Sustaining the Gains: Feasibility of Risk Financing for Education

Task 2 Report:

Applicability of Existing Catastrophe Risk Models and Risk Transfer Programs to Education

Willis Towers Watson
Start Network & Save the Children
Overseas Development Institute

June 2017
## Table of Contents

**Executive Summary** .......................................................................................................................... ii

1 **Introduction** ........................................................................................................................................... 1

2 **Catastrophe Modeling and its Application to the Education Sector** ................................................................. 2
   2.1 Geographical coverage .......................................................................................................................... 2
   2.2 Vulnerability of physical education infrastructure .................................................................................. 3
   2.3 Vulnerability of education services disruption ...................................................................................... 5
   2.4 Education sector exposure data ............................................................................................................. 6
   2.5 Applicability of modeling to the education sector: summary ................................................................. 6

3 **Quantification of Natural Disaster Risk in GPE Partner Countries** ............................................................... 8
   3.1 Post Disaster Needs Assessment (PDNA) reporting ............................................................................... 8
   3.2 UNISDR Global Assessment Report (GAR2015) risk reporting .............................................................. 11
   3.3 Estimating direct losses to the education sector .................................................................................... 12
   3.4 Current risk modeling availability by GPE partner country .................................................................. 13

4 **Possible Risk Financing Modalities and Data Implications** ......................................................................... 14
   4.1 Existing approaches to cat risk financing in developing states ............................................................... 14
   4.2 Cost and affordability of risk financing ................................................................................................ 18
   4.3 Capturing risk to education delivery, and cost implications .................................................................. 19
   4.4 Conditions precedent for access to risk financing for education ......................................................... 20
   4.5 Capturing the resilience dividend ........................................................................................................ 21

5 **Risk Transfer Deal Structure Options for GPE and Partner Countries** ..................................................... 23
   5.1 Deal with the Ministry of Education in a GPE partner country ............................................................. 25
   5.2 Deal with GPE for multiple countries ................................................................................................... 26
   5.3 Deal with GPE to leverage ECW or other contingency funds ............................................................... 27
   5.4 Deal facilitated by GPE but covering partner (NGO) to work at community level .............................. 28

6 **Potential GPE Natural Catastrophe Risk Financing Pilots** ......................................................................... 30
   6.1 Pilot A: Maintaining attendance and learning after drought in sub-Saharan Africa .......................... 30
   6.2 Pilot B: Covering cyclone risk to education at the local level in Madagascar ..................................... 34
   6.3 Pilot C: Pooled cover for multiple perils in small island ACP states ................................................... 39
   6.4 Pilot D: Natural catastrophe coverage in an un-modeled environment .............................................. 40

**References** .................................................................................................................................................. 41
Executive Summary

Natural hazards represent a substantial portion of the overall risk profile for education systems globally. In most private sector and many public sector settings, such risk is actively managed through the use of risk management tools, founded on an understanding of the risks, and including risk reduction and risk transfer through insurance. We have explored the applicability of existing catastrophe models and risk transfer structures to the education sector. As described in this report, we have identified current tools and services which can be quickly accessed and adapted to meet the risk management needs of the education sector in developing countries, and have documented the gaps which would need to be filled to allow for developing countries to quantify and finance a response to the impact of natural disasters on their education sectors. We have also developed actionable strategies for pilot countries where catastrophe models underpinning risk finance products exist and where GPE has active engagements.

There is substantial global knowledge and technology to support quantification of natural disaster risk across the full range of geographical and socio-economic settings. While specific risk models for education infrastructure and service interruption are rare, most developing world countries, including most of the 89 countries eligible for GPE financing under the financing and funding framework (FFF), are covered by some level of hazard and risk modeling. Through the use of proxies or collection of additional exposure information, detailed risk assessments for education systems are possible almost universally and covering most of the main natural hazard perils.

Many GPE partner countries are highly vulnerable to natural disasters. In most cases, we can approximate the national-level risk for most natural perils, in the form of average annualized loss. With additional data, and as we have described for several potential pilot risk financing programs, more detailed risk quantification for the education sector is possible. In Mexico, the FONDEN program supports a detailed database of public assets, including education assets, which, alongside the detailed hazard models available for Mexico, can provide a comprehensive understanding of natural hazard risk to the education sector.

There are a number of risk financing modalities being deployed in the public sector of developing countries. In the past decade, the use of parametric insurance to finance early response by sovereign governments has been tested, with the aim of reducing the overall impacts of natural disaster events. Straddling the development and humanitarian spaces, such instruments have the potential to both protect development gains and increase the timeliness and effectiveness of national and international response. When deployed alongside early warning tools and contingency planning activities, such financing mechanisms can have great impact even when financial flows are relatively small.

