Damage – Intergovernmental and National), UNICEF Global Practice for Climate and Environment, both of whom provided substantial technical input throughout the review process. UNICEF gratefully acknowledges the valuable insights and feedback provided by Joan Pegram, Wongani Grace Taulo, Ingrid Sanchez Tapia, Alicia Jones, Margaret Irving, Clara Buttow, Linus Mofor, Larissa Demel, Natalie Esmail, and Leeya Nix of UNICEF; Fatemeh Bakhtiari of the United Nations Environment Programme; and Mwila Malama of Save the Children. UNICEF also thanks the Country Offices in Ethiopia, Kenya, Mozambique, Somalia, and Zambia for reviewing the case studies and providing valuable contextual inputs.

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## Acronyms (1/2)

<b>BCR</b>	Benefit-Cost Ratio	<b>IDPs</b>	Internally Displaced Persons
<b>CBR</b>	Cost-Benefit Ratio	<b>IEC</b>	Information, Education and Communication
<b>DINA</b>	Drought Impact Needs Assessment	<b>INFORM</b>	Index for Risk Management
<b>DRR</b>	Disaster Risk Reduction	<b>IPCC</b>	Intergovernmental Panel on Climate Change
<b>EiE</b>	Education in Emergencies	<b>JDLNA</b>	Joint Damage, Losses and Needs Assessment
<b>EM-DAT</b>	Emergency Events Database	<b>LandD</b>	Loss and Damage
<b>ESAR</b>	Eastern and Southern Africa Region	<b>MHPSS</b>	Mental Health and Psychosocial Support
<b>ESARO</b>	Eastern and Southern Africa Regional Office	<b>NPV</b>	Net Present Value
<b>FRLD</b>	The Fund for responding to Loss and Damage	<b>PDNAs</b>	Post-Disaster Needs Assessments
<b>HRP</b>	Humanitarian Response Plan	<b>PPP</b>	Purchasing Power Parity

## Acronyms (1/2)

<b>RINA</b>	Rapid Impact and Needs Assessment
<b>SEL</b>	Social-Emotional Learning
<b>SMP</b>	School Meal Programme
<b>SSP-RCP</b>	Shared Socio-economic Pathways-Representative Concentration Pathways
<b>UIS UNESCO</b>	Institute for Statistics
<b>UNFCCC</b>	United Nations Framework Convention on Climate Change
<b>WIM ExCom</b>	Warsaw International Mechanism Executive Committee

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## Context and background

**UNICEF is prioritizing robust, evidence-based research to quantify the economic loss and damage of climate change on education in the Eastern and Southern Africa Region (ESAR), aiming to inform cost-effective, climate-resilient education strategies.** Globally, UNICEF is closely involved in the United Nations Framework Convention on Climate Change (UNFCCC) processes and has supported research and advocacy for increasing climate financing for children. In ESAR, UNICEF is prioritizing robust data and evidence on how climate change exacerbates the existing Learning Crisis in the region, with climate and education being two “flagship” programmatic priorities for UNICEF Eastern and Southern Africa Regional Office (ESARO). An evidence-based approach empowers governments to develop effective policies and strategies – however, information on the economic loss and damage of climate-induced disasters on education is limited. Hence, UNICEF’s priority is to document and quantify economic loss and damage.

**This initiative aims to quantify education-related climate impact in ESAR to strengthen advocacy, inform financing, and increase future resilience.** The overall goal is to quantify the climate-induced immediate historical and expected future loss and damage to education in the ESA region and to develop an advocacy strategy that leverages this data to influence key actors in the climate and education financing space, leading to increased funding (e.g., leveraging the Fund for responding to Loss and Damage) and ensuring education is prioritized in technical assistance, capacity-building, and risk assessments (through strengthened engagement with the Santiago Network and WIM ExCom (Warsaw International Mechanism Executive Committee) expert groups), enabling ESAR countries to build climate-resilient education systems.

**At the end of this engagement, UNICEF aims to answer the following learning questions:**

1. What extreme events occurred since 2005 in the ESA region that can be attributed to climate change?
2. What was the total cost of loss and damage incurred due to extreme climate-induced events on education infrastructure?
3. What do we estimate to be future cost of loss and damage to education infrastructure?
4. What can we learn from selected case studies related to extreme climate-induced events (averting, minimizing, and addressing loss and damage on education systems)?

## Scope and principles

**We developed a model that is simple and accessible to a broad audience, grounded in established frameworks and built with robust data where available.** It followed three main principles:

- **Simplicity** - Making the model accessible to a broad audience: Design a clear and transparent model avoiding excessive complexity, prioritizing credibility and communicability.
- **Grounded** - Using established frameworks where possible: Build on recognized frameworks (e.g., Intergovernmental Panel on Climate Change (IPCC)/UNICEF guidance, Needs assessments like Post-Disaster Needs Assessments (PDNAs), and other education cost estimates) to ensure consistency, legitimacy, and alignment with sector norms.
- **Evidence-Based** - Focusing on measurable, robust data where available: Prioritize robust data where available (particularly for immediate economic costs) and distinguish assumptions or estimates to maintain transparency and trust.

**Our quantitative focus was on immediate economic loss and damage. In addition, given its relevance for advocacy, we explored a high-level estimate of “loss of future income”.** The focus on immediate economic loss and damage - encompassing infrastructure, furniture, learning materials, and costs of temporary learning spaces - was agreed as a result of the higher data quality and availability to conduct this exercise. Long-term economic loss and damage were covered at a high-level through the metric “loss of future earnings” since data is scarce and this was initially out of scope. Non-economic loss and damage were not covered.

## Key results

Since 2005, more than 700 extreme events have impacted the ESA region, affecting a total of 330 million people and leading to more than 40 thousand deaths. Floods, storms and droughts account for 94 per cent of all events, ~100 per cent of all people affected, and 96 per cent of deaths – while floods make up the majority of events, droughts affected more people and led to more deaths. Around ~74 per cent of events were made more likely or severe because of climate change, and disasters are becoming more frequent and intense, affecting more people and leading to more deaths.

### Immediate economic loss and damage

**When we zoom into education, we estimate the total immediate economic loss and damage on education in ESAR to be approximately US\$~1.3 billion from 2005–2024.** Around US\$0.2 billion has been documented through Post-Disaster Assessments (e.g., Post-Disaster Need Assessments, Rapid Impact and Needs Assessments, Drought Impact Needs Assessments, Humanitarian Response Plans, and Joint Damage, Losses and Needs Assessments) and around US\$1.1 billion was estimated during this engagement to account for lack of documentation and direct estimates, as described in the methodology section.

**Damages comprise half of the US\$1.3 billion, with the other half being losses.** Damages primarily affect infrastructure, furniture and learning materials, whereas losses are mostly related to temporary learning spaces.

**Floods contributed the most to the total immediate economic loss and damage on education, mostly composed of damages, whereas drought represented a third of the economic loss and damage, mostly losses.** Key flood events took place in Tanzania (2023), Somalia (2023) and Ethiopia (2023), and around two-thirds of the economic impact of floods is damage and one-third losses. The most relevant storm events were Cyclone Freddy in Malawi (2023), Cyclone Kenneth in Tanzania (2019) and Cyclone Idai in Mozambique (2019), with ~75 per cent of the total impact being damages and ~25 per cent being losses. Key droughts heavily impacted Ethiopia (2015 and 2022) and South Africa (2015), with the majority of impact being losses (mostly driven by additional costs with more meals, more expensive inputs and also reduced school fees).

**In the region, floods and droughts were most common in the East and the Horn of Africa, whereas storms affected mainly Southern Africa, especially Mozambique and Madagascar.** Malawi was the worst affected (overall), followed by Ethiopia, Kenya and Somalia (especially impacted by droughts and floods), and Mozambique (heavily impacted by storms).

**If the status quo is kept, total economic loss and damage on education in the ESA region has the potential to reach an Net Present Value (NPV) of US\$3.3–3.8 billion from 2025 to 2050.** Immediate annual loss and damage has increased from US\$~30 million in 2005 to US\$~100 million in the 2020s, reaching peaks of US\$~170 million. This is projected to continue increasing and reach levels between US\$260 and 320 million by 2050.

### Long-term economic loss and damage

**We estimate that climate change has disrupted the learning of 130 million children cumulatively in pre, primary and secondary levels between 2005 and 2024, resulting in an estimated US\$120 to 140 billion in loss of future earnings, projected to increase until 2050.** If no action is taken to avert and minimize loss and damage, it is estimated that between 2025 and 2050, 440 to 520 million children cumulatively will have their learning disrupted, leading to US\$260 to 380 billion in loss of future earnings.

## Methodology

**We used different approaches for the key 4 modules:**

**Past Immediate Economic Loss and Damage:** We first estimate the impact of major events documented in Post-Disaster Assessments (e.g., Post-Disaster Needs Assessments, Rapid Impact and Needs Assessments, Drought Impact Needs Assessments, Humanitarian Response Plans, and Joint Damage, Loss, and Needs Assessments). We then assess which of these events could be attributed to climate change. For all remaining events where economic loss and damage data is unavailable but metrics such as the number of people affected are available in the EM-DAT (Emergency Events Database), we apply ratios – such as impact per person affected – to extrapolate the likely economic loss and damage.

**Future Immediate Economic Loss and Damage:** We compare two different approaches. Approach ‘A’ regresses past education economic loss and damage (calculated as illustrated above) on student enrolment and temperature increases, and projects future economic loss and damage using population growth and temperature forecasts for two different scenarios. Approach ‘B’ utilizes the INFORM (Index for Risk Management) Climate Change Risk Index, which provides country-level exposure data by disaster type for 2022 and 2050, which we use to forecast economic loss and damage in education.

**Past Long-term Economic Loss and Damage (loss of future earnings – high-level assessment):** We estimate the loss of future income by multiplying: (i) the number of enrolled students across all cohorts from 2005–2024, (ii) the share of students affected by climate change (based on UNICEF data), (iii) the average number of school days lost per year due to climate events (from a World Bank report), and (iv) the estimated loss in future earnings per lost day of education (based on World Bank research on pandemic-related school closures).

**Future Long-term Economic Loss and Damage (loss of future earnings – high-level assessment):** We apply the same high-level assessment framework as used for past long-term economic loss and damage. However, for this projection, we estimate student enrolment based on expected population growth. Across all modules, we conduct sense checks on inputs and outputs, as well as test scenarios.

## Case study – Equity breakdown (Kenya)

**The case study aims to assess how climate change affects equity in access to education for girls, students with disabilities, and marginalized groups – with a focus on Kenya 2024 floods.**

**In Kenya, floods are the most significant climate-related disaster, accounting for 80 per cent of recorded extreme events and 93 per cent of related deaths, with the 2024 floods being the deadliest to date.** The April–May 2024 floods were among the most destructive in recent history, with extensive loss of life, displacement, and damage to critical infrastructure and productive assets. The floods severely disrupted education across Kenya, revealing gaps in the system’s preparedness to safeguard learning and respond effectively. The total education recovery needs, including infrastructure rebuilding, a 10 per cent margin for building back better, and 5 per cent for inflation, are estimated at more than US\$63.5 M.

**The floods hit the most vulnerable hardest.** The post-disaster enrolment drop was higher among girls than boys (10.5 per cent vs. 7.1 per cent) – roughly 1.5 girls left school for every 1 boy. The enrolment drop among students with disabilities was about one-third higher than for students without disabilities (11.7 per cent vs. 8.8 per cent).

**Dropout risks generally soar when gender intersect with informal, non-government-backed schools.** The steeper losses for students with disabilities and girls show how cross-sectoral impacts compound inequities: inaccessible facilities, health risks, care burdens, and restrictive social norms hinder their return to school.

**Building resilient, inclusive education systems requires embedding equity and resilience in Kenya’s education budget.** Schools must integrate disaster preparedness, social protection, and inclusive recovery measures to support vulnerable learners. Financing, monitoring, and coordination across sectors are key to ensuring equitable recovery, accountability, and alignment with regional resilience goals.

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## Case study – Zambia spotlight

**The case study aims to provide a Zambia-specific perspective that grounds discussions on loss and damage to education in local realities.** Zambia was chosen given the upcoming 8<sup>th</sup> Fund for responding to Loss and Damage (FRLD) Board Meeting taking place in the country.

**Zambia's climate has been disrupted by shifting temperatures and rainfall, leading to floods, droughts and extreme events such as the 2023–2024 El Niño-induced drought with 17 million people affected since 2005.** Zambia's 2024 El Niño drought left nearly 10 million people without food, water, or power – one of its worst droughts in decades, affecting people across 84 districts.

**The drought forced children out of school and disrupted learning for those who remained.** Drought-hit areas saw reduced school attendance as children worked to support families and teachers also struggled with its impacts. In Zambia, power shortages from low hydropower forced schools to shorten hours or close early. Even when students attended, hunger, thirst and exhaustion impacted focus, while teachers faced power cuts and extra chores. These disruptions reflect a long-term regional pattern where drought weakens household resilience and deepens educational and economic losses.

**From 2005 to 2024, total immediate economic loss and damage on education in Zambia is estimated at around US\$60M,** with floods representing the biggest share, ~60 per cent, and droughts the remaining ~40 per cent. Without further investment, cumulative immediate economic loss and damage on education in Zambia is expected to reach ~US\$230–295 million by 2050. In addition, we estimate that climate change disrupted the learning of ~5 million students-year, resulting in US\$4 to 5 billion in loss of future earnings, projected to go up to 13 to 21 billion by 2050.

**Beyond financial losses and disrupted schooling, Zambia's drought-flood cycles have caused deep social and psychological stress, especially for rural girls.** Climate shocks displace families, break community ties and leave children socially isolated and traumatized. For rural girls, poverty from climate crises increases child marriage and early pregnancy, with reported teenage pregnancies in Lusangazi District doubling between January–June 2023 and January–June 2024.

**Zambia's case demonstrates why education must be included in FRLD's first allocations.** Climate change has severely disrupted education, highlighting the need for stronger data on related losses. Despite its importance, education is underfunded in climate finance – closing this gap is vital to protect learning and ensure long-term resilience and recovery.

**The case study aims to provide a regional perspective on the economic case for climate-resilient education infrastructure in Eastern and Southern Africa** and demonstrate the value of integrating education into climate and adaptation financing agendas.

**The Benefit Cost Ratio (BCR) measures the additional benefits (avoided losses and damage) relative to the additional costs of including adaptation measures.** BCRs provide clear evidence to inform, prioritize and scale (climate-resilient) investments (in education). Although some BCR estimates exist, there are no estimates specifically for resilient education infrastructure in the ESAR.

**We conducted a high-level exercise to estimate BCR.** We first estimated the benefits based on the avoided projected loss and damage. We then proceed to the cost analysis, estimating the incremental cost per classroom to convert conventional infrastructure into climate-resilient facilities and the number of classrooms affected in the region. With both benefits and costs estimated, we calculate the BCR.

**Investing in resilient schools is cost-effective.** We estimate that every dollar invested in resilient schools yields 2 to 13 times its value in avoided immediate losses and damages, in line with other over all existing BCRs. This can go higher when other benefits (such as avoided loss of future earnings) are accounted for.

**The case for action is clear and actionable.** Quantified BCRs offer governments and partners a concrete economic argument to prioritize resilient infrastructure within climate and adaptation budgets. It is critical to tailor calculations, as returns depend on hazard type, exposure and design. Country-specific applications will refine accuracy and impact.

## Case study – Benefit cost ratio

## Case study – ‘What if’ of resilient infrastructure (Mozambique)

**The case study aims to assess the benefits of investing in resilient school infrastructure, with a focus on safer schools in Mozambique.**

**Mozambique is one of the world’s most climate-vulnerable countries, facing frequent and intensifying cyclones.** Cyclone Idai affected 900,000 children and caused US\$2.8 billion in economic loss and damage; just weeks later, Cyclone Kenneth affected 200,000 children with US\$0.2 billion in additional loss and damage. Combined, they disrupted learning for over 420,000 students and 10,000 teachers across nearly 5,000 classrooms, with US\$24 million in total economic loss and damage to the education sector.

**Amidst the widespread devastation caused by these cyclones, schools built following the UN-Habitat Resilient School Guidelines have remained in good condition.** Resilient schools achieved a 100 per cent survival rate during Cyclones Idai and Kenneth, serving as safe havens during emergencies and enabling a much faster return to learning. Every US\$1 spent on resilient schools in Mozambique can save ~US\$2–14 in reconstruction and emergency costs, which is in line with UNICEF’s estimate of US\$ 4 saved for every US\$1 spent. The full benefit is even higher when factoring in avoided loss of future earnings. In addition, resilient school investments also avert non-economic losses and deliver social benefits, keeping children safe, emotionally secure and in school – with particular benefits for girls.

**With nearly every classroom in Mozambique exposed to hazards – worsened by climate change – investing in resilient school construction is essential to protect children’s safety and learning.** With support from UN-Habitat and UNICEF, Mozambique developed climate-resilient classroom designs tailored to local risks. Despite progress, an immense funding gap remains. Resilience is cheapest when embedded from the start. Recent findings suggest resistance upgrading in a new construction is barely 10 per cent, whereas it can go up to 25 per cent in rehabilitation and reconstruction.

**Delivering resilient and inclusive education in Mozambique requires deepening the focus on where, how and for whom infrastructure is built.** Resilient school investments should target high-risk zones, use locally adapted designs and integrate equity from the start. Bridging Mozambique’s US\$3 billion classroom resilience gap – over three times its annual education budget – demands innovative finance and social measures that sustain learning beyond physical infrastructure.

## Case study – Conflict- climate intersection (Somalia)

**The case study aims to illustrate how climate change and conflict reinforce each other and makes the case for integrated humanitarian-climate responses, with a focus on Somalia.**

**Highly exposed to climate hazards and with limited capacity to adapt, Somalia is one of the world’s most climate-vulnerable countries.** Drought–flood whiplash and protracted conflict are driving mass displacement and combined economic losses estimated at 35–45 per cent of Somalia’s GDP annually.

**Climate shocks and conflict are reinforcing cycles of displacement and disrupted (education) services, especially in south-central Somalia.** The regions most exposed to climate risks are also Somalia’s most exposed to conflict risks, illustrating the interconnected nexus of climate and conflict.

**This double crisis has made Somalia the country with the highest number of child displacements in the Eastern and Southern Africa region, pushing over 4.5 million children out of school.** The education crisis is even more acute in the regions affected by conflict and climate: School enrolment in south-central Somalia (22 per cent) is one-third lower than the national average (32 per cent) and far below the Eastern and Southern Africa average (~98 per cent). In addition, armed groups are deliberately targeting schools and subjecting thousands of children to recruitment, rape and abduction.

**Education systems must be redesigned in Somalia to address climate and conflict as interconnected challenges.** Policies should integrate education, climate and peace agendas while investing in inclusive, resilient systems that build adaptation and peacebuilding skills. Stronger coordination and monitoring are essential to align national and local action and track progress toward resilience.

### Case study – Slow-onset events (Ethiopia)

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**Climate impact reports often focus on more visible extreme weather events. This case study aims to assess the silent crisis of increasing temperatures (inc. heat waves) on education with a focus on Ethiopia.** Increasing temperatures can impact children's education in many different ways, this case study will focus specifically on the direct and silent link between temperature increase and lower education outcomes.

**Temperatures in Ethiopia have increased by 0.8°C since 1950 and are projected to further increase by 1.9 to 3.4°C by the end of the century, depending on the scenario.** Rising temperatures lead to more heatwaves, already affecting 83 per cent of Ethiopian children and projected to intensify by 2050, when 47 million children could face temperatures above 35°C for over 80 days annually.

**Rising temperatures affect children's education through multiple pathways - including physiological, respiratory, mental - and especially in early development.** Heat exposure during pregnancy and childhood harms cognitive and physical development, reducing learning capacity and school attainment. High classroom temperatures worsen fatigue, illness and mental stress, undermining students' focus, attendance and long-term educational outcomes.

**Exposure to high temperatures during school years is linked to lower completion rates and student performance on exams, which can play a decisive role in shaping future opportunities.** 10 extra hot days can reduce average performance by roughly 2.3 per cent, which can play a decisive role in shaping future opportunities. These findings are aligned with studies in other countries, where increases in temperature are associated with poorer education performance. Students from lower-income households are most impacted due to limited cooling infrastructure and children with disabilities often remain invisible. However, girls and students in hotter regions appear slightly more resilient and adapted.

**With the growing evidence that rising temperatures are undermining students' performance in Ethiopia, political commitment to protect youth's education must be translated into action.** To mitigate the direct effects of rising temperatures on learning, education authorities should improve classroom cooling/ventilation, adjust schedules to avoid peak heat and regularly assess thermal conditions.

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# UNICEF is prioritizing robust, evidence-based research to quantify the loss and damage of climate change on education in ESAR, aiming to inform cost-effective, climate-resilient education strategies.

## BACKGROUND

- **Globally, UNICEF is closely involved in UNFCCC processes** and has supported research and advocacy for increasing climate financing for children
- In ESAR:
  - UNICEF's Vision for Climate-Resilient Education Systems: **robust data and evidence on how climate change exacerbates the existing Learning Crisis in ESAR** will drive cost-effective solutions to equip children with the learning and skills necessary for climate adaptation
  - **Climate and education are the two “flagship” programmatic priorities for UNICEF ESARO**
- **An evidence-based approach empowers governments to develop effective policies and strategies** to meet educational challenges posed by climate change:
  - Design and implementation of cost-effective climate adaptation solutions to minimize loss and damage for education
  - Identify and quantify climate co-benefits of integrating climate resilience in education systems
  - Enhance the education sector's adaptability to climate economic loss and damage
  - Safeguard children from the immediate and long-term impacts of climate change on their educational opportunities
- ESARO had **initial brainstorming with Dalberg and StC** on potential areas for collaboration on climate and education, and a **concept was developed** for measurement of the economic loss and damage to education in ESA to inform advocacy.

### Critical priority: document and quantify the economic loss and damage of climate change on education

- Increasing numbers of out-of-school children
- Declining learning outcomes
- Economic loss and damage, particularly to infrastructure *Primary focus*
- Disruptions to local economies that limit training and employment opportunities for youth

# The initiative aims to quantify education-related climate impact in ESA to strengthen advocacy, inform financing and increase future resilience.

**Overall aim:** To quantify the historical and expected future economic loss and damage to education due to climate change in the ESA region and to develop an advocacy strategy that leverages this data to influence key actors in the climate and education financing space.

## Specific objectives:





- Increased availability of cost estimates towards measuring the impact of climate change on education.
- Strengthened advocacy for
  - the consideration of education in Loss and Damage (LandD), adaptation and other climate financing; and
  - domestic resource mobilization for education systems in ESAR to minimize and address loss and damage.
- Increased attention and reference to education within global, regional and country-level climate financing discussions, including the operationalization of the Fund for responding to Loss and Damage (FRLD).
- Increased funding and strengthened engagement with the Santiago Network and WIM ExCom expert groups (particularly the Comprehensive Risk Management expert group) to ensure education is prioritized in technical assistance, capacity-building and risk assessments, enabling ESAR countries to build climate-resilient education systems.

## Learning questions:

1. What extreme events have occurred since 2005 in the ESA region and can be attributed to climate change?
2. What was the total cost of loss and damage incurred due to extreme climate-induced events on education infrastructure?
3. What do we estimate to be the future cost of loss and damage to education infrastructure?
4. What can we learn from selected case studies related to extreme climate-induced events (averting, minimizing and addressing loss and damage on education systems)?



# This project will result in four key deliverables, and this output refers to the final report.

Deliverable	Inception Report	Draft Report	Final Report	Policy and Advocacy
Content	<p><b>Inception Report</b> (20-25 slides) presented during the kick-off meeting, presenting initial findings and detailed workplan as well as proposed framework and methodology for the economic loss and damage research.</p>	<p><b>Draft report</b> (20-30 slides) documenting the research methods, limitations, findings, and key recommendations along with the research datafiles (in XLS).</p>	<p><b>Final report</b> including 4-5 case studies (e.g., focusing on resilient infrastructure, covering a slow-onset event, assessing a fragile context, focusing more on the long-term and non-economic loss, applying a gender lens...).</p>	<p><b>Policy document</b> (5-10 pages) and <b>advocacy pack, containing the advocacy strategy</b> (~10 slides) and <b>advocacy pack</b> (~10 slides).</p>
Focus	<ul style="list-style-type: none"> <li>Ensure alignment of workplan, framework, and methodology.</li> </ul>	<ul style="list-style-type: none"> <li>Map events attributed to, or exacerbated by, climate change in the ESA region from 2005 to the present.</li> <li>Develop a framework to estimate education-related economic loss and damage costs.</li> <li>Quantify historical and projected economic impact to education.</li> </ul>	<ul style="list-style-type: none"> <li>Conduct deeper analysis of education-related impact where data allows.</li> <li>Develop case studies using both quantitative and qualitative research.</li> <li>Address comments in the draft report.</li> </ul>	<ul style="list-style-type: none"> <li>Develop an advocacy strategy that teams can use to direct future engagements.</li> <li>Develop advocacy toolkits to support advocacy messages.</li> <li>Develop a public-facing policy brief intended for a wide external audience.</li> </ul>
Format				
Timeline	At the end of Phase 1	At the end of Phase 2	During Phase 3	At the end of Phase 3

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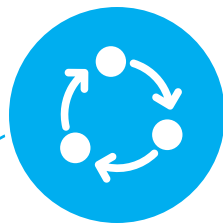
5. Case Studies

Annex

We developed a model that is simple and accessible for a broad audience, grounded in established frameworks and built with robust data where available.



**Simplicity - Making the model accessible to a broad audience:** Design a clear and transparent model avoiding excessive complexity, prioritizing credibility and communicability.



**Grounded - Using established frameworks where possible:** Build on recognized frameworks (e.g., IPCC/UNICEF guidance, Needs assessments, including PDNAs, and other education cost estimates) to ensure consistency, legitimacy and alignment with sector norms.



**Evidence-Based - Focusing on measurable, robust data where available:** Prioritize robust data where available (particularly for immediate economic loss and damage) and distinguish assumptions or estimates to maintain transparency and trust.

# Learning Questions and Key Definitions

Learning Question	Timeline
What extreme events have occurred since 2005 in the ESA region and can be attributed to climate change?	Historical Analysis: estimating the economic impact profiling ~10–15 regional high-impact events
What was the total cost of loss and damage incurred due to extreme climate-induced events on education infrastructure?	
What do we estimate to be the future cost of loss and damage to education infrastructure?	Future projections: estimating the long-term implications up to 2050
What can we learn from selected case studies related to extreme climate-induced events (averting, minimizing and addressing loss and damage on education systems)?	Historical Analysis

Key Definitions	
Loss and damage	<i>“Loss and damage describes the impact associated with the adverse effects of climate change”<sup>2</sup> we use Loss and Damage (capitalised letters) to refer to political debate and loss and damage (lowercase letters) to refer to impacts.<sup>3</sup></i>
Economic loss and damage	<i>“Economic losses can be understood as the loss of resources, goods and services that are commonly traded in markets”<sup>2</sup> and hence can be assigned a monetary value.</i>
Non-economic loss and damage	<i>“Non-economic losses can be understood as the remainder of items that are not economic items; that is to say that non-economic items are those that are not commonly traded in markets”<sup>2</sup></i>
Economic loss	Impacts on economic flows <sup>4</sup> and extra costs that arise because those assets are no longer fully usable.
Economic damage	Impacts on physical stocks and assets, <sup>4</sup> a one-off reduction in the stock of capital.
Extreme weather events	<i>“An extreme weather event is an event that is rare at a particular place and time of a year”<sup>1</sup> such as tropical cyclones, floods, droughts, heat waves and storm surges.</i>
Slow-onset events	<i>“Slow-onset events usually develop gradually over time, and their impacts are often based on a confluence of several different events”<sup>1</sup> such as sea level rise, desertification and land degradation.</i>

# Our quantitative focus was on immediate economic loss and damage – in addition, given its relevance for advocacy, we explored a high-level estimate of “loss of future income”.

Economic vs. non-economic	Immediate vs. Long-term	Description	Scope	Data quality	Approach	Analyses
<b>Economic</b>	<b>Immediate</b> <i>(direct)</i>	<ul style="list-style-type: none"> <li>• <b>Education facilities and fixed services</b> (Classrooms, labs, admin blocks, WASH blocks, power, connectivity nodes)</li> <li>• <b>Learning materials and movable equipment</b> (Furniture, textbooks, ICT devices, lab kits)</li> <li>• <b>Temporary or alternative learning spaces</b> (Tents, prefabs, community centres)</li> <li>• <b>Transport and logistics assets</b> (Buses, boats, access roads, storage depots)</li> <li>• <b>Other</b></li> </ul>	<b>Quantitative analysis</b> (note that due to data availability/quality, the analyses were conducted at the aggregate level, i.e., no breakdown was possible)	<b>Medium/ High</b> <ul style="list-style-type: none"> <li>• Post-Disaster Assessments provide good data points on damage, loss and needs for major events following World Bank definition<sup>1</sup></li> <li>• EM-DAT<sup>2</sup> provides a comprehensive database of all extreme events</li> <li>• <i>Carbon Brief</i><sup>3</sup> assesses attribution to climate change</li> </ul>	<ul style="list-style-type: none"> <li>• Consolidation of existing data</li> <li>• Assessment of attribution to climate change</li> <li>• Extrapolation to cover data gaps</li> <li>• Triangulation and refinement</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Past impact</b></li> <li>• <b>Forecast impact</b></li> </ul>
	<b>Long-term</b> <i>(indirect)</i>	<ul style="list-style-type: none"> <li>• <b>Future learning and earnings for affected children</b> (Long-run wage and human capital impact)</li> <li>• <b>Service-delivery flows</b> (Instructional hours, exams, catch-up classes)</li> <li>• <b>Education workforce</b> (Teachers, support staff)</li> <li>• <b>Household economic burden</b> (Parents and caregivers)</li> <li>• <b>Near-term community economic impact</b> (Local business impact)</li> <li>• <b>Long-term broader economic impact</b> (Total economy impact)</li> </ul>	<b>High-level quant analysis, focusing on “loss of future income”</b>	<b>Low</b> <ul style="list-style-type: none"> <li>• Limited studies conducted to allow a detailed assessment</li> <li>• Few datapoints allowing a back of envelope calculation</li> </ul>	<ul style="list-style-type: none"> <li>• High-level quantitative analysis</li> <li>• Triangulation and refinement</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Past impact</b></li> <li>• <b>Forecast impact</b></li> </ul>
<b>Non-Economic</b>		Mental and physical health impacts, social and cultural disruption...		<p><i>Although not a focus of this quantitative assessment, these are relevant impacts that we cover in the case studies</i></p> <p><i>Out of scope of the quantitative analysis</i></p>		

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## In the past (2005–2024)

- Over 700 climate-related events have caused an estimated US\$1.3 billion<sup>i</sup> in education-related loss and damage, with approximately half attributed to the destruction of infrastructure, furniture and learning materials, and the remainder to additional expenditures associated with temporary learning spaces.
- These disruptions have led to an estimated US\$120–140 billion<sup>ii</sup> in lost future earnings affecting a cumulative 130 million children<sup>iii</sup> in the same period.



## Looking ahead (2026–2050)

- If loss and damage is not averted, minimized or addressed, then education-related loss and damage is projected to reach US\$3.3–3.8<sup>i,iv</sup> billion.
- The resulting education-related loss in future earnings is expected to total US\$260–380<sup>ii,iv</sup> billion.

*Note: i) Figures are presented in constant 2024 US\$; ii) Methodological conventions: direct loss and damage is shown in constant 2024 US\$; loss of future earnings is shown in 2017 PPP and is not directly comparable, hence, please avoid adding or directly comparing these numbers; Net present values use a 3 per cent social discount rate; iii) Cumulative number of students affected over the entire period, it reflects the total number of student-years affected, not the number of unique students – note that this reflects only pre-primary, primary and secondary enrolled students – hence this figure doesn't capture the impact from out-of-school children; iv) in net present value*

*Source: Dalberg analysis*

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Since 2005, more than 700 extreme events impacted the ESA region, affecting a total of 330 million people and leading to 40 thousand deaths.

Past  
vs  
Future  
Immediate  
vs  
Long-term  
All sectors  
vs  
Education

**700+**  
Extreme events<sup>i</sup>



**330 M**  
People affected<sup>ii</sup>



**40k**  
Deaths

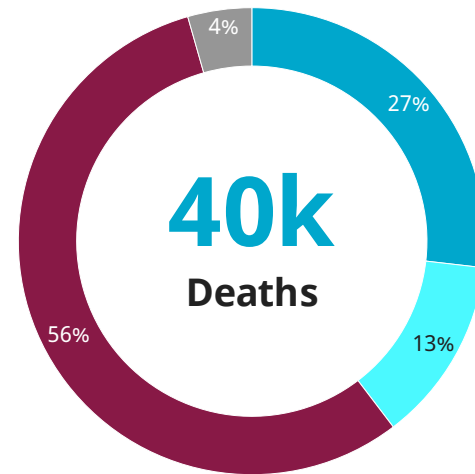
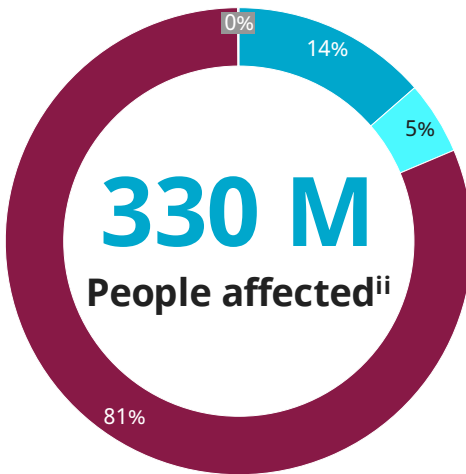


Note: i) One event is the combination of a disaster and country (i.e. One disaster affecting two countries counts as two) – this includes disasters with at least one of the following criteria (i) 10 fatalities; (ii) 100 affected people; (iii) a declaration of state of emergency; (iv) a call for international assistance, with 700+ entries in the data base in the ESA region; ii) cumulative number of people affected over the whole period of 2005–24 and 2025–50 (this is not the number of unique people affected); ii) Include wet mass movement (e.g., driven by rainfall), wildfire and extreme temperature.

Note: these are all extreme events in EM-DAT database, and encompass both climate-induced and not-climate-induced events – the specific impact of climate-induced events are displayed in the education-related loss and damage figures

Source: EM-DAT, [Database](#), Accessed Jul/2025; Dalberg analysis

Floods, storms, and droughts account for 94 per cent of all events, ~100 per cent of all people affected and 96 per cent of deaths – while floods are the majority of events, droughts affected more people and led to more deaths.



■ Flood ■ Storm ■ Drought ■ Others<sup>ii</sup>

Note: i) One event is the combination of a disaster and country (i.e. One disaster affecting two countries counts as two) – this includes disasters with at least one of the following criteria (i) 10 fatalities; (ii) 100 affected people; (iii) a declaration of state of emergency; (iv) a call for international assistance, with 700+ entries in the database in the ESA region; ii) cumulative number of people affected over the whole period of 2005–24 and 2025–50 (this is not the number of unique people affected); ii) Include wet mass movement (e.g., driven by rainfall), wildfire and extreme temperature

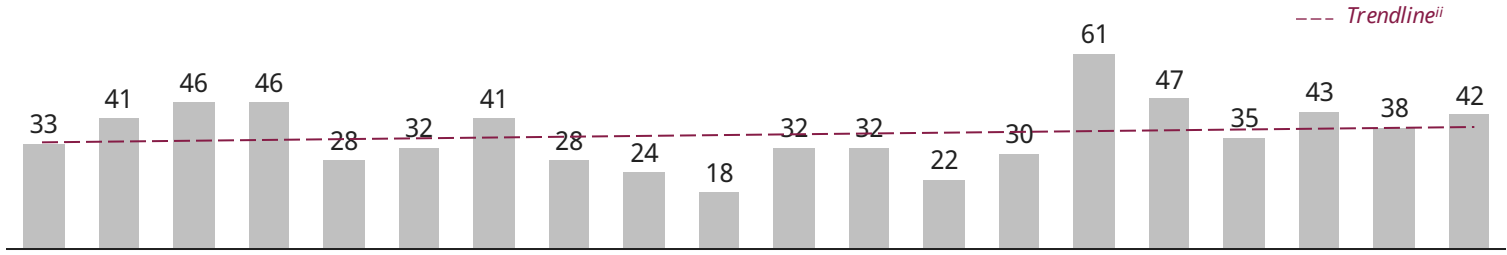
Note: these are all extreme events in EM-DAT database, and encompass both climate-induced and not-climate-induced events – the specific impact of climate-induced events are displayed in the education-related loss and damage figures

Source: EM-DAT, [Database](#), Accessed Jul/2025; Dalberg analysis

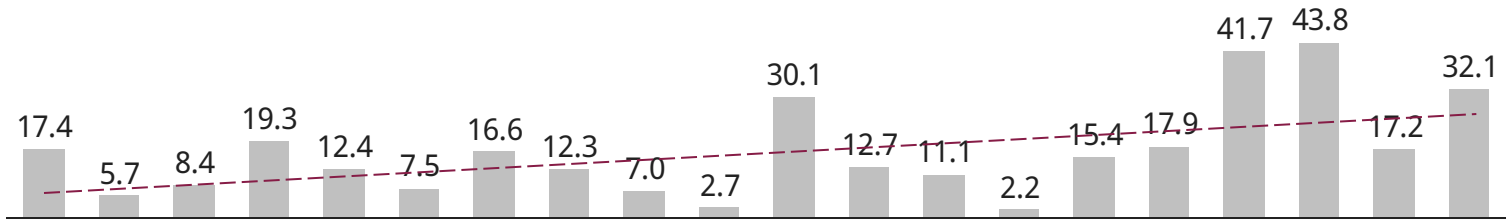
# Disasters are becoming more frequent and intense, affecting more people and leading to more deaths.

Past  
vs  
Future  
Immediate  
vs  
Long-term  
All sectors  
vs  
Education

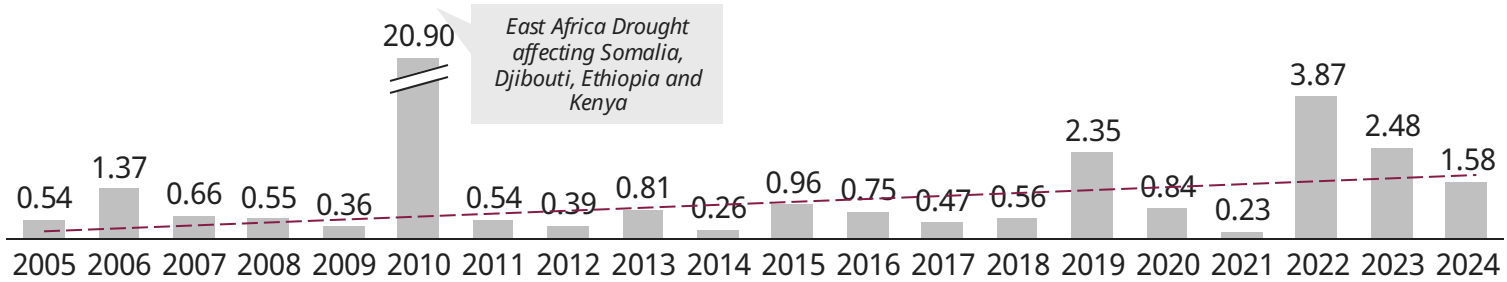
## Number of events<sup>i</sup> (#)



## People affected (M)



## Deaths (k)



Note: i) One event is the combination of a disaster and country (i.e. One disaster affecting two countries counts as two) – this includes disasters with at least one of the following criteria (i) 10 fatalities; (ii) 100 affected people; (iii) a declaration of state of emergency; (iv) a call for international assistance, with 700+ entries in the database in the ESA region; ii) Trendline for deaths exclude outlier in 2010

Note: these are all extreme events in EM-DAT database, and encompass both climate-induced and not-climate-induced events – the specific impact of climate-induced events are displayed in the education-related loss and damage figures

Source: EM-DAT, [Database](#), Accessed Jul/2025; Dalberg Analysis

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# When we zoom into education, total immediate climate-induced economic loss and damage on education in ESAR is estimated to be approximately US\$~1.3B from 2005-2024.

Past  
vs  
Future  
Immediate  
vs  
Long-term  
All sectors  
vs  
Education

## US\$~0.2 B

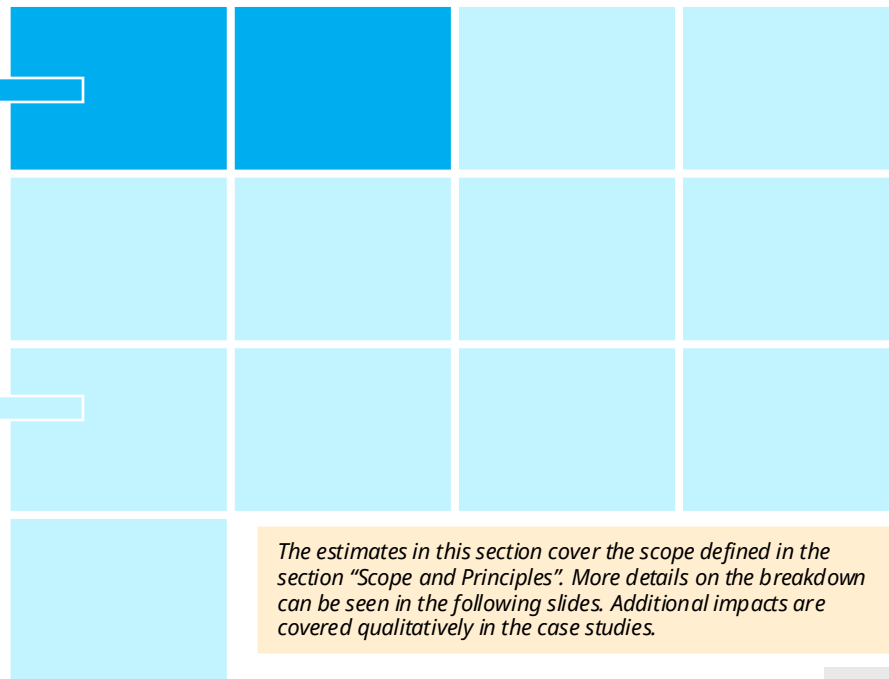
Immediate economic loss and damage to education for documented<sup>i</sup> events

## US\$~1.1 B

Immediate economic loss and damage to education for undocumented<sup>ii</sup> events

## US\$~1.3 B

Immediate economic loss and damage to education

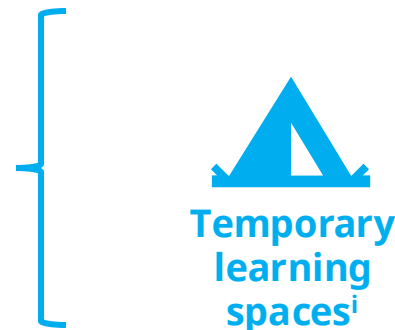
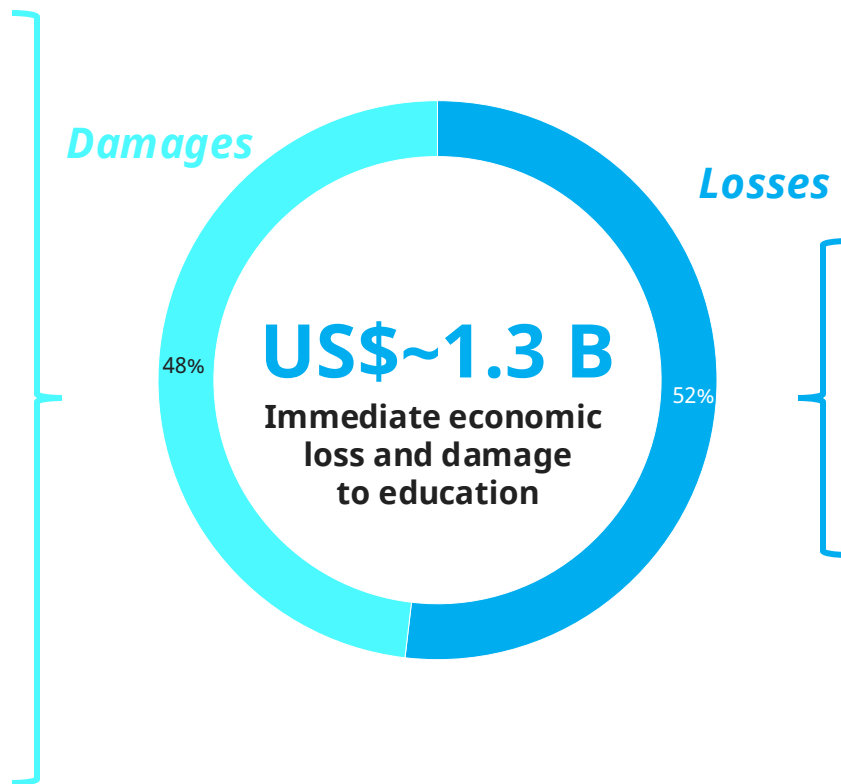


Key 0.1B

Note: i) 18 documented events in Post-Disaster Need Assessments (PDNAs), Rapid Impact and Needs Assessment (RINA), (Drought) Impact Needs Assessment (DINA), Humanitarian Response Plan (HRP), and Joint Damage, Losses and Needs Assessment (JDLNA); ii) Based on extrapolation to cover ~700 undocumented events  
Source: Dalberg analysis

Damages comprise half of economic loss and damage, mostly impact to infrastructure, furniture and learning materials, whereas losses, amounting to the other half, are mostly related to temporary learning spaces.