Alongside the development of parametric insurance instruments which allow transfer of risk from otherwise unserved areas of the developing world, the global appetite for risk has expanded. This appetite has led to the development of new instruments which allow cost effective warehousing and transfer of risk through capital market instruments such as catastrophe bonds and through specialized financial vehicles such as captive insurance companies. Although GPE’s current structure creates challenges to the use of many of these instruments, many GPE partner countries are already engaging with and utilizing risk transfer instruments from one of the three regional sovereign risk pools, providing opportunities for piloting risk financing for education.
We have described four potential pilot programs through which GPE might test risk financing for education to support the building of resilience in education sector plans. Pilot A is a risk management program, including financing, to support school-feeding in one or more sub-Saharan African countries as a response to drought and consequent high absenteeism and drop-out rates amongst school children. Pilot B supports and enhances community level disaster preparedness and rapid post-disaster re-introduction of schooling in the face of tropical cyclone impacts on Madagascar. Both of these pilots utilize the existing African Risk Capacity sovereign risk management and financing system. Pilots C and D are more challenging to implement in the short term, but would, respectively, test the value of pooling resources across the small islands states of the Caribbean and Pacific to enable more effective financing of education system recovery and test the potential for creating a stand-alone risk financing program to support resilience in the education sector for one of several large Asian GPE partner countries.
1 Introduction

This report investigates the applicability of existing natural catastrophe ('nat cat') risk models and risk financing and transfer tools and structures to the education sector in the development context.

Section 2, along with the supporting Annex 2, provides a primer on catastrophe risk modeling, describing current tools and services which could be quickly accessed and adapted to meet the risk management needs of the education sector in developing countries. It also identifies the gaps which would need to be filled to allow for developing countries in general, and all GPE partner countries in particular, to quantify the impact of natural disasters on their education sectors, as a basis for building the resilience of education delivery.

Section 3 presents a natural disaster risk analysis for the education sector and delivery of education in GPE partner countries, in as much detail as possible from existing and accessible data.

In section 4, we review general forms of financial risk transfer, drawing on examples where different strategies have been used by the public sector (at both sovereign and sub-sovereign levels) in developing and middle-income economies. We also investigate potential methodologies for capturing the impacts of natural disasters on the education sector, and the broad risk transfer cost and financial efficiency implications of different strategies and methodologies.

In section 5, we describe a number of potential modalities for GPE engagement in risk financing, and finally, in section 6, we work up actionable strategies for potential pilot countries / programs where catastrophe models underpinning risk finance products exist and where GPE has active engagements.
2 Catastrophe Modeling and its Application to the Education Sector

The description in Annexes 1 and 2 of catastrophe modeling origins, framework and applications highlights current strengths and weaknesses of this approach for quantitative risk assessment to the education sector, particularly in an insurance context.

While Annex 2 concentrates on probabilistic catastrophe modeling which is focused upon loss (indemnity) calculations to exposed portfolio at risk, it should be recognized that this is the most detailed and complex analytical product with which to inform the establishment of risk transfer mechanisms. Parametric index-based mechanisms rely upon the hazard component which is integral to a catastrophe model and so can be developed prior to such a model being created. Research into building hazard indices is a useful preparatory stage for subsequent more detailed modeling and can identify what information is available and at what level of extent, resolution and quality.

2.1 Geographical coverage

The regional focus of natural catastrophe (‘nat cat’) modeling was initially concentrated on industrialized countries with high levels of insurance penetration, such as North America, Western Europe, Japan and Australia/New Zealand. Figure 2.1 maps proprietary ‘vendor’ modeling company (e.g. RMS, AIR, EQECAT / CoreLogic) catastrophe model distribution by country in 2015 (NB: peril type not specified). This map reflects global distributions of insured losses but notably not fatalities by continent (see Annex 4).

![Figure 2.1 Vendor modeling company catastrophe model distribution by country.](image-url)
Recent initiatives, such as the OASIS loss modeling framework and Insurance Development Forum (see Annex 5) are improving the range of models being developed and publicly available for developing countries. Such initiatives also encourage an ‘open-source’ approach to the underlying code of models and increases accessibility and transparency of methodology. An open source approach moves away from the traditional vendor model business case of annual model license fee and allows a wider constituency of model developers to get access to end users, potentially reducing costs by increasing competition. Open-source approaches enable risk analytics capacity building locally in the countries affected by the perils being modelled. Common data standards and interoperability are also promoted.

Annex 6 provides a summary of the latest ClimateWise° data-set of disaster insurance risk transfer solutions in developing countries, with 135 initiatives here categorized into:

- Agricultural insurance (indemnity-based)
- Agricultural insurance (index-based)
- Disaster Micro-insurance
- Property and/or BI insurance
- Property Catastrophe Risk Re/Insurance Pool
- Sovereign Disaster Risk Financing

GPE partner countries represent 59% of all countries (31 entries) and regional schemes (11 entries) listed. 70% of the solutions are focused upon agriculture, with either index and/or indemnity models triggers in place, which would be supported by modeling. Property and/or BI insurance solutions currently only make up 3% of all schemes but such initiatives familiarize stakeholders in both insurance principles and the discipline required in maintaining exposure information of some kind, which is input into risk models.

2.2 Vulnerability of physical education infrastructure

GFDRR (2017, adapted from IPCC, 2012) define disaster risk in school infrastructure as:

The likelihood over a specified time period of severe alterations in the normal functioning of a school network due to hazardous physical events interacting with vulnerable social conditions, leading to widespread adverse human, material, economic, or educational effects that require immediate emergency response to satisfy critical human needs and restore education services, and that may require external support for recovery and reconstruction.

---

1 http://www.cisl.cam.ac.uk/business-action/sustainable-finance/climatewise
Exposure is defined as:

The population and assets—students, teachers and school community, school facilities, furniture, equipment, and other elements—present in a hazard area and thereby subject to potential losses.

Much school infrastructure may be particularly vulnerable due to accelerated efforts to build new schools over the past twenty years to meet with global education targets as included in the Millennium Development Goals and Sustainable Development Goals, for example. Unsafe building practices may have been encouraged by skewed incentives of increasing classroom coverage numbers, independent of consideration of construction quality.