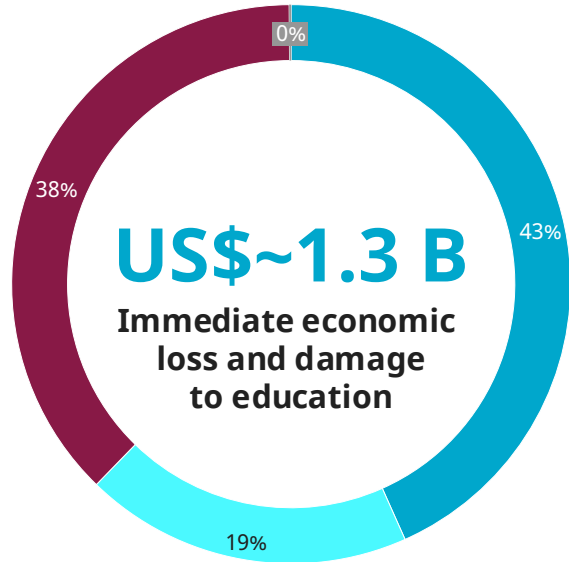
Past  
vs  
Future  
Immediate  
vs  
Long-term  
All sectors  
vs  
Education



Note: i) But also a few other losses, such as psychological support for teachers, among others  
Source: Dalberg analysis

# Floods have contributed the most to total immediate loss and damage on education (mostly composed of damages), whereas drought represented a third of the impact (and is mostly composed of losses).

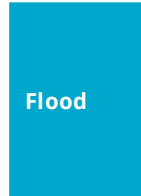
Past  
vs  
Future  
Immediate  
vs  
Long-term  
All sectors  
vs  
Education



■ Flood ■ Storm ■ Drought ■ Others

## Disaster

## Top 5 events by number of people affected<sup>1</sup>



- Flood in Tanzania (2023) – 2.9M people affected
- Flood in Somalia (2023) – 2.5M people affected
- Flood in Ethiopia (2023) – 1.5M people affected
- Flood in Zambia (2007) – 1.4M people affected
- Flood in South Sudan (2024) – 1.4M people affected

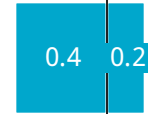


- Cyclone “Freddy” in Malawi (2023) – 2.3M people affected
- Cyclone “Kenneth” in Tanzania (2019) – 2.0M people affected
- Cyclone “Idai” in Mozambique (2019) – 1.5M people affected
- Cyclone “Freddy” in Mozambique (2023) – 1.2M people affected
- Tropical storm “Anna” in Malawi (2022) – 0.9M people affected



- Drought in Ethiopia (2022) – 24.1M people affected
- Drought in South Africa (2021) – 12.0M people affected
- Drought in Sudan (2022) – 11.9M people affected
- Drought in Ethiopia (2015) – 10.2M people affected
- Drought in Zambia (2024) – 9.8M people affected

## Values in US\$ B Damage Loss



Note: i) Include wet mass movement (e.g., driven by rainfall), wildfire and extreme temperature  
Source: 1) EM-DAT, [Database](#), Accessed Jul/2025; Dalberg analysis

# Floods and droughts have affected mostly East and the Horn of Africa, while storms impacted more severely Southern Africa – Malawi, Ethiopia, Kenya, Somalia and Mozambique were the most affected.

Past  
vs  
Future  
Immediate  
vs  
Long-term  
All sectors  
vs  
Education

## Total Economic Loss and Damage

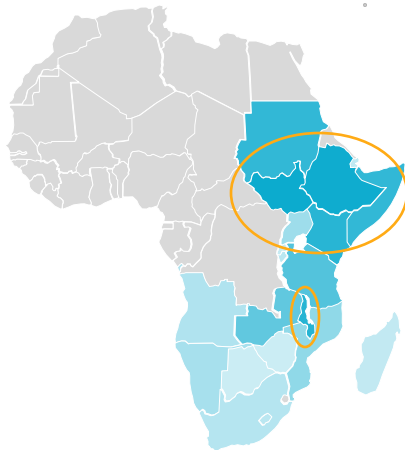


0 LandD (US\$ B) 180

### Top 5 countries affected

- Malawi ~US\$175M
- Ethiopia ~US\$160M
- Kenya ~US\$155
- Somalia ~US\$135M
- Mozambique ~US\$130M

## Flood Economic Loss and Damage



0 LandD (US\$ B) 80

### Top 5 countries affected

- Somalia ~US\$85M
- Malawi ~US\$80M
- South Sudan ~US\$70M
- Ethiopia ~US\$65M
- Kenya ~US\$55M

## Storm Economic Loss and Damage

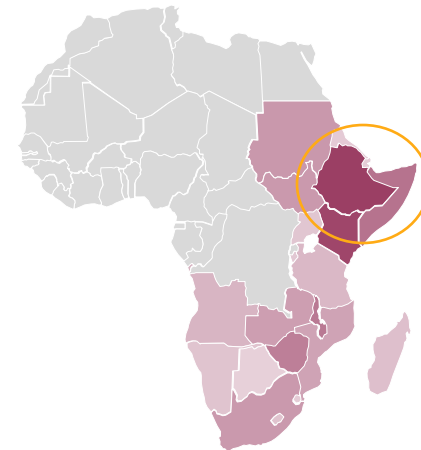


0 LandD (US\$ B) 90

### Top 5 countries affected

- Mozambique ~US\$90M
- Malawi ~US\$55M
- Madagascar ~US\$45M
- Tanzania ~US\$25M
- Zimbabwe ~US\$10M

## Droughts Economic Loss and Damage



0 LandD (US\$ B) 100

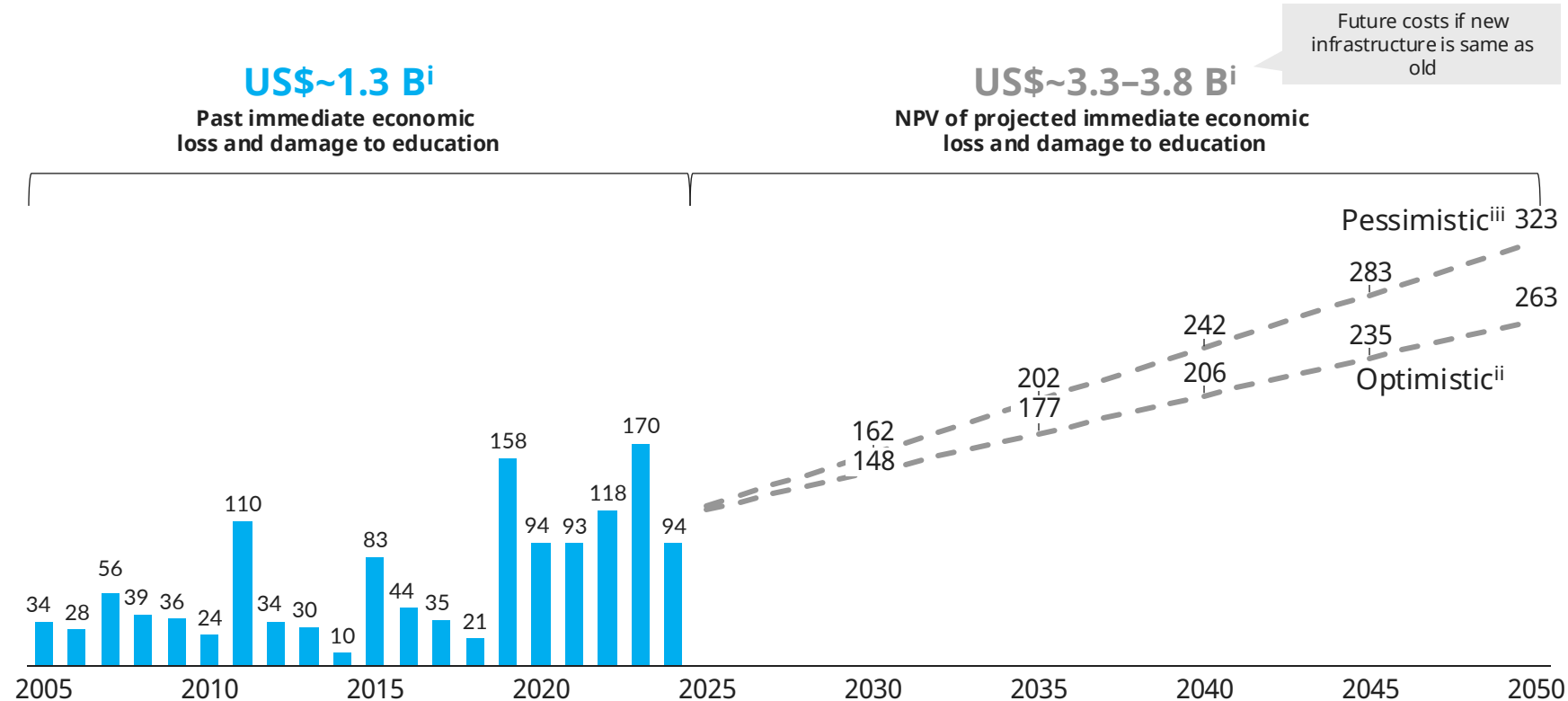
### Top 5 countries affected

- Ethiopia ~US\$100M
- Kenya ~US\$100M
- Somalia ~US\$40M
- Malawi ~US\$40M
- Zimbabwe ~US\$35M

# Breakdown of education-related economic loss and damage by country and climate disaster type.

Country	Damage					Loss					Total
	Flood	Storm	Drought	Other	Total	Flood	Storm	Drought	Other	Total	
Angola	5-10	-	0-5	-	5-10	0-5	-	10-20	-	10-20	20-50
Botswana	0-5	0-5	0-5	-	0-5	0-5	0-5	0-5	-	0-5	0-20
Burundi	0-5	0-5	0-5	0-5	0-5	0-5	0-5	0-5	0-5	0-5	0-20
Comoros	0-5	0-5	-	-	0-5	0-5	0-5	-	-	0-5	0-20
Djibouti	0-5	0-5	0-5	-	0-5	0-5	0-5	0-5	-	0-5	0-20
Eswatini	0-5	0-5	0-5	0-5	0-5	0-5	0-5	0-5	0-5	0-5	0-20
Ethiopia	20+	-	5-10	0-5	20+	10-20	-	20+	0-5	20+	100+
Eritrea	-	-	0-5	-	0-5	-	-	0-5	-	0-5	0-20
Kenya	20+	-	0-5	0-5	20+	10-20	-	20+	0-5	20+	100+
Lesotho	5-10	0-5	0-5	-	5-10	0-5	0-5	5-10	-	5-10	0-20
Madagascar	0-5	20+	0-5	-	20+	0-5	10-20	5-10	-	20+	50-100
Malawi	20+	20+	5-10	0-5	20+	20+	10-20	20+	0-5	20+	100+
Mozambique	10-20	20+	0-5	0-5	20+	5-10	20+	10-20	0-5	20+	100+
Namibia	5-10	-	0-5	-	5-10	0-5	-	5-10	-	5-10	0-20
Rwanda	0-5	0-5	-	0-5	0-5	0-5	0-5	-	0-5	0-5	0-20
Somalia	20+	5-10	0-5	-	20+	10-20	0-5	20+	-	20+	100+
South Africa	5-10	0-5	0-5	0-5	5-10	0-5	0-5	20+	0-5	20+	20-50
South Sudan	20+	-	0-5	0-5	20+	10-20	-	20+	0-5	20+	50-100
Sudan	20+	0-5	0-5	-	20+	10-20	0-5	20+	-	20+	50-100
Uganda	10-20	0-5	0-5	0-5	10-20	0-5	0-5	0-5	0-5	5-10	20-50
United Republic of Tanzania	20+	10-20	0-5	0-5	20+	10-20	5-10	5-10	0-5	20+	50-100
Zambia	20+	-	0-5	0-5	20+	5-10	-	20+	0-5	20+	50-100
Zimbabwe	0-5	5-10	0-5	-	10-20	0-5	0-5	20+	-	20+	20-50
<b>Total</b>	<b>410</b>	<b>180</b>	<b>40</b>	<b>0</b>	<b>630</b>	<b>160</b>	<b>70</b>	<b>450</b>	<b>0</b>	<b>680</b>	<b>1,310</b>

# If the status quo is kept, total economic loss and damage on education in the ESA region can increase up to US\$260–320 million per year by 2050, amounting to a total NPV of US\$3.3–3.8B.



Note: i) Note that bars and lines are yearly impacts in constant 2024 US\$; ii) RCP 4.5 (moderate emissions) and SSP2 – Middle of the Road (Medium challenges to mitigation and adaptation); iii) RCP 8.5 (high emissions) and SSP 3 (Regional Rivalry – high challenges for both mitigation and adaptation, including higher population growth)  
Source: Dalberg analysis

We estimate that climate change disrupted the learning of 130 million students-year, resulting in US\$120 to 140 billion in loss of future earnings, projected to go up to 260 to 380 billion by 2050.

Past  
VS  
Future  
Immediate  
VS  
Long-term  
All sectors  
VS  
Education

2005-2024

**US\$120-140B**

Loss of future earnings<sup>i</sup>



Note that "loss of future earnings" figures were calculated using 2017 PPP<sup>iii</sup>

**130M**

Student-year<sup>ii</sup>



2025-2050

**US\$260-380B**

Loss of future earnings<sup>iv</sup>



**440-520M**

Student-year<sup>ii</sup>



Note: i) Cumulative over the period of 2005–2024 and 2025–2050; ii) Cumulative number of students affected over the whole period of 2005–24 and 2025–50 (this is not the number of unique students); iii) Methodological conventions: direct loss and damage is shown in constant 2024 US\$; loss of future earnings is shown in 2017 PPP and is not directly comparable, hence, please avoid adding or directly comparing these numbers; Net present values use a 3 per cent social discount rate, iv) calculated as the NPV

Source: Dalberg analysis

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**Immediate – Core focus**

**Past Economic Loss and Damage**

Forecasted Economic Loss and Damage

Long-term – High-level estimate

5. Case Studies

Annex

# The next slides focus on quantifying the past immediate economic loss and damage of climate-related events on education.

Past  
VS  
Future  
VS  
Immediate  
VS  
Long-term

Economic vs. non-economic	Immediate vs. Long-term	Description	Scope	Data quality	Approach	Analyses
Economic	Immediate (direct)	<ul style="list-style-type: none"> <li><b>Education facilities and fixed services</b> (Classrooms, labs, admin blocks, WASH blocks, power, connectivity nodes)</li> <li><b>Learning materials and movable equipment</b> (Furniture, textbooks, ICT devices, lab kits)</li> <li><b>Temporary or alternative learning spaces</b> (Tents, prefabs, community centres)</li> <li><b>Transport and logistics assets</b> (Buses, boats, access roads, storage depots)</li> <li><b>Other</b></li> </ul>	<b>Quantitative analysis</b> (note that due to data availability/quality, the analyses were conducted at the aggregate level, i.e., no breakdown was possible)	<b>Medium/High</b> <ul style="list-style-type: none"> <li>Post-Disaster Assessments provide good data points on damage, loss and needs for major events following World Bank definition<sup>1</sup></li> <li>EM-DAT<sup>2</sup> provides a comprehensive database of all extreme events</li> <li><i>Carbon Brief</i><sup>3</sup> assesses attribution to climate change</li> </ul>	<ul style="list-style-type: none"> <li>Consolidation of existing data</li> <li>Assessment of attribution to climate change</li> <li>Extrapolation to cover data gaps</li> <li>Triangulation and refinement</li> </ul>	<ul style="list-style-type: none"> <li><b>Past impact</b> <i>Focus of next slides</i></li> <li><b>Forecast impact</b></li> </ul>
	Long-term (indirect)	<ul style="list-style-type: none"> <li><b>Future learning and earnings for affected children</b> (Long-run wage and human capital impact)</li> <li><b>Service-delivery flows</b> (Instructional hours, exams, catch-up classes)</li> <li><b>Education workforce</b> (Teachers, support staff)</li> <li><b>Household economic burden</b> (Parents and caregivers)</li> <li><b>Near-term community economic impact</b> (Local business impact)</li> <li><b>Long-term broader economic impact</b> (Total economy impact)</li> </ul>	<b>High-level quant analysis,</b> focusing on <b>"loss of future income"</b>	<b>Low</b> <ul style="list-style-type: none"> <li>Limited studies conducted to allow a detailed assessment</li> <li>Few datapoints allowing a back of envelope calculation</li> </ul>	<ul style="list-style-type: none"> <li>High-level quantitative analysis</li> <li>Triangulation and refinement</li> </ul>	<ul style="list-style-type: none"> <li><b>Past impact</b></li> <li><b>Forecast impact</b></li> </ul>
Non-Economic		<ul style="list-style-type: none"> <li>Mental and physical health impacts, social and cultural disruption...</li> </ul>		Although not a focus of this quantitative assessment, these are relevant impacts that were covered in the case studies  Out of scope of the quantitative analysis		

Source: 1) World Bank, [Damage, Loss and Needs Assessment - Guidance Notes](#), 2010; 2) EM-DAT, [Database](#), Accessed Jul/2025; 3) Carbon Brief, [Attribution studies](#), Accessed Jul/2025; Dalberg analysis

# We have mapped relevant sources and databases with EM-DAT being the most comprehensive, PDNAs the most detailed on education related loss and damage, and *Carbon Brief* helpful to assess attribution.

Past  
VS  
Future  
Immediate  
VS  
Long-term

## Most relevant sources and databases covering disasters for the quantitative analysis

NON-EXHAUSTIVE

**Extreme**  
(cyclone, storm surge, flood, drought, heatwave...)

**Slow-onset**  
(sea level rise, increasing temperatures, desertification, salinization, land and forest degradation...)

### Climate-induced

**Needs Assessments<sup>3i</sup>** are assessments conducted after major disasters to assess the loss and damage across multiple sectors (housing, education, health, agriculture...) with 15+ mapped in the ESA region

**Carbon brief<sup>2</sup>** assesses the contribution of climate change to disasters with 50+ analyses in Sub-Saharan Africa

**EM-DAT<sup>1</sup>** records at the country-level human and economic losses for disasters with at least one of the following criteria: (i) 10 fatalities; (ii) 100 affected people; (iii) a declaration of state of emergency; (iv) a call for international assistance, with 700+ entries in the database in the ESA region

Key focus of the quantitative scope

To be covered in qualitative assessments/case studies

### Not climate-induced

Used to collect data on the economic loss and damage on education

Used to assess attribution to climate change (alongside with World Weather Attribution<sup>4</sup>)

Approximated as the universe of all extreme events

Not part of the scope

Not part of the scope

Literature review available in the annex

Note: i) Post-Disaster Need Assessments (PDNAs), Rapid Impact and Needs Assessment (RINA), (Drought) Impact Needs Assessment (DINA), Humanitarian Response Plan (HRP), and Joint Damage, Losses and Needs Assessment (JDLNA)  
Source: 1) EM-DAT, [Database](#), Accessed Jul/2025; 2) Carbon Brief, [Attribution studies](#), Accessed Jul/2025; 3) Several sources; 4) World Weather Attribution, [Studies in Africa](#), Accessed Jul/2025; Dalberg analysis

# Hence, we combine all three key sources to calculate the economic loss and damage of climate-induced extreme disasters on education.

Past  
VS  
Future  
Immediate  
VS  
Long-term

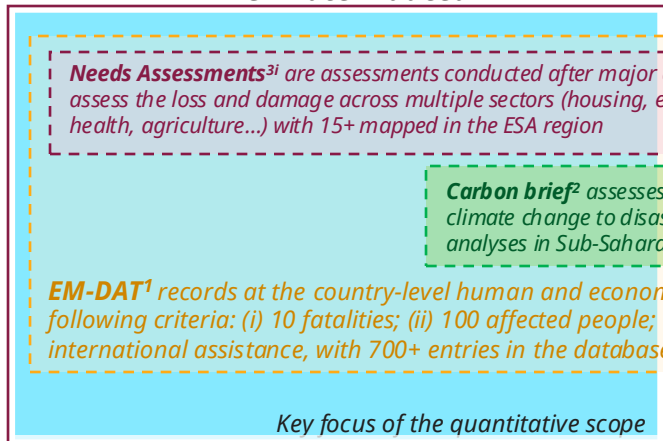
## Most relevant sources and databases covering disasters for the quantitative analysis

NON-EXHAUSTIVE

**Extreme**  
(cyclone, storm surge, flood, drought, heatwave...)

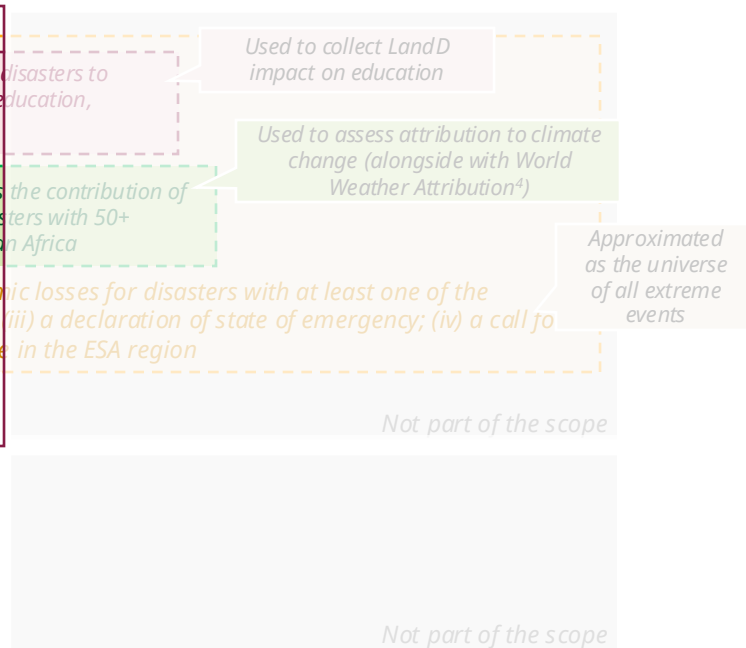
**Slow-onset**  
(sea level rise, increasing temperatures, desertification, salinization, land and forest degradation...)

### Climate-induced



To be covered in qualitative assessments/ case studies

### Not climate-induced

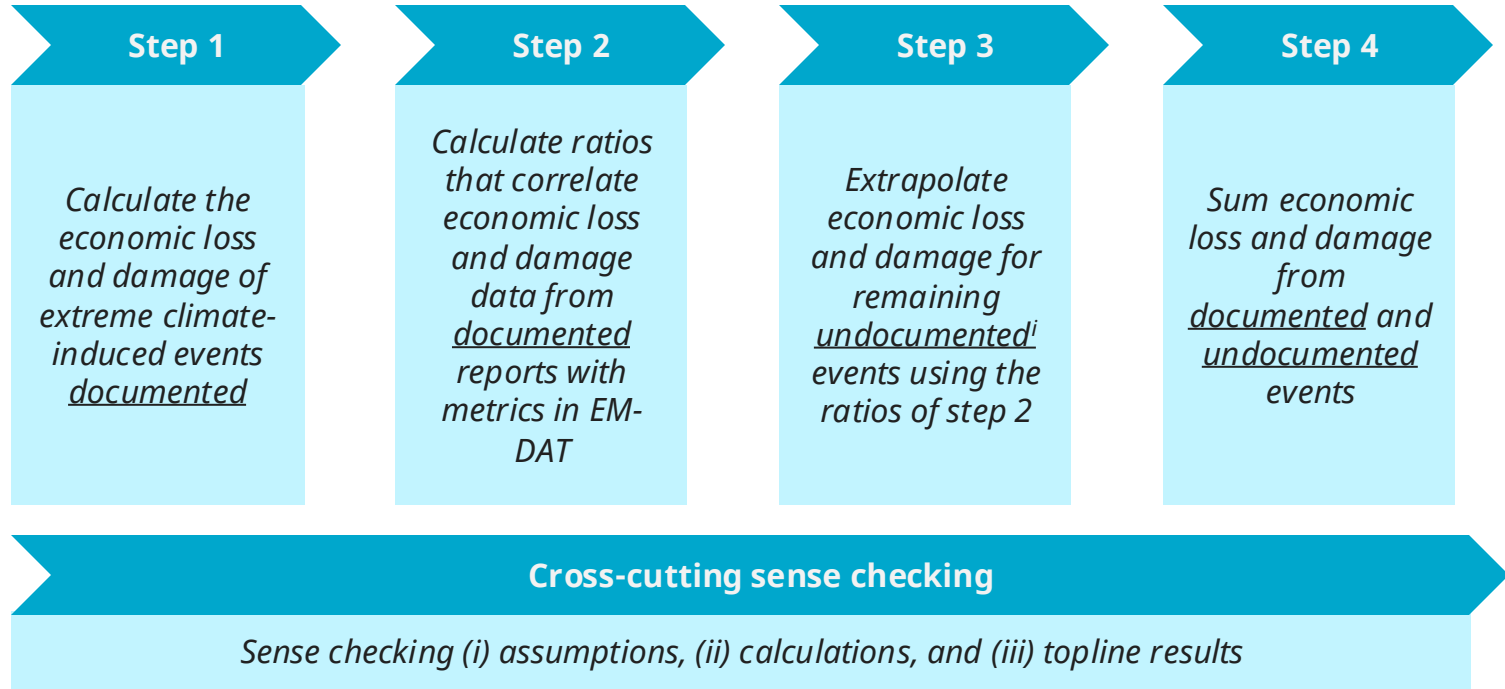


Note: i) Post-Disaster Need Assessments (PDNAs), Rapid Impact and Needs Assessment (RINA), (Drought) Impact Needs Assessment (DINA), Humanitarian Response Plan (HRP), and Joint Damage, Losses and Needs Assessment (JDLNA)

Source: 1) EM-DAT, [Database](#), Accessed Jul/2025; 2) Carbon Brief, [Attribution studies](#), Accessed Jul/2025; 3) Several sources; 4) World Weather Attribution, [Studies in Africa](#), Accessed Jul/2025; Dalberg analysis

We first calculate the impact of the top events documented, we then calculate ratios that can be used to extrapolate economic loss and damage for all remaining undocumented events.

Past  
VS  
Future  
Immediate  
VS  
Long-term



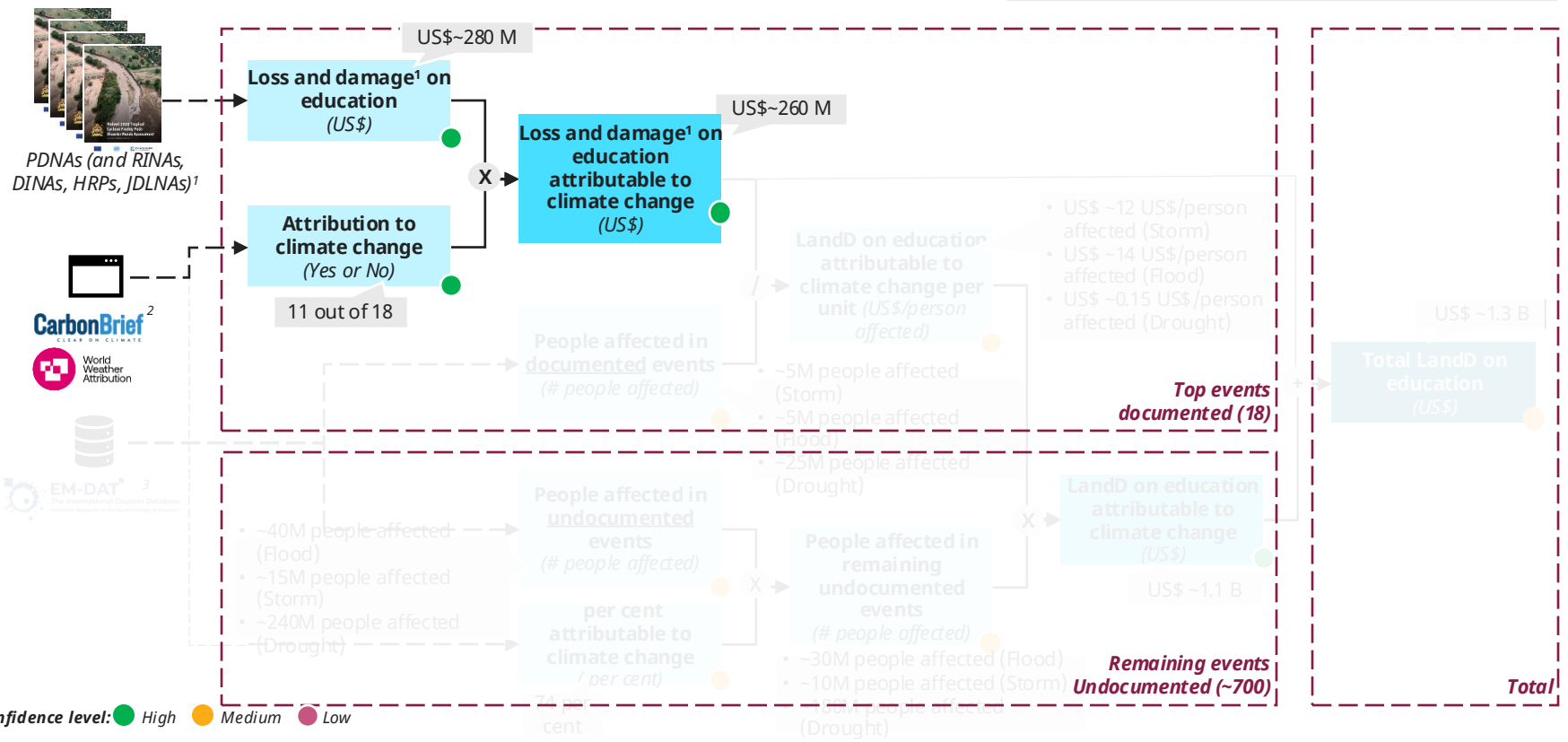
Note: i) For undocumented events (as further explained), we apply ratios adjusted by hazard type (flood, storm, drought) and cost type (damage vs. loss)  
Source: Dalberg analysis

# In the first step we consolidate economic loss and damage as reported in PDNAs and other sources and check which can be attributed to climate change.

Past  
VS  
Future  
Immediate  
VS  
Long-term



## Key sources



Source: 1) Several, 2) Carbon Brief, [Attribution studies](#), Accessed Jul/2025; World Weather Attribution, [Studies in Africa](#), Accessed Jul/2025; and several other studies; 3) EM-DAT, [Database](#), Accessed Jul/2025; Dalberg analysis

# Economic loss and damage figures were consolidated as reported in the several Post-Disaster Needs Assessments, each with differing levels of detail with figures reflecting mainly immediate impacts.

## NON-EXHAUSTIVE

Step 1

Step 2

Step 3

Step 4

Sense-checking

### 2023 - Cyclone Freddy in Malawi<sup>1</sup>

TABLE 1. Summary of Disaster Effects for Tropical Cyclone Freddy in Malawi (US\$, million)

Sector	Subsector	Total effects				
		Damage	Loss	Public	Private	Total
Social	Housing	113.45	11.02	-	124.47	124.47
	Health and nutrition	4.14	3.99	7.93	0.19	8.13
	Education	30.25	11.83	42.09	-	42.08



Overview of whole education, broken down into public and private

### 2015-16 - Droughts in Malawi<sup>2</sup>

TABLE 1: SUMMARY OF DAMAGES, LOSSES AND NEEDS ACROSS ALL SECTORS

Sector	Cost (USD)		
	Damages	Losses	Recovery
Productive Sectors			
Social Sectors			
Food Security	-	-	-
Education	3,358,929	6,946,445	-
Health	-	14,303,878	-
Nutrition	-	11,970,568	33,425,537
Social Protection	-	-	42,908,343
Human & Social Impact	-	-	-

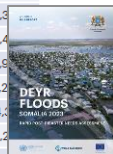
Overview of whole education

### 2023 - Floods in Somalia<sup>3</sup>

Education: Total damage cost

Detailed breakdown by damage type

District	Infrastructure damage	Damage cost for school furniture	Damage cost for school administration furniture	Damage cost for teaching and learning materials	Damage cost for textbooks	Total damage cost (US\$)
Dolow	1,007,000	79,500	30,000	115,920	115,920	1,348,340
Baardheere	423,800	33,000	12,000	67,275	67,275	603,350
Kismayo	1,112,000	87,000	30,000	465,225	465,225	2,159,450
Almadow	1,147,000	111,000	30,000	163,470	163,470	1,614,940
Baldoa	2,898,200	207,000	78,000	543,000	543,000	4,269,200
Beletweyne	3,371,000	252,000	90,000	305,655	305,655	4,324,310
Buuloburde	1,423,800	114,000	42,000	69,225	69,225	1,718,250
Jowhar	1,208,400	87,000	36,000	167,160	167,160	1,665,720
Hudur	972,000	73,500	30,000	67,320	67,320	1,210,140
<b>Total</b>	<b>13,563,200</b>	<b>1,044,000</b>	<b>378,000</b>	<b>1,964,250</b>	<b>1,964,250</b>	<b>18,913,700</b>



### 2018 - Cyclone Sagar in Djibouti<sup>4</sup>

Detailed breakdown by education level

Sous-secteur	Dommages (DJF) (+ 3% pour alean)	Pertes (DJF)	Effets totaux (DJF)
Ecoles Primaires	149,113,100	2,200,464	151,313,564
Colleges	37,801,000	0	37,801,000
Lycees	11,840,592	0	11,840,592
Lycees techniques	4,872,244	0	4,872,244
Centres de formations	0	21,063,000	21,063,000
<b>Total Secteur</b>	<b>203,626,936</b>	<b>23,263,464</b>	<b>261,258,054</b>

Source: 1) Government of Malawi, [Malawi 2023 Tropical Cyclone Freddy Post-Disaster Needs Assessment](#), 2023; 2) World Bank, UN, GFDRR, EU, [Malawi Drought 2015-2016 Post-Disaster Needs Assessment](#), 2016; 3) Federal Government of Somalia, United Nations, World Bank, European Union, [Somalia 2023 Deyr Floods Rapid-Post Disaster Needs Assessment](#), 2024; 4) World Bank, GFDRR, MEFI, [Rapport d'Evaluation Rapide des Dommages et Besoins - Post-Cyclone Sagar](#), 2018; Dalberg analysis

# We then assessed which events can be attributed to climate change.



Disaster Type	Event name	Year	Country/region	Total damage cost (US\$ M) <sup>1</sup>	Total loss cost (US\$ M) <sup>1</sup>	Attributable to climate change? <sup>2</sup>
Storm	Tropical cyclone 'Freddy'	2023	Malawi	31.0	12.1	More severe or likely to occur
Flood		2023	Somalia	19.4	2.2	More severe or likely to occur
Storm	Cyclone 'Idai'	2019	Mozambique	18.1	6.7	More severe or likely to occur
Storm	Cyclone 'Idai'	2019	Zimbabwe	7.9	1.2	More severe or likely to occur
Flood		2019	Malawi	24.4	19.2	More severe or likely to occur
Storm	Cyclone 'Sagar'	2018	Djibouti	1.4	0.2	No studies done
Drought		2016-2017	Somalia	-	-	Insufficient data/inconclusive
Drought		2016-2017	Zimbabwe	-	-	No studies done
Drought		2015-2016	Malawi	4.3	8.9	More severe or likely to occur
Drought		2012-2016	Angola	-	-	No studies done
Flood		2015	Malawi	16.0	12.5	More severe or likely to occur
Flood		2015	Mozambique	7.7	-	No studies done
Flood		2014	Burundi	0.6	-	More severe or likely to occur
Flood		2012	Malawi, Nsanje District	0.0	0.3	More severe or likely to occur
Flood	Heavy rains	2010-2011	Lesotho	5.6	0.1	More severe or likely to occur
Drought		2008-2011	Kenya	0.7	64.1	More severe or likely to occur
Flood		2009	Namibia	5.2	0.7	Less severe or less likely to occur
Storm	Cyclone Fame, Cyclone Ivan, and Cyclone Jokwe	2008	Madagascar	4.6	0.9	No studies done
<b>Total</b>				<b>146.8</b>	<b>129.1</b>	

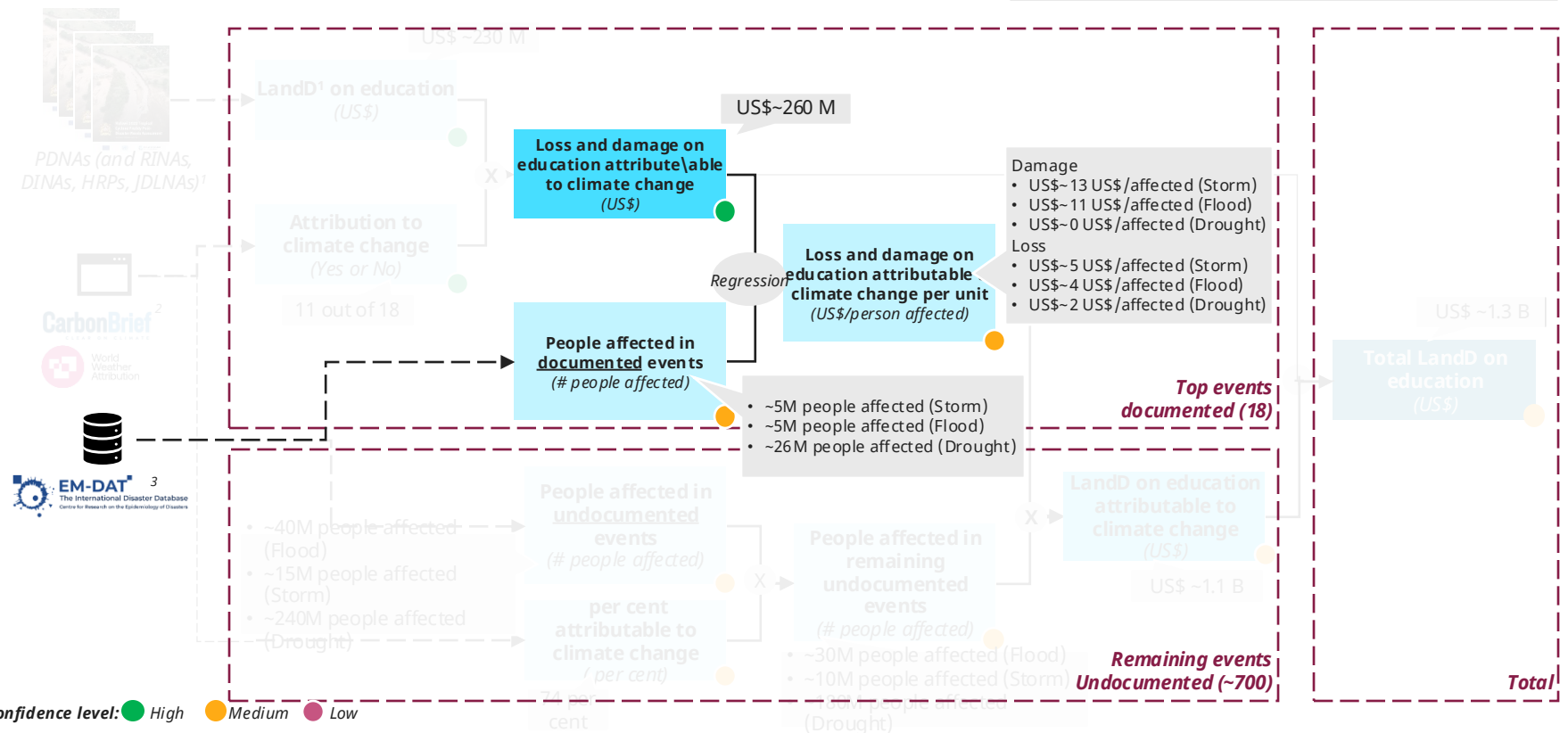
Source: 1) Several PDNAs, 2) Carbon Brief, [Attribution studies](#), Accessed Jul/2025; World Weather Attribution, [Studies in Africa](#), Accessed Jul/2025; and other additional studies; Dalberg analysis

# We then use the loss and damage on education attributable to climate change to correlate with metrics available in EM-DAT, in this case economic loss and damage per person affected.

Past  
VS  
Future  
Immediate  
VS  
Long-term



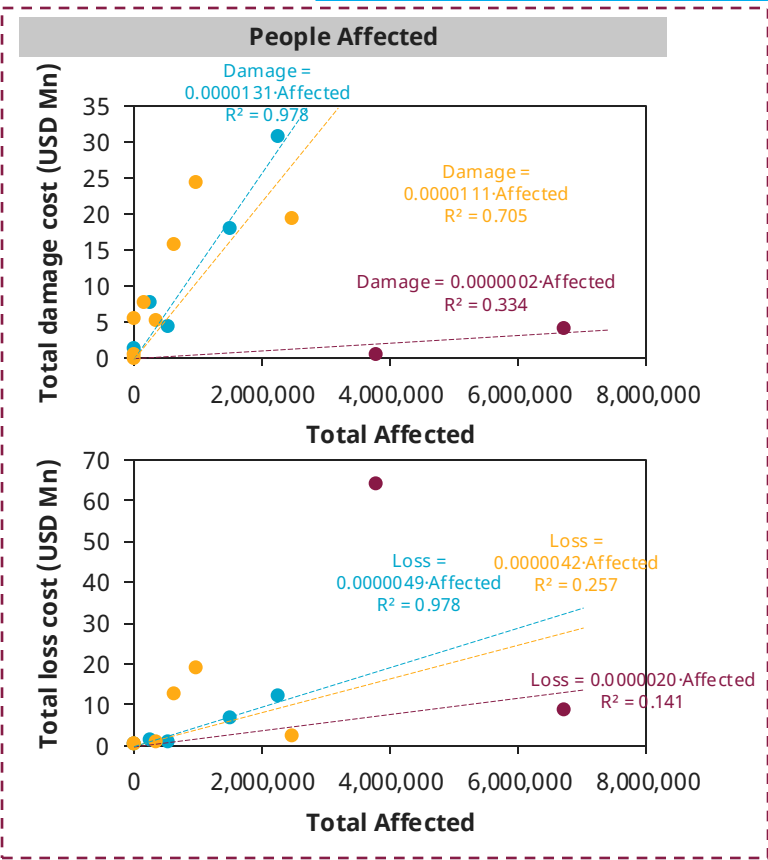
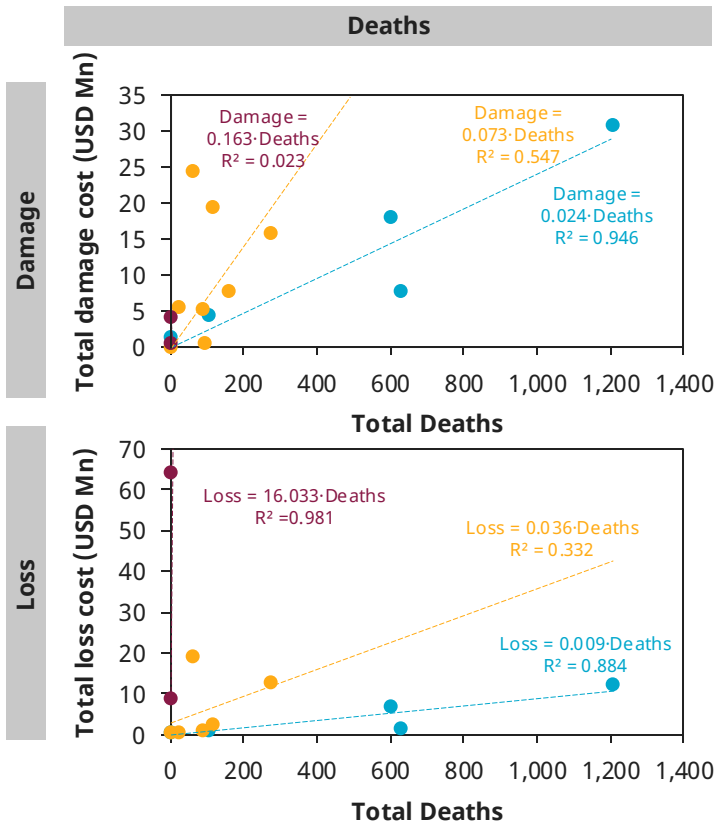
## Key sources



Source: 1) Several, 2) Carbon Brief, [Attribution studies](#), Accessed Jul/2025; World Weather Attribution, [Studies in Africa](#), Accessed Jul/2025; and several other studies; 3) EM-DAT, [Database](#), Accessed Jul/2025; Dalberg analysis

# We tested the correlation of different metrics and decided to use a stratification by event type, correlating total damage and loss with people affected, given the overall better R<sup>2</sup>.

Past  
VS  
Future  
Immediate  
VS  
Long-term



- Storm
- Flood
- Drought

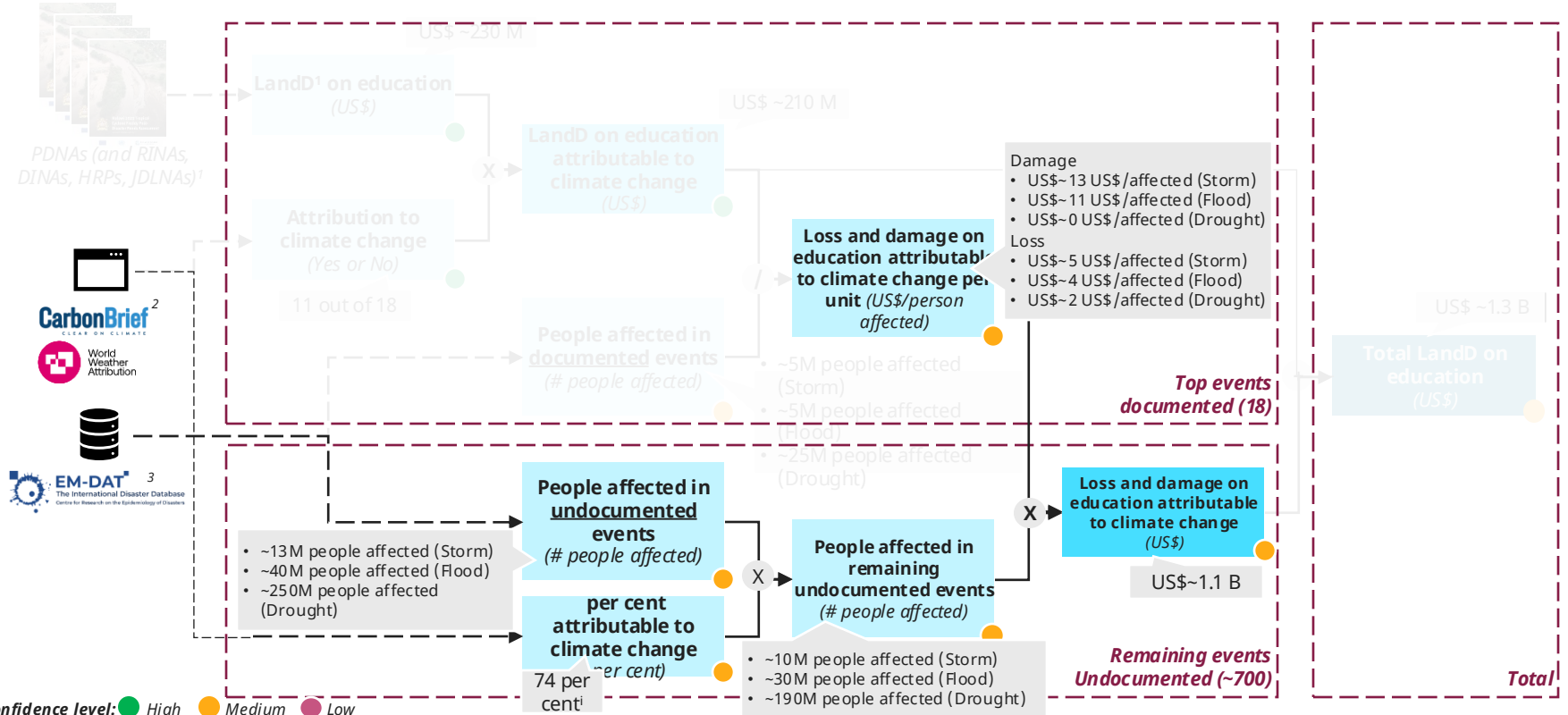
Source: 1) Several PDNAs; 2) EM-DAT, [Database](#), Accessed Jul/2025; Dalberg analysis

# We proceed to extrapolate loss and damage for all remaining events by using the number of people affected, adjusting for attribution and multiplying by the ratio loss and damage per person affected.

Past  
VS  
Future  
Immediate  
VS  
Long-term



## Key sources



**Confidence level:** ● High ● Medium ● Low

Note: i) 74 per cent of 600 studies, covering almost 750 extreme weather events and trends were made more likely or severe because of climate change.

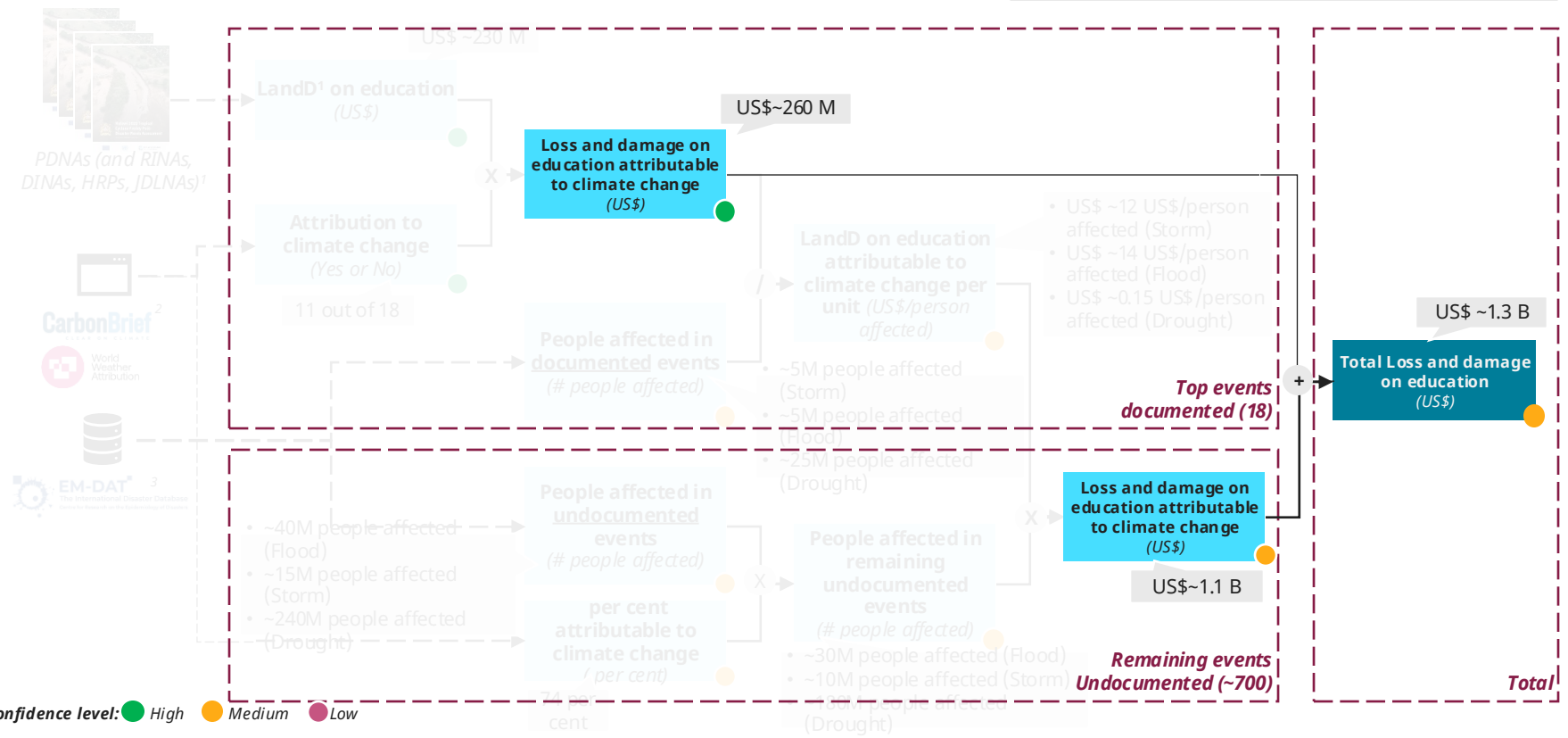
Source: 1) Several, 2) Carbon Brief, [Attribution studies](#), Accessed Jul/2025; World Weather Attribution, [Studies in Africa](#), Accessed Jul/2025; and several other studies; 3) EM-DAT, [Database](#), Accessed Jul/2025; Dalberg analysis

# We finalize by adding up the economic loss and damage of documented events and the extrapolated value of undocumented events.

Past  
VS  
Future  
Immediate  
VS  
Long-term



## Key sources



Source: 1) Several, 2) Carbon Brief, [Attribution studies](#), Accessed Jul/2025; World Weather Attribution, [Studies in Africa](#), Accessed Jul/2025; and several other studies; 3) EM-DAT, [Database](#), Accessed Jul/2025; Dalberg analysis

# Our estimates are on a similar order of magnitude as some publicly available estimates, although more on the conservative side.



	Datapoint	Period	Scope	Sector	Source	US\$ M/year	Adjustment to be comparative to Dalberg estimates
Past	"The study authors estimate the cost of the extreme weather damages from 2000 to 2019 to average <b>around US\$143 billion</b> "	2000–2019	Global	All sectors	<a href="#">source</a> <sup>1</sup>	200–700	~ <b>200M</b> = 143B * ~10 per cent (700M population of ESAR divided by World 8B) * 5 per cent (education over all sectors) * ~30 per cent (loss and damage over total loss, damage and needs)
~ <b>700M</b> = 143B * ~10 per cent (700M population of ESAR divided by World 8B) * 5 per cent (education over all sectors) * ~100 per cent (loss and damage over total loss, damage and needs)							
Future	Dalberg estimate	2005–2019	ESA region	Education	Dalberg	10–170	<i>n/a – see methodology</i>
Immediate	"Estimations for recorded loss and damage costs in developing countries in <b>2022 stood at US\$109 billion</b> "	2022	Developing Countries	All sectors	<a href="#">source</a> <sup>2</sup>	150–550	~ <b>150M</b> = 109B * ~10 per cent (700M population of ESAR divided by Developing Countries 7B) * 5 per cent (education over all sectors) * 30 per cent (loss and damage over total loss, damage and needs)
							~ <b>550M</b> = 109B * ~10 per cent (700M population of ESAR divided by Developing Countries 7B) * 5 per cent (education over all sectors) * 100 per cent (loss and damage over total loss, damage and needs)
Long-term	Dalberg estimate	2022	ESA region	Education	Dalberg	120	<i>n/a – see methodology</i>

Source: 1) WEF, [Climate change is costing the world \\$1.6 million per hour: study](#), 2023; 2) UNCTAD, [Taking Responsibility Towards a Fit-for-Purpose Loss and Damage Fund](#), 2023; Dalberg analysis

# We tested different approaches and are using the extrapolation method 8 for undocumented events and checking for specific studies to assess attribution to climate change for documented events.



Past  
VS  
Future  
VS  
Immediate  
VS  
Long-term

	Scenarios	Damage (US\$ M)	Loss (US\$ M)	Comments
Documented (Climate Attribution scenarios)	<b>Attributed to or exacerbated by climate change based on studies available</b>	128	127	This scenario includes all documented events attributed to or exacerbated by climate change, offering the most accurate reflection of climate-related impacts. 61 per cent of these events are linked to climate change, consistent with findings from the 55 <i>Carbon Brief</i> studies done in Africa.
	<b>Assuming 74 per cent attributed to or exacerbated by climate change</b>	109	96	This scenario assumes that 74 per cent of events are attributed to or exacerbated by climate change, based on <i>Carbon Brief</i> 's global dataset of 600 studies covering 750 extreme weather events. It was used to stress test the analysis.
	<b>Assuming 100 per cent attributed to or exacerbated by climate change</b>	147	129	Treats every documented loss as climate-linked. Provides an upper-bound reference but overstates causality.
Undocumented (Extrapolation scenarios)	<b>1. Arithmetic mean of event-level cost-per-death ratios</b>	2,975	25,436	Simple average of event-level cost/death. Prone to distortion by a few costly, low-fatality events.
	<b>2. Arithmetic mean of event-level cost-per-affected-person ratios</b>	18,177	1,785	Simple average of event-level cost/affected.
	<b>3. Median of event-level cost-per-death ratios</b>	1,015	169	Median dampens outliers in cost/death. Offers a mid-range check on the death-based approach.
	<b>4. Median of event-level cost-per-affected-person ratios</b>	2,990	753	Median of cost/affected ratios. Reduces outlier influence but still limited by thin sample size.
	<b>5. Weighted average (<math>\Sigma</math>Cost / <math>\Sigma</math>deaths)</b>	1,202	1,057	Weights by total deaths, giving larger events more influence. Useful cross-check on death-based scaling.
	<b>6. Weighted average (<math>\Sigma</math>Cost / <math>\Sigma</math>Total affected)</b>	971	854	Weights by total affected. Serves as an alternative affected-based benchmark.
	<b>7. Weighted least-squares slope of Cost vs. Deaths (forced through zero) stratified by disaster type</b>	660	363	Regression of total cost on fatalities by disaster category, forcing the line through zero. Four drought entries produced extrapolated costs above the 95th per centile and were excluded to prevent extreme projections.
	<b>8. Weighted least-squares slope of Cost vs. Affected (forced through zero) stratified by disaster type</b>	503	552	Best statistical fit (e.g., compared to deaths). Chosen as the official estimate.
	<b>9. Cost-per-death ratio stratified by disaster type</b>	832	415	For droughts, when the extrapolation driver is based on deaths, the resulting estimates are very high due to the low number of recorded deaths. Four drought entries produced extrapolated costs above the 95th per centile and were excluded to prevent extreme projections.
	<b>10. Cost-per-affected-person ratio stratified by disaster type</b>	684	816	Uses type-specific cost/affected ratios. Offers a category-level view but still volatile; included for completeness.
	<b>11. Weighted least-squares slope of Cost vs. Affected (forced through zero) stratified by disaster type, adjusted for 61 per cent climate change attribution</b>	413	454	Similar scenario as the chosen one, however using a 61 per cent of climate attribution ratio specific to Africa (however differently from the 74 per cent based on ~600 studies, the 61 per cent is based on a smaller sample of 55 studies).

## Limitations: We have sufficient PDNA data to make informed estimates, yet analysis relies on a relatively small pool of documented events and on imperfect attribution and extrapolation approaches.

Step 1

Step 2

Step 3

Step 4

Sense-checking

- **Relatively few documented events available through detailed assessments (e.g., PDNAs):** Although scarce, PDNAs and similar reports are the best source of LandD data in monetary terms, which is the key input for this exercise, and follow relatively consistent definitions. To increase confidence, we test different correlations, select those with higher  $R^2$  values, and conduct sense checks against other aggregated datapoints.
- **Reliance on EM-DAT for over 700 “undocumented” events, which only includes disasters meeting a minimum threshold ( $\geq 10$  deaths or  $\geq 100$  people affected):** While this excludes smaller disasters, EM-DAT remains the most comprehensive and publicly available database in the ESA region. Using it ensures replicability and makes our total estimates conservative rather than overstated.
- **One cost-per-affected-person ratio is applied per disaster type, regardless of country context:** Although country-specific ratios would be ideal, data limitations prevent this. Stratifying by event type provided the best statistical fit (highest  $R^2$ ) and kept the model transparent and easy to replicate.
- **A uniform 74 per cent climate-attribution factor applied to undocumented events:** Event-specific attribution is often unavailable, so we used *Carbon Brief's* systematic review of ~600 peer-reviewed studies as an evidence-based proxy. This ensures scientific alignment and avoids arbitrary judgments. We also have a scenario where we use a 61 per cent climate-attribution factor, which is more specific to our geographic scope, but relies on a smaller subset of 55 studies.
- **Slow-onset hazards (e.g., sea-level rise, land degradation) were not included in this analysis:** These are typically not reported, and when information is available, it is not standardized, making robust inclusion infeasible within the current framework. This has been aligned to potentially be covered in a case study, during Phase 3.
- **Definition of loss and damage and possible bias in PDNAs:** In some instances, loss can encompass impact categories that are closely related to long-term economic impact, and granularity in reports does not allow for adjustments. There may also be a bias toward only conducting PDNAs for the most extreme events. Nevertheless, we kept PDNAs as the main source, given they provide the best data for this exercise.
- **Limited disaggregation by key interest groups (e.g., gender, disability):** Due to data constraints, we are unable to provide group-specific estimates and suggest using case studies to focus on those aspects.

# CONTENTS

Executive Summary

1. Context and Background

2. Scope and Principles

3. Key Results

**4. Methodology**

**Immediate – Core focus**

Past Economic Loss and Damage

**Forecasted Economic Loss and Damage**

Long-term – High-level estimate

5. Case Studies

Annex

# The next slides focus on quantifying the future economic loss and damage of climate-related events on education.

	Economic vs. non-economic	Immediate vs. Long-term	Description	Scope	Data quality	Approach	Analyses
Past	Economic	Immediate (direct)	<ul style="list-style-type: none"> <li>• <b>Education facilities and fixed services</b> (Classrooms, labs, admin blocks, WASH blocks, power, connectivity nodes)</li> <li>• <b>Learning materials and movable equipment</b> (Furniture, textbooks, ICT devices, lab kits)</li> <li>• <b>Temporary or alternative learning spaces</b> (Tents, prefabs, community centres)</li> <li>• <b>Transport and logistics assets</b> (Buses, boats, access roads, storage depots)</li> <li>• <b>Other</b></li> </ul>	Quantitative analysis (note that due to data availability/quality, the analyses were conducted at the aggregate level, i.e., no breakdown was possible)	<b>Medium/High</b> <ul style="list-style-type: none"> <li>• Post-Disaster Assessments provide good data points on damage, loss and needs for major events following World Bank definition<sup>1</sup></li> <li>• EM-DAT<sup>2</sup> provides a comprehensive database of all extreme events</li> <li>• <i>Carbon Brief</i><sup>3</sup> assesses attribution to climate change</li> </ul>	<ul style="list-style-type: none"> <li>• Consolidation of existing data</li> <li>• Assessment of attribution to climate change</li> <li>• Extrapolation to cover data gaps</li> <li>• Triangulation and refinement</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Past impact</b></li> <li>• <b>Forecast impact</b></li> </ul> <p><i>Focus of next slides</i></p>
Future		Long-term (indirect)	<ul style="list-style-type: none"> <li>• <b>Future learning and earnings for affected children</b> (Long-run wage and human capital impact)</li> <li>• <b>Service-delivery flows</b> (Instructional hours, exams, catch-up classes)</li> <li>• <b>Education workforce</b> (Teachers, support staff)</li> <li>• <b>Household economic burden</b> (Parents and caregivers)</li> <li>• <b>Near-term community economic impact</b> (Local business impact)</li> <li>• <b>Long-term broader economic impact</b> (Total economy impact)</li> </ul>	High-level quant analysis, focusing on <b>“loss of future income”</b>	<b>Low</b> <ul style="list-style-type: none"> <li>• Limited studies conducted to allow a detailed assessment</li> <li>• Few datapoints allowing a back of envelope calculation</li> </ul>	<ul style="list-style-type: none"> <li>• High-level quantitative analysis</li> <li>• Triangulation and refinement</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Past impact</b></li> <li>• <b>Forecast impact</b></li> </ul>
Immediate	Non-Economic		<ul style="list-style-type: none"> <li>• Mental and physical health impacts, social and cultural disruption...</li> </ul>				
Long-term							

Although not a focus of this quantitative assessment, these are relevant impacts that were covered in the case studies

Out of scope of the quantitative analysis

To forecast loss and damage on education we tested two different approaches, one based on a regression exercise, and another based on projecting based on scenarios provided by INFORM CC Risk Index.

Past  
vs  
Future  
vs  
Immediate  
vs  
Long-term

### Approach A

*Regress calculated past economic loss and damage on education on students enrolled and temperature and projected economic loss and damage based on forecast students and temperature*

### Approach B

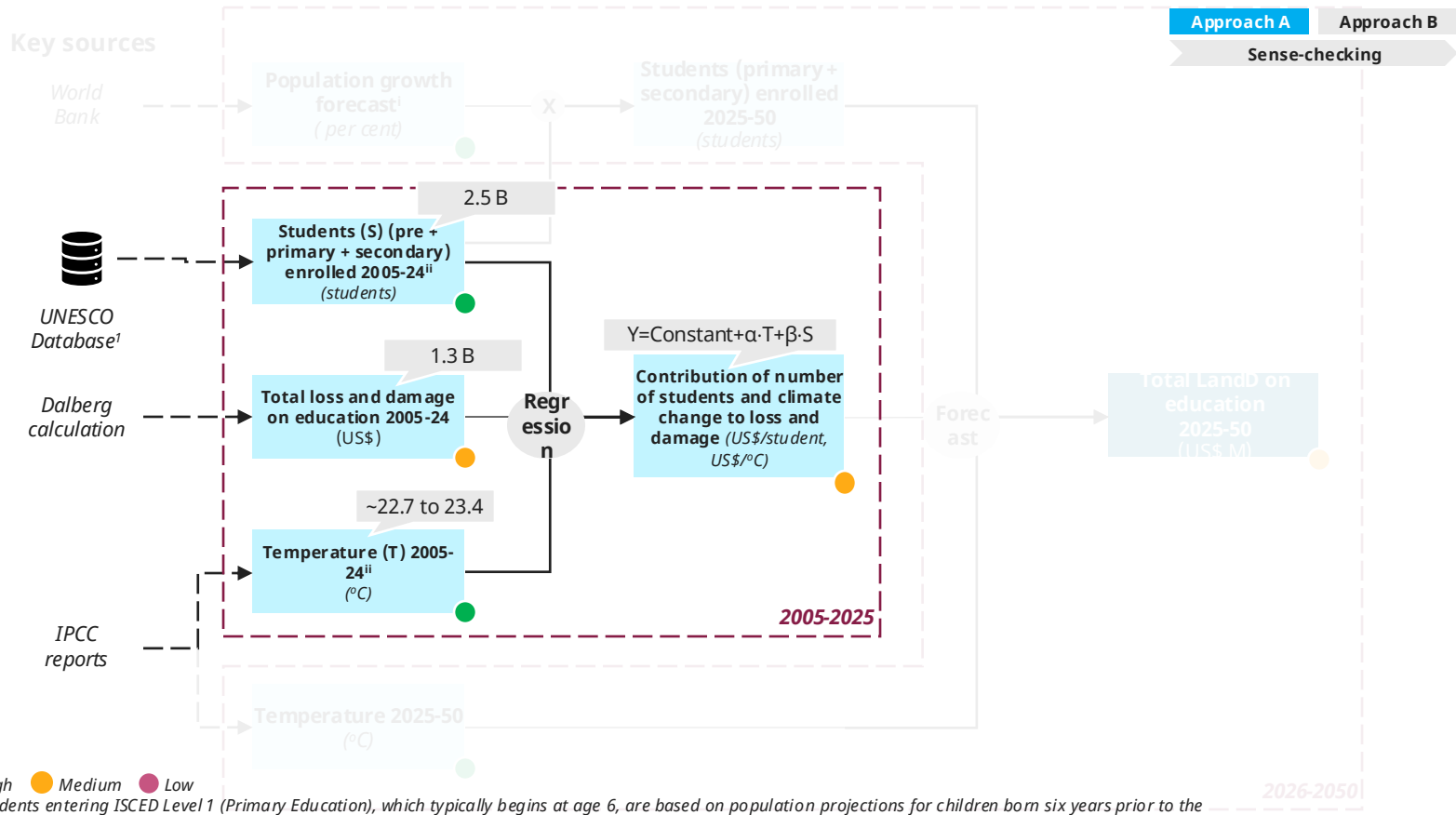
*Use INFORM climate change risk index which already projects exposure for different scenarios to forecast economic loss and damage on education*

### Cross-cutting sense checking

*Sense checking (i) assumptions, (ii) calculations, and (iii) topline results*

# To project values, we conduct a regression on economic loss and damage on the number of students and temperature...

Past  
VS  
Future  
Immediate  
VS  
Long-term



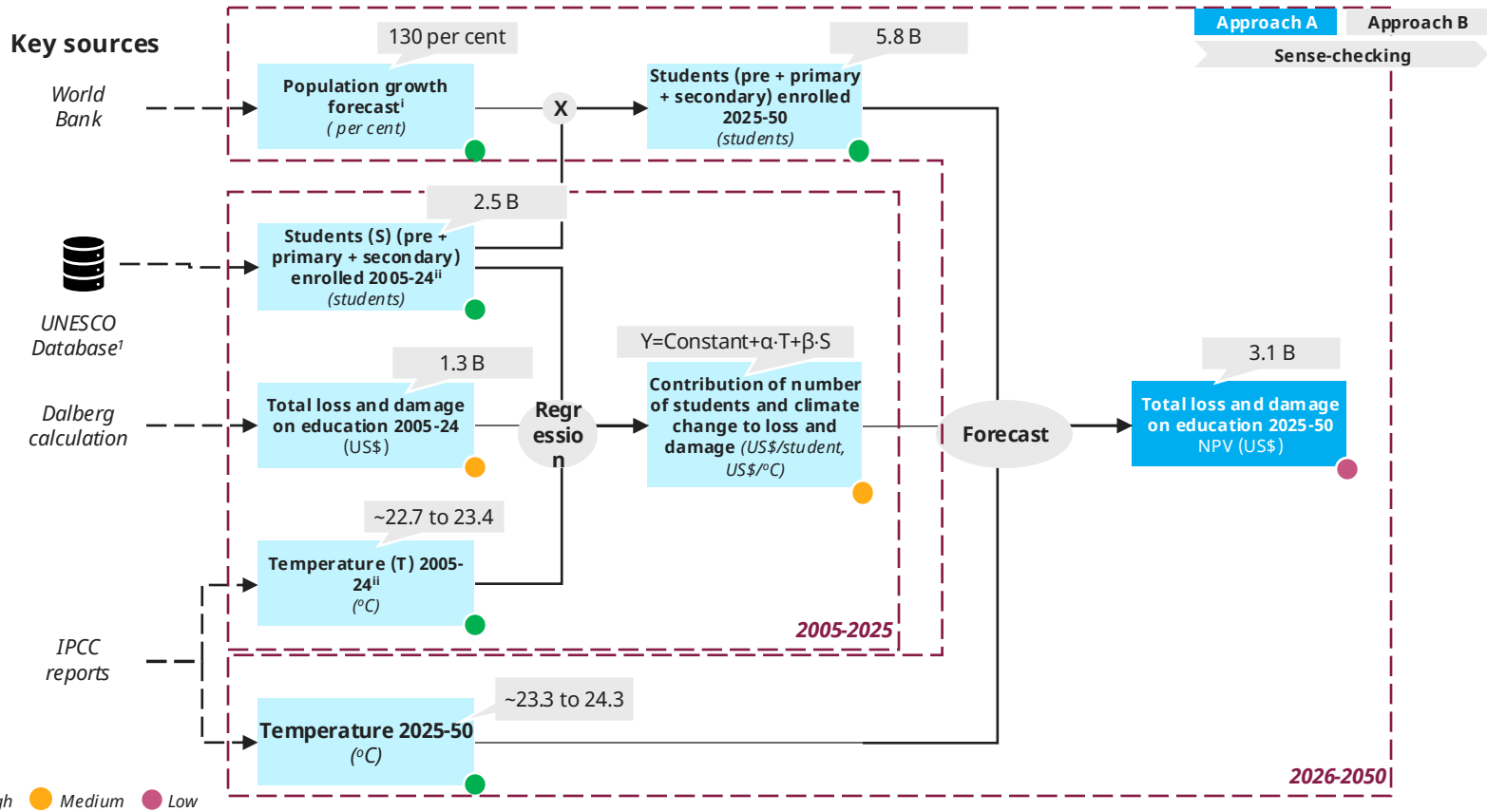
**Confidence level:** ● High ● Medium ● Low

Note: i) Projections of students entering ISCED Level 1 (Primary Education), which typically begins at age 6, are based on population projections for children born six years prior to the target school year. For example, estimates for 6-year-olds entering primary school in 2030 rely on the population of children born in 2024; ii) Dalberg is testing different metrics with a high correlation and forecast

Source: 1) UNESCO, [Enrolment Data](#), Accessed Jul/2025; Dalberg analysis

# ... And then used projected student base growth and IPCC temperature forecast to project economic loss and damage.

Past  
VS  
Future  
Immediate  
VS  
Long-term

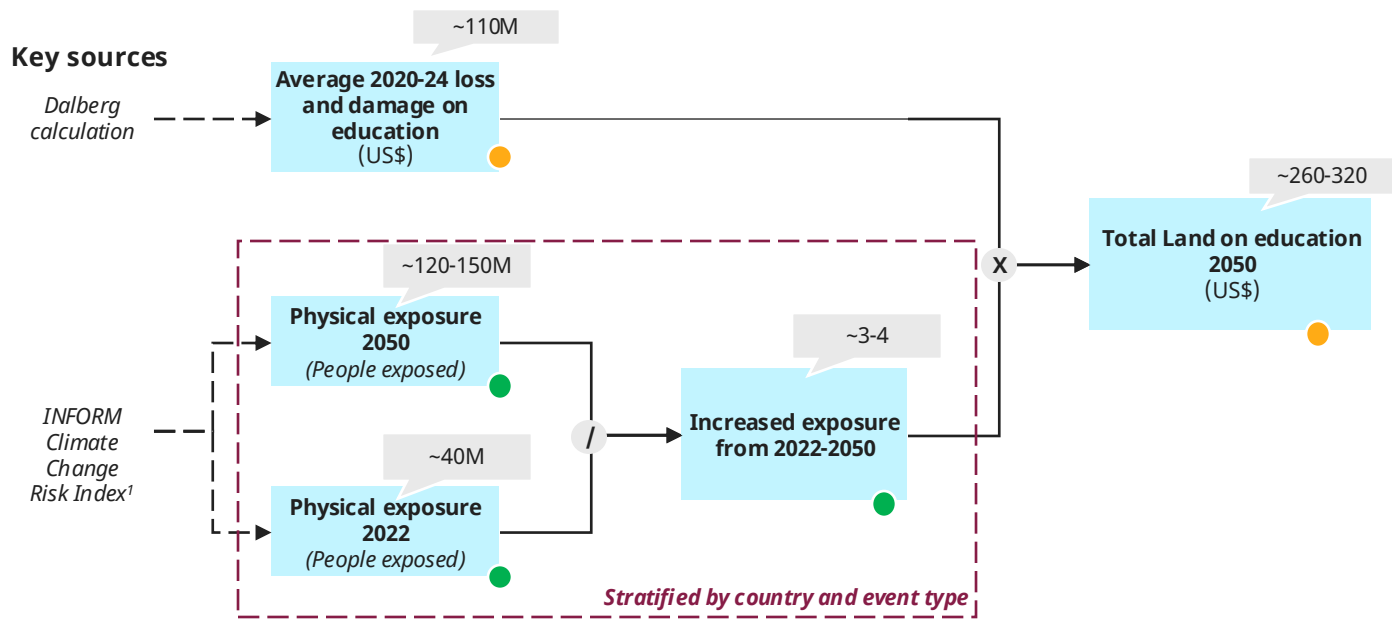


Note: i) Projections of students entering ISCED Level 1 (Primary Education), which typically begins at age 6, are based on population projections for children born six years prior to the target school year. For example, estimates for 6-year-olds entering primary school in 2030 rely on the population of children born in 2024; ii) Dalberg is testing different metrics with a high correlation and forecast  
Source: 1) UNESCO, [Enrolment Data](#), Accessed Jul/2025; Dalberg analysis

In approach B, we use the INFORM Climate Change Risk Index, which already projects exposure for different scenarios by country and by disaster type to forecast economic loss and damage on education.

Past  
VS  
Future  
Immediate  
VS  
Long-term

Approach A    Approach B  
Sense-checking



Confidence level: ● High    ● Medium    ● Low

Source: 1) The European Commission Joint Research Centre, [INFORM Climate Change Risk Index](#), 2022; Dalberg analysis

# Our estimates are on a similar order of magnitude as some publicly available estimates, although more on the conservative side.

Past  
vs  
Future  
vs  
Immediate  
vs  
Long-term

Approach A    Approach B  
Sense-checking

Datapoint	Period	Scope	Sector	Source	US\$ M/year	Adjustment to be comparative to Dalberg estimates
<p><i>“Conservative projections show the economic costs of climate change-induced loss and damage in developing countries at <b>US\$290–580 billion in 2030”</b></i></p>	2030	Developing Countries	All sectors	<a href="#">source</a> <sup>1</sup>	430-2,900	<p>~<b>430M</b> = 290B * ~10 per cent (700M population of ESAR divided by Developing Countries 7B <a href="#">source</a>) * ~5 per cent (education over all sectors) * ~30 per cent (loss and damage over total loss, damage and needs)</p> <p>~<b>2,900M</b> = 580B * ~10 per cent (700M population of ESAR divided by Developing Countries 7B <a href="#">source</a>) * ~5 per cent (education over all sectors) * ~100 per cent (loss and damage over total loss, damage , and needs)</p>
Dalberg estimate	2030	ESA region	Education	Dalberg	150-160	<i>n/a – see methodology</i>

Source: 1) Climate Analytics, [Loss and damage fund gearing up to deliver early support](#), 2025; Dalberg analysis

# We tested different projection approaches and are using figures based on the INFORM Climate Change Risk Index.

Past  
VS  
Future  
VS  
Immediate  
VS  
Long-term

Approach A    Approach B  
Sense-checking

	Scenarios	Sum Damage and Loss Forecast (US\$ M)	Observations
High-level exercise for sense checking	Trend by country	US\$3,151 M	Uses each country's historical economic loss and damage trend to project values to 2050. Serves as a benchmark.
	Trend by event	US\$3,130 M	Uses hazard-specific historical economic loss and damage trend (flood, storm, drought) to 2050. Highlights event-level trajectories yet ignores population/exposure shifts; retained solely for comparative stress testing.
	Trend by country and event	US\$3,310 M	Most granular trend (nation × hazard). Useful for stress testing.
Approach A: Forecast based on regression	Projection based on ESARO Temperature Optimistic	US\$2,901 M	Employs linear regression of economic loss and damage on temperature anomalies under SSP2. R <sup>2</sup> is 0.36, lower than competing models, so the scenario is kept only for comparison.
	Projection based on ESARO Temperature and Demographics Optimistic	US\$3,807 M	Adds a demographic exposure multiplier (UN medium variant) to the temperature-economic loss and damage regression. R <sup>2</sup> 0.41, adjusted R <sup>2</sup> 0.34, p-value 0.011. A statistically significant model with moderate explanatory power. Kept as a comparator.
	Projection based on ESARO Temperature and Students Optimistic	US\$3,078 M	Regression of economic loss and damage on temperature anomalies and students enrolment growth. R <sup>2</sup> = 0.37, adjusted R <sup>2</sup> = 0.29, p = 0.021.
	Projection based on ESARO Temperature and Students Pessimistic	US\$3,120 M	Statistically significant with modest explanatory power.
Approach B: Forecast based on INFORM climate change risk index	Projection based on INFORM Optimistic	US\$3,349 M	INFORM provides projections of absolute multi-hazard exposure to 2050 by integrating Shared Socio-economic Pathways-Representative Concentration Pathways (SSP-RCP) scenario pathways with corresponding population growth estimates – giving potentially the most accurate forward view and therefore serving as the baseline.
	Projection based on INFORM Pessimistic	US\$3,847 M	

   Suggested scenario

# Limitations: Forward-looking estimates are evidence based yet limited and largely linear projections.



Most of the limitations mentioned in the exercise of assessing “past immediate” economic loss and damage apply here, in addition to:

- **Linear link between temperature rise, enrolment growth and monetary loss assumes no change in vulnerability over time.** This was done deliberately to illustrate the cost of inaction, i.e., the education losses that would occur if no additional resilience investments are made.
- **Enrolment projections are based on population growth, without adjustments for future shifts in enrolment rates, migration, or dropout.** We acknowledge this limitation and are open to refining the model using projected enrolment ratios or more granular data, such as UNICEF enrolment forecasts, if available.
- **INFORM provides a 2050 estimate, requiring linear interpolation between 2024 and 2050.** This approach ensures simplicity and transparency, although it does not capture annual variability. We also applied a multilinear regression as an alternative model to explore this further.

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Immediate – Core focus

**Long-term – High-level estimate**

**Past Economic Loss and Damage**

Forecasted Economic Loss and Damage

### 5. Case Studies

## Annex

# The next slides focus on quantifying the past long-term economic loss and damage of climate-related events on education, namely loss of future earnings.

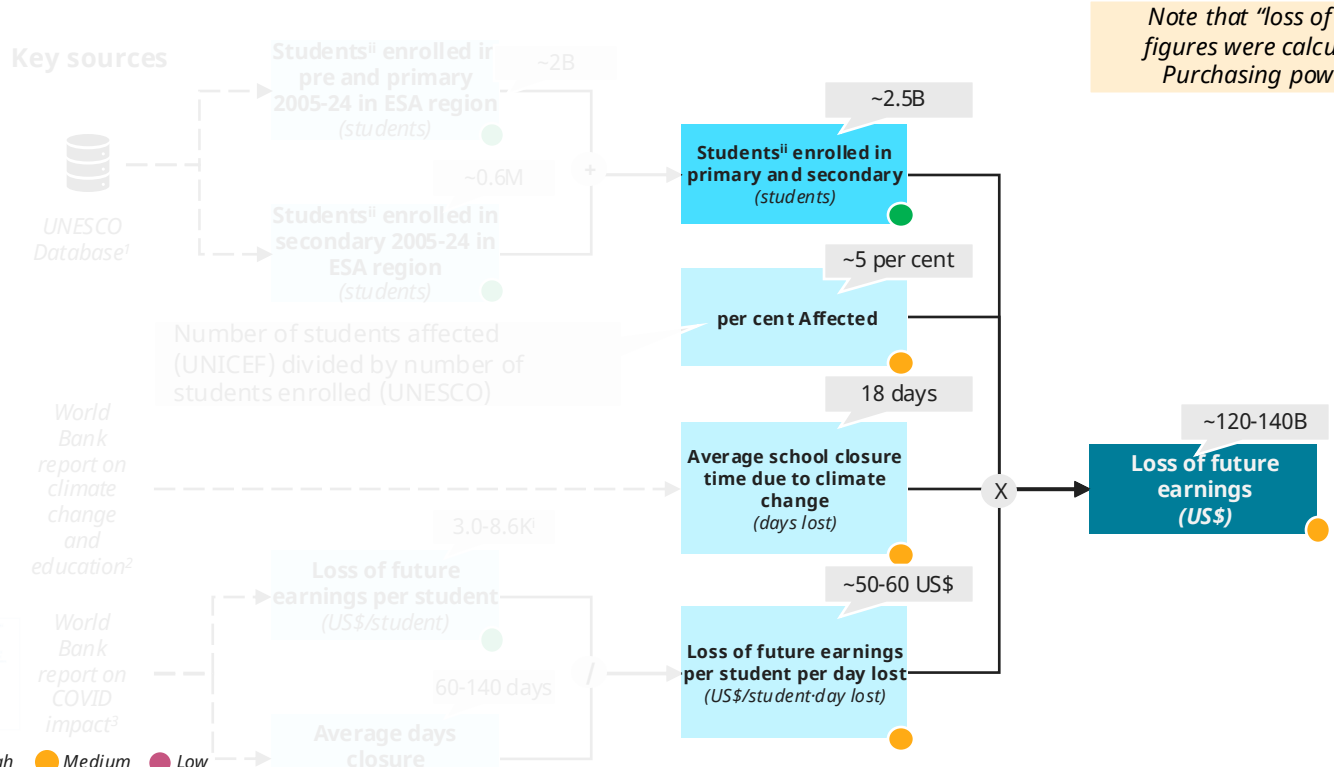
Economic vs. non-economic	Immediate vs. Long-term	Description	Scope	Data quality	Approach	Analyses
Economic	Immediate (direct)	<ul style="list-style-type: none"> <li><b>Education facilities and fixed services</b> (Classrooms, labs, admin blocks, WASH blocks, power, connectivity nodes)</li> <li><b>Learning materials and movable equipment</b> (Furniture, textbooks, ICT devices, lab kits)</li> <li><b>Temporary or alternative learning spaces</b> (Tents, prefabs, community centres)</li> <li><b>Transport and logistics assets</b> (Buses, boats, access roads, storage depots)</li> <li><b>Other</b></li> </ul>	<b>Quantitative analysis</b> (note that due to data availability/quality, the analyses were conducted at the aggregate level, i.e., no breakdown was possible)	<b>Medium/ High</b> <ul style="list-style-type: none"> <li>Post-Disaster Assessments provide good data points on damage, loss, and needs for major events following World Bank definition<sup>1</sup></li> <li>EM-DAT<sup>2</sup> provides a comprehensive database of all extreme events</li> <li><i>Carbon Brief</i><sup>3</sup> assesses attribution to climate change</li> </ul>	<ul style="list-style-type: none"> <li>Consolidation of existing data</li> <li>Assessment of attribution to climate change</li> <li>Extrapolation to cover data gaps</li> <li>Triangulation and refinement</li> </ul>	<ul style="list-style-type: none"> <li><b>Past impact</b></li> <li><b>Forecast impact</b></li> </ul>
	Long-term (indirect)	<ul style="list-style-type: none"> <li><b>Future learning and earnings for affected children</b> (Long-run wage and human capital impact)</li> <li><b>Service-delivery flows</b> (Instructional hours, exams, catch-up classes)</li> <li><b>Education workforce</b> (Teachers, support staff)</li> <li><b>Household economic burden</b> (Parents and caregivers)</li> <li><b>Near-term community economic impact</b> (Local business impact)</li> <li><b>Long-term broader economic impact</b> (Total economy impact)</li> </ul>	<b>High-level quant analysis, focusing on “loss of future income”</b>	<b>Low</b> <ul style="list-style-type: none"> <li>Limited studies conducted to allow a detailed assessment</li> <li>Few datapoints allowing a back of envelope calculation</li> </ul>	<ul style="list-style-type: none"> <li>High-level quantitative analysis</li> <li>Triangulation and refinement</li> </ul>	<ul style="list-style-type: none"> <li><b>Past impact</b></li> <li><b>Forecast impact</b></li> </ul> <p><i>Focus of next slides</i></p>
Non-Economic		Mental and physical health impacts, social and cultural disruption...				

*Although not a focus of this quantitative assessment, these are relevant impacts that were covered in the case studies*

*Out of scope of the quantitative analysis*

# To calculate the loss of future income, we conduct a high-level assessment by multiplying number of students by per cent affected by average days lost by loss of future earnings per lost day.