Vendor catastrophe models often contain a wide array of classifications from which to attach appropriately modified vulnerability curves to building stock within a portfolio, often based around national or international building codes (see Annex 7). Such classifications include sub-categories for educational services, as in Table A7.2, which could be to specify known damageability responses to physical assets, if such information is available. Basic levels of school occupancy type may be recorded for educational services, such as primary or secondary education, but additional construction type information may perhaps facility surveying, an example of which is shown in Figure A9.1.

Figure 2.2 shows an example of school building vulnerability assessment in Kyrgyzstan (Buratovich, 2016), undertaken as part of the UNICEF methodology formulation for the national assessment of school safety at individual building level, which was applied to more than 6,000 school and pre-school buildings across Kyrgyzstan (Arup, 2016). NB: Kyrgyzstan is ranked 6th most vulnerable country in the world to earthquake risk, according to GAR2015 modeled loss analysis: see Table 3.4 and Section 3.

![Figure 2.2 Peak ground acceleration fragility curves for school buildings: Kyrgyzstan.](image-url)
2.3 Vulnerability of education services disruption

Regarding indirect consequences of nat cat impact, the World Bank (2011) notes that damaged school infrastructure exposes the educational community to physical and mental stress and interferes with school operations, teaching, and learning.

Evidence-based knowledge and data to quantify such indirect effects is hard to find, particularly on duration. Cuaresma (2009), in a pioneering study, found strong evidence of negative long-run effects of geological natural disaster risk on secondary school enrollment rates. McDermott (2012) noted that disasters have persistent effects on human capital up to 15 years after the event. For school enrolment rates, these effects are mitigated by access to credit, whereas aid flows appear to be effective in mitigating the longer-term effects of disasters on health outcomes. This result builds upon Gitter and Barham (2007), who observed credit rationed households hit by a shock were likely to remove their children from school and that children who live closer to a secondary school had higher educational attainment. Hermida (2010) differentiated a gender dimension to the effects of nat cat events on schooling in a Central American case study:

- decreased completed education by 0.4 years for children aged 4 to 9.
- decreased completed education by 0.7 years for girls aged 4 to 9.
- decreased completed education by 1.5 years for girls aged 4 to 9 of daughters of mothers with at least some schooling.

Bundy and O'Connell (2010) and Bundy (2011) stress that learning is not only about schooling. Programs addressing hunger, malnutrition, and disease among schoolchildren significantly improve their academic performance. Thus, investment in school-based feeding and health programs can be valuable in times of drought and natural disasters.

Compilation of quantitative data regarding disruption to educational services is one of the delivery elements of the World Bank’s The Global Program for Safer Schools (GFDRR, 2017) which includes:

- Quantitative assessment of historical impact on the education sector (global study).
- Global library of structural typologies for school buildings and seismic fragility/vulnerability functions.
- Standard methodology for vulnerability and damage assessment (V&DA) of school buildings in the aftermath of a disaster.

As discussed in Annex 2 (section A2.4), in a catastrophe modeling framework, disruption to school services can be considered as a form of business interruption (BI). Modeling physical losses to buildings and contents relates directly to the severity magnitude of the event. Estimating BI losses is more complicated because it includes a temporal component, depending on public and private decisions during event recovery with respect to resilience tactics that dampen losses by using remaining resources more efficiently to maintain business function and to recover more quickly. This component of loss has become a renewed topic of applied research in recent years (e.g. Rose and Huyck, 2016), with lessons that may apply to quantifying educational services disruption, always requiring the establishment of some form of coherent evidence base, however.
2.4 Education sector exposure data

Consideration of both direct and indirect losses to education sector portfolios requires quantification of the value at risk to natural hazards or political risk.

The FONDEN scheme (see Box 4.1), which includes effective insurance cover to local government and infrastructure exposures, provides a good benchmark for education sector data collection. Around 200,000 individual assets are recorded in the FONDEN exposure database, with a buildings sums insured value (BSI) of approximately 350 billion pesos (US$18 billion). Schools represent 12.3% of the federal insured portfolio, by value at risk. Table A8.1 and A8.2 of Annex 8 demonstrate the comprehensive capture of data for FONDEN educational facilities, including high resolution latitude, longitude locational data, sums insured and primary and secondary modifier information down to year built and number of floors.

An example of developing country fieldwork data collection to define educational services infrastructure vulnerability in given in Figure A9.1 of Annex 9, by the Safer Communities through Safer Schools (SCOSSO) project\(^1\) at University College London.

Rapid survey forms have been devised to collect exposure data relevant to vulnerability of school buildings to earthquakes, typhoons, and flood in the Philippines, as well as allowing the feasibility of retrofitting measures to be assessed and managed.

2.5 Applicability of modeling to the education sector: summary

Existing catastrophe models already provide the capability to model losses to the physical assets of the education sector, but currently only for a limited range of perils and territories with respect to the GPE portfolio. However, public and private sector engagement and open-source modeling approaches (see Annex 4) are rapidly expanding the availability of catastrophe models in low income and emerging economies, so that data and modeling relevant to GPE is increasing in quality and volume.

Asset register data of education sector physical value at risk (e.g. buildings and contents) is required for catastrophe model input; at a minimum, this means capture of location and value, or a proxy parameter thereof, such as pupil size of school, floor space etc. Ideally, characteristics such as construction type would also be recorded. The FONDEN schools portfolio data (Table A8.1 and A8.2 of Annex 8) represents an exemplar of such data provision.