Past  
VS  
Future  
Immediate  
VS  
Long-term



Note that "loss of future earnings" figures were calculated using 2017 Purchasing power parity (PPP)<sup>iii</sup>

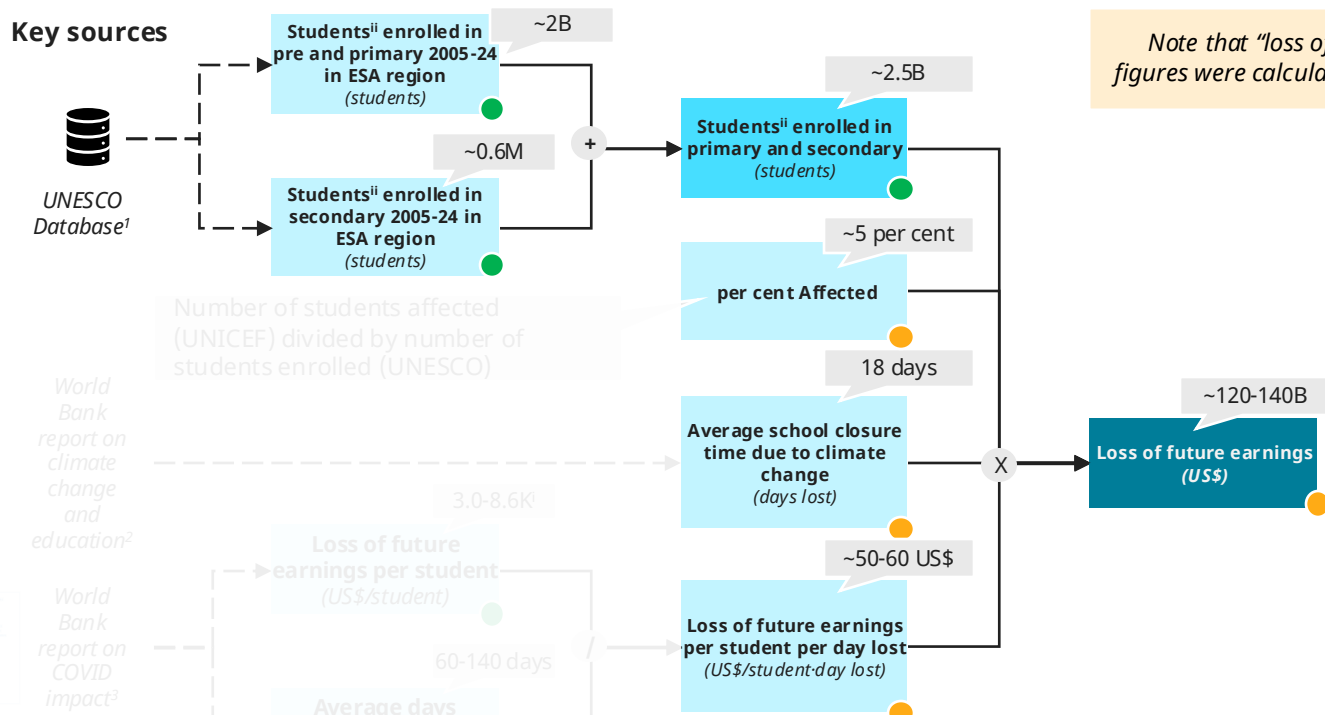
**Confidence level:** ● High ● Medium ● Low

Note: i) Adjusted by inflation from 2017 to 2024; ii) Cumulative number of students affected over the whole period of 2005-24 and 2025-50 (this is not the number of unique students); iii) While it's reasonable to present loss and damage in nominal terms and future earnings in PPP as standalone figures, this could create confusion if readers compare the two. We'd welcome your views on the best messaging approach and can revert with a suggestion for potential approaches to adjust the calculations

Source: 1) UNESCO, [Enrolment Data](#), Accessed Jul/2025; 2) World Bank, [More than 400 Million Students Affected by Climate-Related School Closures since 2022](#), 2024; 3) World Bank, [Simulating the Potential Impacts of COVID-19 School Closures on Schooling and Learning Outcomes](#), 2020; 4) UNICEF, [Global Snapshot of Climate-related School Disruptions](#), 2025; 5) UNESCO, [Enrolment Data](#), Accessed Jul/2025; Dalberg analysis

# Students enrolled come from UNESCO Database.

Past  
VS  
Future  
Immediate  
VS  
Long-term



Note that "loss of future earnings" figures were calculated using 2017 PPP<sup>iii</sup>

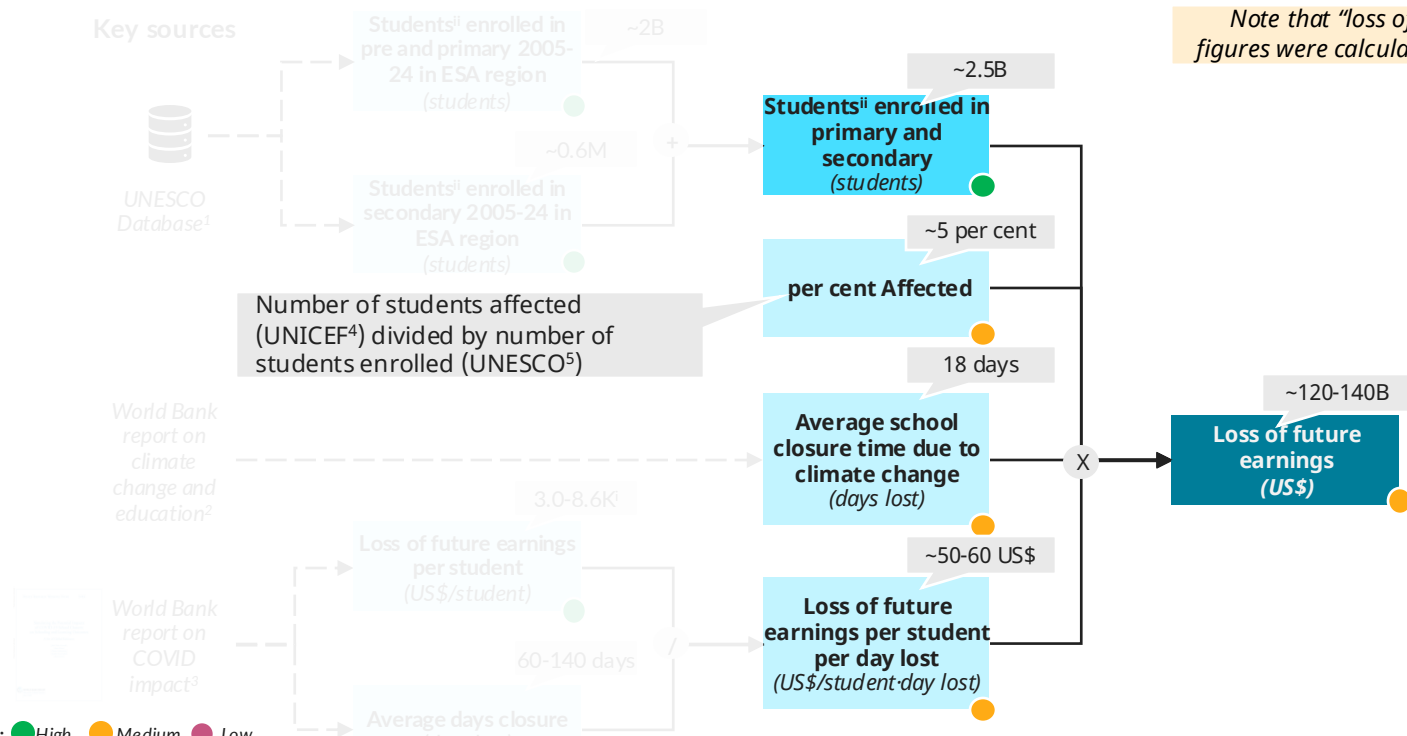
**Confidence level:** ● High ● Medium ● Low

Note: i) Adjusted by inflation from 2017 to 2024; ii) Cumulative number of students affected over the whole period of 2005-24 and 2025-50 (this is not the number of unique students); iii) While it's reasonable to present loss and damage in nominal terms and future earnings in PPP as standalone figures, this could create confusion if readers compare the two. We'd welcome your views on the best messaging approach and can revert with a suggestion for potential approaches to adjust the calculations

Source: 1) UNESCO, [Enrolment Data](#), Accessed Jul/2025; 2) World Bank, [More than 400 Million Students Affected by Climate-Related School Closures since 2022](#), 2024; 3) World Bank, [Simulating the Potential Impacts of COVID-19 School Closures on Schooling and Learning Outcomes](#), 2020; 4) UNICEF, [Global Snapshot of Climate-related School Disruptions](#), 2025; 5) UNESCO, [Enrolment Data](#), Accessed Jul/2025; Dalberg analysis

# The percentage affected comes from an approximation of total number of people impacted divided by total population.

Past  
VS  
Future  
Immediate  
VS  
Long-term



Note that "loss of future earnings" figures were calculated using 2017 PPP<sup>iii</sup>

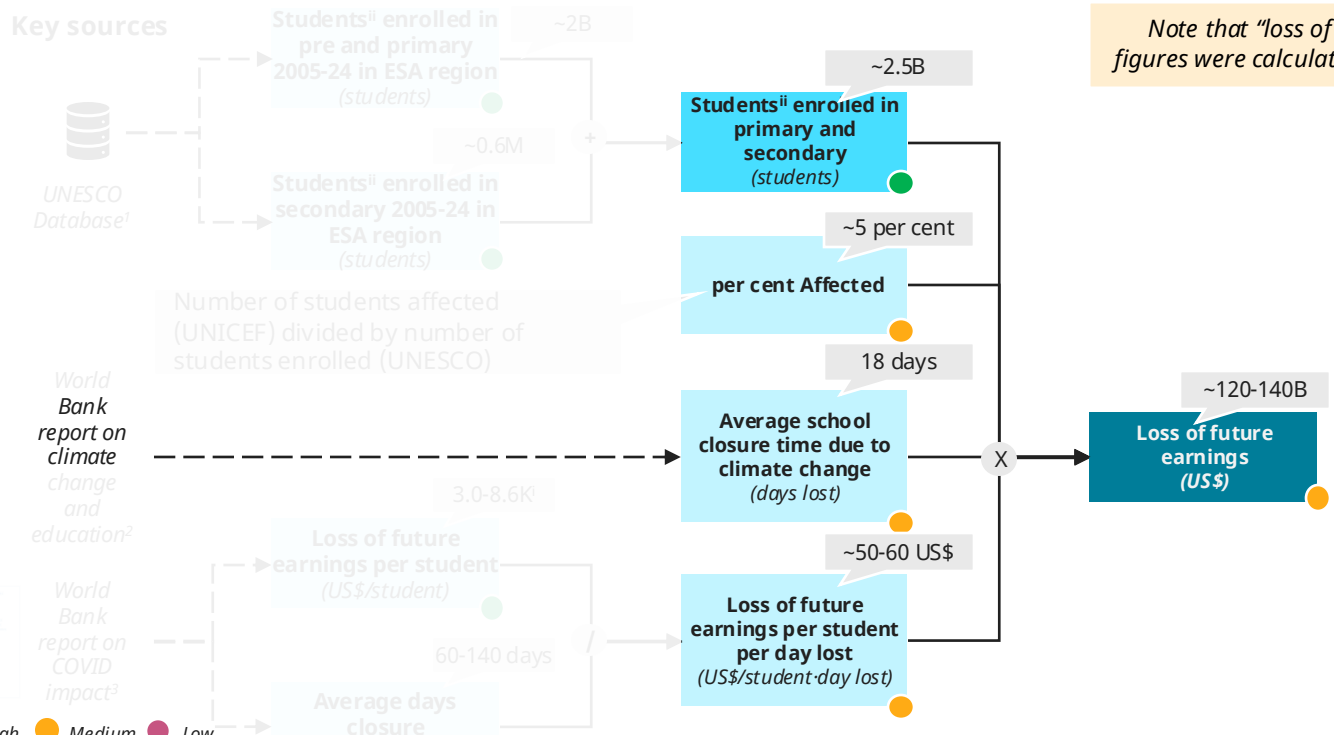
Confidence level: ● High ● Medium ● Low

Note: i) Adjusted by inflation from 2017 to 2024; ii) Cumulative number of students affected over the whole period of 2005-24 and 2025-50 (this is not the number of unique students); iii) While it's reasonable to present loss and damage in nominal terms and future earnings in PPP as standalone figures, this could create confusion if readers compare the two. We'd welcome your views on the best messaging approach and can revert with a suggestion for potential approaches to adjust the calculations

Source: 1) UNESCO, [Enrolment Data](#), Accessed Jul/2025; 2) World Bank, [More than 400 Million Students Affected by Climate-Related School Closures since 2022](#), 2024; 3) World Bank, [Simulating the Potential Impacts of COVID-19 School Closures on Schooling and Learning Outcomes](#), 2020; 4) UNICEF, [Global Snapshot of Climate-related School Disruptions](#), 2025; 5) UNESCO, [Enrolment Data](#), Accessed Jul/2025; Dalberg analysis

# Average school closures come from a World Bank report.

Past  
VS  
Future  
Immediate  
VS  
Long-term



Note that "loss of future earnings" figures were calculated using 2017 PPP<sup>iii</sup>

**Confidence level:** ● High ● Medium ● Low

Note: i) Adjusted by inflation from 2017 to 2024; ii) Cumulative number of students affected over the whole period of 2005-24 and 2025-50 (this is not the number of unique students); iii) While it's reasonable to present loss and damage in nominal terms and future earnings in PPP as standalone figures, this could create confusion if readers compare the two. We'd welcome your views on the best messaging approach and can revert with a suggestion for potential approaches to adjust the calculations

Source: 1) UNESCO, [Enrolment Data](#), Accessed Jul/2025; 2) World Bank, [More than 400 Million Students Affected by Climate-Related School Closures since 2022](#), 2024; 3) World Bank, [Simulating the Potential Impacts of COVID-19 School Closures on Schooling and Learning Outcomes](#), 2020; 4) UNICEF, [Global Snapshot of Climate-related School Disruptions](#), 2025; 5) UNESCO, [Enrolment Data](#), Accessed Jul/2025; Dalberg analysis



# We are prioritizing data points from publicly available sources.

Past

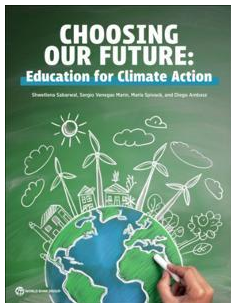
VS

Future

Immediate

VS

Long-term



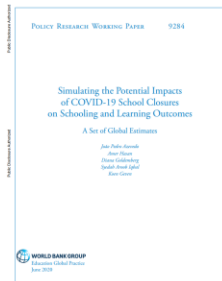
## 2. Schooling and learning, especially for the poorest, are at significant risk because of climate change. Education systems need to adapt for a changing climate. This report shows how countries can do this.

- Countries lost on average 18 days of instruction per year (or 6 percent of an academic year) in affected schools due to climate-related school closures. But impacts were highly unequal – low-income countries lost about 18 days per year, but persistent and acute year-in, affected schools, while high-income countries lost only 2.4 days. Unless managed, this lost schooling will translate into big learning deficits for children in low-income countries. For instance, it takes about 18 days to teach a student how to add two-digit numbers to one- or two-digit numbers, with carrying (assuming well-designed and structured pedagogy).<sup>2</sup>

**Table A.3.5: Per student average lifetime earning loss at present value by region, income group and lending type**

Post COVID-19			
Aggregate	Optimistic	Intermediate	Pessimistic
EAP	6965	17239	27901
ECA	10361	27039	44394
LAC	4422	9750	15229
MNA	8331	20273	32647
NAC	11923	33534	56092
SAR	2110	3949	5813
SSF	2375	4593	6848
<b>Grand Total</b>	<b>6472</b>	<b>15901</b>	<b>25680</b>

- **Optimistic** – schools are closed only for 3 months of a 10-month school year, and the effectiveness of mitigation measures put in place by governments (such as remote learning) is high.
- **Intermediate** – schools are closed for 5 months, and the mitigation measures have a middle level of effectiveness.
- **Pessimistic** – schools are closed for 7 months, and the mitigation measures have low levels of effectiveness.



Source: 1) World Bank, [More than 400 Million Students Affected by Climate-Related School Closures since 2022](#), 2024; 2) World Bank, [Simulating the Potential Impacts of COVID-19 School Closures on Schooling and Learning Outcomes](#), 2020; Dalberg analysis

# We tested different scenarios for the per cent of students affected and we are using the datapoint of 5.2 per cent.

Sense-checking

		Different per cent of students affected				Comments
	Scenarios	Annual Lifetime Earnings Lost per Pre-primary, Primary and Secondary Student in ESARO Countries (Bn US\$) - 3.1 per cent	Annual Lifetime Earnings Lost per Pre-primary, Primary and Secondary Student in ESARO Countries (Bn US\$) - 3.2 per cent	Annual Lifetime Earnings Lost per Pre-primary, Primary and Secondary Student in ESARO Countries (Bn US\$) - 5.2 per cent	Annual Lifetime Earnings Lost per Pre-primary, Primary and Secondary Student in ESARO Countries (Bn US\$) - 6.8 per cent	
Different impact per student per day of school lost	Optimistic Scenario	<b>US\$70 B</b>	<b>US\$72 B</b>	<b>US\$117 B</b>	<b>US\$154 B</b>	Uses ~US\$50 per student per day of school lost
	Pessimistic Scenario	<b>US\$86 B</b>	<b>US\$89 B</b>	<b>US\$145 B</b>	<b>US\$191 B</b>	Uses ~US\$60 per student per day of school lost
Comments		3.1 per cent = simple average of EM-DAT "people affected ÷ total population" for ESAR	3.2 per cent = weighted average of EM-DAT "people affected ÷ total population" for ESAR	5.2 per cent = students enrolled in ESA (UIS/UNESCO) × share of pupils disrupted in UNICEF 2024 global snapshot; adopted as the most accurate baseline	6.8 per cent = same method as the 5.2 per cent, applied to all of Sub-Saharan Africa; retained only for stress-testing upper-bound scenarios	

   Suggested scenario

Using the EM-DAT database, it is possible to see that per cent affected varies year by year – however, in our exercise, we maintain the per cent affected constant to keep this high-level estimate simple and accessible.

Sense-checking			
Year	Total people affected <sup>1</sup>	Total population ESAR <sup>2</sup>	per cent affected
2005	17,351,563	403,667,329	4.3 per cent
2006	5,655,200	414,361,832	1.4 per cent
2007	8,377,288	425,483,120	2.0 per cent
2008	19,273,067	437,067,963	4.4 per cent
2009	12,350,572	448,990,351	2.8 per cent
2010	7,512,897	461,153,628	1.6 per cent
2011	16,593,808	473,311,736	3.5 per cent
2012	12,302,968	485,788,466	2.5 per cent
2013	6,953,217	498,856,104	1.4 per cent
2014	2,684,730	512,019,131	0.5 per cent
2015	30,133,919	525,551,462	5.7 per cent
2016	12,743,908	538,888,526	2.4 per cent
2017	11,070,461	552,462,484	2.0 per cent
2018	2,244,415	567,252,797	0.4 per cent
2019	15,390,640	582,514,454	2.6 per cent
2020	17,931,134	597,979,379	3.0 per cent
2021	41,675,120	613,475,691	6.8 per cent
2022	43,811,196	628,952,815	7.0 per cent
2023	17,166,942	644,255,292	2.7 per cent
2024	32,104,654	660,867,570	4.9 per cent
<b>Total</b>	<b>333,327,699</b>	<b>10,472,900,130</b>	<b>3.2 per cent</b>

Source: 1) EM-DAT, [Database](#), Accessed Jul/2025; 2) United Nations, Department of Economic and Social Affairs, Population Division, [World Population Prospects](#), Accessed Jul/2025; Dalberg analysis

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### Long-term – High-level estimate

Past Economic Loss and Damage

### Forecasted Economic Loss and Damage

### 5. Case Studies

## Annex

# The next slides focus on quantifying the future economic loss and damage of climate-related events on education.

	Economic vs. non-economic	Immediate vs. Long-term	Description	Scope	Data quality	Approach	Analyses
Past	Economic	Immediate (direct)	<ul style="list-style-type: none"> <li>• <b>Education facilities and fixed services</b> (Classrooms, labs, admin blocks, WASH blocks, power, connectivity nodes)</li> <li>• <b>Learning materials and movable equipment</b> (Furniture, textbooks, ICT devices, lab kits)</li> <li>• <b>Temporary or alternative learning spaces</b> (Tents, prefabs, community centres)</li> <li>• <b>Transport and logistics assets</b> (Buses, boats, access roads, storage depots)</li> <li>• <b>Other</b></li> </ul>	Quantitative analysis (note that due to data availability/quality, the analyses were conducted at the aggregate level, i.e., no breakdown was possible)	<b>Medium/ High</b> <ul style="list-style-type: none"> <li>• Post-Disaster Assessments provide good data points on damage, loss, and needs for major events following World Bank definition<sup>1</sup></li> <li>• EM-DAT<sup>2</sup> provides a comprehensive database of all extreme events</li> <li>• <i>Carbon Brief</i><sup>3</sup> assesses attribution to climate change</li> </ul>	<ul style="list-style-type: none"> <li>• Consolidation of existing data</li> <li>• Assessment of attribution to climate change</li> <li>• Extrapolation to cover data gaps</li> <li>• Triangulation and refinement</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Past impact</b></li> <li>• <b>Forecast impact</b></li> </ul>
Future		Long-term (indirect)	<ul style="list-style-type: none"> <li>• <b>Future learning and earnings for affected children</b> (Long-run wage and human capital impact)</li> <li>• <b>Service-delivery flows</b> (Instructional hours, exams, catch-up classes)</li> <li>• <b>Education workforce</b> (Teachers, support staff)</li> <li>• <b>Household economic burden</b> (Parents and caregivers)</li> <li>• <b>Near-term community economic impact</b> (Local business impact)</li> <li>• <b>Long-term broader economic impact</b> (Total economy impact)</li> </ul>	High-level quant analysis, focusing on <b>“loss of future income”</b>	<b>Low</b> <ul style="list-style-type: none"> <li>• Limited studies conducted to allow a detailed assessment</li> <li>• Few datapoints allowing a back of envelope calculation</li> </ul>	<ul style="list-style-type: none"> <li>• High-level quantitative analysis</li> <li>• Triangulation and refinement</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Past impact</b></li> <li>• <b>Forecast impact</b></li> </ul>
Immediate	Non-Economic		<ul style="list-style-type: none"> <li>• Mental and physical health impacts, social and cultural disruption...</li> </ul>				
Long-term							

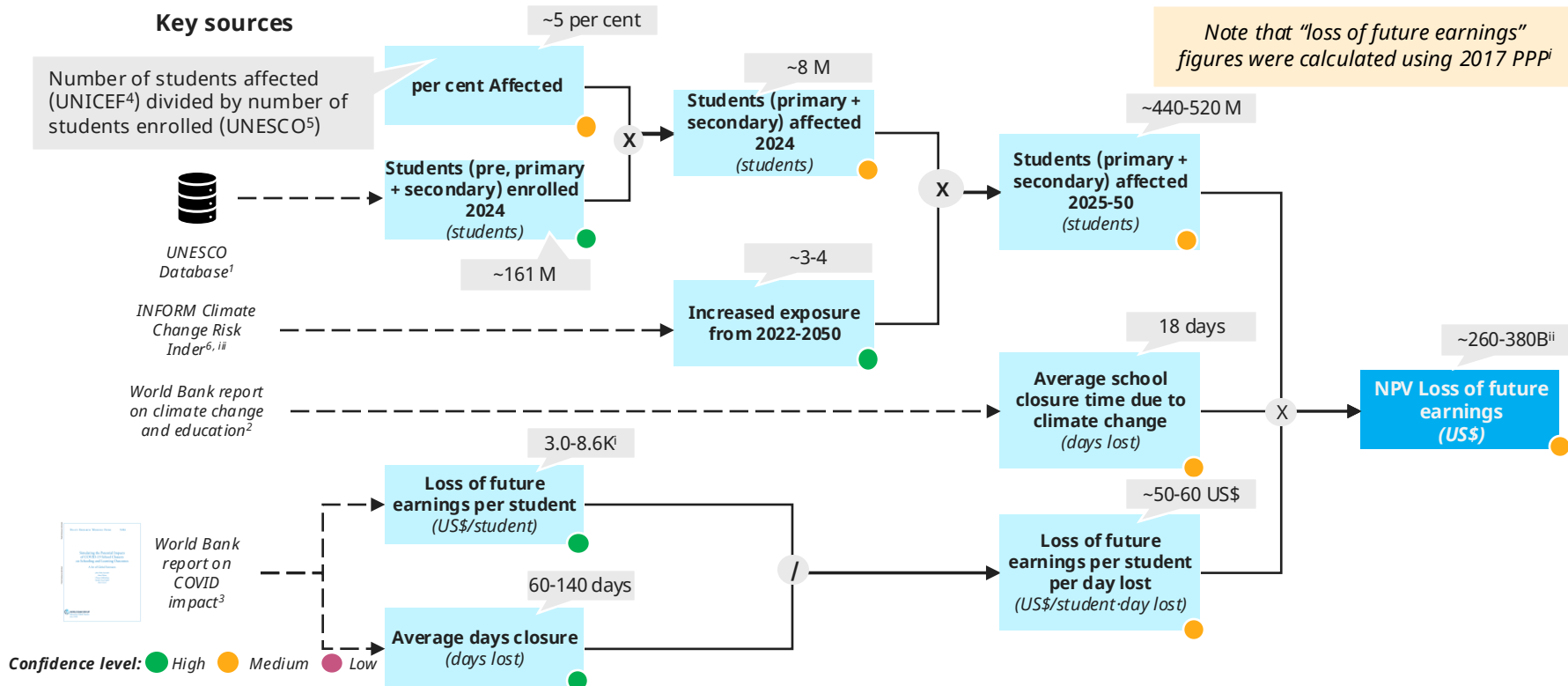
*Focus of next slides*

*Although not a focus of this quantitative assessment, these are relevant impacts that were covered in the case studies*

*Out of scope of the quantitative analysis*

Source: 1) World Bank, [Damage, Loss and Needs Assessment - Guidance Notes](#), 2010; 2) EM-DAT, [Database](#), Accessed Jul/2025; 3) Carbon Brief, [Attribution studies](#), Accessed Jul/2025; Dalberg analysis

# We apply country- and disaster-specific exposure scenarios from INFORM to project the number of students affected between 2025 and 2050, enabling the forecast of loss of future earnings.



Note: i) Methodological conventions: direct loss and damage is shown in constant 2024 US\$; loss of future earnings is shown in 2017 PPP and is not directly comparable, hence, please avoid adding or directly comparing these numbers; ii) Net present values use a 3 per cent social discount rate; iii) RCP 4.5 (moderate emissions) and SSP2 - Middle of the Road (Medium challenges to mitigation and adaptation); and RCP 8.5 (high emissions) and SSP3 (Regional Rivalry - high challenges for both mitigation and adaptation, including higher population growth)  
 Source: 1) UNESCO, [Enrolment Data](#), Accessed Jul/2025; 2) World Bank, [More than 400 Million Students Affected by Climate-Related School Closures since 2022](#), 2024; 3) World Bank, [Simulating the Potential Impacts of COVID-19 School Closures on Schooling and Learning Outcomes](#), 2020; 4) UNICEF, [Global Snapshot of Climate-related School Disruptions](#), 2025; 5) UNESCO, [Enrolment Data](#), Accessed Jul/2025; 6) The European Commission Joint Research Centre, [INFORM Climate Change Risk Index](#), 2022; Dalberg analysis

# We tested different approaches, with the main variable being the per cent of students affected, ranging from 3.1 to 6.8 per cent and we are using a datapoint of 5.2 per cent.

Sense-checking

		Different per cent of students affected				Comments
	Scenarios	Annual Lifetime Earnings Lost per Pre-primary, Primary and Secondary Student in ESARO Countries (Bn US\$) - 3.1 per cent	Annual Lifetime Earnings Lost per Pre-primary, Primary and Secondary Student in ESARO Countries (Bn US\$) - 3.2 per cent	Annual Lifetime Earnings Lost per Pre-primary, Primary and Secondary Student in ESARO Countries (Bn US\$) - 5.2 per cent	Annual Lifetime Earnings Lost per Pre-primary, Primary and Secondary Student in ESARO Countries (Bn US\$) - 6.8 per cent	
Different impact per student per day of school lost	Optimistic Scenario	<b>US\$156 B</b>	<b>US\$161 B</b>	<b>US\$262 B</b>	<b>US\$345 B</b>	Uses ~US\$50 per student per day of school lost
	Pessimistic Scenario	<b>US\$223 B</b>	<b>US\$230 B</b>	<b>US\$376 B</b>	<b>US\$494 B</b>	Uses ~US\$60 per student per day of school lost
Comments		3.1 per cent = simple average of EM-DAT "people affected ÷ total population" for ESAR	3.2 per cent = weighted average of EM-DAT "people affected ÷ total population" for ESAR	5.2 per cent = students enrolled in ESA (UIS/UNESCO) × share of pupils disrupted in UNICEF 2024 global snapshot; adopted as the most accurate baseline	6.8 per cent = Same method as above, applied to all of Sub-Saharan Africa; retained only for stress-testing upper-bound scenarios	

   Suggested scenario

# Limitations: Data allows only a directional, high-level estimate for future earnings loss.

Sense-checking

- **Fixed average school closure at 18 days, based on a single climate-related study.** This is the most current climate-specific estimate available for Africa and low-income countries. While school closures may have been shorter in earlier years (e.g., around 2005) and are expected to be longer in the future (if nothing changes), we chose not to introduce additional complexity in this high-level analysis.
- **Uniform US\$ loss per student-day applied across all income levels.** There are no income-specific elasticities (although another report does provide data for different income levels, there is no information available on the closure length to allow the calculation of loss of future earnings per student per day). We used a single range for simplicity and to avoid the false sense of precision.
- **Assumption that the loss per student is proportional to the duration of closure.** When calculating the loss per student per day, we divide loss per student by the length of closure, which means assuming loss is proportional to closure length, and we understand this might not be the case, as losses likely worsen with a longer disruption, especially related to events that take longer to recover from and have a higher dropout risk.
- **Fixed percentage of students affected.** In reality, we know that this percentage varies substantially by year (as we can see from the EM-DAT database), however, we decided to keep the model simple and straightforward by using a fixed percentage.
- **Long-term economic loss and damage limited to the loss of future earnings only.** Although other long-term economic loss and damage is also relevant, the assessment of long-term impact is out of scope, but we agreed to extend the scope and focus on a high-level estimate of future earnings as this metric is one of the most significant and policy-relevant channels for advocacy.
- **Wide uncertainty range driven by variation in the percentage of students affected.** Presenting the full range ensures transparency and avoids false precision, while also highlighting where improved exposure data could sharpen future estimates.
- **Use of COVID-19 school disruption studies to estimate learning-related income losses.** Although the nature of the disruptions differs (pandemic vs. climate events), we drew on the educational impacts from the closure itself, which should be comparable. In the absence of climate-specific data, these studies provide the most reliable proxy.
- **Enrolment projections are based on population growth, without adjustments for future shifts in enrolment rates, migration, or dropout.** We acknowledge this limitation and are open to refining the model using enrolment ratios or more granular data, such as UNICEF enrolment forecasts, if available.

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Zambia Country Case

Benefit Cost Ratio

What If of Resilient Infrastructure

Conflict-Climate Intersection

Increasing Temperatures (and Heat Waves)

## Annex

# About this case study

Summary

## Purpose of the Case Study

To assess how climate change affects **equity in access to education** for girls, students with disabilities, and marginalized groups

## Guiding question

When climate disasters disrupt education, **who is most affected and why?**

## Content covered

Kenya 2024 floods

Country Overview

## Key Methodology and sources

- **EM-DAT database** used to illustrate how extreme weather events in Kenya are becoming more frequent and severe, affecting more people and causing more deaths.
- **World Weather Attribution** proving climate change increased the likelihood and intensity of the 2024 floods and is driving the long-term rise in flood impacts.
- **Elimu Bora Working Group** survey of 45 flood-affected schools documenting enrolment changes, infrastructure damage and coping responses.
- **Additional sources (UNICEF, UNDP, World Bank, Amnesty Kenya, Phillips-Howard PA et al, etc.)** providing evidence on how girls, students with disabilities and marginalized groups are disproportionately affected.

Insights

## Key takeaways

- **Floods expose systemic weaknesses in education preparedness:** schools lacked resilient infrastructure, disaster plans and timely recovery support, making learning highly vulnerable to shocks.
- **Equity gaps widened after the floods:**
  - Gender: The enrolment drop among girls was about 50 per cent higher than among boys (10.5 per cent vs. 7.1 per cent) – roughly 1.5 girls left school for every 1 boy.
  - Disability: The enrolment drop among students with disabilities was about one-third higher than for students without disabilities (11.7 per cent vs. 8.8 per cent).
- **Cross-sectoral pressures compound exclusion:** disrupted WASH, health and livelihoods created barriers that made returning to school especially difficult for girls, students with disabilities and low-income learners.
- **Current recovery approaches risk reinforcing inequality:** aid and repairs prioritized the majority, unintentionally sidelining marginalized groups who require different conditions to resume education safely.

Recommendations

# In Kenya, floods are the most significant climate-related disaster, accounting for 80 per cent of recorded extreme events and 93 per cent of related deaths, with the 2024 floods being the deadliest to date.

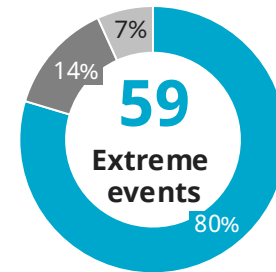
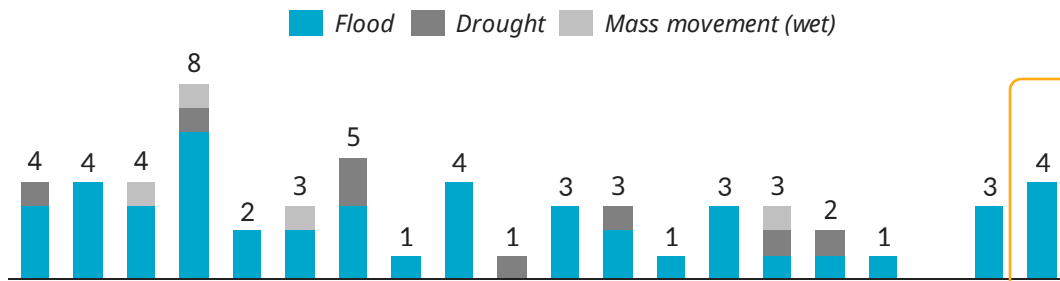
Summary

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## Number of events<sup>i</sup> (#)

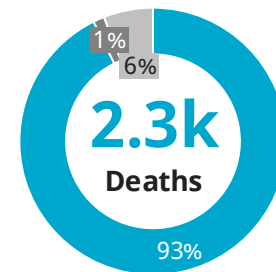
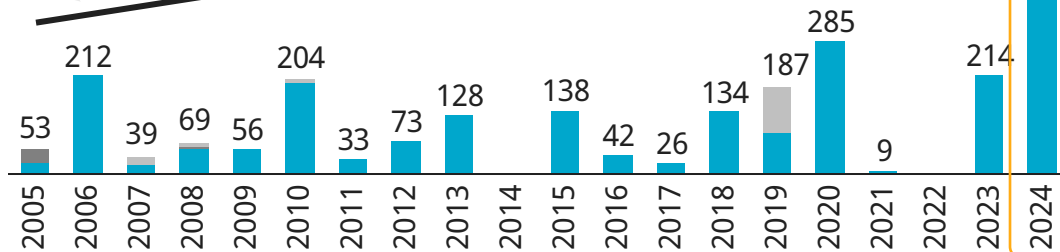


While the number of climate-related events has remained relatively stable, their intensity and human impact have increased, as shown by the upward trend in deaths

+11%



## Deaths (k)



Kenya typically experiences two main rainy seasons: the long rains (March–May) and the short rains (October–December). In recent years, rainfall patterns have become increasingly variable, with episodes of intense downpours causing floods and prolonged dry spells leading to droughts. These extremes have had major consequences for agriculture, water resources and the broader socioeconomic landscape.<sup>2</sup>

Note: i) One event is the combination of a disaster and country (i.e., One disaster affecting two countries counts as two) – includes disasters with at least one of the following criteria: (i) 10 fatalities; (ii) 100 affected people; (iii) a declaration of state of emergency; (iv) a call for international assistance, with 700+ entries in the database in the ESA region  
 Note: these are all extreme events in EM-DAT database, and encompass both climate-induced and not-climate-induced events – the specific impact on children is displayed in the next slides  
 Source: 1) EM-DAT, [Database](#), Accessed Jul/2025; 2) Kenya Meteorological Department, [State of Climate Kenya 2023, 2024](#); Dalberg Analysis

# The April–May 2024 floods were among the most destructive in recent history, with extensive loss of life, displacement and damage to critical infrastructure and productive assets.



## Human toll

- **147,130** children affected (48 per cent of total 306,522 people affected)<sup>1</sup>
- **140,738** displaced children<sup>1</sup>
- **376** deaths<sup>2, i</sup>
- **188** injuries<sup>3</sup>



## Infrastructure<sup>3</sup>

- **62** health facilities destroyed
- **61** roads damaged
- **1,465** water sources destroyed



## Productive assets<sup>3</sup>

- **886** businesses damaged
- **9,973** livestock lost
- **41,562** acres of cropland destroyed

The 2024 floods caused an estimated US\$783 M in damage and US\$672 M in losses nationwide<sup>5</sup>

**In Kenya, human-induced global warming of about 1.2 °C has likely made extreme rainfall events like this – which drive flooding – about twice as likely and 5 per cent more intense<sup>4</sup>**

Note: i) The number of deaths in the two slides (3 vs. 4) is different because Slide 3 reflects all flood events in 2024, while Slide 4 reflects only the April–May events

Source: 1) UNICEF, [UNICEF Kenya March–April–May \(MAM\) 2024 Seasonal Floods Response Flash Update #2](#), 2024 2) EM-DAT, [Database](#), Accessed Jul/2025; 3) Elimu Bora Working Group, [The Impact of 2024 Deadly Floods on Schools](#), 2024; 4) World Weather Attribution, [Urban planning at the heart of increasingly severe East African flood impacts in a warming world](#), 2024; 5) UNDP, [Kenya Floods Recovery Needs Assessment Report](#), 2025; Dalberg analysis

# The floods severely disrupted education across Kenya, revealing gaps in the system's preparedness to safeguard learning and respond effectively.

Floodwaters left schools unsafe and unusable, stripping away the basic infrastructure children depend on to learn

The education system lacked the plans, infrastructure and support to protect students and learning from the floods<sup>2</sup>

5,278

Schools affected<sup>1, i</sup>

~2 M

Students experienced disrupted education<sup>2, ii</sup>

+20,000

toilet blocks collapsed or sunk<sup>3</sup>

+1.5 M

Children at risk<sup>3, i</sup>

- **Most of the affected schools had no disaster preparedness plans** in place and lacked training in both preparedness and mitigation.
- **Schools lacked resilient infrastructure** that could withstand floods, leaving buildings unsafe even after waters receded.
- **Fewer than 20 per cent of schools received post-disaster recovery support.**
- **Many students returned to unsafe or makeshift classrooms** (e.g., tents previously used by Internally Displaced Persons were repurposed into classrooms). Additionally, In Kadibo, Kisumu, schools such as Nduru and Odiinya temporarily housed displaced families before being cleared to host makeshift classrooms.<sup>3, iv</sup>
- Many schools had **no structured curriculum recovery, psychosocial support, or rapid replacement of materials.**
- In the education sector, the **floods caused at least US\$48.9 M in damage** and US\$0.23 M in losses.<sup>4, iii</sup>

Note: i) More than 20,000 toilet blocks were either sunken or severely damaged by raging floodwaters, posing serious health risks to over 1.5 million schoolchildren across the country; ii) More than 2 million learners experienced disrupted schooling due to loss of teaching and learning materials and damaged school infrastructures caused by heavy rains and flooding; iii) "At least" is used as the Kenya Floods Recovery Needs Assessment covered 24 counties; a actual damages and losses may be higher; iv) At least 62 primary schools destroyed and 1,967 schools damaged<sup>3</sup> iv) In some cases, when climate-resilient schools are the only structures standing after disasters, they may serve as emergency shelters – supporting community recovery but potentially disrupting education due to repurposing – this is related to the concept of maladaptation<sup>5</sup>

Source: 1) UNICEF, [UNICEF Kenya March-April-May \(MAM\) 2024 Seasonal Floods Response Flash Update #2](#), 2024; UNICEF, [Nearly a quarter of a billion children's schooling was disrupted by climate crises in 2024](#), 2025; 3) Elimu Bora Working Group, [The Impact of 2024 Deadly Floods on Schools](#), 2024; 4) UNDP, [Kenya Floods Recovery Needs Assessment Report](#), 2025; 5) Carbon Brief, [Why Avoiding Climate Change 'Maladaptation' Is Vital](#), 2021; Dalberg analysis

# Education recovery needs are estimated at over US\$63.5 million, accounting for infrastructure rebuilding, a 10 per cent resilience margin and 5 per cent inflation adjustment.

The 2024 Kenya Floods Recovery Needs Assessment was a government-led exercise (supported by partners like the United Nations) to quantify the funding required for recovery and resilience across affected sectors – including education

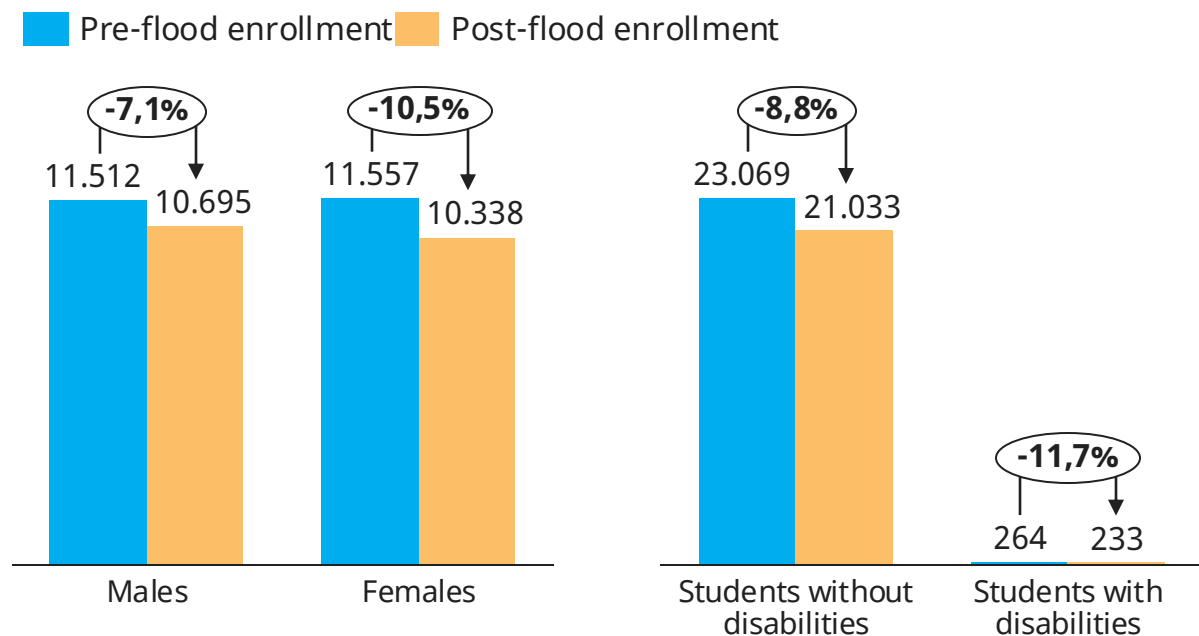
	Education Recovery Needs	Needs in KES million	Needs in US\$ <sup>ii</sup> million
Summary	Provide safe and inclusive learning environment with phases: 1) Establish temporary learning spaces with mobile WASH facilities/with access to WASH facilities; 2) Rehabilitation/construction of school infrastructure including WASH in schools.	6,483	50.2
	Provide age-appropriate/inclusive teaching learning materials (textbooks, education kits, dignity kits, learning assistive devices for children with disabilities). Provide school furniture (desks, lockers, etc.) and equipment to the affected schools/schools used by Internally Displaced Persons (IDPs).	769	6.0
Country Overview	Provide catch-up and remedial programmes for affected children and out-of-school children.	428	3.3
	Provide Mental Health and Psychosocial Support (MHPSS) and Social-Emotional Learning (SEL) to affected learners, teachers and other school communities including referral mechanism.	285	2.2
	Promote safe hygiene behaviours and practices through Information, Education and Communication (IEC) materials and messaging to keep schools safe from potential health risks.	47	0.4
	Engage learners, communities and schools in climate/DRR/anticipatory actions.	95	0.7
Insights	Review Education in Emergencies (EiE)/Disaster Risk Reduction (DRR) policies and strengthen EiE preparedness and response capacity at national and county levels. Advocate for increased financing for EiE at national and county levels.	76	0.6
	Advocate for provision and sustainable school meal programme (SMP) to affected schools to ensure attendance, and retention of learners especially in high-risk areas for climate-induced emergencies.	Included in the above	
Recommendations	Strengthen real-time EiE data management (KEMIS, KIRA) and post-disaster needs assessment capacity on the impact of emergencies on learning.	19	0.1
	<b>Total</b>	<b>8,203</b>	<b>63.6</b>

The recovery plan targets 3,335 flood-affected schools (2,261 primary and 1,074 secondary) for rehabilitation and reconstruction, benefiting an estimated over 1.5 million learners across the most impacted counties

Note: i) "More than US\$63.5 M" is used as the Kenya Floods Recovery Needs Assessment covered 24 counties; actual recovery needs may be higher; ii) using 1 US\$ = 6,483 KES  
 Source: UNDP, [Kenya Floods Recovery Needs Assessment Report, 2025](#); Dalberg analysis

The floods hit the most vulnerable hardest: the post-disaster enrolment drop was nearly 50 per cent higher among girls than boys (10.5 per cent vs. 7.1 per cent) and 33 per cent higher among disabled than non-disabled students (11.7 vs. 8.8 per cent).

## Enrolment drop-off by gender (male vs. female) and disability (with vs. without)<sup>1, i, ii</sup> Number of students



## Key comments

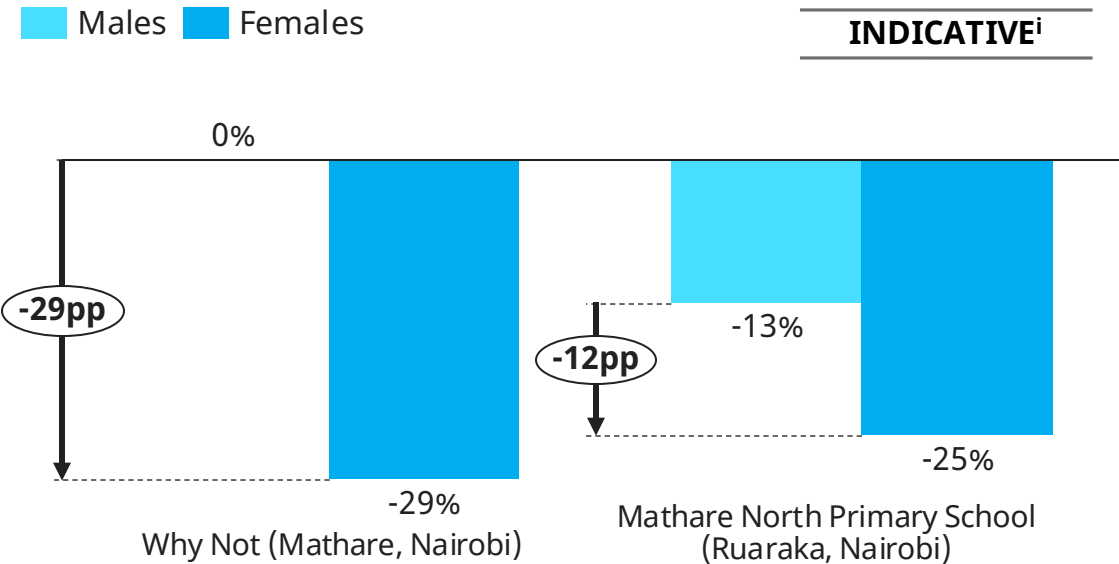
- Floods (induced or exacerbated by climate change)<sup>2</sup> impact on schools reveals how climate shocks deepen education inequities.
- Disaster recovery can unintentionally reinforce exclusion: aid and school repairs often focus on getting the majority back quickly, following standard processes that may overlook the specific barriers faced by learners with disabilities or girls (e.g., unsafe WASH environments).

Note: i) The analysis is based on the raw data for male, female, and students with disabilities as reported in the school-level table in Chapter 3 of the report (Data collection, analysis and presentation), covering the 46 schools available as raw data, without reliance on the 'Total' or consolidated figures. These 46 schools are a subset of the overall affected schools and span a geographically diverse area across nine counties in Kenya; ii) The enrolment data ("After floods") was measured immediately after the severe flooding during a rapid survey conducted by the Elimu Bora Working Group in May 2024. Source: 1) Elimu Bora Working Group, [The Impact of 2024 Deadly Floods on Schools](#), 2024; 2) World Weather Attribution, [Urban planning at the heart of increasingly severe East African flood impacts in a warming world](#), 2024; Dalberg analysis

# Dropout risks generally soar when gender intersects with informal, non-government-backed schools.

## Indicative<sup>i</sup> Comparison of Dropout Rates (Government-backed vs. Not government-backed)<sup>1,ii, iii</sup>

Dropout rate



## Key comments

- A comparison of two schools exposed to similar flood intensity illustrates how intersectionality matters: At Why Not (not government-backed), girls faced a 29-point dropout gap (29 per cent vs. 0 per cent), more than double the 12-point gap (25 per cent vs. 13 per cent) at Mathare North Primary School (government-backed).
- Government-backed schools cushion but do not eliminate equity risks: Even in better-resourced schools, girls still drop out at 25 per cent compared to 13 per cent for boys, showing that systemic gender barriers persist beyond settlement type.

Note: i) Note that this analysis is indicative since it compares only two schools – these schools were selected for being close to each other (less than 1km apart from each other), hence exposed to similar flood intensity, but differing in infrastructure and resourcing, i.e., “Why Not” operates as a non-government-backed school, whereas “Mathare North” is a government-backed school. This distinction matters for resilience, as government-backed schools generally have stronger infrastructure and are more likely to receive rapid public support to restore operations after floods, while non-government-backed schools may rely on weaker structures and have limited recovery capacity; ii) The analysis is based on the raw data for male, female and students with disabilities as reported in the school-level table in Chapter 3 of the report (Data collection, analysis and presentation), without reliance on the ‘Total’ or consolidated figures; iii) The enrolment data (“After floods”) was measured immediately after the severe flooding during a rapid survey conducted by the Elimu Bora Working Group in May 2024

Source: 1) Elimu Bora Working Group, [The Impact of 2024 Deadly Floods on Schools](#), 2024; Dalberg analysis

# The steeper losses for students with disabilities and girls show how cross-sectoral impacts compound inequities: inaccessible facilities, health risks, care burdens and restrictive social norms make their return to school harder.

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## GENDER

- **Economic stress during climate disasters leads families to prioritize boys' schooling**, while girls are withdrawn to take on domestic or income-earning roles.<sup>1</sup>
- **Floods destroy roads and make journeys to school more hazardous**, increasing girls' risk of dropout or absenteeism.<sup>2</sup>
- **When floods damage WASH facilities**, leaving them unsafe, non-private, and/or without water, **menstruating learners (and teachers) are likely to miss school as a result.**<sup>3</sup>
- **Climate change disasters increase child marriage**, with girls pulled from school as families seek to reduce household burdens or secure dowries.<sup>4</sup>

For every 100 girls from the richest quintile who finish primary school, only 16 girls from the poorest quintile do!<sup>2</sup>



## DISABILITY

- **Flood-damaged roads and paths make the journey to school harder for learners with physical disabilities**, especially in rural areas.<sup>5</sup>
- **Damaged infrastructure, especially sunken latrines and unsafe classrooms, create physical barriers** that disproportionately affected students with disabilities.
- **Floods destroy assistive materials and adapted resources**, with little provision for replacement, making re-enrolment harder for learners with disabilities.<sup>6</sup>

**Floods and other shocks can be especially distressing for students with neurological disabilities (e.g., neurodiverse learners)**, leading to disorientation, panic and anxiety, and making it harder for them to adapt and return to school after disruptions

In Kenya, a refugee child is more than five times more likely to be out of school than a non-refugee child<sup>10, 11</sup>



## LOW INCOME AND MARGINALIZED

- **For children living in informal settlements, floods are especially devastating.** Their fragile shelters provide almost no protection, increasing children's risk of displacement and exposure to harm.<sup>7</sup>
- **Fragile or absent basic services increase the risk of drop out.** Exposure to contaminated sewage, loss of WASH and electricity, and destruction of homes and assets can force children into rebuilding or income-generating roles, which can force them temporarily or permanently out of school.
- **Poor households rely heavily on school feeding programs and community services.** When these are disrupted by floods, children are forced into work or left out of school because families cannot absorb the shock.<sup>8</sup>

Loss of homes, displacement and loss of community ties and members cause emotional distress and social disruption to all groups, further hindering children's return to school<sup>9</sup>

Source: 1) Daily Nation, [Toll of climate change on education of Kenyan girl](#), 2024; 2) Crown Trust, [Impact of Ongoing Floods in Kenya](#), Accessed Jul/2025; 3) Well Aware, [How are Women and Girls Disproportionately Affected?](#), 2023; 4) Time, [Kenya Is Trying to End Child Marriage](#), 2020; 5) Enable Me, [Disability and CC in Kenya](#), 2021; 6) Senator Crystal Asige, [2024 Floods](#), 2024; 7) Amnesty Kenya, [Let's Rebuild our Children's Lives as Schools Reopen](#), 2024; 8) World Bank, [How Kenya's school meals program is building resilience](#), 2024; 9) CGTN, [Nearly 500,000 children are yet to return to school](#), 2024; (10) UNHCR, [Education](#), Accessed Oct/2025; (11) The Star, [Number of children out of school](#), 2024; (12) Malala Fund, [Education](#), Accessed Oct/2025; Dalberg analysis

## "We had no choice": Girls describe how floods forced them into marriage and caregiving.

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“ The floods took all our harvest ... I tried to negotiate to tell my parents that I wasn't ready, that I didn't want to get married, but they told me that I had to because that would mean one mouth less at the table. I had to get married because they didn't have enough to feed the whole family.”

Ntonya (age 15, married at 13)<sup>1</sup>

“ I had dreams of becoming a teacher, but the floods took everything away from us. I had no choice but to drop out of school and take care of my younger siblings, the youngest being 2 years old.”

Sharon Akinyi (Age 13)<sup>2</sup>

Source: 1) Pope, D. H., McMullen, H., Baschieri, A., Philipose, A., Udeh, C., Diallo, J., and McCoy, D., [What is the current evidence for the relationship between the climate and environmental crises and child marriage? A scoping review](#), 2022; 2) Mongaway, [Kenya's Lake Victoria floods leave orphaned children to run their households](#), 2023; Dalberg analysis



//

Ever since our house was affected by the floods, we are having trouble sleeping well. Children are scared and they start crying whenever it starts raining. The teachers tell me that even in school, they get scared when it starts raining and they won't calm down until the rains stop

Jackson

*a parent in one of Nairobi's informal settlement<sup>1</sup>*

# Building resilient, inclusive education systems requires equity and resilience to be embedded in Kenya's education budget.

Summary

1

**Disaster preparedness must be embedded at the school level** so that infrastructure, WASH and learning continuity are protected before the next flood. In flood-prone areas, schools should integrate age-appropriate safety and preparedness training, including swimming and flood survival training, complemented by child-sensitive early warning systems for schools and communities.

2

**Equity gaps must be prioritized in recovery** to ensure girls, learners with disabilities and marginalized communities are not sidelined when resources are limited, including mental health and psychosocial support. Education recovery could link more closely with household social protection or emergency cash support, coordinate with child protection or adolescent-focused services and mobilize school committees to support re-enrolment for these collectives.

3

**Financing mechanisms must be in place to fund timely recovery support**, beyond ad-hoc donor responses, to fund safe classrooms, materials and psychosocial services. This includes ringfencing emergency response budgets within the government education budget to ensure timely, equitable recovery and reduce reliance on external aid.

4

**Cross-sectoral solutions** (health, WASH, livelihoods) **must be integrated** to minimize barriers for children to return to school after a disaster.

5

**Monitoring and accountability systems are needed** to track who returns to school, with disaggregated data by gender, income and displacement status to analyse intersectionality and identify when the most vulnerable girls are being left behind and enable timely action.

6

**Government actions should also align with the African Union's Continental Education Strategy for Africa (CESA 16-25)**, strengthening coherence with regional resilience and equity priorities.

Recommendations

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## Annex

# About this case study

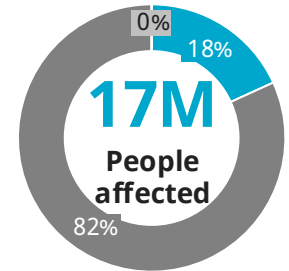
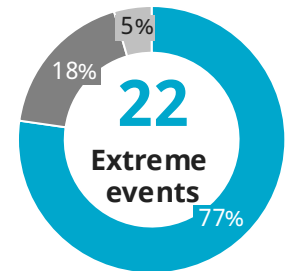
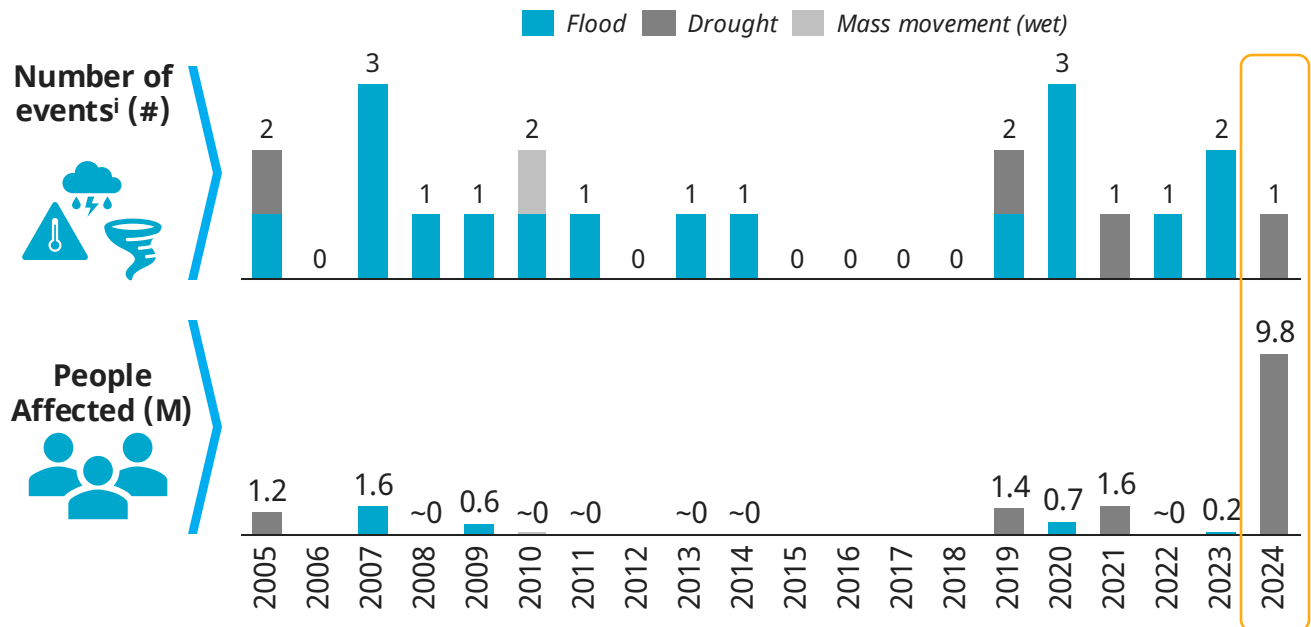
Summary	<b>Purpose of the Case Study</b>	<b>This case aims to provide a Zambia-specific perspective that grounds discussions on loss and damage to education in local realities.</b> While the evidence base remains limited (e.g., no relevant reports were identified providing education-specific economic impacts from climate-induced events), this case study offers <b>distinctive Zambia-focused estimates and valuable input for advocacy materials for the 8th Board Meeting of the Fund for responding to Loss and Damage (FRLD).</b>
	<b>Guiding question</b>	What is the scale of climate-related loss and damage in Zambia's education sector, and how can new evidence strengthen advocacy for education in the LandD agenda?
Country Overview	<b>Content covered</b>	Zambia's climate hazards from 2005 to 2024 and their impacts on education – past, present and projected loss and damage.
	<b>Key Methodology and sources</b>	<b>Given the absence of comprehensive needs assessments in Zambia, the economic loss and damage estimates were derived using the same methodology applied at the ESA regional level, with the added focus of zooming in on Zambia.</b> <ul style="list-style-type: none"><li>• <b>EM-DAT database</b> to quantify Zambia's exposure to extreme weather events, people affected and fatalities.</li><li>• <b>Carbon Brief</b> to estimate the percentage of extreme weather events that are attributable to or exacerbated by climate change.</li><li>• <b>Regional methodology</b> to estimate immediate and long-term loss and damage in education, including future projections.<sup>i</sup></li><li>• <b>Secondary reports (UNICEF, Acaps, Zambia government sources)</b> to supplement evidence and highlight local impacts.</li></ul>
Insights	<b>Key takeaways</b>	<ul style="list-style-type: none"><li>• <b>Evidence gap:</b> Zambia lacks systematic, education-specific estimates of climate-related economic loss and damage, limiting its voice in loss and damage financing debates. We applied a regional evidence-based approach to generate estimates.</li><li>• <b>Past immediate impact:</b> From 2005 to 2024, total immediate loss and damage on education<sup>i</sup> in Zambia (mostly focused on infrastructure, furniture, learning materials and temporary learning spaces) is estimated at ~US\$60 M, with floods accounting for the biggest share, while drought made up a third, encompassing mainly losses (although El Niño drought in 2024 accounted for nearly 60 per cent of all people affected since 2005, and accounted for 27 per cent of total loss and damage in the period).</li><li>• <b>Past long-term impact:</b> We estimate that climate change disrupted the learning of ~5 millions students-year, resulting in US\$4 to 5 billion in loss of future earnings.<sup>ii</sup></li><li>• <b>Future risk:</b> Without further investment, cumulative immediate loss and damage on education in Zambia is expected to reach ~US\$230–295 million by 2050,<sup>iii</sup> while long-term impacts could erode future earnings by an additional US\$13–21 billion, compounding long-term human capital losses.<sup>ii</sup></li></ul>
Recommendations		

Note: i) Additional information on the methodology can be found in the main report, alongside with limitations; ii) Methodological conventions: direct loss and damage is shown in constant 2024 US\$; loss of future earnings is shown in 2017 PPP and is not directly comparable, hence, please avoid adding or directly comparing these numbers; iii) Net present values use a 3 per cent social discount rate

Source: Dalberg analysis

# Zambia's climate has been disrupted by shifting temperatures and rainfall, leading to floods, droughts and extreme events such as the 2023–24 El Niño-induced drought: 17M people have been affected since 2005.

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Zambia experiences three distinct seasons: a hot dry season from mid-August to mid-November, a wet rainy season from mid-November to April and a cool dry season from May to mid-August.<sup>2</sup> In recent years, sharp fluctuations in temperature and rainfall have increasingly disrupted these patterns, triggering natural hazards such as floods, droughts and extreme weather events – most notably the 2023–2024 El Niño-induced drought.<sup>3</sup>

Note: i) One event is the combination of a disaster and country (i.e. One disaster affecting two countries counts as two) – includes disasters with at least one of the following criteria: (i) 10 fatalities; (ii) 100 affected people; (iii) a declaration of state of emergency; (iv) a call for international assistance, with 700+ entries in the database in the ESA region  
 Note: these are all extreme events in EM-DAT database, and encompass both climate-induced and not-climate-induced events – the specific impact on children of climate-induced events is displayed in the education-related loss and damage figures  
 Source: 1) EM-DAT, [Database](#), Accessed Jul/2025; 2) The African Climate Foundation, [From Climate Risk To Resilience: Unpacking The Economic Impacts Of Climate Change In Zambia](#), 2023; 3) Akademiya2023, [Impacts of El Niño-Induced Drought in Zambia](#), 2024; Dalberg Analysis

# Zambia's 2024 El Niño drought left nearly 10 million people without food, water, or power.

Beginning January 2024, Zambia entered one of its worst droughts in decades, affecting nearly **9.8 million people** across 84 districts<sup>1,2,3,i</sup>



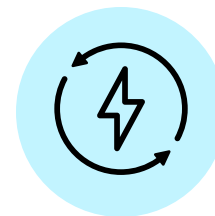
**6.6 million people**

in need of urgent humanitarian assistance with crucial health, WASH, nutrition, water and child protection.<sup>2</sup>



**3 million children**

in need of urgent humanitarian assistance with crucial health, WASH, nutrition, water and education support.<sup>2,3</sup>



**80 per cent of  
Zambians**

who rely on hydroelectric power were hit by crippling load shedding as Kariba's reservoir fell to just 8 per cent usable storage, triggering daily blackouts of up to 21 hours<sup>4</sup>

*"El Niño, which is especially intensified by human-induced climate change, highlights the widespread negative impact of the climate crisis on children" – UNICEF<sup>4</sup>*

Note: i) 84 of the country's 116 districts

Source: 1) EM-DAT, [Database](#), Accessed Jul/2025; 2) UNICEF, [Addressing the Drought Crisis in Zambia](#), Accessed Sep/2025; 3) Acpas, [ZAMBIA: Update on the impact of drought](#), 2025; 4) UNICEF, [Turning climate hardship into hope in Eastern and Southern Africa](#), 2025; Dalberg analysis

# The drought forced children out of school and disrupted learning for those who remained.

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## ATTENDANCE

- 66 per cent of respondents of the Rapid Needs Assessment in drought-affected districts indicated that children were not attending school because of their involvement in supporting their families or engaging in work.<sup>1</sup>
- Teacher attendance declined as teachers also suffer from drought's impacts.<sup>2</sup>
- In Zambia, where 83 per cent of electricity comes from hydropower,<sup>5</sup> drought-driven blackouts left schools without water and power, disrupting operations and, in some cases, limiting school hours or attendance.<sup>4,5</sup>



## LEARNING

- Even when students attended, hunger, thirst and heat exhaustion reduced their ability to focus on lessons. For example, in Shang'ombo, children were often too tired or hungry to engage in class.<sup>3</sup>
- In addition, teachers faced difficulties preparing and delivering lessons because of power cuts, time spent fetching water, etc.<sup>1</sup>
- Extended power outages disrupted learning quality by halting evening study sessions and shutting down ICT and science labs for weeks.<sup>4</sup>

*But 2024 is not an isolated case – it reflects a two-decade regional pattern where school disruptions are deeply intertwined with household and community resilience, driving escalating education-related economic and non-economic loss and damage*

Source: 1) UNICEF, [Zambia Humanitarian Situation Report update # 9](#), 2024; 2) UNICEF, [Rapid qualitative assessment of drought-related community perceptions and behaviors in Zambia](#), 2024; 3) UNICEF, [Drought in Shang'ombo](#), 2024; 4) Acaps, [ZAMBIA: Update on the impact of drought](#), 2025; 5) Peas, [The hidden crisis: How Zambia's drought is impacting education](#); Accessed Sep/2025; 6) Yale, [As Drought Shrivels Hydro, This African Nation Pivots to Solar](#), 2024; Dalberg analysis



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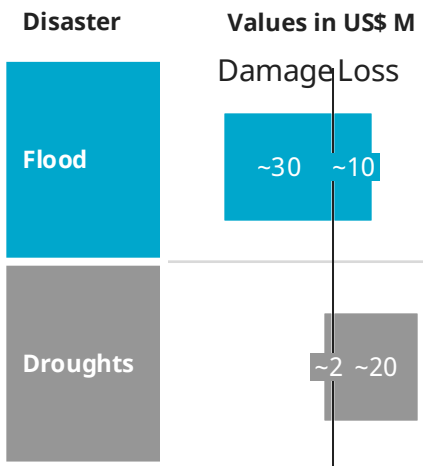
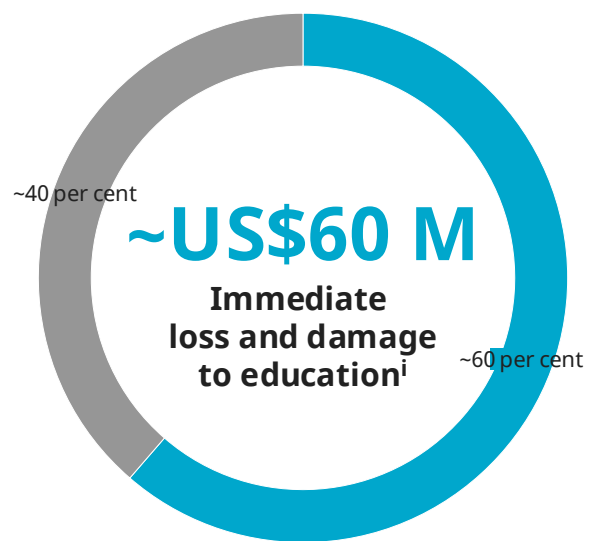
**The drought effects ripple beyond hunger as many families' survival in the district takes precedence, forcing tough decisions that rob children of their education and a chance of a brighter future**

**Sasa Muletambo**

*District's Standard Education Officer<sup>1</sup>*

From 2005 to 2024, total immediate economic loss and damage<sup>i</sup> in Zambia is estimated at around US\$60M, with floods representing the biggest share ~60 per cent and droughts the remaining ~40 per cent.

Summary  
Country Overview  
Insights  
Recommendations



**Key comments**

Floods drive the bulk of immediate economic damages, destroying infrastructure/buildings, furniture and learning materials.

Droughts generate fewer economic infrastructure damages but lead to higher economic losses, with most drought losses linked to restoring student meal consumption.<sup>ii</sup>

Although El Niño drought accounted for nearly 60 per cent of all people affected since 2005, it accounts for “only” 27 per cent of total loss and damage in education. Floods affected fewer people but generated higher damages.<sup>1</sup>

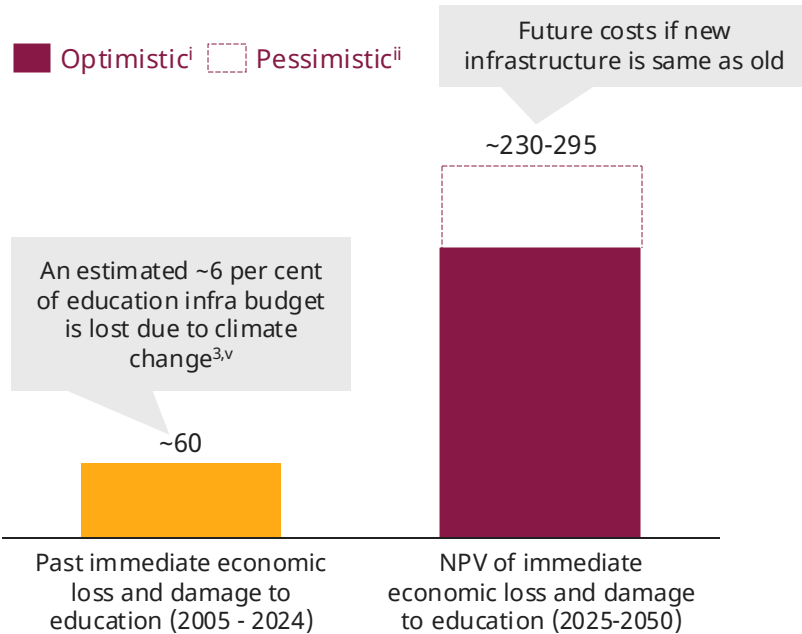
■ Flood ■ Drought

Note: i) Estimates of immediate economic loss and damage on education are limited to education facilities, learning materials, temporary and alternative learning spaces, among others; ii) But also a few other losses, such as psychological support for teachers, among others  
Source: 1) EM-DAT, [Database](#), Accessed Jul/2025; Dalberg analysis

# Without further investment, cumulative immediate economic loss and damage on education in Zambia is expected to reach ~US\$230–295 million by 2050.

## Immediate loss and damage to education<sup>iv</sup>

US\$ million



## Future loss and damage increases mainly due to rising climate extremes, population growth and longer exposure period



**Rising climate extremes:** Higher greenhouse gas concentrations are projected to increase Zambia's average temperatures by 1.6°C to 1.7°C by 2050 compared to 2005 levels.<sup>1</sup>



**Population growth:** Zambia's population is projected to nearly double from ~21 million in 2024 to ~37–41 million by 2050, with school-age children accounting for the largest share of growth.<sup>2,iii</sup>



**Longer exposure period:** The future horizon spans 26 years (2025–2050) compared to 20 years (2005–2024).

Note: i) RCP 4.5 (moderate emissions) and SSP2 – Middle of the Road (Medium challenges to mitigation and adaptation); ii) RCP 8.5 (high emissions) and SSP 3 (Regional Rivalry – high challenges for both mitigation and adaptation, including higher population growth); iii) More students means more classrooms at risk, multiplying potential losses and damages; iv) According to INFORM Climate projections, by 2050 total exposure is expected to increase 4.2–5.7 times in Zambia and 2.3–2.9 times across ESAR, relative to 2022 levels; v) Average of ~6M of loss and damage per year in the period of 2022–24 divided by an education infrastructure budget of 105M<sup>4</sup> in 2026 (using conversion of ZMW to US\$ of 0.046 as of Oct/2025)

Source: 1) World Bank, [Climate Knowledge Portal](#), Accessed Jul/2025; 2) United Nations, [World Population Prospects 2024](#), 2024; 3) KPMG and UNDP, [2026 Budget Highlights](#), 2025; Dalberg analysis

# We estimate that climate change disrupted the learning of ~5 millions students-year, resulting in US\$4 to 5 billion in loss of future earnings, projected to go up to 13 to 21 billion by 2050.

Note that "loss of future earnings" figures were calculated using 2017 PPP<sup>iii</sup>

Summary



## Missed school days today mean lower lifetime earnings tomorrow

Climate events force temporary school closures or reduced learning hours, compounding losses in lifetime earnings.

Country Overview



## Rural students face the greater earnings penalty

Rural areas rely heavily on subsistence farming. When households lose crops and income, children often drop out of school to work or migrate, widening inequalities. Only 13 per cent of rural children complete upper secondary school, compared to 50 per cent in urban areas.<sup>1</sup>

Insights



## Girls faced compounded income penalties

Girls in Zambia complete upper secondary school at lower rates (~26 per cent vs. 33 per cent for boys) and represent 46 per cent of the labour force.<sup>2</sup> Climate shocks can further widen this gap.<sup>1</sup>

Recommendations



**US\$4-5 B**      **~5 M**  
**Loss of future earnings<sup>i</sup> Student-year<sup>ii</sup>**



**US\$13-21 B**      **~ 23-29 M**  
**Loss of future earnings Student-year<sup>ii</sup>**



Note: i) Cumulative over the period of 2005–2024 and 2025–2050; ii) Cumulative number of students affected over the whole period of 2005-24 and 2025-50 (this is not the number of unique students); iii) Methodological conventions: direct loss and damage is shown in constant 2024 US\$; loss of future earnings is shown in 2017 PPP and is not directly comparable, hence, please avoid adding or directly comparing these numbers; Net present values use a 3 per cent social discount rate  
Source: 1) Action Aid, [Zambia factsheet](#), 2022; 2) World Bank, [Labour Force – Female](#), Accessed Oct/2025; Dalberg analysis

# Beyond financial losses and disrupted schooling, Zambia's drought-flood cycles have caused deep social and psychological stress, especially for rural girls.

Summary

Country Overview

Insights

Recommendations

**Beyond lost school days and dropouts, climate shocks fracture children's social networks and trigger psychological distress**



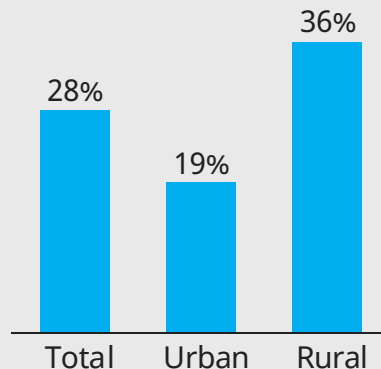
**Social distress:** Climate-induced displacement, such as forced migration after floods or droughts, fractures community ties and support networks, leaving families and children socially isolated.<sup>1</sup>



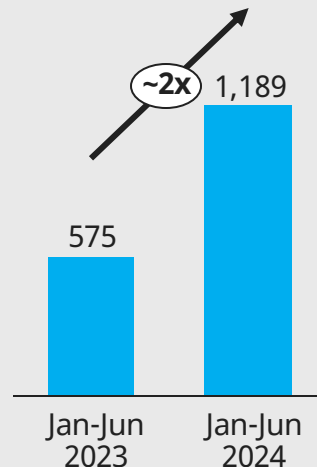
**Psychological distress:** There is increased incidence of trauma, including symptoms of post-traumatic stress disorder, depression and emotional withdrawal, particularly following the loss of homes or loved ones in climate disasters.<sup>1,2</sup>

**For girls, especially in rural areas, this is worsened by climate poverty that drives child marriage and early pregnancy<sup>3</sup>**

**Early pregnancy and motherhood by residence<sup>4</sup>**  
per cent of women age 15–19 who have begun childbearing



**Reported pregnancies<sup>5</sup>**  
Girls aged 10–19 years in Lusangazi District



Source: 1) Catherine Whitnes Bulambo, [Copying strategies to chronic floods in kuku residential area in Lusaka district, Zambia](#), 2023; 2) Akpan UU, Ja'Afar IK, Eke SC., [Addressing the psychological impact of climate-induced disasters on young people in Africa](#), 2025; 3) Rosen, J.G. et al., [Climate-induced livelihood transformations](#), 2021; 4) Government of Zambia, [Demographic and Health Survey](#), 2024; 5) UNICEF, [Zambia Humanitarian Situation Report update # 8, 2024](#); Dalberg analysis

# Zambia's case demonstrates why education must be included in FRLD's first allocations.

Summary



## IMPACT

The Zambia case evidences the significant economic impact of climate change on education, showing how both immediate and long-term disruptions undermine learning and development. Countries should further collect climate change-related education loss and damage data to strengthen evidence (e.g., UNICEF upcoming Global Hazard Database<sup>1</sup>).

Country Overview



## NEED FOR RESILIENT INVESTMENT

Investing in climate-resilient education systems is essential to reduce future costs, protect schools and learning, and ensure continuity during climate shocks. However, education remains severely underfunded in climate finance. Addressing this gap is critical, as strengthening education through resilience measures aligns directly with FRLD's objective of supporting countries to avert, minimize and address loss and damage.

Insights



## RIGHTS AND PROTECTION

Education is a basic right. By including education in its first allocations, FRLD can safeguard this right while also laying the foundation for resilience and long-term recovery.

Recommendations

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Increasing Temperatures (and Heat Waves)

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# About this case study

Summary	<b>Purpose of the Case Study</b>	<b>Provide a regional perspective on the economic case for climate-resilient education infrastructure in Eastern and Southern Africa and demonstrate the value of integrating education into climate and adaptation financing agendas.</b>
	<b>Guiding question</b>	What is the estimated benefit-cost ratio (BCR) of investing in resilient school infrastructure to reduce climate-related loss and damage in Eastern and Southern Africa – and how can this evidence guide policy and financing decisions?
	<b>Content covered</b>	Eastern and Southern Africa regional estimation of avoided loss and damage to education from 2025 to 2050.
Relevance of BCRs	<b>Key Methodology and sources</b>	<ul style="list-style-type: none"><li>• <b>UNDRR, World Bank and Institute of Development Studies</b> to benchmark BCRs for resilient infrastructure and disaster risk reduction.</li><li>• <b>UN-Habitat and World Bank</b> to estimate avoided loss and damage due to adaptation measures, the cost per classroom in ESA, and the premium for resilient construction.</li><li>• <b>UNESCO and UNICEF</b> to derive the number of students and the pupil-teacher ratio, informing classroom estimates, and impacted students.</li></ul>
Methodology and Limitations	<b>Limitations</b>	<b>This case study presents indicative estimates intended to provide an initial approximation</b> – as such, it is subject to limitations, such as exclusion of long-term benefits, use of regional averages and exposure, limited differentiation by hazard type, maintenance costs not modelled, assumption of all investments upfront making estimate conservative, and assumptions about the geographical concentration of events.
Recommendations	<b>Key takeaways</b>	<ul style="list-style-type: none"><li>• <b>BCRs provide clear evidence to inform, prioritize and scale (climate-resilient) investments (in education).</b></li><li>• <b>Investing in resilient schools is cost-effective:</b> Every dollar invested in resilient school infrastructure yields between 2 and 13 times its value in avoided immediate losses and damages, which is in line with other overall existing BCRs, and this can go even higher when other benefits (such as avoided loss of future earnings) are accounted for.</li><li>• <b>The case for action is clear and actionable:</b> Quantified BCRs offer governments and partners a concrete economic argument to prioritize resilient infrastructure within climate and adaptation budgets.</li><li>• <b>Tailoring matters:</b> Returns depend on hazard type, exposure and design; country-specific applications will refine accuracy and impact.</li><li>• <b>Prioritize disaster risk reduction investments based on the tailoring:</b> Overall, disaster risk reduction delivers strong returns. However, the best options – whether early warning systems, resilient infrastructure, and/or relocation – vary by hazard, geography and sector.</li></ul>

# The Benefit Cost Ratio measures the additional benefits (avoided losses and damage) relative to the additional costs of including adaptation measures.

Summary

Relevance of BCRs

Methodology and Limitations

Recommendations



## Benefit Cost Ratio (BCR)

- $BCR > 1$  → Benefits outweigh costs (good investment)
- $BCR < 1$  → Costs exceed measurable benefits (less cost-effective)



### Additional **benefits** of including adaption measures

Measured as the Net Present Value of avoided loss and damage over 2025–2050








### Additional **costs** of including adaption measures

Represents the additional/incremental/premium cost of building, rehabilitating, and/or reconstructing schools to resilient standards

*Note that other metrics can be used to assess adaptation and resilience measures, such as Cost-Effectiveness Ratio (whenever benefits are hard to monetize), Internal Rate of Return (when adaptation measures has clear cash flows), among others. The BCR is particularly valuable when both costs and benefits can be expressed in monetary terms – in the scope of this report, it can build on the quantitative analysis presented in the “Main Report”.*

# BCRs provide clear evidence to inform, prioritize and scale (climate-resilient) investments (in education).

Summary	 <p>Quantifies value for money</p>	Demonstrates how every dollar invested (e.g., in climate-resilient schools) translates into additional benefits (e.g., avoided climate-related loss and damage).
Relevance of BCRs	 <p>Supports investment prioritization</p>	Helps governments and partners target limited resources toward the most cost-effective resilience measures.
	 <p>Builds the economic case</p>	Positions investments (e.g., resilient school construction) as a sound development and climate investment, comparable to other investments.
Methodology and Limitations	 <p>Strengthens advocacy and financing</p>	Offers evidence to engage ministries of finance, climate funds and development partners in scaling up adaptation in the education sector.
Recommendations	 <p>Highlights trade-offs and data needs</p>	Reveals where data gaps or assumptions affect cost-effectiveness estimates, guiding future research and refinement.

# Some BCR estimates exist, but there are no estimates specifically for resilient education infrastructure in the ESAR.

	BCRs <sup>i</sup>	Description	Hazards	Regions	Sectors	Source
Summary	4	Every US\$1 invested in making infrastructure disaster-resilient saves US\$4 through fewer disruptions and reduced economic impacts	Floods, storms, droughts and earthquakes	Low- and middle-income countries	Power, water and sanitation, transport and telecommunications	World Bank <sup>1,ii</sup>
Relevance of BCRs	Without climate change, the median benefit-cost ratio would be equal to 2, but it doubles when climate change is considered <sup>1</sup>					
	15	Every US\$1 invested in risk reduction and prevention can save up to US\$15 in post-disaster recovery	A globally and cross-sectorally recognized, generic cost-benefit ratio utilized by the UNDRR to underscore the necessity of moving international development financing toward pre-emptive disaster risk reduction			UNDRR <sup>2,i</sup>
Methodology and Limitations	3 to 50	Economic returns from climate-resilient investments are consistently positive, with BCRs typically above 3 and up to 50	Floods, storms, and droughts	Synthesis of studies from around the world	Across sectors	Institute of Development Studies <sup>3</sup>
Recommendations	2 to 100	Each US\$1 spent on climate change adaptation interventions can yield US\$2 to US\$100 in benefits	Floods, storms and droughts	Africa	Across sectors	Swiss Re Institute <sup>4</sup>

Note: i) BCRs stands for Benefit Cost Ratios; ii) This report assesses, for the first time, the cost of infrastructure disruptions to low- and middle-income countries and the economic benefits of investing in resilient infrastructure. Education is not included.

Source: 1) World Bank, [Lifelines: The Resilient Infrastructure Opportunity](#), 2019; 2) UNDRR, [International cooperation disaster risk reduction target E](#), 2021; 3) Institute of Development Studies, [Cost-effectiveness of disaster risk reduction and adaptation to climate change](#), 2018; 4) Swiss Re Institute, [We need to talk about climate adaptation](#), 2023; Dalberg analysis



**Every day that we delay adapting to climate change is another day wasted. Another day when we're delaying investment now, but paying the cost later. *Failure to capitalize on the economic benefit of adaptation through high-return investment now will result in the loss of trillions of dollars in potential development.* ... Education is vital for building a climate-resilient future**

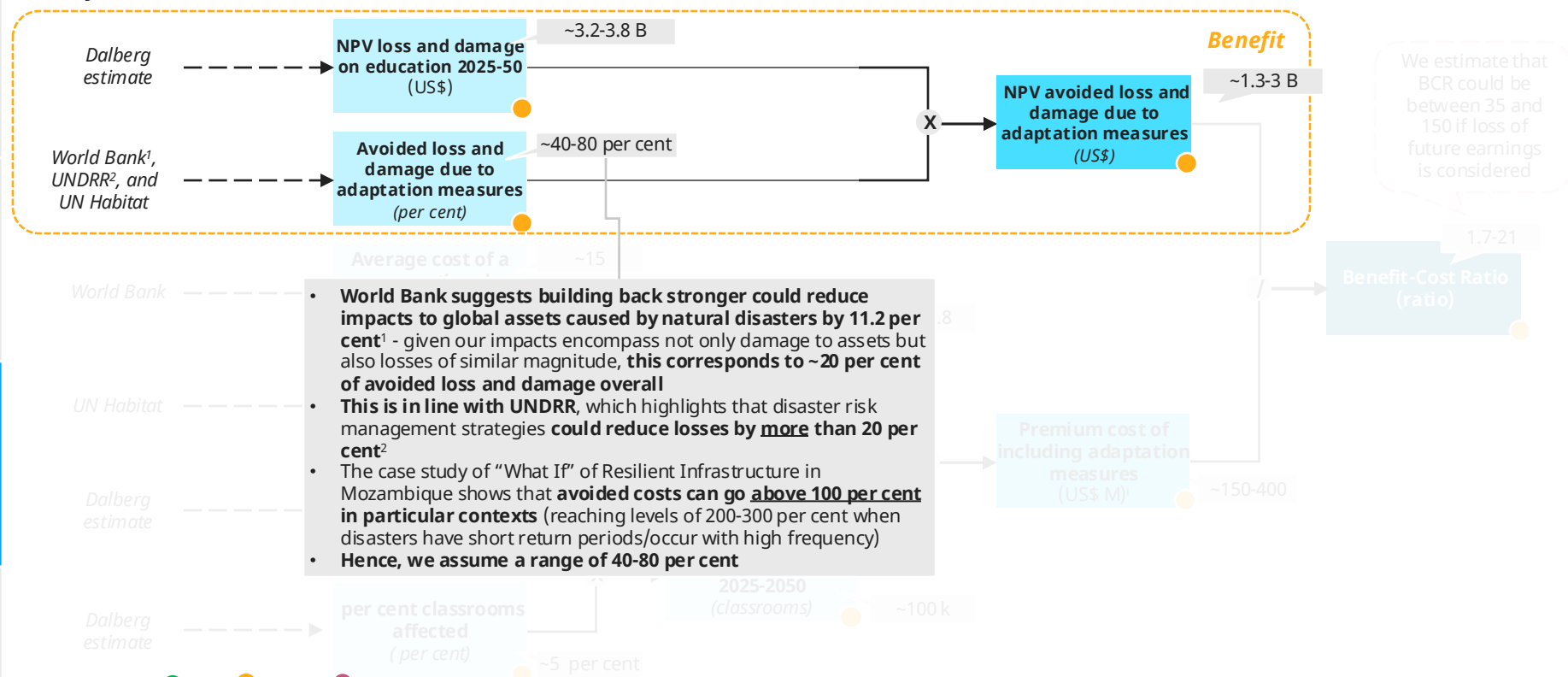
Ban Ki-moon

*8th Secretary-General of the United Nations and Chair of the Global Center on Adaptation<sup>1</sup>*

# To estimate the BCR of avoiding climate-related loss and damage in the education sector through resilient infrastructure in Eastern and Southern Africa, we start by assessing the benefits.