\(^1\) [www.ucl.ac.uk/epicentre/epicentre-news-publication/SCOSSO](http://www.ucl.ac.uk/epicentre/epicentre-news-publication/SCOSSO)
Regarding building standards, inevitably many educational establishments in GPE partner countries will have been constructed without any codes in place, or will not have been built to code due to lack of enforcement or cost-cutting. The flexibility of the catastrophe modeling framework allows appropriate vulnerability curves to be selected that match understanding of construction quality. The models can also provide sensitivity analysis of the impact of selecting differing damage functions to represent building stock, extending to an ability to demonstrate the risk reduction benefits of building code implementation strategies.

Alongside physical damage estimation, catastrophe models also calculate business interruption for loss of profits (or additional living expenses for residential property portfolios), which has a duration component. Disruption to education service provision could be modeled in this way; ideally, field data from disasters could be used to calibrate event magnitude to disruption cost relationships, which could then be applied to education sector portfolios. Unfortunately, there is almost no usable data in this regard, even from the most recent large natural disasters, so that directly capturing education service disruption within the normal catastrophe modeling environment is impossible, and proxies must instead be used.

A range of complexity of modeling approaches are available to support the implementation and pricing of disaster risk financing schemes. Catastrophe models represent a 'gold standard' with respect to loss estimation. Parametric approaches to loss estimation and triggering insurance payout, which are simpler to establish models for, particularly in data-limited environments, are described with working examples in section 4. Over time, such parametric approaches may evolve into more detailed risk modeling, or they may exist in parallel with 'indemnity'-based catastrophe modeling to support a range of financial instruments, as with FONDEN (see Box 4.1). However, all modeling approaches require the provision of accurate and orderly exposure data to quantify risk.
3 Quantification of Natural Disaster Risk in GPE Partner Countries

A data-set of 89 countries where GPE has interests was constructed, as shown in Table A10.1 of Annex 10. Various classifications of these countries were appended including GPE-specific (Table A10.2) and world income group, as well as region. ISO 3-character country codes were used to link this data to other data sources.

Drought, as a slow onset hazard, is not included in our analysis below. Drought impacts are directly on agricultural crops rather than on hard infrastructure, and are thus modeled and recorded in a different way to rapid onset perils. Less than 10% of the post disaster needs assessments collated as part of this project are for drought events, and other recording of the impacts of drought do not include metrics on education infrastructure or service delivery impacts. Further, the current GAR2015 probabilistic modeling does not include drought as a natural catastrophe peril.

The drought module of the Africa RiskView modeling platform developed by the African Risk Capacity has broken new ground in terms of applying agricultural risk modeling techniques to develop population impact outcomes in terms of food security needs, but these outputs cannot be compared with traditional catastrophe model outputs in terms of loss and damage assessment. However, the impacts of drought on child health and nutrition means that it is a critical natural peril from an education system perspective.

We note here that historical drought statistics are included in EM-DAT, which reports event-level fatalities, number of people affected, and economic damage, where this information is available. EM-DAT drought statistics have been included in the analysis of GPE partner country historical exposure to hazards (2000 - 2016) presented in the Task 1 Report.

3.1 Post Disaster Needs Assessment (PDNA) reporting

A series of 52 PDNAs were collated and analyzed for material relating to education sector losses from natural catastrophic events. These events ranged from 1995 (Anguilla) to 2015 (Nepal, Malawi, Vanuatu, Myanmar). 42 GPE partner countries had at least one PDNA.

27 GPE partner countries had PDNAs with quantitative information on education sector losses, representing a 30% sample size and 34 PDNA events in total. Tables A11.1, A11.2 and A11.3 of Annex 11 show that:

- GPE partner countries are well sampled across income group classifications (low, lower middle and upper middle).
- LAC and South Asia regions are well sampled.
- Middle East and North Africa and Europe and Central Asia are under-represented.

---

1 This and subsequent totals do not include 4 drought PDNAs identified for GPE partner countries.
Losses recorded by PDNAs are 'direct', representing physical damage recorded after the event. Social costs to interrupted education, as considered in the policy case and benefit-cost ratios of the Task 1 Report are thus not included here. As with all data sources, issues of reliability exist around PDNA cost reporting, which may be inflated for various reasons, including donor operations being more expensive than that of local authorities, a normal assumption that only part of the stated need will be met by humanitarian response, and the lack of any incentive to not inflate loss and damage numbers. Further analysis beyond the scope of this feasibility study would be required to compare actual damage and repair costs with reported PDNA estimates.

To assess the sampling validity of the PDNAs assessed here, they were compared with EM-DAT\(^1\) disaster database statistics, which was established in 1988 to serve the purposes of humanitarian action at national and international levels by supporting decision-making for disaster preparedness, vulnerability assessment and priority setting. The database is compiled from various sources, including UN agencies, non-governmental organizations, insurance companies, research institutes and press agencies. As ever, a caveat must be added regarding both data quality and data completeness. Regarding completeness of events, although EM-DAT records date from 1900, the recent period analyzed here over the last 15 to 20 years has a much greater event capture rate. Three severity measures are recorded in EM-DAT: number of people affected, fatalities and damage (USD). For GPE partner countries for 1988 to 2015, capture rates for these three attributes are 73%, 39% and 36% respectively.