Summary  
Relevance of BCRs  
Methodology and Limitations  
Recommendations

## Key sources



We estimate that BCR could be between 35 and 150 if loss of future earnings is considered

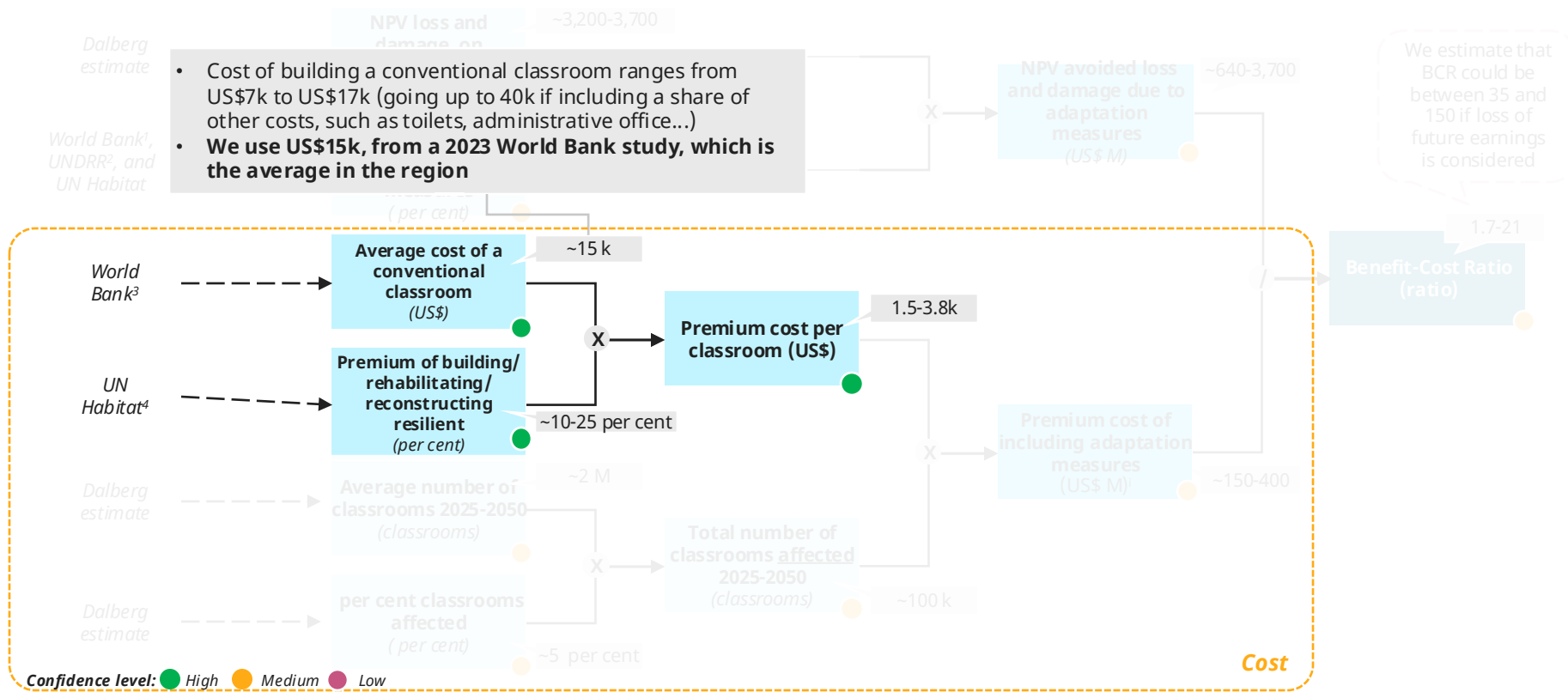
Confidence level: ● High ● Medium ● Low

Source: 1) World Bank, [Building Back Better](#), 2018; 2) UNDRR, [Global Assessment Report on Disaster Risk Reduction](#), 2015; 3) World Bank, [Zanzibar Basic Education Public Expenditure Review](#), 2023; 4) UN Habitat, [Building Climate Resilience in Mozambique - the case of Safer Schools](#), 2023; 5) UNICEF, [Global Snapshot of Climate-related School Disruptions](#), 2025; 6) UNESCO, [Enrolment Data](#), Accessed Jul/2025; Dalberg analysis

# We then proceed to the cost analysis, starting with an estimate of the incremental cost per classroom needed to convert conventional infrastructure into climate-resilient facilities.

## Key sources

Summary  
Relevance of BCRs  
Methodology and Limitations  
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- Cost of building a conventional classroom ranges from US\$7k to US\$17k (going up to 40k if including a share of other costs, such as toilets, administrative office...)
- **We use US\$15k, from a 2023 World Bank study, which is the average in the region**

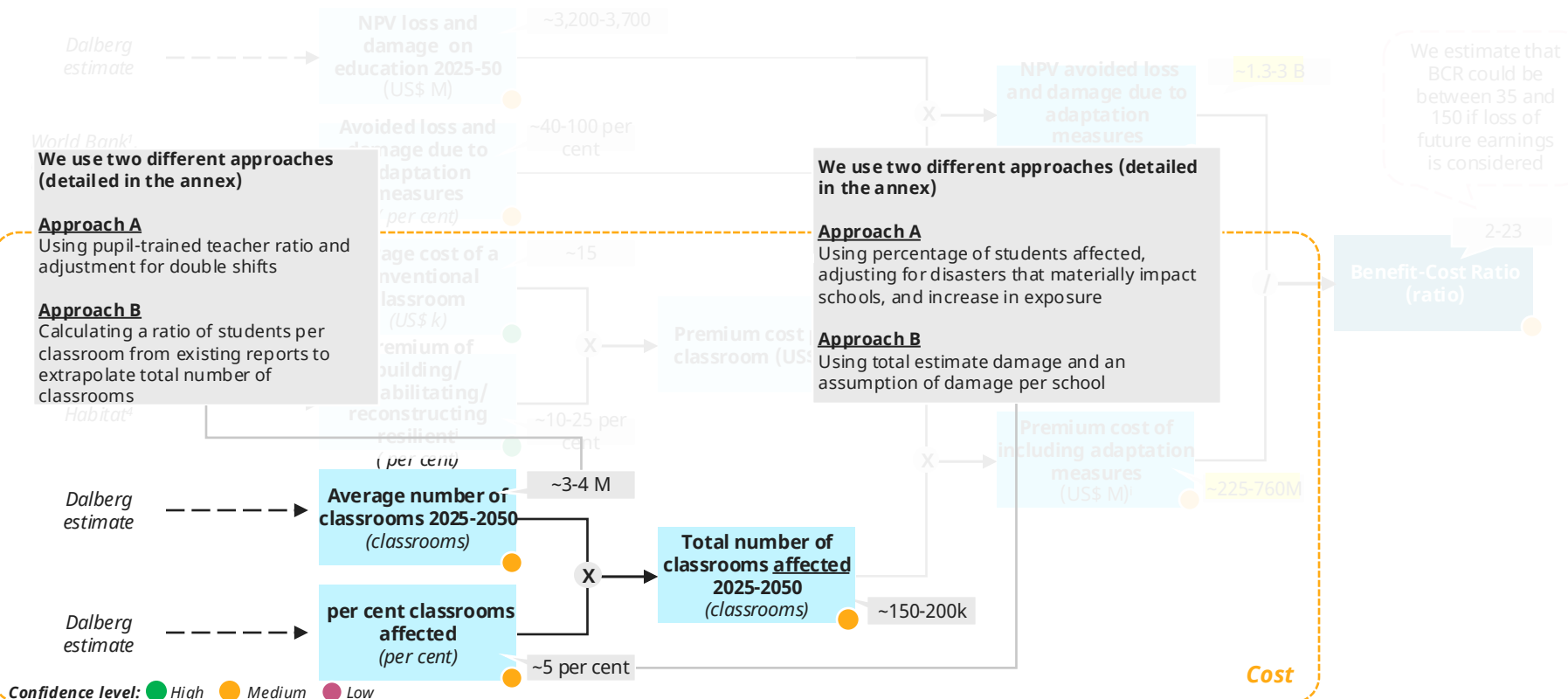
We estimate that BCR could be between 35 and 150 if loss of future earnings is considered

Source: 1) World Bank, [Building Back Better](#), 2018; 2) UNDRR, [Global Assessment Report on Disaster Risk Reduction](#), 2015; 3) World Bank, [Zanzibar Basic Education Public Expenditure Review](#), 2023; 4) UN Habitat, [Building Climate Resilience in Mozambique - the case of Safer Schools](#), 2023; 5) UNICEF, [Global Snapshot of Climate-related School Disruptions](#), 2025; 6) UNESCO, [Enrolment Data](#), Accessed Jul/2025; Dalberg analysis

# We then estimate the number of classrooms affected in the region based on the total number of classrooms and an estimate of what percentage should be impacted.

Summary  
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## Key sources



Source: 1) World Bank, [Building Back Better](#), 2018; 2) UNDRR, [Global Assessment Report on Disaster Risk Reduction](#), 2015; 3) World Bank, [Zanzibar Basic Education Public Expenditure Review](#), 2023; 4) UN Habitat, [Building Climate Resilience in Mozambique - the case of Safer Schools](#), 2023; 5) UNICEF, [Global Snapshot of Climate-related School Disruptions](#), 2025; 6) UNESCO, [Enrolment Data](#), Accessed Jul/2025; Dalberg analysis



# Limitations: The model offers valuable regional estimates but lacks the hazard-, location-, and intervention-specific detail required for precise local decision-making.

**This case study presents indicative estimates intended to provide an initial approximation – as such, it is subject to a number of limitations, outlined below:**

- **Indirect benefits excluded:** The model captures immediate avoided loss and damage to education infrastructure. If other benefits, such as avoided loss of future earnings, are accounted for, BCR increases further.
- **Limited hazard differentiation:** Key parameters (e.g., share of classrooms affected, premium for resilient construction, avoided loss and damage) are applied as aggregate values across all hazards. They are not differentiated by hazard type (e.g., floods, droughts, storms) and exposure intensity.
- **Regional averages:** Uses regional estimates for cost per classroom, students per teacher, and other ratios, which may not reflect large country-level or subnational variations.
- **Generic exposure data:** The number of affected classrooms is not derived from detailed geospatial risk models but from regional assumptions.
- **Truncated benefits:** Benefits are counted through 2050, while some new schools built late in the period (e.g., 2040) will continue generating avoided losses for some additional years (e.g., 15 additional years). This biases the BCR downward.
- **Maintenance omitted:** Operation and maintenance costs and performance decay over time are not modelled for either conventional or resilient schools.
- **Geographical concentration of events:** The model assumes that climate disasters will be concentrated in the same regions, exposing typically the same schools to the same hazards, included in the 15 per cent estimate of all schools being affected.

*To explore a case study that incorporates hazard-, location-, and intervention-specific factors, see the Mozambique case study.*

# Investments in resilient infrastructure are consistently cost-effective, especially in high-risk settings – but tailoring to context is critical to maximize impact.

Summary

**1 Translate BCR into a decision-support tool for governments and agencies:** A user-friendly tool can support Ministries of Education, Finance and Infrastructure in developing strong business cases for climate-resilient investments, ensuring alignment with local hazard profiles and budget constraints.

Relevance of BCRs

**2 Contextualize Benefit–Cost Ratios:** Cost-effectiveness and Benefit–Cost Ratios are highly hazard-, location-, and intervention-specific, varying by geography, hazard type, sector, intervention type and socio-economic conditions – having information to make investments where exposure is highest is crucial to achieve high BCRs.

Methodology and Limitations

**3 Prioritize disaster risk reduction investments:** Overall, disaster risk reduction deliver strong returns. The best options – whether early warning systems, resilient infrastructure, and/or relocation – vary by hazard, geography and sector.

**4 Invest in more resilient infrastructure as a proven, cost-effective solution:** BCR is greater than 1 in 96 per cent of the 3,000 scenarios explored, exceeds 2 in 77 per cent of scenarios, and exceeds 6 in 25 per cent of scenarios.<sup>1</sup> Our analysis supports these results for the education sector in Eastern and Southern Africa.

Recommendations

**5 Strengthen the evidence base and capture non-economic benefits for education:** More studies are needed to quantify the specific BCRs<sup>i</sup> of resilient education infrastructure across different hazards (floods, droughts and storms) and country contexts, including both immediate and long-term climate-related losses and damages.

*Note: i) To strengthen the evidence base, a case study was conducted (available here), leveraging available data to estimate the Benefit–Cost Ratio of investing in resilient education infrastructure against flood risks in Mozambique*

*Note: Analysis based on resilient infrastructure across power, water and sanitation, transport, and telecommunications sectors*

*Source: 1) World Bank, [Lifelines: The Resilient Infrastructure Opportunity](#), 2019; Dalberg analysis*

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# About this case study

Summary

## Purpose of the Case Study

To assess the benefits of investing in resilient school infrastructure

## Guiding question

When faced with a climate disaster, what is the cost-benefit of building schools to resilient standards?

## Content covered

The case of Safer Schools in Mozambique

*This case study focuses primarily on Cyclones Idai and Kenneth, given the greater data availability on costs and benefits, which enabled an estimate of the benefit-cost ratio in this specific context. In addition, the analysis draws on complementary insights from other sources, including the UNICEF Mozambique case study and related reports, to strengthen the overall findings.*

Country Overview

## Key Methodology and sources

- **EM-DAT database** to quantify Mozambique's exposure to extreme weather events, people affected and fatalities.
- **Carbon Brief and Mester, B. et al** to estimate the percentage of extreme weather events that are attributable to or exacerbated by climate change, including cyclones Idai and Kenneth.
- **UN-Habitat's Safer Schools Initiative** evaluations documenting performance of resilient schools compared to standard ones.
- **Secondary reports (UNICEF, UNDRR, World Bank, etc.)** to supplement evidence and highlight local impacts.

Insights

## Key takeaways

- **Proven survival during disasters.** Resilient schools achieved a 100 per cent survival rate during Cyclones Idai and Kenneth, serving as safe havens during emergencies and enabling a much faster return to learning.
- **Resilience pays for itself.** Every US\$1 spent on resilient schools in Mozambique can save ~US\$2-14 in reconstruction and emergency costs, which is in line with UNICEF's estimate of US\$4 saved for every US\$ spent (in particularly disaster-prone areas, the true ratio can be significantly higher, as some regions are repeatedly affected by climate-related disasters), and the full benefit is even higher when other impacts, such as avoided loss of future earnings, are accounted for.
- **Resilience is cheapest when embedded from the start.** Recent findings suggest resistance upgrading in a new construction is barely 10 per cent, whereas it can go up to 25 per cent in rehabilitation and reconstruction.
- **Resilience also averts non-economic losses and delivers social benefits.** Beyond cost savings, resilient schools protect children's safety, reduce absenteeism (especially for girls) and provide psychological security for learners and teachers.

Recommendations

# Mozambique is among the world's most climate-vulnerable countries, facing frequent and intensifying cyclones.

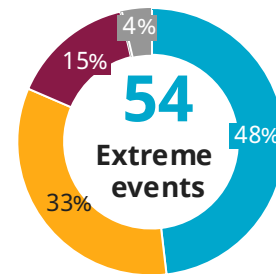
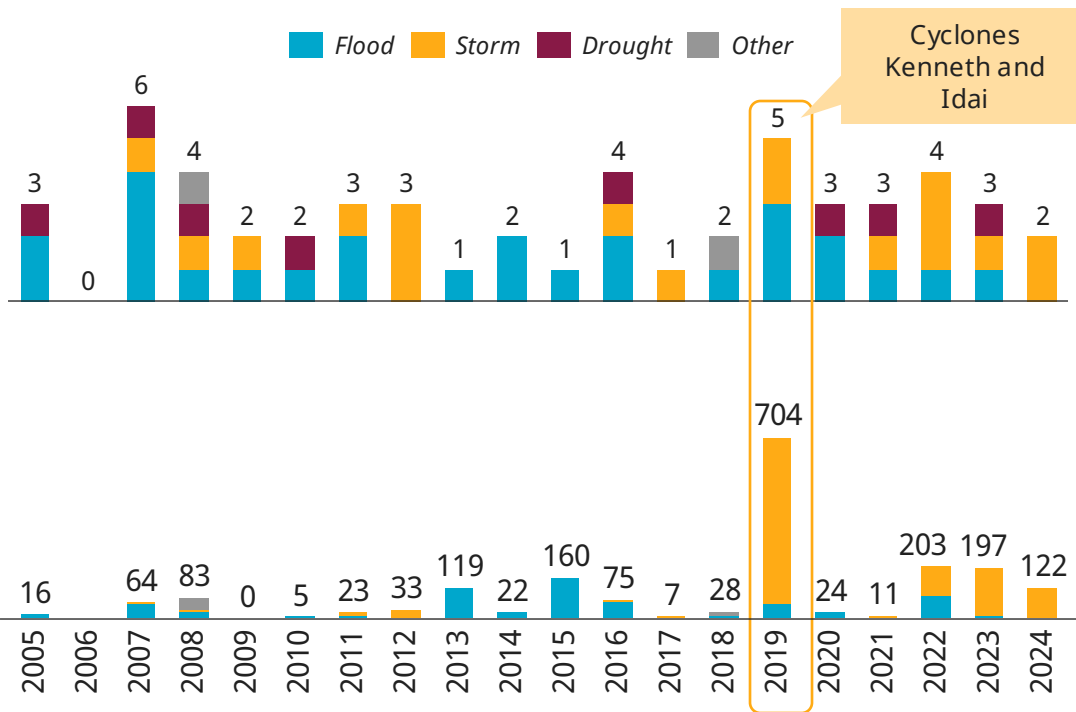
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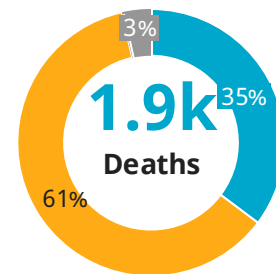
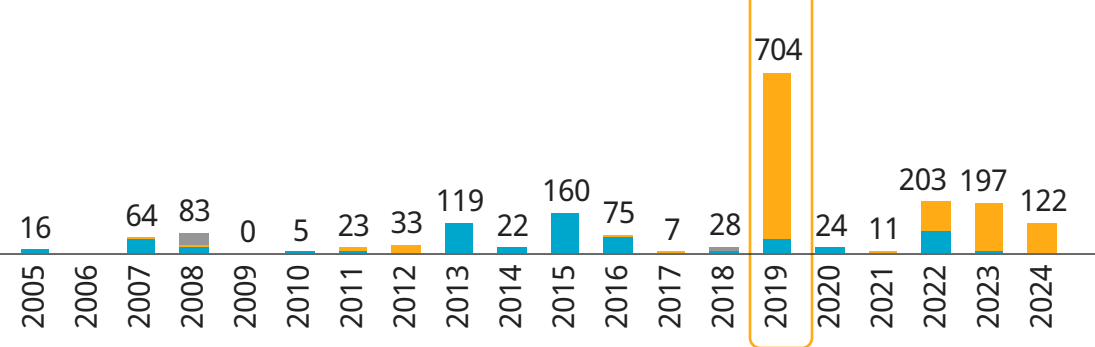
Insights

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## Number of events<sup>i</sup> (#)



## Deaths (#)



Mozambique lies within the primary cyclone zone<sup>2</sup> and is among the world's most climate-vulnerable countries, with children disproportionately affected by increasingly frequent and intense cyclones.<sup>3</sup> It ranked 10<sup>th</sup> out of 163 countries for children most at risk from climate change.<sup>4</sup>

Note: i) One event is the combination of a disaster and country (i.e., One disaster affecting two countries counts as two) – includes disasters with at least one of the following criteria: (i) 10 fatalities; (ii) 100 affected people; (iii) a declaration of state of emergency; (iv) a call for international assistance, with 700+ entries in the database in the ESA region

Note: these are all extreme events in the EM-DAT database, and encompass both climate-induced and not-climate-induced events – the specific impact on children is displayed in the next slides

Source: 1) EM-DAT, [Database](#), Accessed Jul/2025; 2) World Bank, [Climate Risk Profile: Mozambique](#), 2025; 3) UNICEF, [Protecting Mozambique's Children from Climate Shocks](#), 2025; 4) UNICEF, [The Climate Crisis is a Child Rights Crisis: Introducing the Children's Climate Risk Index](#), 2021; Dalberg Analysis

# Cyclone Idai affected 900K children and caused US\$2.8B in economic loss and damage; just weeks later, Cyclone Kenneth affected 200K children with US\$0.2B in additional loss and damage.

## Cyclone Idai (March 2019)



- **900K** children affected<sup>2</sup>
- **1.8M** people affected (~6.5 per cent Mozambique population)<sup>1</sup>
- **400K** people displaced<sup>1</sup>
- **603** deaths<sup>1</sup>
- **2.8B** US\$ in economic loss and damage<sup>5, ii</sup>

Estimates indicate that climate change has increased displacement risk from this event by approximately 12,600–14,900 additional displaced persons<sup>3</sup>

## Cyclone Kenneth (April 2019)



- **200K** children affected<sup>i</sup>
- **400K** people affected (~1.5 per cent Mozambique population)<sup>4</sup>
- **3K** people displaced<sup>1</sup>
- **45** deaths<sup>1</sup>
- **0.2B** US\$ in economic loss and damage<sup>5, ii</sup>

Despite the absence of specific detection and attribution studies for Cyclone Kenneth, there is high confidence that global warming has intensified both the rainfall and windspeeds associated with tropical cyclones<sup>7</sup>

*Note: i) No official disaggregated figure is available for children affected by Cyclone Kenneth. However, it is expected to be around 50 per cent, similar to Cyclone Idai, given that children represent approximately 52 per cent of Mozambique's population;<sup>6</sup> ii) Damage refers to the total or partial destruction of physical assets in the disaster-affected areas. Damages occur during and immediately after the disaster and are measured in physical units (i.e., number of damaged houses, roads, crops, land, etc.). Their monetary values are expressed as the replacement costs according to prices prevailing just before the event. Loss refers to changes in economic flows arising from the disaster. They occur until full economic recovery and reconstruction is achieved. Typical losses include the decline in output in productive sectors*

*Source: 1) WHO, [Tropical Cyclones Idai and Kenneth](#), 2019; 2) UNICEF, [1 million children affected by Cyclone Idai and subsequent floods in Mozambique](#), 2019; 3) Mester, B. et al, [Human displacements from Tropical Cyclone Idai attributable to climate change](#), 2023; 4) EM-DAT, [Database](#), Accessed Jul/2025; 5) Prevention Web, [Mozambique Cyclone Idai](#), 2019; 6) UNICEF, [The Situation of Children in Mozambique](#), 2021; 7) IPCC, [Climate Change 2022: Impacts, Adaptation and Vulnerability](#), 2022; Dalberg analysis*

# Cyclones Idai and Kenneth disrupted learning for over 420K students and 10K teachers across nearly 5K classrooms, with US 24M in total economic loss and damage to the education sector.



**4.7K**

## Classrooms damaged or destroyed<sup>1</sup>

Idai alone accounted for ~4.2K destroyed or partially destroyed classrooms, while Kenneth destroyed or damaged ~500 more



**420K**

## Students impacted<sup>1</sup>

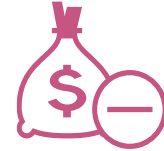
Idai disrupted learning for ~380K students, with Kenneth adding another ~40K



**10.5K**

## Teachers affected<sup>1</sup>

Teaching staff were also hit hard, with 9.6K affected by Idai and 900 by Kenneth



**US\$24.1M**

## Economic loss and damage<sup>i, 1</sup>

Loss and damage in the education sector amounted to US\$20.5M from Idai and US\$3.6M from Kenneth

*Given most existing school infrastructure is precarious, even in “non crisis” years, Mozambique loses an estimated 600 classrooms annually to storms and erosion, further eroding educational access for thousands of students, especially in coastal and riverine zones prone to weather extremes<sup>2,3</sup>*

Note: i) Damage refers to the total or partial destruction of physical assets in the disaster-affected areas. Damages occur during and immediately after the disaster and are measured in physical units (i.e., number of damaged houses, roads, crops, land, etc.). Their monetary values are expressed as the replacement costs according to prices prevailing just before the event. Loss refers to changes in economic flows arising from the disaster. They occur until full economic recovery and reconstruction is achieved. Typical losses include the decline in output in productive sectors

Source: 1) Prevention Web, [Mozambique Cyclone Idai](#), 2019; 2) UNICEF, *Case Study: Transforming Mozambique’s School Infrastructure for Climate Resilience*, 2025; 3) UNDRR, [Safe Schools top agenda in Mozambique](#), 2019; Dalberg analysis

# Amidst the widespread devastation caused by these cyclones, schools built following the UN-Habitat Resilient School Guidelines have remained in good condition.

## Resilient schools demonstrated a 100 per cent survival rate during the two cyclones: Idai and Kenneth

- **No resilient school building collapsed or became unsafe:** Every site built to resilient standards<sup>i</sup> withstood the full force of Cyclones Idai and Kenneth. This remarkable performance validated the Safer Schools Initiative, proving that all newly rehabilitated or reconstructed schools endured despite the cyclones' devastating power.
- **However, only ~5 per cent of schools are climate-resilient and more investment is needed:** an estimate of 3.5K schools were built or re-built following adequate climate-resilient standards over a total stock of 63.5K schools.

## Providing safe shelter during emergencies and enabling a quicker return to learning

- **Resilient schools served as reliable emergency shelters during crises:** Resilient schools were activated as part of Mozambique's emergency response, protecting thousands of people as safe havens during Cyclones Idai and Kenneth.
- **In addition, they enabled a faster return to safe learning:** Resilient schools enabled between ~160K and 200K children to keep going to school in safe structures once normalcy has been re-established.<sup>ii</sup>

**This result validated the approach and strengthened institutional confidence:** The schools' successful performance validated the entire Safer Schools Initiative and its underlying concepts. This feat gave the government full confidence in the 'Living with Natural Hazards' approach, consolidating the political will necessary to sustain the initiative.<sup>iii</sup>

“The Safer Schools Initiative is a unique experience with limitless possibilities of being replicated in other parts of the continent and the world... [It] is currently inspiring the reconstruction process in other sectors such as the rebuilding of hospitals and community housing projects.”

Filipe Nyusi, Former President of Mozambique and African Union Champion for Disaster Risk Management

Note: i) Schools built following the UN-Habitat Resilient School Guidelines; ii) Estimate based on 3,500 classrooms built or re-built to resilient standards across affected areas, combined with Mozambique's pupil-trained teacher ratios (46.73 in pre-primary and 57.74 in primary education);<sup>2</sup> iii) The term “natural hazards” is used as per the official name of the initiative; however, many such hazards are increasingly climate-induced

Source: UN Habitat, [Building Climate Resilience in Mozambique - the case of Safer Schools](#), 2023; 2) UNESCO, [UIS](#), Accessed Oct/2025; Dalberg analysis; Dalberg analysis

Every US\$1 spent on resilient schools in Mozambique can save ~US\$2–14 in reconstruction and emergency costs – the full benefit is even higher when factoring in avoided loss of future earnings.

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## Per classroom

INDICATIVE

Per classroom		INDICATIVE	
Avoided damage <sup>i</sup>	Reconstruction Cost	US\$15,000 <sup>1,v</sup>	
	Cost of Emergency Response	US\$200 <sup>1</sup>	
	Cost of Asset Losses	US\$300 <sup>1</sup>	
	Total avoided damage	US\$15,500 <sup>1</sup>	
Premium cost <sup>ii</sup>	Cost of including adaptation measures	US\$6,500 <sup>1</sup> (20 per cent of original cost)	US\$3,250 <sup>vii</sup> (10 per cent of original cost)
BCR <sup>iii</sup>	Damage prevented once	2.4x	4.8x
	Damage prevented twice	4.6x	9.1x
	Damage prevented three times	6.7x	13.5x

## Comments

- **BCR varies by exposure:** in high-risk areas, schools may be hit several times within a decade. For example, Sambazo Primary School in Sofala's Dondo district was destroyed three times – by Cyclone Idai in 2019, Tropical Storm Chalane in 2020 and Tropical Cyclone Eloise in 2021.<sup>2</sup>
- **Findings align with estimates:** high-level estimate in previous case study provides a range of 2-13, which is also in line with other CBRs, e.g., UNDRR figure that every US\$1 invested in resilient infrastructure and risk reduction saves between US\$4–15 in reconstruction and post-disaster recovery costs.<sup>3,iv</sup>
- **Resilience is cheapest when embedded from the start:** Resistance upgrading in a new construction is barely 10 per cent, whereas it can go up to 25 per cent in rehabilitation and reconstruction.<sup>1</sup>
- **Adaptation investments vary:** UN Habitat uses 20 per cent of original cost (and mentions recent studies showing 10 per cent),<sup>1</sup> whereas new UNICEF analysis suggests 30 per cent of original cost.<sup>4,vi</sup> Despite the variance, even under a higher investment, BCR would still be larger than 1.

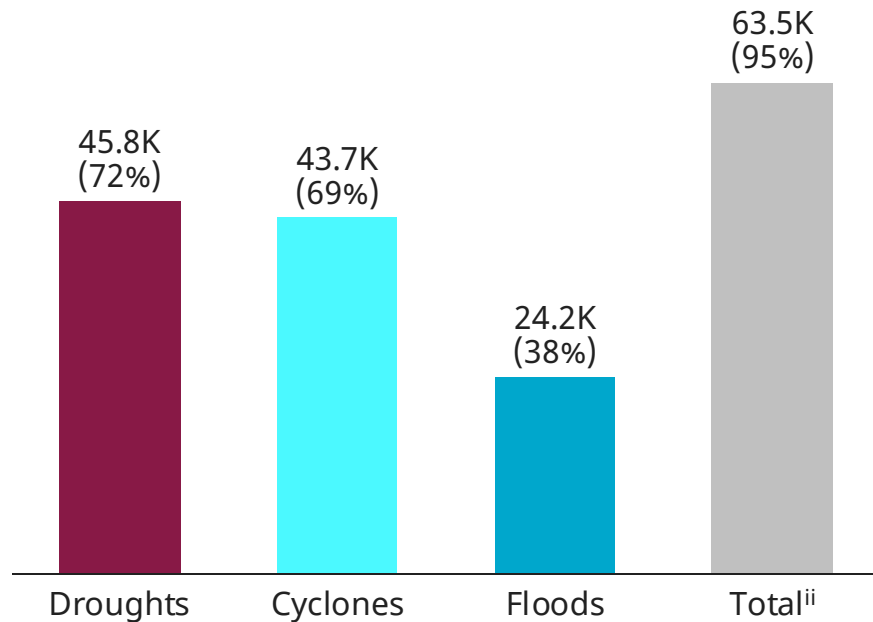
Note: i) Avoided damage due to building back better; ii) Premium cost of building back better; iii) BCR=Benefit-Cost Ratio; iv) In UNDRR's analysis, the lower bound (~US\$4) refers to avoided reconstruction costs, while the upper bound (~US\$15) reflects broader post-disaster recovery costs; v) The figure of US\$15K represents the projected Reconstruction Cost per classroom used in the Safer Schools Initiative's cost-benefit model. This value covers the cost to rebuild a partially damaged classroom (estimated at 20-30 per cent of the initial cost of US\$32.5K = US\$8K) plus expenses for surveys, tender and implementation; vi) Note that different sources provide different estimates, with a new UNICEF study<sup>4</sup> suggesting US\$12K of additional resilience investments on top of US\$28K for the construction of a new school (i.e., ~40 per cent of original cost); vii) calculated based on recent findings showing that with new construction, costs of resistance upgrading are barely 10 per cent<sup>1</sup>

Source: 1) UN Habitat, [Building Climate Resilience in Mozambique - the case of Safer Schools](#), 2023; 2) UNICEF, [Climate-Proof Schools in Mozambique: Climate Adaptation That Works](#), 2023; 3) UNDRR, [International Cooperation in Disaster Risk Reduction: Target E](#), 2021; 4) UNICEF, [Case Study: Transforming Mozambique's School Infrastructure for Climate Resilience](#), 2025; Dalberg analysis

# With nearly every classroom in Mozambique exposed to hazards – worsened by climate change – investing in resilient school construction is essential to protect children’s safety and learning.

## Number of classrooms at risk<sup>1, i</sup>

percentage and number of schools at risk



## Key comments<sup>1</sup>

- **95 per cent of classrooms are exposed to at least one major hazard**,<sup>ii</sup> and 72 per cent of schools are located in high-risk areas for one or more hazards.<sup>ii</sup>
- **Each year, ~540 classrooms and 57K students face school disruptions** in Mozambique from hazards – driven mostly by cyclones (70 per cent), with coastal flooding (14 per cent) and riverine flooding (12 per cent).<sup>iii</sup>
- **As a result, four specific natural hazards were undertaken and specific technical guidance was produced** for safer construction according to the hazard type (cyclones, floods, droughts...).

*“The government of Mozambique recognizes that the country is vulnerable to catastrophes and that the hazards resulting from climate change are some of the factors that aggravate the situation of absolute poverty in Mozambique”<sup>2</sup>*

Note: i) Based on its hazard mapping and vulnerability analyses, UN-Habitat estimated the relative exposure of classrooms by risk category; ii) The total also includes earthquake exposure. Earthquakes are not shown separately here as their impact on students in Mozambique is minimal compared to other hazards; iii) Earthquakes account for the remaining ~3 per cent  
Source: 1) UN Habitat, [Building Climate Resilience in Mozambique - the case of Safer Schools](#), 2023; 2) UNDP, [Mozambique](#), Accessed Sep/2025; Dalberg analysis

# With support from UN-Habitat and UNICEF, Mozambique developed climate-resilient classroom designs tailored to local risks. Despite progress, an immense funding gap remains.






Summary

Mozambique with support from UN-Habitat and UNICEF developed climate-resilient classroom designs tailored to the specific risks...<sup>1,2</sup>

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	<b>Cyclone-resistant roofing</b>	Reinforced roofs with thicker steel sheets, specialized nails and truss connections, and independent veranda roofs prevent uplift and failure in winds above 200km/h.
	<b>Elevated foundations (flood zones)</b>	Elevated concrete foundations protect the structures as well as other materials, such as desks, books and learning materials.
	<b>Heat and ventilation solutions</b>	Cross-ventilation, larger windows and ventilated roof spaces reduce temperatures during heatwaves (especially useful for rural districts lacking electricity or fans).
	<b>Evolutive/localized construction</b>	Improved design with more resilient core structure that allows for future expansion and usage of mixed materials <sup>i</sup> to balance longevity and cost.
	<b>Maintenance considerations</b>	Standardized, modular components plus strengthened local supply chains and skills for ongoing maintenance (e.g., cyclone-rated fasteners, thicker roofing sheets).

...UNICEF also supported build and rehabilitate infrastructure...<sup>1</sup>

Between 2023 and 2025, UNICEF helped build/rehabilitate over 1,000 classrooms to climate-resilient standards; despite the intense 2024 cyclone season, ~99 per cent remained intact, with only 15 reported as damaged.

...However, an immense funding gap remains...<sup>1</sup>

Despite great progress with Mozambique's 2021 decree mandating resilient standards, there remains an immense funding gap with over US\$3 billion required to deliver roughly 80,000 additional classrooms.

If the current pace of less than 600 new classrooms built per year is maintained, it would take more than a century to close the gap.

Note: i) Such as concrete for walls, steel for roofs, local bricks when available

Source: 1) UNICEF, Case Study: Transforming Mozambique's School Infrastructure for Climate Resilience, 2025; 2) UNICEF, [Building climate and disaster-resilient schools](#), Accessed Nov/2025; Dalberg analysis

# Resilient school investment also averts non-economic losses and delivers social benefits, keeping children safe, emotionally secure and in school – with particular benefits for girls.

## Resilient schools also avert non-economic losses and deliver social benefits



### Resilient schools can protect learning and well-being...

Resilient schools can provide psychological security for students and teachers by preventing separation of children from their families, gender-based violence, forced child-marriage, child labour and psychological trauma, as well as avoiding interruptions in education programmes.<sup>1</sup>

## Children feel safer and can stay in school

“My friends and I feel safe. We don't fear floods or cyclones anymore.”

Margarida, 15<sup>2</sup>



### ... and can prevent absenteeism for girls

Cyclone Freddy destroyed Landinho's school waterpoint in March 2023, leaving students and teachers without safe water for over six months. The lack of onsite WASH facilities had an outsized impact on girls at the school, as many could not manage their menstrual hygiene safely and missed two to three days of class each month until water services were restored. Resilient schools could prevent this by ensuring reliable WASH facilities even after extreme weather events.<sup>3</sup>

“Before the school had water [again], I had to ask the teacher to go home during the time of menstruation.”

Anatalia Daniel, a 14-year-old student at the Landinho primary school<sup>3</sup>

“When girls were menstruating, they would stay home for 2-3 days and miss all the lessons.”

Anatalia's teacher, Ms Zuhari Rui Goncalves<sup>3</sup>

# Delivering resilient and inclusive education in Mozambique requires deepening the focus on where, how and for whom infrastructure is built.

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**1 Prioritize highest-risk zones to maximize cost-benefit:** Identify areas most vulnerable to climate change and direct initial resilient school investments where exposure to cyclones, floods and other shocks is highest.

**2 Align infrastructure with zone-specific risks:** Select resilient school designs tailored to local hazard profiles, ensuring each investment addresses the relevant climate threats in that region (e.g., cyclone-proof designs for coastal areas and heat/drought-adapted models inland), ensuring structures can withstand multiple hazards where risks overlap.

**3 Invest in resilience from the start:** Make resilient design mandatory for all new construction in high-risk zones, as upfront investments are more cost effective and deliver the highest cost-benefit returns.

**4 Mobilize innovative finance:** Unlock climate funds, risk-pooling instruments and blended finance to bridge Mozambique's US\$3+ B classroom resilience gap.<sup>1</sup> The current gap is over three times Mozambique's annual education budget and roughly 26 times its current capital investment in education.<sup>i, 2, 3, 4</sup>

**5 Put equity at the centre:** Ensure that every infrastructure investment includes gender- and child-responsive design, safeguarding all learners regardless of geography, gender, or disability.

**6 Pair physical resilience with social readiness:** Complement resilient school infrastructure with measures that address teachers' well-being, care burdens and social and economic stressors to ensure recovery and learning continuity are sustained beyond the physical environment.

Note: i) Calculation based on 2025 education budget of ~US\$980 million and capital investment of ~US\$118 million per year<sup>2, 3, 4</sup>

Source: 1) UNICEF, UNICEF Case Study: Transforming Mozambique's School Infrastructure for Climate Resilience, 2025; 2) 360 Mozambique, [President Enacts the 2025 State Budget Law](#), 2025; 3) 360 Mozambique, [2025 State Budget: Education's Budget Share Drops from 14.2 per cent to 12.1 per cent](#), 2025; 4) UNICEF Mozambique, [Budget Brief: Education \(Mozambique 2019\)](#), 2019; Dalberg analysis

//

**The additional cost of making schools climate-resilient amounts to only US\$8 per student. This additionality can – and should – be covered by climate finance.**

UNICEF

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Increasing Temperatures (and Heat Waves)

## Annex

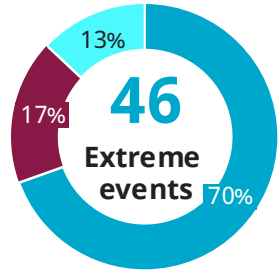
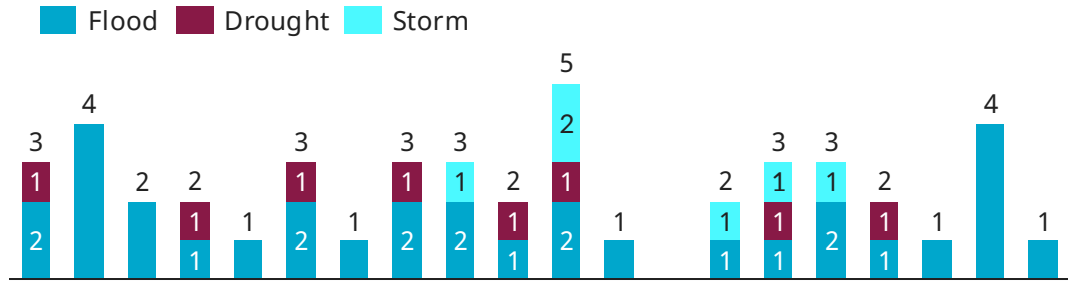
# About this case study

Summary	<b>Purpose of the Case Study</b>	Illustrate <u>how climate change and conflict reinforce each other in Somalia</u> and makes the case for integrated humanitarian-climate responses.
	<b>Guiding question</b>	How does conflict and climate change exacerbate education exclusion and disruption in Somalia?
	<b>Content covered</b>	Drought-flood whiplash with ongoing insecurity in Somalia.
Country Overview	<b>Key Methodology and sources</b>	<ul style="list-style-type: none"><li>• <b>EM-DAT database</b> to quantify Somalia's exposure to extreme weather events, people affected and fatalities.</li><li>• <b>IMDC and Humanitarian Action</b> to assess the number and causes of internal displacements and internally displaced people.</li><li>• <b>UNICEF</b> to quantify child displacement and number of children out of school.</li><li>• <b>SPARC and IEP</b> to estimate the economic cost of climate change and conflict.</li><li>• <b>Climate-Conflict-Vulnerability Index</b> to assess the climate and conflict risk levels in the different regions of Somalia.</li></ul>
Insights	<b>Key takeaways</b>	<ul style="list-style-type: none"><li>• <b>Somalia faces severe economic and human losses:</b> Drought-flood whiplash and protracted conflict are driving mass displacement and combined economic losses estimated at 35–45 per cent of Somalia's GDP annually.</li><li>• <b>Climate change and conflict reinforce each other:</b> Climate shocks and conflict are reinforcing cycles of displacement and disrupted (education) services, especially in south-central Somalia.</li><li>• <b>Children bear the brunt of this compounded crisis:</b> Somalia now records the highest number of child displacements in Eastern and Southern Africa, leaving over 4.5 million children, more than 60 per cent of the school-aged population, out of school.</li><li>• <b>The education crisis is even more acute in the regions affected by conflict and climate:</b> School enrolment in south-central Somalia (22 per cent) is one-third lower than the national average (32 per cent) and far below the Eastern and Southern Africa average (~98 per cent).</li><li>• <b>Violence is directly targeting education:</b> Armed groups are attacking schools and subjecting thousands of children to recruitment, rape and abduction.</li></ul>
Recommendations		

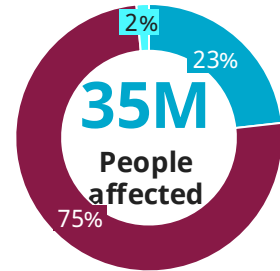
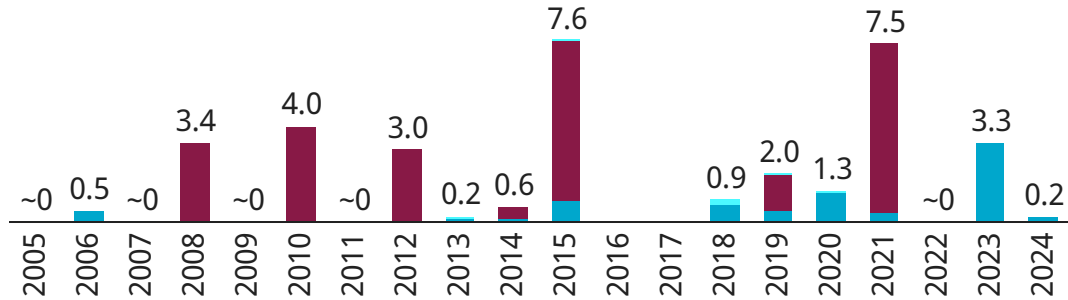
# Highly exposed to climate hazards and with limited capacity to adapt, Somalia is one of the world's most climate-vulnerable countries.

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## Number of events<sup>i</sup> (#)



## People Affected (M)



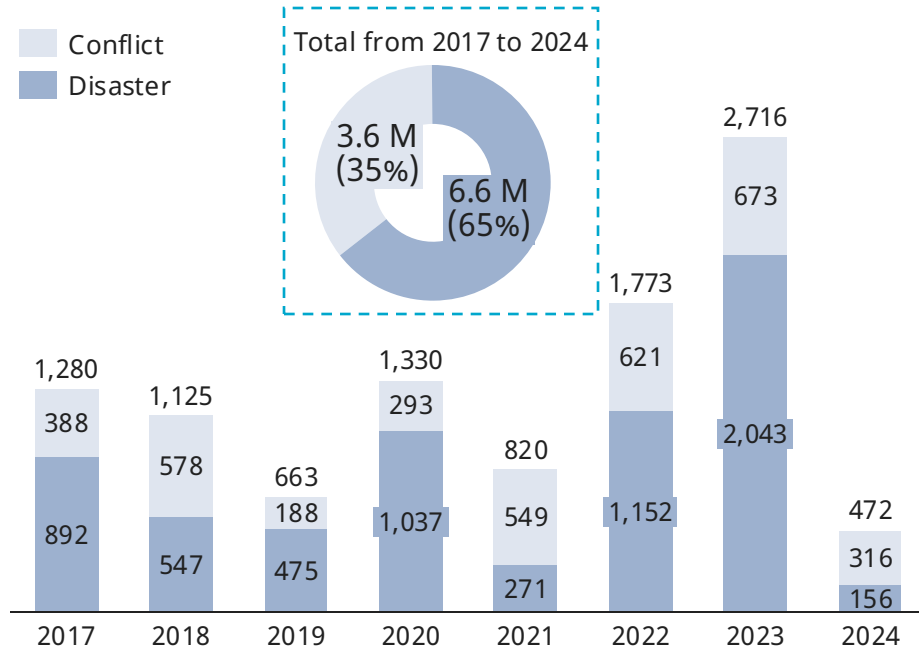
Somalia ranks 181<sup>st</sup> in vulnerability to climate change and 121<sup>st</sup> in readiness to adapt, out of 192 countries on the Notre Dame-Global Adaptation Index (ND-GAIN)<sup>2</sup>

Note: i) One event is the combination of a disaster and country (i.e. One disaster affecting two countries counts as two) – includes disasters with at least one of the following criteria: (i) 10 fatalities; (ii) 100 affected people; (iii) a declaration of state of emergency; (iv) a call for international assistance, with 700+ entries in the database in the ESA region  
 Note: these are all extreme events in EM-DAT database, and encompass both climate-induced and not-climate-induced events – the specific impact on children is displayed in the next slides  
 Source: 1) EM-DAT, [Database](#), Accessed Jul/2025; 2) ND- GAIN, [Rankings](#), 2023; Dalberg Analysis

# Drought–flood whiplash and protracted conflict are driving mass displacement and combined economic losses estimated at 35–45 per cent of Somalia’s GDP annually.

## Internal displacements in Somalia<sup>i, 1</sup>

Thousands of people



## Key comments

- **From 2017 to 2024, Somalia experienced 10.2M internal displacements:** Disasters (mainly drought and flooding) accounted for 6.6M (~65 per cent), while conflict-related displacements totalled 3.6M (~35 per cent).<sup>1</sup>
- **As of 2024, there are ~3.8M Internally Displaced People (IDPs) in Somalia:**<sup>ii</sup> 81 per cent (3.1M) due to conflict and 19 per cent (0.7M) due to disasters.<sup>1</sup>
- **Although disasters caused most new displacements (~65 per cent since 2017), conflict accounts for most current IDPs (~81 per cent),** as climate-related displacements are often temporary while conflict displacements tend to be protracted.<sup>2</sup>
- **On average, economic impacts from droughts and floods in Somalia amounted to 7.9 per cent of the country’s GDP between 2000 and 2021,** excluding the 2010 drought event.<sup>iii</sup> About half (3.3 per cent of GDP) of these total losses and damages could be attributable to climate change.<sup>3</sup> This figure may be underestimating the true cost, as climate impacts also heighten conflict and its economic toll.
- **In 2022, Somalia's economic cost of violence was 35 per cent of GDP,<sup>4</sup> up from 30 per cent in 2017.<sup>5, iv</sup>**

Note: i) The internal displacements figure refers to the number of forced movements of people within the borders of their country recorded during the year. Figures may include individuals who have been displaced more than once – so totals do not match the number of IDPs; ii) The total number of IDPs is a snapshot of all the people living in internal displacements at the end of the year; iii) Including the 2010/2011 drought, which led to economic damages of over \$4 billion, this proportion of attributable loss and damage rises to 8.4 per cent of GDP; iv) This entails all direct and indirect expenses from violence, excluding multiplier effects. Direct costs cover spending by victims, perpetrators and the government (e.g., policing, military, and medical). Indirect costs captures indirect economic losses, lost of productivity, etc.

Source: 1) IMDC, [Data portal - Displacement](#), Accessed Oct/2025; 2) Humanitarian Action, [Somalia](#), 2025 3) SPARC, [Report Assessing and financing loss and damage due to climate change in Somalia](#), 2024; 4) IEP, [Global Peace Index](#), 2023; 5) IEP, [Global Peace Index](#), 2018; Dalberg analysis

# Climate shocks and conflict are reinforcing cycles of displacement and disrupted (education) services, especially in south-central Somalia – where school enrolment is one-third lower than the national average.

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## Climate stress

Drought–flood cycles damage infrastructure, deplete natural resources, and degrade farmland.<sup>1</sup>



## Lower resilience

Lower resilience reduces communities' ability to adapt to future shocks.<sup>5</sup>



## Service disruption

Climate stress, conflict and displacement disrupt services (education, health, WASH), which further weakens community resilience.



## Resource competition

Climate shocks drive competition for scarce water, pasture and arable land, deepening livelihood losses and local tensions.<sup>1</sup>



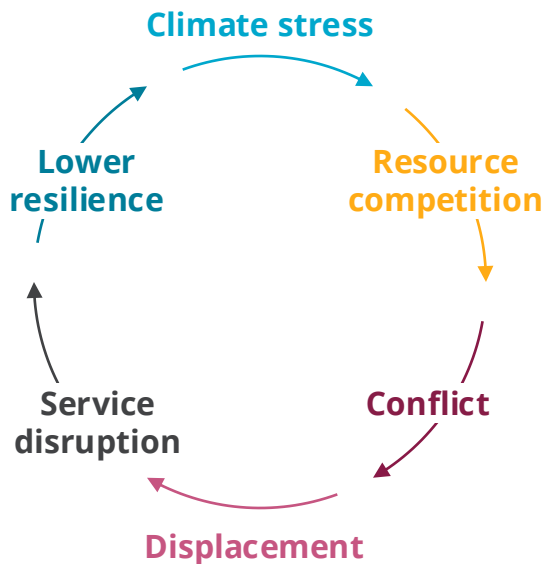
## Conflict

Scarcity and weak governance fuel localized violence and insecurity. Conflict harms the environment by increasing emissions, contaminating water and degrading soil.<sup>2</sup>



## Displacement

Climate change and conflict destroy livelihoods, infrastructure and force displacements.<sup>3</sup>



These dynamics drive displacement, undermine food security and health, and ultimately harm education by forcing schools to close or leaving them damaged or occupied by armed actors. For example, in 2017 **only 22.1 per cent of children in the south-central region were enrolled in school, compared to a national average of 32 per cent and an ESA average of ~98 per cent.**<sup>4,6</sup>

Source: 1) LSHTM, [Climate shock and water crisis in Somalia](#), 2025; 2) GGI, [Scarcity, Mobility, and Conflict in Somalia](#), 2023; 3) OCHA, [Somalia 2025 Humanitarian Needs and Response Plan](#), 2025; 4) Borgen Project, [Primary Education Development in Central-Southern Somalia](#), 2018; 5) National Economic Council of Somalia, [Climate change, adaptation and building human resilience in Somalia](#), 2022; 6) UNESCO, [UIS](#), Accessed Oct/2025; Dalberg analysis

# The regions most exposed to climate risks are also Somalia's most exposed to conflict risks, illustrating this interconnected nexus of climate and conflict.

## The southern and central regions of Somalia face the country's highest climate risks

### Climate risk<sup>i, 1</sup>

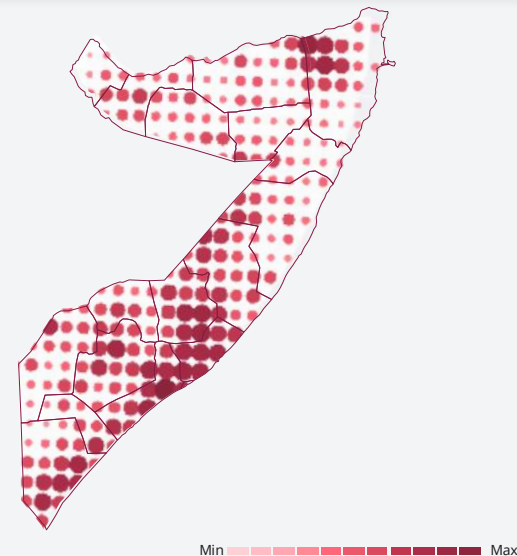
Risk scores, scaled between 0-10



## Conflict is also concentrated in these same south-central regions, reinforcing vulnerability

### Conflict risk<sup>ii, 1</sup>

Conflict scores, scaled between 0-10

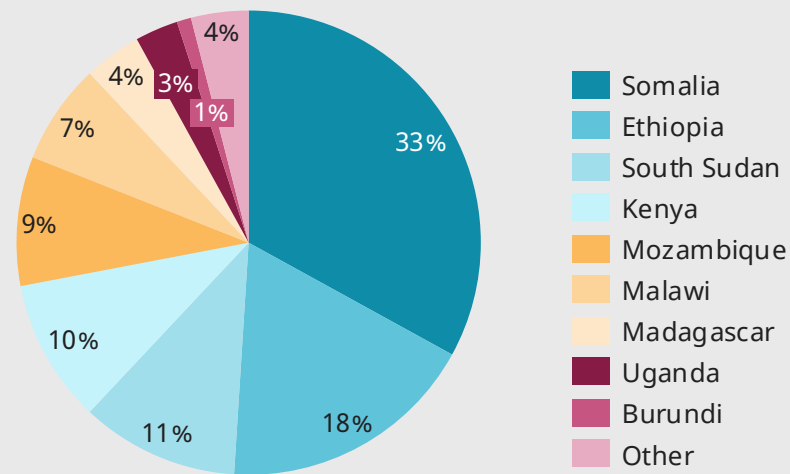


Note: i) Climate risk refers to the potential adverse impacts resulting from the interaction of climate hazards, vulnerability and exposure; ii) Conflict risk refers to the potential adverse impacts resulting from the interaction of conflict hazards, vulnerability and exposure. Conflict hazards capture the presence of current or recent violence and unrest, which are endogenously linked to socio-economic and political vulnerabilities.  
Source: 1) Climate Conflict, [Climate—Conflict—Vulnerability Index](#), Accessed Oct/2025; Dalberg analysis

# This double crisis has made Somalia the country with the highest number of child displacements in the Eastern and Southern Africa region, pushing over 4.5 million children out of school.

## Somalia accounted for one-third of child displacements in the Eastern and Southern Africa region from 2017 to 2023

Child displacement in Eastern and Southern Africa<sup>i, 1</sup>  
per cent of children (2017–2023)



## Conflict and climate change have pushed 4.5 million Somali children out of school



**More than 4.5M children and youth are out of school in Somalia**, which represents more than 60 per cent of the school-aged population, as a result of conflict, climate change and other crises.<sup>2,3,4,5</sup>



**Displaced children are the most excluded.**<sup>6</sup> School attendance rates for newly displaced children are as low as 21 per cent, compared with 39 per cent for children who are not displaced.<sup>3</sup>



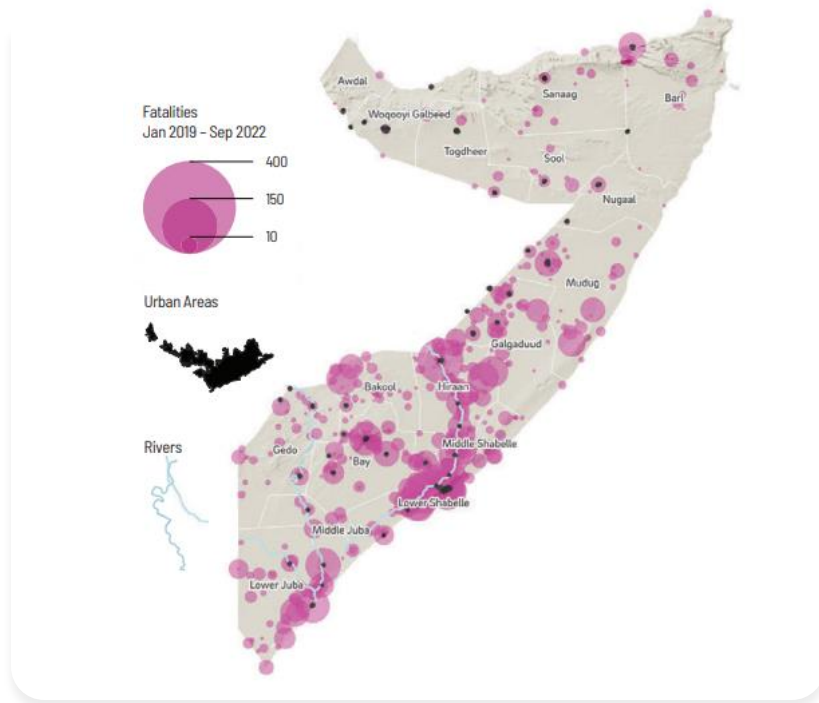
**Girls are also more excluded**, with primary school completion rates of 23 per cent vs. 32 per cent for boys.<sup>7</sup> As climate shocks and conflict intensify poverty, many girls face child marriage and greater household responsibilities, further limiting their chances to attend and complete school.<sup>8</sup>

Note: i) Displacement in Eastern and Southern Africa is rarely the result of climate hazards alone – it emerges where environmental shocks intersect with poverty, conflict and weak governance, creating acute protection risks for children.

Source: 1) UNICEF, [Children displaced in a changing climate](#), 2025; 2) SOS Children's Villages, [Somalia Humanitarian Crisis](#), Accessed Oct/2025; 3) UNICEF, [Somalia](#), 2024; 4) Education cannot wait, [Education Cannot Wait Scales-Up Funding for Education in Somalia with US\\$17 Million Catalytic Grant](#), 2025; 5) UNESCO, [SDG4 Profile Somalia](#), 2025; 6) UNICEF, [Education Case Study](#), 2021; 7) UNESCO, [UIS](#), Accessed Oct/2025; 8) Girls Education Challenge, [Somalia](#), 2022; Dalberg analysis

# In addition, armed groups are deliberately targeting schools and subjecting thousands of children to recruitment, rape and abduction.

## Armed violence across Somalia<sup>1</sup> Fatalities, January 2019 to September 2022



## Key comments

- **Schools and education systems have become direct targets**, with at least 92 school attacks from October 2019 to September 2021.<sup>2</sup>
- **Children are severely impacted by the conflict.** Between October 2019 and September 2021:<sup>2</sup>
  - **Recruitment and use:** 2,852 children (2,752 boys, 100 girls), 80 per cent by Al-Shabaab
  - Killing and maiming: 1,857 children (1,388 boys, 469 girls)
  - Rape and other forms of sexual violence: 701 children (7 boys, 694 girls)
  - Abductions: 2,502 children (2,323 boys, 179 girls)
- **Armed violence is more concentrated in the same south-central regions hardest hit by climate shocks**, including Hiiraan, Middle and Lower Shabelle, Bay, Galgaduud, Gedo and Middle and Lower Juba.<sup>1</sup> These areas account for the majority of fatalities from armed violence between January 2019 and September 2022.



**Somalia is a perfect case study of what happens when climate change and conflict combine – the consequences are disastrous.**

Abdallah Togolla

ICRC economic-security coordinator<sup>1</sup>

# Despite this crisis, Somalia is taking steps to address challenges across education, climate and conflict.

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## Components

## Sub-components

### Education



Launched the Education Sector Strategic Plan 2022–2026, which sets out priorities on access, equity, quality governance.<sup>1</sup>

While it focuses on emergency preparedness and response to sustain learning during droughts, floods, and displacement, it gives limited attention to climate-resilient infrastructure and long-term adaptation



Expanded 134 temporary learning spaces across 12 drought-affected districts with the support of UNICEF.<sup>2</sup>

Limited established coordination mechanisms between FGS, FMS and district governments were highlighted as a barrier to policy implementation<sup>7</sup>

### Climate



Advanced the development of policy, legal and institutional frameworks for climate change adaptation, including National Development Plan NDP-9, National Climate Change Policy, Somalia's Resilience and Recovery Framework and the National Adaptation Planning process.<sup>3</sup>



Implementing the US\$~95M GCF-financed climate-resilient agriculture programme, reaching over 1.1M people and restoring agro-pastoral systems in climate-vulnerable areas.<sup>4</sup>



Launched its Centennial Vision 2060 roadmap in mid-2025 focused on peace, stability and institutional reform as a long-term goal.<sup>5</sup>

### Conflict



Transitioning from African Union Transition Mission to the new African Union Support and Stabilization Mission in 2025, focusing on Somali-led stabilization and state-building.<sup>6</sup>

Source: 1) Federal Government of Somalia, [National Education Sector Strategic Plan](#), 2022; 2) United Nations, [Enhancing access to high-quality education for Somali children](#), 2024; 3) UNFCCC, [Somalia's First Adaptation Communication to the United Nations Framework Convention on Climate Change](#), 2022; 4) GCF, [EP246](#), Accessed Oct/2025; 5) Africa News, [Somalia launches Centennial Vision 2060 roadmap for 'peace, prosperity and progress'](#), 2025; 6) Africa Union, [Communiqué from the 1287th Meeting of the Peace and Security Council](#), 2025; 7) Dalberg, Stakeholder engagement undertaken in Somalia as part of ASPAN project design phase, 2024; Dalberg analysis

# Education systems must be redesigned in Somalia to address climate and conflict as interconnected challenges.

Summary

1

**Integrate the nexus of education, climate change and conflict into policy design:** Identify policy gaps and ensure education, climate and peace agendas are planned and financed as interconnected systems. This includes reflecting climate resilience in peace talks and negotiation platforms. Given the complexities, climate adaptation policies need to follow a multidimensional approach that is carefully prioritized and tailored to specific contexts and local communities and that supports conflict prevention and resolution.<sup>1</sup>

Country Overview

2

**Prioritize inclusive and resilient education systems that foster peacebuilding and climate adaptation skills:** Invest in school infrastructure, teacher training and curricula that equip children and youth with the knowledge and skills to adapt and build peace. NDC 3.0 emphasizes prioritizing adaptation efforts that are peace, security and displacement-sensitive, acknowledging the complex interplay between climate impacts, conflict and mobility.<sup>2</sup>

Insights

3

**Bridge federal-state-local coordination:** Strengthen governance and accountability mechanisms to ensure national policies translate into coherent local implementation across all administrative levels.

Recommendations

4

**Institutionalize monitoring, evaluation and learning:** Establish a unified MEL system with clear KPIs across education, climate and conflict dimensions to track resilience outcomes and enable real-time adaptation and evidence-based scaling of what works.

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Conflict-Climate Intersection

### **Increasing Temperatures (and Heat Waves)**

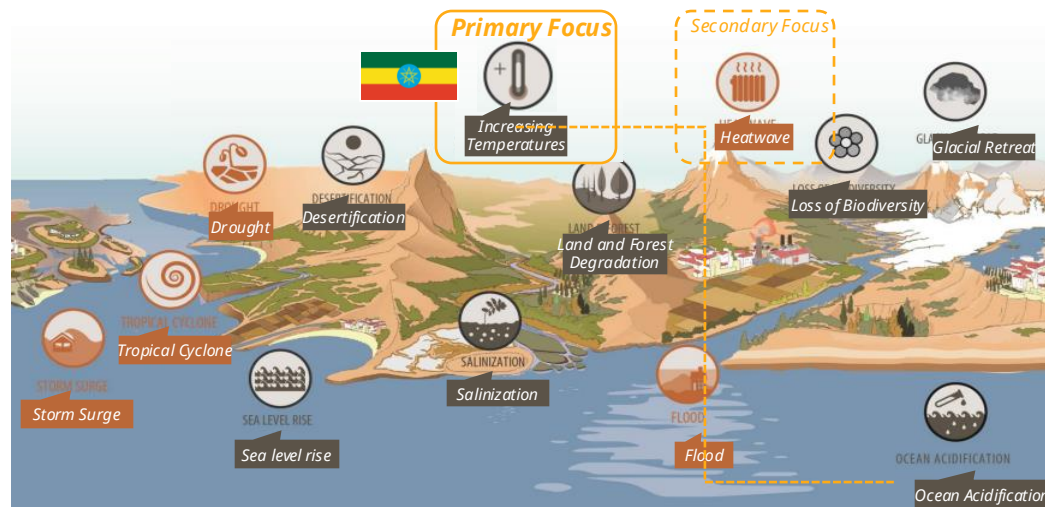
Annex

# About this case study

Summary	<b>Purpose of the Case Study</b>	<b>To assess the silent crisis of increasing temperatures (incl. heat waves) on education.</b> Note: increasing temperatures can affect children's education through multiple pathways (such as amplifying extreme weather events that damage education infrastructure, impacting household incomes that lead to child labour/marriage and increase absenteeism/dropout rates, among other pathways)– and these have been covered in the quantitative analyses and other case studies, hence are <u>not</u> the focus of this case study.
	<b>Guiding question</b>	What are the hidden impacts of rising temperatures on education outcomes?
Country Overview	<b>Content covered</b>	Temperature increase, with a focus on Ethiopia, while also drawing relevant insights from other countries.
	<b>Key Methodology and sources</b>	<ul style="list-style-type: none"><li>• <b>UNFCCC</b> definitions of extreme weather events vs. slow-onset</li><li>• <b>World Bank Report</b> assessing the impact of increasing temperatures on education outcomes in Ethiopia</li><li>• <b>World Bank Climate Knowledge Portal</b> for temperature scenarios</li><li>• <b>Other reports (UNICEF, Prentice et al, GPE, Randell et al, Costa and Goldenberg, Osendorf, Park et al, Government of Ethiopia, World Bank etc.)</b> to supplement evidence and highlight local impacts</li></ul>
Insights	<b>Key takeaways</b>	<ul style="list-style-type: none"><li>• <b>Temperatures in Ethiopia have increased by 0.8°C since 1950</b> (ranging from +0.7 in Addis Ababa and Somali up to +1.0 in Sidama), <b>and are projected to further increase by 1.9 to 3.4°C by the end of the century</b>, depending on the scenario.</li><li>• <b>Exposure to high temperatures is expected to further increase</b> – 83 per cent of Ethiopian children currently experience heatwaves – by 2050, exposure will intensify drastically, with over 47 million children affected with temperatures above 35°C. Impacts are expected to worsen as education performance begins to deteriorate above 27°C.</li><li>• <b>Rising temperatures affect children's education through multiple pathways</b> – including physiological, respiratory, mental and developmental impacts – reducing concentration and increasing absenteeism.</li><li>• <b>Exposure to high temperatures during school years is linked to lower student performance on exams</b>, i.e., over a year, 10 extra hot days can reduce average performance by roughly 2.3 per cent, which can play a decisive role in shaping future opportunities – these findings are aligned with studies in other countries.</li><li>• <b>To mitigate the direct effects of rising temperatures on learning, education authorities should improve classroom cooling/ventilation</b> (prioritizing context-appropriate solutions, such as passive measures), <b>adjust schedules to avoid peak heat and regularly assess thermal conditions.</b></li></ul>
Recommendations		

# Climate impact reports often focus on more visible extreme weather events – this case study will cover the silent impact of increasing temperatures (and heat waves) on education in Ethiopia.

## Extreme versus slow-onset events<sup>1</sup>



## Comments



### Extreme weather events

“An extreme weather event is an event that is rare at a particular place and time of a year”,<sup>1</sup> as a result, extreme weather events are relatively better documented (and the quantitative analyses and other case studies already cover the impacts of storms, floods, cyclones and droughts).



### Slow-onset events

“Slow onset events usually develop gradually over time”,<sup>1</sup> as a result, there are fewer studies assessing their impacts on education. In this case study we focus on the impact of increasing temperatures on education in Ethiopia.

## Focus

- Rising temperatures stand out for their *widespread and cross-cutting* impacts across the ESA region (whereas other slow-onset events are more localized) – hence, this case study focuses on temperature increase, as insights can be broadly relevant across contexts.
- Increasing temperatures (and heat waves) can impact children’s education in many ways, and this case study focuses on the *direct and silent link* between temperature increase and lower education outcomes.

Note: i) Note that in some analyses we include information related to heatwaves – although not classified as a “slow-onset” event, the information can complement the assessment of the direct relationship of higher temperatures and impacts on education – increasing temperatures and heat waves are directly linked, with every additional 0.5°C of global warming leading to discernible increases in the intensity and frequency of hot extremes, including heatwaves<sup>2</sup>

Source: 1) UNFCCC, [Loss and Damage](#), 2024; 2) IPCC, [Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change](#), 2021; Dalberg analysis

# Increasing temperatures can impact children's education in many different ways, this case study will focus specifically on the direct and silent link between temperature increase and lower education outcomes.



# Temperatures in Ethiopia have increased by 0.8°C since 1950 and are projected to further increase by 1.9 to 3.4°C by the end of the century, depending on the scenario.



Summary

Scope and Country Overview

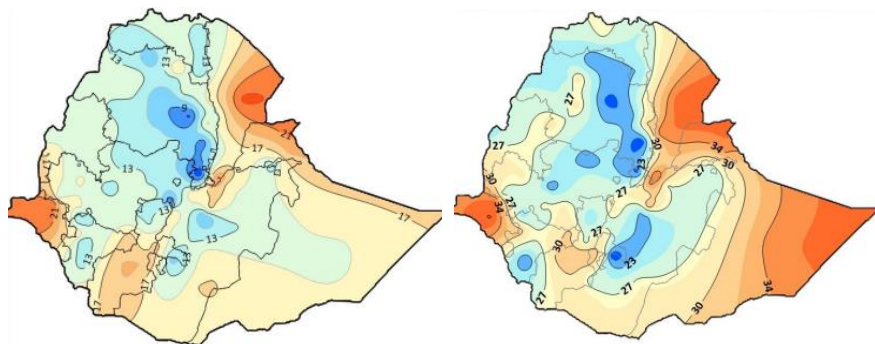
Insights

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## Mean temperature, 2024<sup>1</sup> (°C)

Min

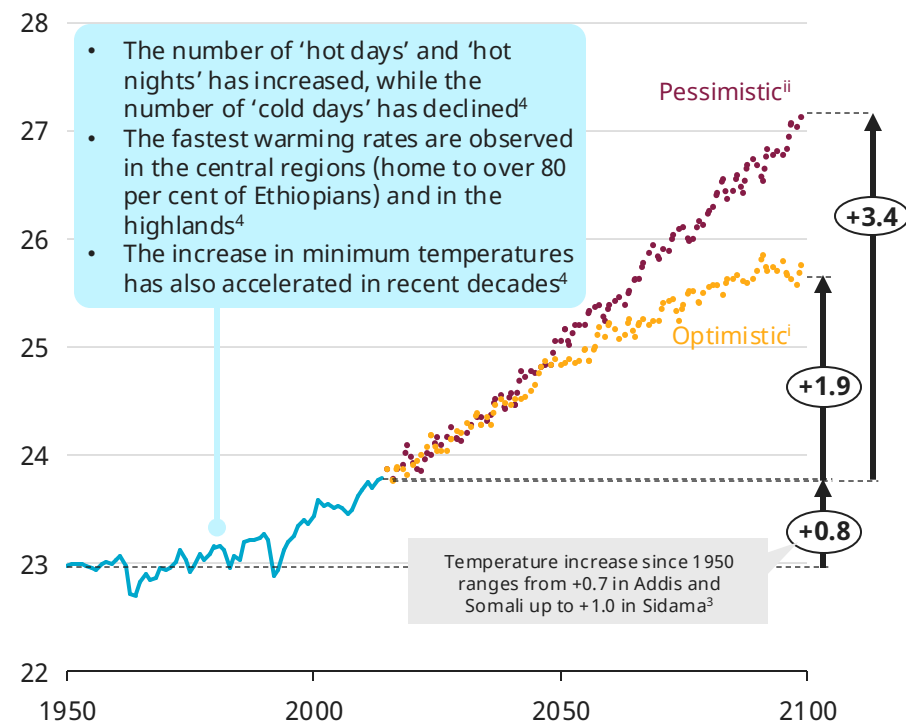
Max



Ethiopia's climate varies significantly with altitude and can be categorized into three main zones:<sup>2</sup>

- **A cool alpine zone** above 2,600 meters with temperatures near freezing to 16°C;
- **A temperate zone** between 1,500 and 2,500 metres with temperatures ranging from 16°C to 30°C; and
- **A hot zone** encompassing tropical and arid regions where temperatures range from 27°C to 50°C

## Temperature over time<sup>3</sup> (°C)



Note: i) RCP 4.5 (moderate emissions) and SSP2 – Middle of the Road (Medium challenges to mitigation and adaptation); ii) RCP 7.0 (medium-to-high emissions) and SSP3 (Regional Rivalry – high challenges for both mitigation and adaptation, including higher population growth)

Source: 1) Ethiopian Meteorological Institute, [Annual Climate Bulletin](#), 2024; 2) World Bank, [High Temperature and Learning Outcomes – Evidence from Ethiopia](#), 2024; 3) World Bank, [Climate Knowledge Portal](#), Accessed Jul/2025; 4) UNICEF, [Ethiopian Children in an Escalating Climate Crisis](#), 2024; Dalberg Analysis

Rising temperatures lead to more heatwaves, already affecting 83 per cent of Ethiopian children and projected to intensify by 2050, when 47 million children could face temperatures above 35°C for over 80 days annually.



## Currently

- **3.7M** children are exposed to high heat frequency<sup>1</sup>
- **83 per cent** of children are estimated to be exposed to heat waves<sup>1</sup>
- **4.7 days** average duration of heat waves<sup>1</sup>

## By 2050





- **47.2M** children will be exposed to high heat frequency<sup>1</sup>
- **5.4 – 6.8M** children will be exposed to extreme high temperatures<sup>1</sup>
- **83.5 days a year** (~25 per cent of a calendar year) where temperatures exceed 35°C<sup>1,i</sup>

*Increasing temperatures and heat waves are directly linked, with every additional 0.5°C of global warming leading to discernible increases in the intensity and frequency of hot extremes, including heatwaves<sup>3</sup>*

*Note that in some analyses we include information related to heatwaves – related to heatwaves – although not classified as a “slow-onset” event, the information can complement the assessment of the direct relationship of higher temperatures and impacts on education; i) Note that impacts are expected to be even worse, as temperatures above 27°C already begin to deteriorate cognitive performance<sup>2</sup>*  
Source: 1) UNICEF, [Ethiopian Children in an Escalating Climate Crisis](#), 2024; 2) GPE, [Heatwaves and Torrential Rains: Education in Tanzania Faces a Climate Crisis](#), 2024; 3) IPCC, [Summary for Policymakers, In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change](#), 2021; Dalberg analysis

# Rising temperatures affect children's education through multiple pathways – including physiological, respiratory, mental – and especially in early development.



Summary	 <b>Early Development</b>	<b>High temperatures during pregnancy or early childhood can have lasting consequences on educational outcomes.</b> In Ethiopia, higher temperatures in utero are associated with severe stunting, which is associated with reduced neurocognitive function and lower educational attainment. <sup>3</sup> This in turn can affect early education and developing foundational skills, with impacts compounding over time. In Southeast Asia, children exposed to heat stress in utero or early life completed 1.5 fewer years of schooling on average. Similarly, in Colombia, an exposure to extreme weather conditions before birth reduced the likelihood of remaining in school by about 5 per cent, highlighting the enduring educational and developmental effects of early-life heat exposure. <sup>2</sup>
Country Overview	 <b>Physiological</b>	<b>Heat stress impairs children's ability to learn by affecting their bodies' core functions – as their bodies dehydrate more easily, have less efficient temperature regulation and more vulnerable immune systems.</b> <sup>1</sup> Rising temperatures can impair reaction time, processing speed and accuracy due to elevated heart and respiratory rates. On average, a child's heart rate increases by about 10 beats per minute and respiratory rate by up to 2 breaths per minute for every 1°C rise in body temperature, putting them at greater risk of heat-related illness and fatigue. <sup>2</sup>
Insights	 <b>Respiratory</b>	<b>Higher classroom temperatures have been linked to a range of respiratory and physical symptoms – including fatigue, headaches, dizziness and difficulty concentrating<sup>2</sup> – affecting students' health and learning.</b> Extreme heat can also worsen asthma and other respiratory conditions, particularly in settings with poor indoor air quality. In Ethiopia, where four out of five children are exposed to heatwaves and indoor air pollution levels remain high, the combined impact of heat stress and air pollution heightens the risk of chronic respiratory disease. <sup>1</sup>
Recommendations	 <b>Mental and Emotional</b>	<b>Exposure to extreme heat can undermine children's mental and emotional health, reducing concentration, disrupting learning and contributing to school absenteeism.</b> Evidence suggests that sustained heat exposure may interfere with the development of emotional regulation circuits in the brains of unborn and young children. As a result, children and adolescents are particularly vulnerable to heat-related stress, anxiety and mood disturbances, with long-term implications for cognitive and emotional development. <sup>1</sup>

Source: 1) UNICEF, [Ethiopian Children in an Escalating Climate Crisis](#), 2024; 2) World Bank, [The Impact Of Climate Change On Education](#), 2024; 3) Randell H, Gray C, Grace K., [Stunted from the start: Early life weather conditions and child undernutrition in Ethiopia](#), 2020; Dalberg analysis

# Exposure to high temperatures during school years is linked to lower completion rates and student performance on exams, which can play a decisive role in shaping future opportunities.



Exposure to high temperatures during school years leads to lower student performance on exams...<sup>1</sup>

- Each additional day with temperatures above 33°C leads to a measurable decline in learning outcomes (equivalent to about one-hundredth of a standard deviation drop in test scores).<sup>1</sup>
- Over a year, 10 extra hot days can reduce average performance by roughly 2.3 per cent<sup>1</sup> – this is especially relevant considering that by 2050, it is estimated that 83.5 days a year will be above 35°C.<sup>3</sup>
- While both unusually cold and hot conditions affect learning, the negative impact of extreme heat (>33°C) is estimated to be three to four times greater than that of moderate temperature deviations from the optimal learning range (18–21°C).<sup>1</sup>



... Which can play a decisive role in shaping a child's future opportunities<sup>1</sup>

- In Ethiopia, performance on the national high-stakes university entrance exam – the Ethiopian Higher Education Entrance Certificate Examination (EHEECE) – is particularly critical.<sup>1</sup>
- These exams have a major impact on students' futures. Students who do not pass often experience lower lifetime earnings, while those who succeed gain access to higher-paying blue- and white-collar jobs with better prospects and benefits.<sup>1</sup>

Available data focuses primarily on the impact on teenagers at the end of secondary education, a small portion of the student population.<sup>i</sup> The impact of heat on early education and foundational skills in the early grades is likely worse, as it compounds over time.

Note: i) Only about 21 per cent complete lower secondary education in Ethiopia,<sup>4</sup> even fewer take the university entrance exam

Source: World Bank, [High Temperature and Learning Outcomes – Evidence from Ethiopia](#), 2024; 2) Prentice C. M., Meneveau M., Wu Y., Girard L-S, Zheng Y, Vergunst F., [Heat Effects on Children's Education Outcomes: A Systematic Review and Meta-analysis](#); 2025; 3) UNICEF, [Ethiopian Children in an Escalating Climate Crisis](#), 2024; 4) World Bank, [Lower Secondary Completion Rate](#), Accessed Oct/2025; Dalberg analysis

# These findings are aligned with others studies in Ethiopia and elsewhere, where increases in temperature are associated with poorer education performance.










Summary

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Country	Year published (period covered)	Key Findings
 Ethiopia	2016 (1994, 1999, 2004, and 2009)	<b>Higher temperatures affecting grade completion.</b> Temperatures 0.5 SD above village temperature mean linked with 21 per cent and 28 per cent lower odds of child completing at least one grade of school. <sup>1</sup>
 Brazil	2025 (2007–2016)	<b>One SD increase in number of days above 34°C was associated with a 5.1 per cent increase in dropout rates</b> – effects were mainly in public schools in urban areas, possibly due to worse air conditioning access versus private schools <sup>i</sup> and more crowded classrooms than in rural areas. <sup>ii,2</sup>
 Tanzania	2022 (2016–2019)	<b>Hotter days associated with lower exam performance.</b> Taking exams when the outdoor temperature is 33°C results in 14 per cent of a SD lower exam performance relative to a day at 24°C, which for the average Tanzanian student, means a 13 per cent lower chance of passing a given subject. <sup>3</sup>
 India	2020 (2006–2014)	<b>Higher average temperatures linked to reduced maths and reading ASER (Annual Status of Education Report) scores,</b> where ten extra days average above 29°C associated with the following score reductions: maths = 0.03 SD and reading = 0.02 SD. <sup>1</sup>
 Vietnam	2022	<b>Hotter test days had a negative impact on mathematics exam scores,</b> where an increase of ~0.6°C reduced the maths Z-score by approximately .006 SD, and deviations from 25.5°C to 28.2°C were linked to a 1.64 per cent decrease in exam score. <sup>1</sup>
 Mexico	2024 (2007–2013)	<b>Years with 1°C higher average temperatures were associated with decreased scores</b> in Spanish (0.07 SD) and maths (0.08 SD), with an exception for students living in colder regions, where warmer temperatures might have positive effects. <sup>1</sup>
 China	2020 (2005–2011)	<b>A 1 SD increase in temperature within each county was linked with exam score reduction of 0.68 per cent or 5.83 per cent of an SD,</b> equivalent to 1.2 per cent lower chance of admission to a top-tier university – with a higher impact on highest performing students. <sup>1</sup>

Note: i) 48 per cent of private school classrooms and 24 per cent of public school classrooms have climate control systems such as air conditioning or heating; ii) urban schools average 31 students per classroom versus 22 in rural areas. Note that some studies might have assessed heatwaves (although not classified as a “slow-onset” event, the information can complement the assessment of the direct relationship of higher temperatures on education)

Source: 1) Prentice C. M., Meneveau M., Wu Y., Girard L-S, Zheng Y, Vergunst F., *Heat Effects on Children’s Education Outcomes: A Systematic Review and Meta-analysis*; 2025; 2) Costa F., Goldemberg D., *Too hot to learn? Evidence from high school dropouts in Brazil*, 2025; 3) Osendorf A. N., *Climate Change In The Classroom: Temperature And Educational Achievement In Africa*, 2022; Dalberg analysis

# Poorer students are most impacted due to limited cooling infrastructure, children with disabilities remain largely invisible, however girls and students in hotter regions appear slightly more resilient and adapted.

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## Gender Lens

**Excluding other factors, girls seem to be more resilient than boys.**

High temperatures appear to have a smaller adverse effect on female students' scores in Ethiopia, which may be, among other possible factors, explained by physiological differences in heat resilience between boys and girls, by how female students tend to approach high-stakes exams with greater seriousness than their male peers, and by evolving social norms that increasingly support girls' educational outcomes.<sup>1</sup>



## Income Lens

**Students from low-income households are among the most affected.** Hot days are likely to disproportionately affect students from low-income households, who often live in vulnerable communities where school infrastructure is limited or damaged, leading to inadequate cooling systems.<sup>3</sup> For example, in Brazil, increases in temperatures are associated with higher dropout rates, especially in public schools in urban areas (typically attended by students from low-income households), with no effects in private schools, possibly due to better cooling systems.



Note that effects related to university entrance exams are valid for teenagers by the end of secondary education



## Disability Lens

**Lack of data on disability leads to invisible impacts.**

Data disaggregated by disability are generally lacking in Ethiopia, making it difficult to identify and address the needs of children with disabilities – as a result, they often remain invisible in climate-related planning and investments, limiting the effectiveness and inclusivity of adaptation and resilience efforts.<sup>2</sup> Evidence from other countries shows that people with disabilities are more likely to be hospitalized due to heat exposure,<sup>4</sup> which may translate into greater learning disruptions compared to their peers without disabilities.



## Regional Lens

**Differences in regions due to adaptation.**

Students attending schools in hotter regions appear better able to cope with high temperatures than their peers in relatively cooler areas – this difference may reflect physiological adaptation or acclimatization to heat among students in hotter regions, or possibly greater use of climate adaptation measures (though the latter is less likely, given few schools have any form of heat adaptation technology).<sup>1</sup>



Note: 1) Other factors can adversely affect women's education more than men's, including greater household pressure on girls to drop out and support domestic chores when climate change reduces family income or crop yields, higher risk of child marriage or early pregnancy as an economic coping strategy, increased time spent fetching water when sources dry up, among others Source: World Bank, [High Temperature and Learning Outcomes – Evidence from Ethiopia](#), 2024; 2) UNICEF, [Ethiopian Children in an Escalating Climate Crisis](#), 2024; 3) World Bank, [The Impact Of Climate Change On Education](#), 2024; 4) Park J., Kim A., Kim Y. et al, [Association Between Heat and Hospital Admissions in People with Disabilities in South Korea: a Nationwide, Case-crossover Study](#), 2024; Dalberg analysis

# There is growing evidence that rising temperatures are undermining students' performance in Ethiopia, and political commitment to protect youth's education must be translated into action.



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“There is now robust evidence that heat reduces student performance from many countries around the world [including Ethiopia now]...”

“...Heat may also reduce teacher effort or attendance in ways that reduce the amount that students learn...”

**“...Overall lesson is clear: Students learn better when they are not exposed to high temperatures in the classroom and policy-makers should try to develop solutions that can protect students from these extreme temperatures.”**

Lead Researcher, Patrick Behrer (World Bank Economist)<sup>1</sup>

“Climate change is a fundamental development issue for Ethiopia. Young people make up 50 per cent of our nation's population. Education provides the main instrument of social change and progress, while preparing present and future generations for an increasingly uncertain future.”

H.E. Dr. Gemedo Dalle  
Former Minister of Environment, Forest and Climate Change (MEFCC), Government of Ethiopia

H.E. Dr. Telaye Gete  
Former Minister of Education, Government of Ethiopia<sup>2</sup>

Political commitment must be translated into planning and action – Ethiopia's NAP<sup>3</sup> only briefly mentions “education” with no concrete actions defined for the sector



**1 Reduce heat exposure within the school environment:** Prioritize context-appropriate and low-cost solutions, such as passive measures (tree planting to provide shade, reflective/white roofing, improved natural ventilation, insulating materials) and, if possible, active cooling options (fans, air conditioning) to mitigate discomfort and improve learning conditions.

**2 Consider adjustments to the academic day and calendar, as well as instructional practices** to protect students and teachers from the direct negative effects of peak heat, e.g., by modifying school schedules to start earlier and/or finish later<sup>1</sup> and aligning school holidays with the hottest season.

**3 Implement a systematic evaluation of classroom learning environments,** particularly for thermal comfort, to guide infrastructural improvements and classroom management strategies.