The PDNAs include 6 out of the top 10 EM-DAT losses by total (direct) damage for GPE partner countries. The PDNAs capture around 30 per cent of all such EM-DAT losses, where recorded, between 1998 and 2015, from natural catastrophes including drought.

Figures A11.1, A11.2 and A11.3 of Annex 11 split the sampled GPE-PDNA education sector impact data by natural hazard type, earthquake, windstorm or flood. NB: education sector financial losses converted to US Dollars when reported in local currencies and then indexed to 2016 values using IMF Gross Domestic Product (GDP) based on purchasing-power-parity (PPP), thereby accounting for inflation, economic growth and population change across years of the reporting.

Table 3.1 summarizes percentage impact on various education sector indicators reported in PDNAs. Earthquakes dominate the financial losses to the education sector, followed by tropical cyclone, both causing significant structural damage. However, more children and schools (these indicators share a similar distribution by natural hazard) are affected by tropical cyclone, perhaps due to the larger average event footprint size.

\(^{1}\) http://www.emdat.be/database
### Table 3.1  GPE PDNA education sector impact indicators by natural hazard.

<table>
<thead>
<tr>
<th>Natural Hazard</th>
<th>Total Education Dollar Loss</th>
<th>No. of Schools Affected</th>
<th>No. of Children Affected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earthquake</td>
<td>43.8%</td>
<td>19.0%</td>
<td>10.2%</td>
</tr>
<tr>
<td>Flood</td>
<td>25.1%</td>
<td>36.3%</td>
<td>31.6%</td>
</tr>
<tr>
<td>Tropical Cyclone</td>
<td>31.2%</td>
<td>44.7%</td>
<td>58.2%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
<td><strong>100%</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Table 3.2 shows average numbers of schools and children affected by natural hazard type. There is little variation in the numbers of schools but marked differences in number of children affected, tropical cyclones affecting twice as many children as earthquake. Again, this may be down to the larger damaging physical footprint size of an average cyclone compared to an earthquake. Greater statistical robustness is required to support these initial findings, based on both the increased number of PDNAs being analyzed and more detailed quality control of numbers being reported. For example, sometimes number of buildings damaged or collapsed are interchangeably reported.

### Table 3.2  Average numbers of schools and children affected by natural hazard.

<table>
<thead>
<tr>
<th>Natural Hazard</th>
<th>Average No. of Schools Affected per Event</th>
<th>Average No. of Children Affected per Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earthquake</td>
<td>2,442</td>
<td>477,029</td>
</tr>
<tr>
<td>Flood</td>
<td>2,508</td>
<td>884,877</td>
</tr>
<tr>
<td>Tropical Cyclone</td>
<td>2,874</td>
<td>1,019,978</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2,645</strong></td>
<td><strong>875,956</strong></td>
</tr>
<tr>
<td>PDNA sample</td>
<td>34</td>
<td>16</td>
</tr>
</tbody>
</table>

Table 3.3 compares selected PDNA events for GPE partner countries with UNESCO schooling data¹ to calculate percentage number of schoolchildren affected per event. A significant range can be seen from over 13% in the Nepal earthquake of 2015 to 0.1% in the Malawi floods of 2012 (a localized event affecting 6 schools on the Nsanje district). This data does not describe the severity or duration of impact, and the percentage affected is largely driven by the footprint area of the natural disaster impact.

¹ [http://data.uis.unesco.org/](http://data.uis.unesco.org/) (data not available for all countries for all years)
<table>
<thead>
<tr>
<th>Country</th>
<th>Event Type</th>
<th>Year</th>
<th>Event Name</th>
<th>Children Affected</th>
<th>Primary + Secondary Schooling (UNESCO)</th>
<th>% Schoolchildren Affected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nepal</td>
<td>Earthquake</td>
<td>2015</td>
<td>Gorkha</td>
<td>1,000,000</td>
<td>7,511,675</td>
<td>13.3%</td>
</tr>
<tr>
<td>Pakistan</td>
<td>Flood</td>
<td>2011</td>
<td></td>
<td>3,170,000</td>
<td>27,990,125</td>
<td>11.3%</td>
</tr>
<tr>
<td>Mozambique</td>
<td>Flood and Cyclone</td>
<td>2000</td>
<td></td>
<td>208,000</td>
<td>2,667,630</td>
<td>7.8%</td>
</tr>
<tr>
<td>Guatemala</td>
<td>Volcano / Trop. Cyc.</td>
<td>2010</td>
<td>Pacaya / Agatha</td>
<td>229,940</td>
<td>3,735,803</td>
<td>6.2%</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>Tropical Cyclone</td>
<td>2007</td>
<td>Sidr</td>
<td>1,500,000</td>
<td>26,757,621</td>
<td>5.6%</td>
</tr>
<tr>
<td>Tonga</td>
<td>Tropical Cyclone</td>
<td>2014</td>
<td>Ian</td>
<td>1,293</td>
<td>31,625</td>
<td>4.1%</td>
</tr>
<tr>
<td>Pakistan</td>
<td>Flood</td>
<td>2010</td>
<td></td>
<td>1,040,000</td>
<td>28,411,288</td>
<td>3.7%</td>
</tr>
<tr>
<td>Philippines</td>
<td>Tropical Cyclone</td>
<td>2013</td>
<td>Haiyan</td>
<td>483,976</td>
<td>21,680,766</td>
<td>2.2%</td>
</tr>
<tr>
<td>Samoa</td>
<td>EQ and Tsunami</td>
<td>2009</td>
<td></td>
<td>1,087</td>
<td>55,092</td>
<td>2.0%</td>
</tr>
<tr>
<td>Moldova</td>
<td>Flood</td>
<td>2010</td>
<td></td>
<td>1,663</td>
<td>448,816</td>
<td>0.4%</td>
</tr>
<tr>
<td>Malawi</td>
<td>Flood</td>
<td>2012</td>
<td></td>
<td>4,722</td>
<td>4,448,991</td>
<td>0.1%</td>
</tr>
</tbody>
</table>

Table 3.3 Percentage number of schoolchildren affected in selected GPE-PDNA events.