**4 Minimize impact by addressing health issues caused directly by heat exposure** to improve student alertness, concentration and attendance. This includes ensuring water availability to students during classroom hours, especially when temperatures are high.<sup>2</sup>

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## **Annex**

### **Non-Economic Impacts**

Literature Review

Additional Slides on the BCR

Details of Climate Attribution

# We covered several non-economic impacts throughout this report (1/2)

NON-EXHAUSTIVE

Non-economic impact <sup>1</sup>	Examples of where it was covered
<b>Reduced learning outcomes</b>	<ul style="list-style-type: none"> <li>• <b>Increasing temperatures and heat waves (Ethiopia):</b> Exposure to high temperatures leading to cognitive, physiological, respiratory and mental pathways undermining learning (fatigue, headaches, difficulty concentrating, anxiety); High temperatures lower exam performance; ~10 extra hot days in a school year reduces average performance by ~2.3 per cent, with broader links to long-term opportunity.</li> </ul>
<b>Loss of educational continuity</b>	<ul style="list-style-type: none"> <li>• <b>Country Case Study (Zambia):</b> Schools shortened hours or closed early due to hydropower shortages; Hunger, thirst and exhaustion impaired students' ability to learn, and teachers faced power cuts and extra chores, disrupting continuity.</li> </ul>
<b>Estimated loss of future income due to school days lost, dropout, or reduced attainment in disaster-affected areas</b>	<ul style="list-style-type: none"> <li>• <b>Quantitative Exercise:</b> Climate-related learning disruptions between 2005 and 2024 affected an estimated 130 million children cumulatively, resulting in US\$120–140 billion in lost future earnings. Projections suggest that without interventions to avert and minimize impacts, 440–520 million children cumulatively could have their learning disrupted between 2025 and 2050, resulting in an additional US\$260–380 billion in losses.</li> <li>• <b>Country Case Study (Zambia):</b> Disruption of ~5 millions students-year, resulting in US\$4 to 5 billion in loss of future earnings; Without further investment, long-term impacts could erode future earnings by an additional US\$13–21 billion.</li> </ul>
<b>Increased protection risks (e.g., child marriage, pregnancy, GBV, recruitment)</b>	<ul style="list-style-type: none"> <li>• <b>Country Case Study (Zambia):</b> Climate-driven poverty increased child marriage and early pregnancy; Reported teenage pregnancies in Lusangazi District doubled between Jan–Jun 2023 and Jan–Jun 2024.</li> <li>• <b>Conflict-Climate Intersection (Somalia):</b> Armed groups target schools; Violations include child recruitment/use (2,852 cases), rape/sexual violence (701), abduction (2,502).</li> </ul>
<b>Disruption to learning access due to displacement, climate events</b>	<ul style="list-style-type: none"> <li>• <b>Conflict-Climate Intersection (Somalia):</b> Climate shocks and conflict drive mass displacement; Somalia accounts for one-third of child displacements in ESAR (2017–2023); Newly displaced children have attendance rates as low as 21 per cent (vs. 39 per cent non-displaced); Schools often closed/damaged/occupied; both teachers and students displaced, disrupting education services.</li> <li>• <b>Country Case Study (Zambia):</b> Climate shocks displace families, fracturing community ties and isolating children.</li> </ul>
<b>Increased dropout (especially for girls, IDPs and vulnerable groups)</b>	<ul style="list-style-type: none"> <li>• <b>Equity Breakdown (Kenya):</b> Post-disaster enrolment drop higher for girls than boys (10.5 per cent vs. 7.1 per cent); Students with disabilities saw ~one-third higher drop (11.7 per cent vs. 8.8 per cent), with main barriers including inaccessible facilities, health risks, care burdens, restrictive norms.</li> <li>• <b>Increasing temperatures and heat waves (Ethiopia):</b> Higher temperatures (0.5 SD above village mean temperature) linked with lower odds of a child completing at least one grade of school, i.e., reduction of 21 per cent to 28 per cent depending on the season.</li> </ul>

Note: i) Categorization similar to UNICEF's Loss and Damage Indicators for Education<sup>1</sup>  
 Source: 1) UNICEF, PDNA Loss and Damage Indicators Education and WASH Sectors, n.d.; Dalberg analysis

# We covered several non-economic impacts throughout this report (2/2)

NON-EXHAUSTIVE

Non-economic impact <sup>i</sup>	Examples of where it was covered
<b>Closure or disruption of transport routes affecting student and teacher access to educational facilities</b>	<ul style="list-style-type: none"> <li>• <b>Equity Breakdown (Kenya):</b> Floods destroy roads and make journeys to school more hazardous, increasing girls' risk of dropout or absenteeism.</li> </ul>
<b>Reduced teacher capacity due to climate/disaster impacts (e.g., absenteeism, displacement, mental health)</b>	<ul style="list-style-type: none"> <li>• <b>Country Case Study (Zambia):</b> Teacher attendance declined as teachers also suffer from drought's impacts; Teachers faced difficulties preparing and delivering lessons because of power cuts, time spent fetching water.</li> <li>• <b>What If of Resilient Infrastructure (Mozambique):</b> Teaching staff were also hit hard, with 9.6K affected by Idai and 900 by Kenneth.</li> <li>• <b>Conflict-Climate Intersection (Somalia):</b> Teachers displaced alongside students when schools are closed/damaged/occupied.</li> <li>• <b>Increasing temperatures and heat waves (Ethiopia):</b> Heat reducing teacher effort or attendance in ways that reduce the amount that students learn.</li> </ul>
<b>Classrooms with unsafe thermal conditions/heat stress</b>	<ul style="list-style-type: none"> <li>• <b>Increasing temperatures and heat waves (Ethiopia):</b> widespread exposure to heatwaves – 83 per cent of children already affected; &gt;47 M children could face &gt;35 °C temperatures for 80+ days annually by 2050; Guidance to improve cooling/ventilation and adjust schedules; Heat impairs reaction time, processing speed; increases fatigue, headaches, dizziness; worsens asthma and respiratory disease – directly degrading classroom learning conditions.</li> </ul>
<b>Student/teacher trauma from destruction of the familiar environment (psychosocial impacts)</b>	<ul style="list-style-type: none"> <li>• <b>Country Case Study (Zambia):</b> “deep social and psychological stress,” isolation and trauma after displacement; Climate shocks fracturing social networks and triggering psychological distress among children (including PTSD and depression).</li> </ul>
<b>Gendered exclusion and barriers to return (cross-cutting equity dimension)</b>	<ul style="list-style-type: none"> <li>• <b>Equity Breakdown (Kenya):</b> Compounding inequities leave girls and students with disabilities less likely to re-enrol; Calls for disability-inclusive, gender-responsive recovery (preparedness, social protection).</li> <li>• <b>Conflict-Climate Intersection (Somalia):</b> Girls face child marriage pressures as poverty intensifies; primary completion rate lower for girls (23 per cent vs. 32 per cent for boys).</li> </ul>
<b>School safety and protection environment degraded (attacks on education)</b>	<ul style="list-style-type: none"> <li>• <b>Conflict-Climate Intersection (Somalia):</b> At least 92 attacks on schools (Oct 2019–Sep 2021); schools become direct targets amid compounded climate-conflict stress.</li> </ul>

Note: i) Categorization similar to UNICEF's Loss and Damage Indicators for Education<sup>1</sup>  
 Source: 1) UNICEF, PDNA Loss and Damage Indicators Education and WASH Sectors, n.d.; Dalberg analysis

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## **Annex**

Non-Economic Impacts

## **Literature Review**

Additional Slides on the BCR

Details of Climate Attribution

# Literature review (1/13)

Source	Observation
360 Mozambique, <a href="#">2025 State Budget: Education's Budget Share Drops from 14.2 per cent to 12.1 per cent</a> , 2025	National annual education budget in Mozambique
360 Mozambique, <a href="#">President Enacts the 2025 State Budget Law</a> , 2025	Mozambique's annual government budget
Acaps, <a href="#">ZAMBIA: Update on the impact of drought</a> , 2025	Children in need of urgent humanitarian assistance
Action Aid, <a href="#">Zambia factsheet</a> , 2022	Children completing upper secondary school, compared to in urban areas
Africa News, <a href="#">Somalia launches Centennial Vision 2060 roadmap for 'peace, prosperity and progress'</a> , 2025	Somalia national long-term vision for peace and resilience
Africa Union, <a href="#">Communiqué from the 1287th Meeting of the Peace and Security Council</a> , 2025	Transitioning from African Union Transition Mission to the new African Union Support and Stabilization Mission in 2025
Akademiya2023, <a href="#">Impacts of El Niño-Induced Drought in Zambia</a> , 2024	Evidence on El Niño's impacts in Zambia
Akpan UU, Ja'Afar IK, Eke SC., <a href="#">Addressing the psychological impact of climate-induced disasters on young people in Africa</a> , 2025	Impact of climate disasters on youth mental health
American Meteorological Society, <a href="#">Explaining Extreme Events of 2016 from a Climate Perspective</a> , 2018	Annual bulletin collection assessing the role of climate change in 2016 extreme events. Used for attribution to, or exacerbation by, climate change
Amnesty Kenya, <a href="#">Let's Rebuild our Children's Lives as Schools Reopen</a> , 2024	Return-to-school challenges after the 2024 floods in Kenya
Bidassey-Manilal S, Wright CY, Engelbrecht JC, Albers PN, Garland RM, Matookane M., <a href="#">Students' Perceived Heat-Health Symptoms Increased with Warmer Classroom Temperatures</a> , 2016	The effect of heat exposure on learners' health and classroom performance
Borgen Project, <a href="#">Primary Education Development in Central-Southern Somalia</a> , 2018	Enrolment in Somalia vs. South Central region

## Literature review (2/13)

Source	Observation
Catherine Whitniss Bulambo, <a href="#">Copying strategies to chronic floods in kuku residential area in Lusaka district, Zambia</a> , 2023	Household coping and adaptation to recurrent flooding in Zambia
Carbon Brief, <a href="#">Attribution studies</a> , Accessed Jul/2025	Repository of climate change attribution research. Used to link extreme weather events to climate change
Carbon Brief, <a href="#">Why Avoiding Climate Change 'Maladaptation' Is Vital</a> , 2021	Maladaptation risk under recovery and reconstruction
CGTN, <a href="#">Nearly 500,000 children are yet to return to school</a> , 2024	Source for education disruption and displacement figures following Kenya floods
Climate Analytics, <a href="#">Loss and damage fund gearing up to deliver early support</a> , 2025	Study providing estimates of the costs of climate change. Used to sense check results
Climate Conflict, <a href="#">Climate—Conflict—Vulnerability Index</a> , Accessed Oct/2025	Mapping climate and conflict overlap; used to identify high-risk regions
Costa F., Goldemberg D., <a href="#">Too hot to learn? Evidence from high school dropouts in Brazil</a> , 2025	Empirical evidence linking rising temperatures to increased dropout rates; used to strengthen argument
Crawn Trust, <a href="#">Impact of Ongoing Floods in Kenya</a> , Accessed Jul/2025	Ongoing flood impacts on Kenyan schools and communities
Daily Nation, <a href="#">Toll of climate change on education of Kenyan girl</a> , 2024	Provides testimony and gender-specific impact data on girls' education after floods
Down to Earth, <a href="#">World Bank Study Reveals High Temperatures Linked to Lower Exam Scores in Ethiopia</a> , 2024	Evidence on the link between high temperatures and lower academic performance
Education cannot Wait, <a href="#">Education Cannot Wait Scales-Up Funding for Education in Somalia with US\$17 Million Catalytic Grant</a> , 2025	Reference on donor funding to strengthen education system resilience in Somalia
Elimu Bora Working Group, <a href="#">The Impact of 2024 Deadly Floods on Schools</a> , 2024	Primary data on enrolment drop by gender and disability after Kenya floods
EM-DAT, <a href="#">Database</a> , Accessed Jul/2025	Global disaster database with event-level impacts. Used to source +700 historical disaster occurrence and severity data in ESA

## Literature review (3/13)

Source	Observation
Enable Me, <a href="#">Disability and CC in Kenya</a> , 2021	Barriers to inclusive education for children with disabilities in Kenya
Ethiopian Meteorological Institute, <a href="#">Annual Climate Bulletin</a> , 2024	National climate record providing meteorological evidence on extreme weather events
European Commission, <a href="#">DRMKC – INFORM</a> , Accessed Sep/2025	Dataset combining multi-hazard and vulnerability indicators
European Commission Joint Research Centre, <a href="#">INFORM Climate Change Index – Results and Data</a> , 2024	Projections of absolute multi-hazard exposure to 2050 by integrating SSP-RCP scenario pathways with corresponding population growth estimates. Used to project immediate impact
EuroNews, <a href="#">Girls in Southern Africa are being married off in exchange for food amid El Niño drought</a> , 2024	Negative coping mechanisms for girls during drought emergencies
Federal Government of Somalia, <a href="#">National Education Sector Strategic Plan</a> , 2022	National strategy outlining education sector priorities
Federal Government of Somalia, <a href="#">Somalia 2023 Deyr Floods Rapid-Post Disaster Needs Assessment</a> , 2024	Rapid PDNA for Deyr floods. Used for data on losses, damages and needs for education
Federal Government of Somalia, <a href="#">Somalia Drought Impact and Needs Assessment, Volume I</a> , 2018	Drought impact and recovery assessment. Used for data on losses, damages and needs for education
Federal Government of Somalia, United Nations, World Bank, European Union, <a href="#">Somalia 2023 Deyr Floods Rapid-Post Disaster Needs Assessment</a> , 2024	Rapid PDNA for Somalia floods. Used for data on losses, damages and needs for education
GCA, <a href="#">Section 3 – Cross-sectoral Themes</a> , 2023	Quote for the BCR case study
GCF, <a href="#">FP246</a> , Accessed Oct/2025	Adaptation funding for education resilience projects in Somalia
Geneva Global Hub for Education in Emergencies, <a href="#">Leveraging Education in Emergencies for Climate Action</a> , 2023	Recommendations for slow onsets
GGI, <a href="#">Scarcity, Mobility, and Conflict in Somalia</a> , 2023	Evidence on displacement drivers at the intersection of climate stress and conflict in Somalia

## Literature review (4/13)

Source	Observation
<i>Girls Education Challenge, <a href="#">Somalia</a>, 2022</i>	Programme evidence on interventions for girls' education access in fragile and climate-affected areas
<i>Government of Angola, <a href="#">Droughts in Angola 2012–2016 Post-Disaster Needs Assessment</a>, 2016</i>	PDNA for Angola drought. Used for data on losses, damages and needs for education
<i>Government of Burundi, <a href="#">Rapport d'évaluation des dommages, pertes et besoins post-catastrophe</a>, 2014</i>	PDNA for Burundi disaster event. Used for data on losses, damages and needs for education
<i>Government of Djibouti, <a href="#">Rapport d'évaluation Rapide des Dommages et Besoins</a>, 2018</i>	Rapid PDNA for Cyclone 'Sagar' in Djibouti. Used for data on losses, damages and needs for education
<i>Government of Ethiopia, <a href="#">Climate Change Education Strategy of Ethiopia 2017-2030</a>, 2020</i>	National policy framework on integrating climate education and resilience into curricula
<i>Government of Ethiopia, <a href="#">Ethiopia's National Adaptation Plan</a>, 2019</i>	National strategy identifying adaptation priorities for the education sector
<i>Government of Kenya, <a href="#">Kenya 2011 Post-Disaster Needs Assessment</a>, 2011</i>	PDNA for Kenya drought. Used for data on losses, damages and needs for education
<i>Government of Lesotho, <a href="#">Lesotho 2011 Floods Post-Disaster Needs Assessment</a>, 2011</i>	PDNA for Lesotho floods. Used for data on losses, damages and needs for education
<i>Government of Madagascar, <a href="#">Madagascar 2008 Post-Disaster Needs Assessment</a>, 2008</i>	PDNA for Madagascar disaster event. Used for data on losses, damages and needs for education
<i>Government of Malawi, <a href="#">Malawi 2023 Tropical Cyclone Freddy Post-Disaster Needs Assessment</a>, 2023</i>	PDNA for Cyclone Freddy. Used for data on losses, damages and needs for education
<i>Government of Malawi, <a href="#">Malawi 2015–2016 Drought Post-Disaster Needs Assessment</a>, 2016</i>	PDNA for Malawi drought. Used for data on losses, damages and needs for education
<i>Government of Malawi, <a href="#">Malawi 2015 Floods Post-Disaster Needs Assessment</a>, 2015</i>	PDNA for Malawi floods. Used for data on losses, damages and needs for education

# Literature review (5/13)

Source	Observation
Government of Malawi, <a href="#">Nsanje District Floods 2012: Disaster Impact Assessment and Transitional Recovery Framework</a> , 2012	District-level disaster impact assessment for the 2012 Nsanje floods. Used for data on losses, damages and needs for education
Government of Mozambique, <a href="#">Mozambique Rapid Assessment Report</a> , 2015	Rapid assessment for disaster recovery. Used for data on losses, damages and needs for education
Government of Namibia, <a href="#">Namibia 2009 Post-Disaster Needs Assessment</a> , 2009	PDNA for Namibia floods. Used for data on losses, damages and needs for education
Government of Zambia, <a href="#">Demographic and Health Survey</a> , 2024	National survey providing demographic and education data relevant to resilience analysis
Government of Zimbabwe, <a href="#">Zimbabwe Humanitarian Response Plan April 2016 – March 2017</a> , 2016	Humanitarian response plan with needs overview. Used for data on losses, damages and needs for education
GPE, <a href="#">Heatwaves and Torrential Rains: Education in Tanzania Faces a Climate Crisis</a> , 2024	Source highlighting the impact of extreme weather on schooling and infrastructure in Tanzania
Humanitarian Action, <a href="#">Somalia</a> , 2025	Situation overview on humanitarian response and education system challenges under climate stress
ICRC, <a href="#">“If your animals die, you die with them” – Somali herders defenceless against the climate crisis</a> , 2021	Qualitative evidence on livelihoods and vulnerability among Somali pastoralists
IEP, <a href="#">Global Peace Index</a> , 2018	Dataset on Global Peace Index
IEP, <a href="#">Global Peace Index</a> , 2023	Dataset on Global Peace Index
ILO, <a href="#">Cyclone Idai: Mapping the Impact on Employment</a> , 2019	PDNA for Cyclone Idai in Mozambique. Used for data on losses, damages and needs for education
IMDC, <a href="#">Data portal - Displacement</a> , Accessed Oct/2025	Database on internal displacement
Institute of Development Studies, <a href="#">Cost-effectiveness of disaster risk reduction and adaptation to climate change</a> , 2018	Evidence base on the economic benefits of investing in resilience and risk reduction
IPCC, <a href="#">Climate Change 2022: Impacts, Adaptation and Vulnerability</a> , 2022	Scientific reference on climate vulnerability and adaptation

## Literature review (6/13)

Source	Observation
IPCC, <a href="#">Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change</a> , 2021	Link between increasing temperatures and heat waves
Kenya Meteorological Department, <a href="#">State of Climate Kenya 2023</a> , 2024	Climate consequences for agriculture, water resources and the broader socioeconomic landscape
KPMG and UNDP, <a href="#">2026 Budget Highlights</a> , 2025	Reference to Zambia education budget
LSHTM, <a href="#">Climate shock and water crisis in Somalia</a> , 2025	Source on health and WASH impacts of drought in Somalia, with education implications
Malala Fund, <a href="#">Education</a> , Accessed Oct/2025	Resource on gender equality and education rights
Mester, B., Vogt, T., Bryant, S., Otto, C., Frieler, K., and Schewe, J., <a href="#">Human displacements from Tropical Cyclone Idai attributable to climate change</a> , 2023	Peer-reviewed study quantifying the share of Idai displacement linked to climate change. Used for attribution to, or exacerbation by, climate change
Mongaway, <a href="#">Kenya's Lake Victoria floods leave orphaned children to run their households</a> , 2023	Case evidence on social impacts of flooding on children and family structures
National Economic Council of Somalia, <a href="#">Climate change, adaptation and building human resilience in Somalia</a> , 2022	Policy framework linking climate adaptation and human resilience priorities in Somalia
ND- GAIN, <a href="#">Rankings</a> , 2023	Global index ranking countries' climate vulnerability and readiness
OCHA, <a href="#">Somalia 2025 Humanitarian Needs and Response Plan</a> , 2025	Humanitarian overview detailing education and protection needs under ongoing climate emergencies
Osendorf A. N., <a href="#">Climate Change In The Classroom: Temperature And Educational Achivement In Africa</a> , 2022	Empirical study linking temperature rise to reduced student performance across African countries
Park J., Kim A., Kim Y. et al, <a href="#">Association Between Heat and Hospital Admissions in People with Disabilities in South Korea: a Nationwide, Case-crossover Study</a> , 2024	Evidence on heightened health risks from extreme heat among persons with disabilities

# Literature review (7/13)

Source	Observation
Peas, <a href="#">The hidden crisis: How Zambia's drought is impacting education</a> , Accessed Sep/2025	Source describing how drought disrupts schooling, attendance and learning outcomes in Zambia
Pope, D. H., McMullen, H., Baschieri, A., Philipose, A., Udeh, C., Diallo, J., and McCoy, D., <a href="#">What is the current evidence for the relationship between the climate and environmental crises and child marriage? A scoping review</a> , 2022	Evidence synthesis on links between environmental stress and increased child-marriage risk
Prentice C. M., Meneveau M., Wu Y., Girard L-S, Zheng Y, Vergunst F., <a href="#">Heat Effects on Children's Education Outcomes: A Systematic Review and Meta-analysis</a> ; 2025	Quantitative meta-analysis on the impacts of heat exposure on student outcomes
Prevention Web, <a href="#">Mozambique Cyclone Idai</a> , 2019	Impacts of Cyclone Idai and post-disaster response
Randell H, Gray C, Grace K., <a href="#">Stunted from the start: Early life weather conditions and child undernutrition in Ethiopia</a> , 2020	Study linking early-life weather shocks to child health and learning potential
Republic of Burundi – Ministry of Environment, Agriculture and Livestock, <a href="#">Third National Communication on Climate Change (TNCCC)</a> , 2019	National communication outlining climate impacts and technology needs. Used for attribution to, or exacerbation by, climate change
Rosen, J.G. et al., <a href="#">Climate-induced livelihood transformations</a> , 2021	Evidence on livelihood shifts driven by climate change
The Star, <a href="#">Number of children out of school</a> , 2024	Out of school information for Kenya
The African Climate Foundation, <a href="#">From Climate Risk To Resilience: Unpacking The Economic Impacts Of Climate Change In Zambia</a> , 2023	Economic analysis quantifying climate-related losses in Zambia
Time, <a href="#">Kenya Is Trying to End Child Marriage</a> , 2020	Linking climate shocks and poverty to heightened child marriage risk in Kenya
Senator Crystal Asige, <a href="#">2024 Floods</a> , 2024	Commentary highlighting the 2024 floods' effects
SOS Children's Villages, <a href="#">Somalia Humanitarian Crisis</a> , Accessed Oct/2025	Source describing the humanitarian situation in Somalia, including education and child protection needs

## Literature review (8/13)

Source	Observation
SPARC, <a href="#">Report Assessing and financing loss and damage due to climate change in Somalia</a> , 2024	Analytical source on financial mechanisms and loss and damage assessment for Somalia
Swiss Re Institute, <a href="#">We need to talk about climate adaptation</a> , 2023	Evidence on adaptation investment gaps and the economic rationale for resilience
UN Habitat, <a href="#">Building Climate Resilience in Mozambique - the case of Safer Schools</a> , 2023	Case study on resilient school infrastructure and risk-informed design in Mozambique
UNCTAD, <a href="#">Taking Responsibility Towards a Fit-for-Purpose Loss and Damage Fund</a> , 2023	Study providing estimates of the costs of climate change. Used to sense check results
UNDP, <a href="#">Mozambique</a> , Accessed Sep/2025	Country data source providing economic and climate indicators for Mozambique
UNDP, <a href="#">Kenya Floods Recovery Needs Assessment Report</a> , 2025	National assessment on post-flood recovery priorities, including education and WASH sectors
UNDRR, <a href="#">Global Assessment Report on Disaster Risk Reduction</a> , 2015	Global UNDRR reference on disaster risk reduction benefits. Used to estimate avoided damage value from “building back better”
UNDRR, <a href="#">International cooperation disaster risk reduction target F</a> , 2021	UNDRR reporting on global progress toward Target F
UNDRR, <a href="#">Our Impact</a> , 2024	UNDRR impact reporting on disaster risk reduction benefits. Used to estimate avoided damage value from “building back better”
UNESCO, <a href="#">Enrolment Data</a> , Accessed Jul/2025	Global education statistics. Used to establish baseline student population for loss and damage estimations
UNESCO, <a href="#">Pupils to trained teacher ratio</a> , Accessed Oct/2025	Education indicator on teacher capacity
UNESCO, <a href="#">SDG4 Profile Somalia</a> , 2025	Country-level SDG4 profile
UNFCCC, <a href="#">Loss and Damage</a> , 2024	Online guide on loss and damage under the UNFCCC framework. Used for definitions, policy context and guidance

# Literature review (9/13)

Source	Observation
UNFCCC, <a href="#">Somalia's First Adaptation Communication to the United Nations Framework Convention on Climate Change</a> , 2022	National adaptation communication outlining Somalia's sectoral priorities for climate adaption
UNHCR, <a href="#">Education</a> , Accessed Oct/2025	Global education data for displaced and refugee learners
UNICEF, <a href="#">1 million children affected by Cyclone Idai and subsequent floods in Mozambique</a> , 2019	Situation update quantifying the number of affected children and education infrastructure damages after Cyclone Idai
UNICEF, <a href="#">Addressing the Drought Crisis in Zambia</a> , Accessed Sep/2025	Source detailing the impacts of Zambia's 2025 drought
UNICEF Mozambique, <a href="#">Budget Brief: Education (Mozambique 2019)</a> , 2019	Budget allocations in Mozambique
UNICEF, <a href="#">Building climate and disaster-resilient schools</a> , Accessed Nov/2025	Global brief on resilient education infrastructure and climate-adaptive school design
UNICEF, <a href="#">Children displaced in a changing climate</a> , 2025	Global overview of climate-induced child displacement
UNICEF, <a href="#">Climate-Proof Schools in Mozambique: Climate Adaptation That Works</a> , 2023	Case example of climate-resilient school construction and adaptation benefits in Mozambique
UNICEF, <a href="#">Drought in Shang'ombo</a> , 2024	Illustrating drought impacts on attendance and school feeding in Zambia
UNICEF, <a href="#">Case Study: Transforming Mozambique's School Infrastructure for Climate Resilience</a> , 2025	Case example in resilient education infrastructure in Mozambique
UNICEF, <a href="#">Ethiopian Children in an Escalating Climate Crisis</a> , 2024	Warming rates in Ethiopia
UNICEF, <a href="#">Global snapshot of climate-related school disruptions in 2024</a> , 2025	Global overview of climate-induced school closures. Used to estimate the number of students impacted by climate change in Eastern and Southern Africa.
UNICEF, <a href="#">Malawi 2019 Floods Post-Disaster Needs Assessment Report</a> , 2019	PDNA for Malawi floods. Used for data on losses, damages and needs for education
UNICEF, <a href="#">Nearly a quarter of a billion children's schooling was disrupted by climate crises in 2024</a> , 2025	Global statistic quantifying education disruption due to climate-related crises

## Literature review (10/13)

Source	Observation
UNICEF, <a href="#">Protecting Mozambique's Children from Climate Shocks</a> , 2025	Impact of cyclones on children in Mozambique
UNICEF, <a href="#">Rapid qualitative assessment of drought-related community perceptions and behaviors in Zambia</a> , 2024	Assessment documenting drought impacts in Zambia
UNICEF, <a href="#">Restoration of WASH facilities transforms school life for girls in Mozambique</a> , 2024	Case example illustrating school WASH restoration to improved access and safety for girls
UNICEF, <a href="#">Somalia</a> , 2024	School attendance rates for newly displaced children
UNICEF, <a href="#">UNICEF Kenya March-April-May (MAM) 2024 Seasonal Floods Response Flash Update #2</a> , 2024	Situation update on flood response
UNICEF, <a href="#">The Climate Crisis is a Child Rights Crisis: Introducing the Children's Climate Risk Index</a> , 2021	Source for global child climate risk classification
UNICEF, <a href="#">The Situation of Children in Mozambique</a> , 2021	Country report about the situation of children in Mozambique
UNICEF, <a href="#">Theory of Change. UNICEF Strategic Plan 2026-2029</a> , 2025	Theory of change informing about UNICEF upcoming Global Hazard Database
UNICEF, <a href="#">Turning climate hardship into hope in Eastern and Southern Africa</a> , 2025	Zambia's 2024 El Niño drought impact on hydroelectric power
UNICEF, <a href="#">Zambia Humanitarian Situation Report update # 8</a> , 2024	Situation update quantifying education impacts and ongoing drought response in Zambia
UNICEF, <a href="#">Zambia Humanitarian Situation Report update # 9</a> , 2024	Situation update quantifying education impacts and ongoing drought response in Zambia
UNICEF, <a href="#">Education Case Study</a> , 2021	Impact on displaced students
United Nations, Department of Economic and Social Affairs, Population Division, <a href="#">World Population Prospects</a> , Accessed Jul/2025	Official United Nations dataset on demographic estimates and projections. Used for historical demographic data and future population projections

# Literature review (11/13)

Source	Observation
United Nations, <a href="#">Enhancing access to high-quality education for Somali children</a> , 2024	Expanded temporary learning spaces in Somalia
United Nations, <a href="#">Situation of Children in Somalia Alarming: New Report Details Staggering Levels of Grave Violations</a> , 2022	Humanitarian report providing data on children's impact due to violence
WHO, <a href="#">Tropical Cyclones Idai and Kenneth</a> , 2019	Impact overview of Cyclones Idai and Kenneth in Mozambique
WEF, <a href="#">Climate change is costing the world \$16 million per hour: study</a> , 2023	Article providing estimates of the costs of climate change. Used to sense check results
Well Aware, <a href="#">How are Women and Girls Disproportionately Affected?</a> , 2023	Source highlighting gender-specific vulnerabilities
World Bank Group, <a href="#">Climate Change Knowledge Portal – Download Data</a> , Accessed Jul/2025	Historical and projected annual mean surface air temperature series at 0.25° resolution. Used for historical climate analysis and projections under SSP3-7.0 and SSP2-4.5 scenarios
World Bank, <a href="#">Building Back Better</a> , 2018	Conceptual framework promoting resilient recovery and reconstruction after disasters
World Bank, <a href="#">Climate Risk Profile: Mozambique</a> , 2025	National-level climate risk assessment
World Bank, <a href="#">Damage, Loss and Needs Assessment - Guidance Notes</a> , 2010	Methodological guide outlining global PDNA standards. Used as a benchmark and framework to compare the PDNAs analysed
World Bank, <a href="#">Lifelines: The Resilient Infrastructure Opportunity</a> , 2019	Analytical report demonstrating the economic and social returns of investing in resilient infrastructure
World Bank, <a href="#">High Temperature and Learning Outcomes – Evidence from Ethiopia</a> , 2024	Empirical study linking heat exposure to reduced student learning performance
World Bank, <a href="#">How Kenya's school meals program is building resilience</a> , 2024	Case study showing how school meal programmes strengthen learning continuity during climate shocks
World Bank, UN, GFDRR, EU, <a href="#">Malawi Drought 2015-2016 Post-Disaster Needs Assessment</a> , 2016	PDNA for Malawi drought. Used for data on losses, damages and needs for education

## Literature review (12/13)

Source	Observation
World Bank, <a href="#">Labour Force – Female</a> , Accessed Oct/2025	Dataset providing female labour participation rates. Used to contextualize gender-related education disparities
World Bank, GFDRR, MEFI, <a href="#">Rapport d'Évaluation Rapide des Dommages et Besoins – Post-Cyclone Sagar</a> , 2018	PDNA for Cyclone Sagar. Used for data on losses, damages and needs for education
World Bank, <a href="#">More than 400 Million Students Affected by Climate-Related School Closures since 2022</a> , 2024	Global report on climate-related school closures. Used for estimating lost school days per year
World Bank, <a href="#">Lower Secondary Completion Rate</a> , Accessed Oct/2025	Education indicator used to benchmark completion rates
World Bank, <a href="#">Simulating the Potential Impacts of COVID-19 School Closures on Schooling and Learning Outcomes</a> , 2020	Modelling study on school closure impacts. Used to inform methodology for estimating learning loss from climate-induced closures. Source for the lifetime earnings loss per person (both optimistic and pessimistic) and the discount rate
World Bank, <a href="#">Somalia Climate Risk Review</a> , 2023	National climate assessment providing key risks and adaptation measures
World Bank, <a href="#">World Development Indicators – GDP Deflator</a> , 2025	Economic indicator dataset providing GDP deflator values. Used for inflation adjustment calculations
World Bank, <a href="#">Why Invest in Resilience? A BRACC Policy Brief</a> , 2023	Policy brief outlining the cost–benefit ratio (CBR) range for resilience infrastructure investments. Used to stress test the model
World Bank, <a href="#">Project Document – Building Back Better</a> , 2025	Project-level document providing multiplier factors for “building back better” in infrastructure recovery. Used to stress test the model
World Bank, <a href="#">Education Sector Analysis Document</a> , 2023	Report noting observed declines in school enrolment due to drought events. Used to stress test the model
World Bank, <a href="#">Building Back Better: Achieving Resilience through Stronger, Faster, and More Inclusive Post-Disaster Reconstruction</a> , 2018	Analytical report quantifying avoided impacts from “building back better.” Used to estimate avoided education loss impacts

## Literature review (13/13)

Source	Observation
World Bank, <a href="#">The Impact Of Climate Change On Education</a> , 2024	Analytical overview on how climate change affects education
World Bank, <a href="#">The State of Global Learning Poverty: 2022 Update</a> , 2022	Key global reference on learning poverty. Identified as relevant for contextualizing education impacts, but not used due to data limitations
World Bank, GFDRR, <a href="#">Zimbabwe Rapid Impact and Needs Assessment</a> , 2019	Rapid needs assessment for Cyclone Idai impacts in Zimbabwe. Used for data on losses, damages and needs for education
World Weather Attribution, <a href="#">Studies in Africa</a> , Accessed Jul/2025	Peer-reviewed attribution studies for African events. Used to link extreme weather events to climate change
World Weather Attribution, <a href="#">Urban planning at the heart of increasingly severe East African flood impacts in a warming world</a> , 2024	Attribution study estimating the likelihood of such events occurring due to climate change

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5. Case Studies

## **Annex**

Non-Economic Impacts

Literature Review

## **Additional Slides on the BCR**

Details of Climate Attribution

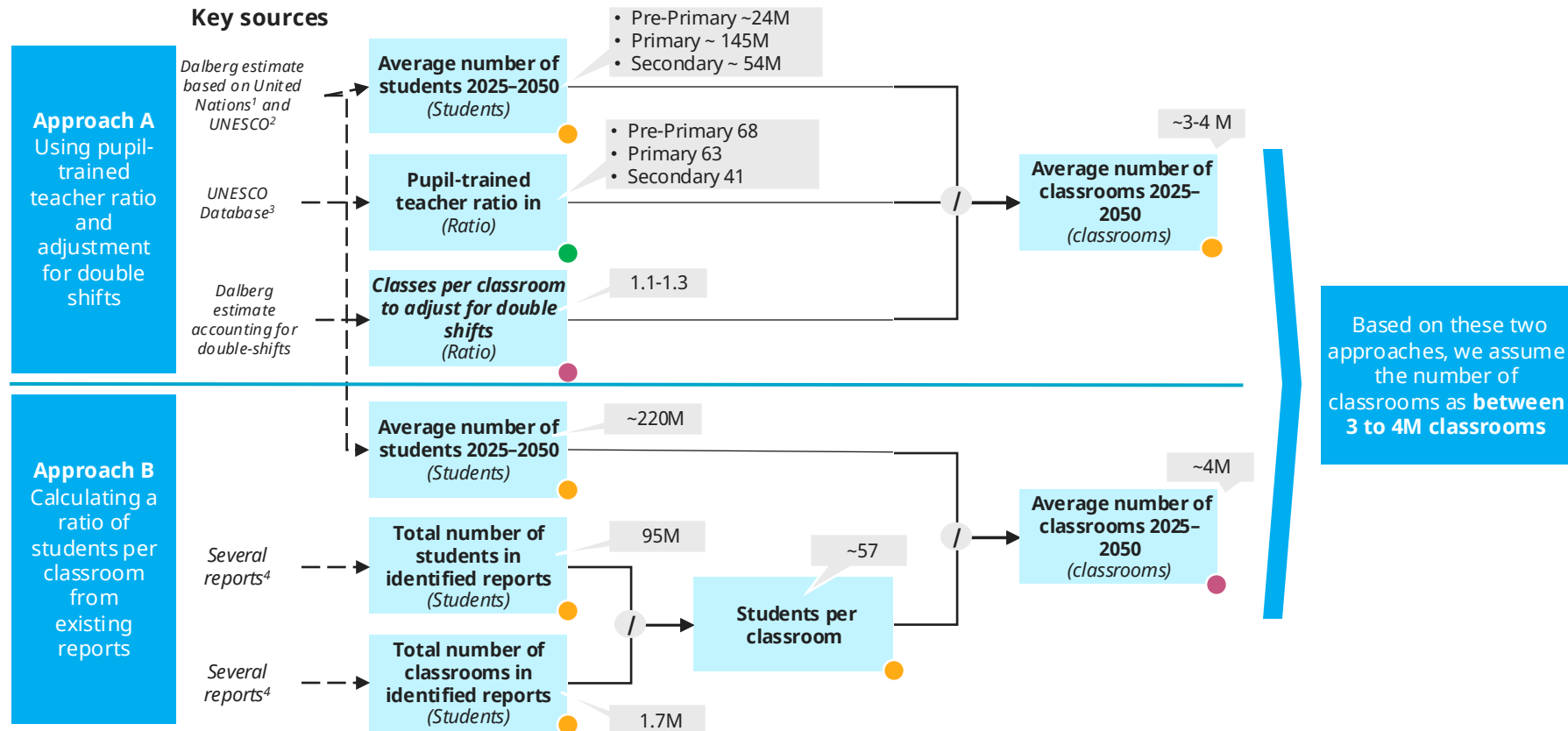
# To estimate the number of classrooms, we combine two different approaches: one using pupil to teacher ratio and adjusting for double shifts, and another calculating a ratio of students to classrooms from available reports.

Summary

Relevance of BCRs

Methodology and Limitations

Recommendations



Based on these two approaches, we assume the number of classrooms as **between 3 to 4M classrooms**

Assuming 20-50 per cent of students part of double shifts mean a class per classroom ratio of 1.1 to 1.3 (for reference, assuming 100 per cent of students in double shift would mean a class per classroom ratio of 2)

Sources: 1) United Nations, Department of Economic and Social Affairs, Population Division, [World Population Prospects](#), Accessed Jul/2025; 2) UNESCO, [Enrolment Data](#), Accessed Jul/2025; 3) UNESCO, [Pupils to trained teacher ratio](#), Accessed Oct/2025; 4) Several sources that can be seen in the Excel model; Dalberg analysis

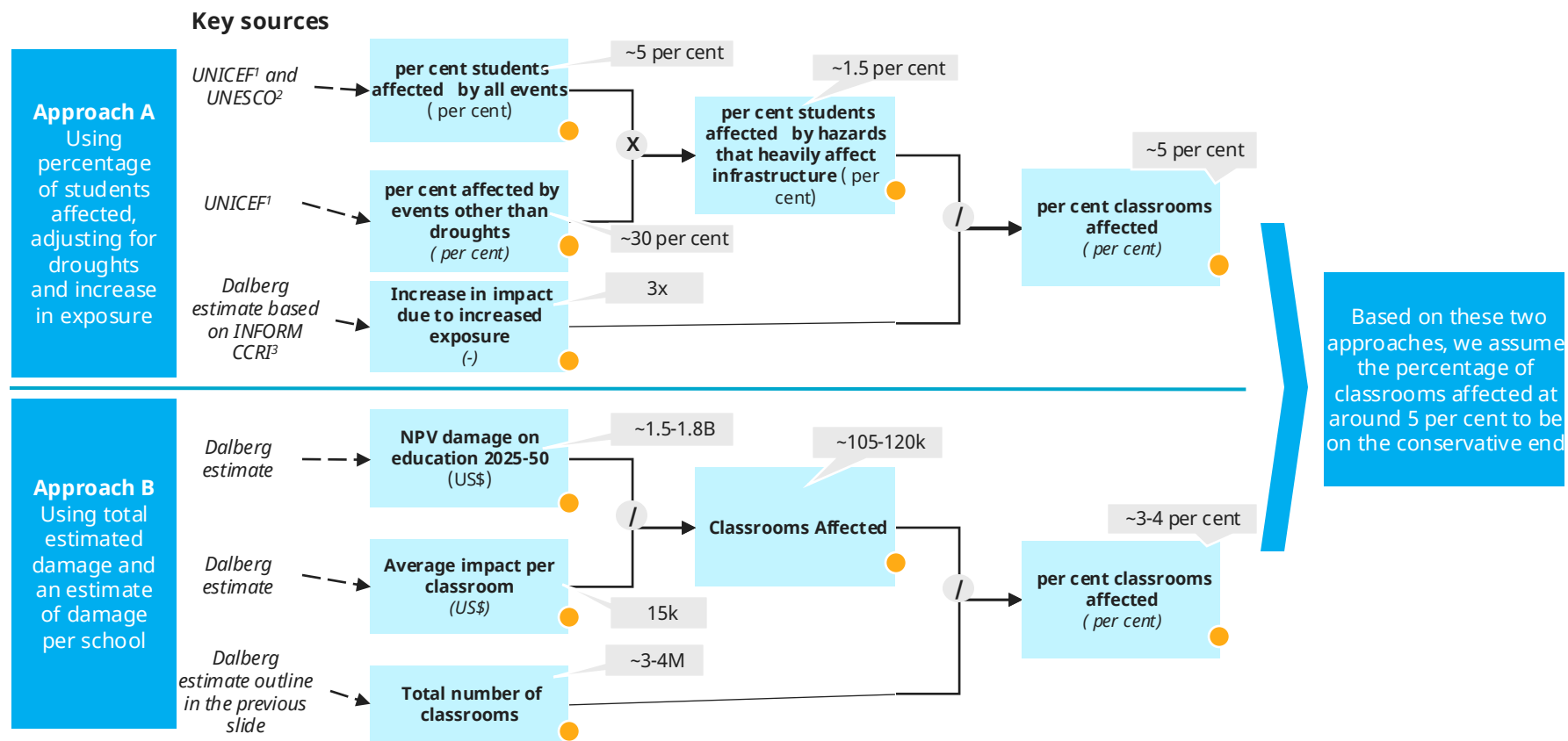
# To estimate the percentage of classrooms affected, we combine two different approaches: one based on students affected and projecting exposure and another one based on average damage.

Summary

Relevance of BCRs

Methodology and Limitations

Recommendations



Confidence level: ● High ● Medium ● Low

Sources: UNICEF, [Global Snapshot of Climate-related School Disruptions](#), 2025; 2) UNESCO, [Enrolment Data](#), Accessed Jul/2025; 3) The European Commission Joint Research Centre, [INFORM Climate Change Risk Index](#), 2022; Dalberg analysis

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1. Context and Background

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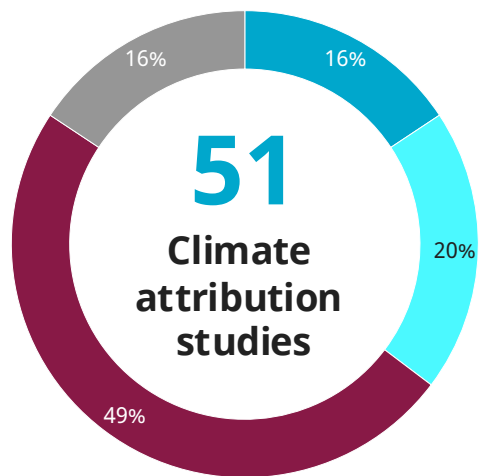
Literature Review

Additional Slides on the BCR

**Details of Climate Attribution**

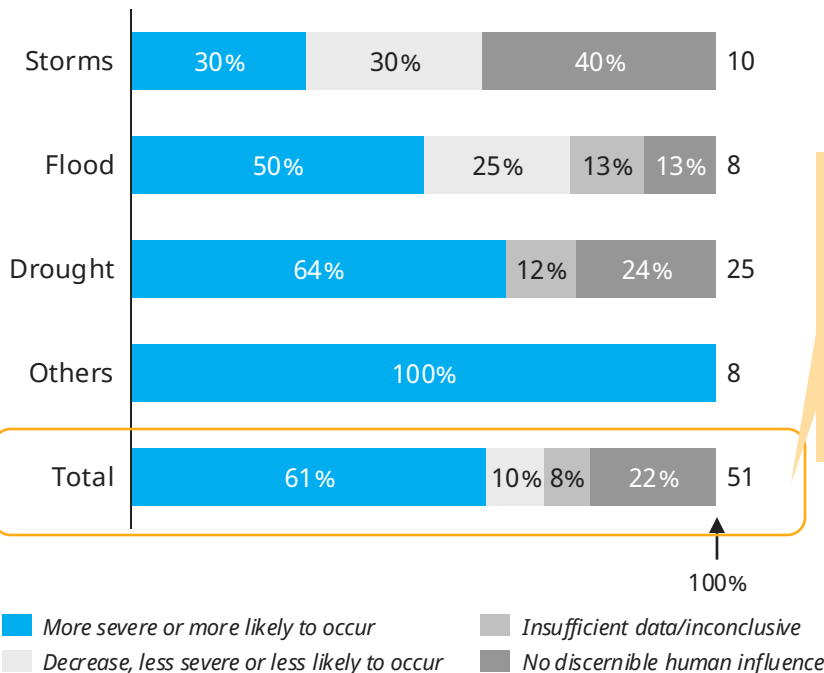
There are only 51 climate attribution studies in Sub-Saharan Africa, which reduces the confidence level of this metric – hence, we suggest using the global average of 74 per cent based on 750+ studies.

### Climate Attribution Studies in Sub-Saharan Africa



■ Flood ■ Storm ■ Drought ■ Others<sup>i</sup>

### Climate attribution



We ran a scenario using the 61 per cent but suggested using the global average of 74 per cent based on 750+ studies

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