3.2 UNISDR Global Assessment Report (GAR2015) risk reporting

Country-level natural hazard data was obtained from the UNISDR as part of the Global Assessment Report (GAR2015) analytics, which is also available online\(^1\), by country:

Broad scale, “1st order” hazard modeling has been undertaken globally on exposures of estimated capital stock. Probabilistic models for a range of perils have calculated common re/insurance risk metrics of average annual loss (AAL) and probable maximum losses (PMLs) for varying return periods (see also Annex 2, section A2.5). While the generalized nature of these models means they have limited value compared to high resolution portfolios (e.g. FONDEN schools data), they are nevertheless useful for country comparison and screening purposes. Table A12.1 of Annex 12 presents GAR2015 AAL values (USD million) by 5 hazards for the 89 GPE partner countries; earthquake, tropical cyclone, tsunami, flood and volcanic ash.

A useful comparative metric for the GAR2015 modeled output is Loss Damage Ratio (LDR), expressed as percentage, which normalizes absolute AAL and PML values by the total exposed value of capital stock (also included in Table A12.1). LDR % values can be compared directly across countries and hazards as a relative measure of risk. Table A12.2 of Annex 12 ranks LDR % values by hazard for all 89 GPE partner countries. The top 10 GPE partner countries per hazard, according to GAR2015 modeling, are shown in Table 3.4.

<table>
<thead>
<tr>
<th>Rank</th>
<th>Earthquake (EQ)</th>
<th>Tropical Cyclones (TC)</th>
<th>Tsunami (TS)</th>
<th>Floods (FL)</th>
<th>Multi-Hazard (EQ+TC+TS+FL)</th>
<th>Volcanic Ash (VA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Honduras</td>
<td>Dominica</td>
<td>Tonga</td>
<td>Myanmar</td>
<td>Dominica</td>
<td>Indonesia</td>
</tr>
<tr>
<td>2</td>
<td>Dominica</td>
<td>Tonga</td>
<td>Philippines</td>
<td>Lao PDR</td>
<td>Tonga</td>
<td>Vanuatu</td>
</tr>
<tr>
<td>3</td>
<td>Haiti</td>
<td>Vanuatu</td>
<td>Solomon Islands</td>
<td>Cambodia</td>
<td>Vanuatu</td>
<td>Philippines</td>
</tr>
<tr>
<td>4</td>
<td>Guatemala</td>
<td>St. Lucia</td>
<td>Vanuatu</td>
<td>Bangladesh</td>
<td>St. Lucia</td>
<td>Papua New Guinea</td>
</tr>
<tr>
<td>5</td>
<td>El Salvador</td>
<td>Philippines</td>
<td>Timor-Leste</td>
<td>Vietnam</td>
<td>Philippines</td>
<td>Solomon Islands</td>
</tr>
<tr>
<td>6</td>
<td>Kyrgyz Republic</td>
<td>Solomon Islands</td>
<td>Indonesia</td>
<td>Guyana</td>
<td>Solomon Islands</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Tajikistan</td>
<td>Madagascar</td>
<td>Kiribati</td>
<td>Bhutan</td>
<td>Madagascar</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Vanuatu</td>
<td>St. Vincent and the Grenadines</td>
<td>Myanmar</td>
<td>Somalia</td>
<td>Myanmar</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Tonga</td>
<td>Samoa</td>
<td>Micronesia, Federated States of Sierra Leone</td>
<td></td>
<td>Honduras</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Afghanistan</td>
<td>Micronesia, Federated States of</td>
<td>Bangladesh</td>
<td>Moldova</td>
<td>Lao PDR</td>
<td></td>
</tr>
</tbody>
</table>

Table 3.4 UNISDR GAR2015 AAL as loss damage ratio %, ranked by hazard: Top 10.

This ranking denotes not only the level of hazard faced by each country but also the level of vulnerability of the exposed value.

3.3 Estimating direct losses to the education sector

Annex 2 to the Task 1 Report summarizes available historical information regarding the cost to education of natural disasters in GPE partner countries. As presented in Figure A2.4 of that report, the estimated annual total education cost is about US$850 million. Introduction of the GAR2015 risk analysis results provides a basis for an alternative annualized loss estimate, if losses to the education sector can be linked to losses at the national level.

Based on 28 PDNAs across both GPE and non-GPE partner countries and covering all four of the main GAR2015 peril types (EQ, TC, TS and FL), we find that the education sector accounts for an average of 5.2% of direct damage, 2.3% of indirect losses and 4.2% of total damage and loss. Given the nature of the GAR2015 annualized losses, the direct damage value is more relevant.
In work undertaken for the World Bank under the ISLANDS project, AIR Worldwide constructed an exposure database for five islands in the Southwest Indian Ocean using ground and remotely sensed data; this exposure database comprises 5% education infrastructure.

Given these two completely independent approaches to estimating the relative value and loss rate of education damage in natural disasters, we can reasonably conclude that direct damage to education systems can be approximated to 5% of total national losses. Applying this rate to the GAR2015 risk analysis results provides a total annual direct damage estimate for the education systems in the 89 GPE partner countries of $1.87 billion, equivalent to 0.77% of the total spend on education across those same countries. Higher than average values, up to almost 15% of total annual education spend, predominate in the small island developing states, consistent with their high risk relative to GDP.

3.4 Current risk modeling availability by GPE partner country

Willis Towers Watson worked with the Insurance Development Forum’s (IDF) Risk Modelling and Mapping Group (RMMG) to create a catalogue of risk model availability by country. NB: GAR2015 modeling is not included, due to its low geographical resolution nature.

Table A13.1 of Annex 13 lists GPE partner countries with columns indicating parametric scheme (e.g. ARC, CCRIF, PCRAFI) if applicable and number of risk models available, if any, by peril. The model count includes both parametric and indemnity models together. Table A13.2 of Annex 13 provides a complete disaggregation of GPE partner country, risk model and modeling company. Table A13.2 can be usefully compared to the ClimateWise compendium of disaster risk insurance initiatives in Table A6.1.

Table A13.3 provides a high-level summary count of model availability by hazard and modeling company for GPE partner countries.
4 Possible Risk Financing Modalities and Data Implications

Although natural hazard elements of catastrophe models are widely available in the developing world (though do not cover all GPE partner countries for all natural hazards), the vulnerability and exposure information specific to education systems is generally not available except in a few specific examples. In this context, this section presents a summary of potential modalities for risk financing already available to GPE partner countries, and which future data collection programs and operational developments would be required before additional modalities might become deployable in the education sector for developing countries.

4.1 Existing approaches to cat risk financing in developing states

Protection of public assets, both physical and financial, from natural disaster risk in the developing world has primarily been through one of the three existing sovereign parametric risk pools which have been set up over the past 10 years, namely the Caribbean Catastrophe Risk Insurance Facility which now includes Central America (CCRIF-SPC), the African Risk Capacity (ARC) and the Pacific Catastrophe Risk Assessment and Financing Initiative and Facility (PCRAFI), all of which are summarized in Annex 1 to the Task 1 Report.

Some middle-income countries have developed more elaborate approaches to managing nat cat risk to public assets, particularly Mexico (see Box 4.1), and others have used formal contingent credit lines (through the World Bank’s Catastrophe Deferred Drawdown Option, Cat-DDO1).

Box 4.1 FONDEN

In Mexico, the country’s Natural Disaster Fund, FONDEN (Fondo de Desastres Naturales), operates a rules-based system to reconstruct public infrastructure such as roads, hospitals, and schools after a disaster hits. In this collaboration among the federal government, state governments, and the private sector, everyone has agreed to an objective procedure to determine the degree of damage, which is implemented by an independent third party and audited by all parties. The result is clarity before the disaster over who will pay for what. FONDEN also offers incentives for risk reduction, rewarding such investments. Financial markets are used to lock in this rules-based approach. By facilitating faster reconstruction of infrastructure assets, FONDEN has contributed to increasing post-disaster local economic activity by 2 to 4 percent on average (De Janvry et al., 2016).

FONDEN was established in 1996 by the Federal Government of Mexico as a mechanism to finance the post-disaster recovery and reconstruction of public assets and low income housing at both Federal and State level. FONDEN consists of three primary financial accounts and collectively these instruments assist the Government of Mexico in its efforts to respond quickly to natural disasters, providing funding for emergency relief, rehabilitation and reconstruction. Continuous changes are made to enhance the efficiency and effectiveness of these instruments. FONDEN is complemented by the FOPREDEN (Fondo para la Prevención de Desastres Naturales) to finance prevention activities for subnational governments.

The FONDEN Program for Reconstruction provides financial support to rehabilitate and reconstruct assets destroyed by natural disasters. It focuses on the reconstruction and restoration of public infrastructure at the three levels of government (federal, state and municipal), low-income housing, and environmental risks. The program uses the principles of insurance to finance the reconstruction of public assets; it has a transparent damage reporting system, clear rules for how funds are disbursed, a clear plan for how money will be spent, and a credible monitoring system for expenditures.

The Federal Budget Law requires that no less than 0.4 percent of the annual federal budget should be allocated for FONDEN and related activities through a dedicated budget line item. To further manage the volatility of the FONDEN budget and to leverage its resources, FONDEN is allowed to transfer disaster risks through insurance and other risk transfer mechanisms such as catastrophe bonds. The presence of a dedicated budget line item has allowed the Mexican Government to be at the forefront of innovations in sovereign risk transfer, including the first parametric cat bond for public infrastructure in 2006 and development of a comprehensive asset database to underpin a complementary indemnity reinsurance program.

In 2016, technical support and access to markets by FONDEN was formally expanded to the Mexican States. This collaborative effort aims to help the State Governments develop an Integral Risk Management Strategy (IRMS), which can only receive Federal funding if some standards are met, such as data quality and methodological approach to risk identification, measurement and management set by FONDEN rules. It provides the State Governments with advisory services in risk modeling, using the catastrophe risk model R-FONDEN, catastrophe risk assessment, insurance product design, and drafting of insurance policies. The IRMS standards have brought several benefits to States. For example, the State of Oaxaca has publicly acknowledged that their IRMS helped them not only to purchase insurance on better terms, but it also provided crucial information to strengthen their disaster response capacity and emergency relief strategy to better protect the population.

In some developing and middle-income countries, as in many developed countries, other contingent liabilities from natural disasters are managed through insurance mechanisms, especially in agriculture (through heavily subsidized premiums for crop or livestock insurance) and through micro-insurance (still largely focused on agriculture but also including small businesses and micro-entrepreneurs.)

Micro-insurance for natural catastrophe risk has proven particularly challenging to implement due to a variety of factors, including the non-scalability of the loss adjustment process for indemnity products (so the expense load on premium to cover loss adjustment costs dwarf the risk element of the premium) and the inability of parametric insurance products to capture risk and losses to individuals, leaving purchasers holding substantial basis risk.

Subsidized and / or legally mandated consumer property insurance against specific natural perils has also been used, for example through the Turkish Catastrophe Insurance Pool¹, but even with high subsidies and legal requirements, take-up rate remains low.

In each specific case, the approach to building public sector resilience through proactive management of natural disaster liabilities has been pursued due to a combination of factors, the assessment of which can help to identify which approaches are currently suitable for consideration in the GPE / education sector context and which may become suitable in the future. These factors are described in detail in Annex 1 to

¹ http://www.tcip.gov.tr/
the Task 1 Report, and are expanded upon below to illustrate the specific case of potential natural disaster risk financing modalities for the education sector in a generic GPE partner country.

- **Risk information:** A full indemnity insurance program, covering education infrastructure and service delivery interruption, could not be implemented in any GPE partner country at present, due to lack of data, particularly exposure data for physical infrastructure, and vulnerability data for service delivery interruption. Thus, a parametric approach is required, with the data challenge then being managing basis risk, both through finding adequate proxies for impacts to education delivery at the sovereign and sub-sovereign level from natural disasters and through managing expectations of what such a risk financing mechanism can and cannot deliver.

- **Cost of capital:** Except in particular circumstances where donor financing for pro-active risk management may be additional for the education sector (see section 4.2), risk financing should not be regarded as a sustainable source of new finance. However, as discussed in the Task 1 Report, the cost of capital made available through an insurance mechanism paying out at a specific point in time (and funded through regular premium payments) may be less (possibly much less) than the cost assigned to other sources of capital (assuming they are available – which is not a strong assumption for the education sector in GPE partner countries.) It should be noted that the cost of capital through risk transfer is strongly aligned with quality of risk information, as further discussed in section 4.3.

- **Timeliness:** For risk financing to be effective, it must be available when needed most. The ability of parametric insurance programs to pay out rapidly is a key feature in all of the sovereign parametric insurance pools formed to date. As described in the Task 1 Report, the avoidance of prolonged breaks in education after a natural disaster is very valuable in the long term, and thus a risk financing mechanism which allows for rapid financial flows to fund pre-targeted activities with demonstrated value (see next bullet) will be most appropriate in the GPE / education sector case.

- **Discipline:** Identifying a risk financing mechanism that can act as the cornerstone of a structured risk management approach to building sustainable resilience is increasingly being recognized as having great value over and above a pure economic cost-benefit calculation. Although risk reduction, including preparedness, does feature in education sector plans in some GPE partner countries, and investments are being made in education system resilience to natural catastrophes (particularly through building stronger classrooms, see Box 4.2), any approach is never fully integrated with broader education sector planning and financing. Completing the risk analytics required as a precursor to risk financing provides the basis for making good decisions about risk reduction priorities, and directly incentivizing risk reduction and contingency planning through making it the access route to risk financing fully captures the resilience dividend for all.

- **Ownership:** In the case of GPE and the education sector, definition of risk ownership is critical, and any risk financing modality supported by GPE, either directly or through partner country systems, must recognize the need to build risk ownership within the host Ministry of Education (and its supporting Ministry of Finance) as part of a long term and sustainable commitment to education financing. The status quo is that GPE and its donor partners own most of the natural catastrophe risk in most GPE partner countries. Financing this risk (which is there whether it is explicitly recognized or not) would be beneficial in and of itself, but those benefits are greatly enhanced, and become sustainable, when risk financing also drives increased sharing of risk with sovereign governments (and, potentially, other

---

1 Natural catastrophe risk is embedded deep within GPE partner country education systems and their overall financing; it is not explicitly recognized, but materializes both through individual shocks (the response to which is generally funded by donors, both directly and indirectly) and through slowed and less complete implementation of Education Sector Plans. In most GPE partner countries, this means that most if not all natural catastrophe risk is effectively funded by GPE and its donor partners
actors in the national education space) as they build capacity to do so (and as they work actively to reduce the risk they will be taking on.)

**Box 4.2 Disaster Risk Reduction (DRR): Safer Schools**

The concept of ‘Build Back Better’ aims to define what went wrong after a catastrophic event, and then to determine how rebuilding can be made to a more resilient standard to face future adverse situations. Governments, development partners and donors must look beyond brick and cement ‘replacement solutions’ to also include a comprehensive understanding of the risk environments within which people live and work.

Action Aid (2011) highlighted the rationale of promoting DRR through schools and the challenge of building resilience to ever-increasing threats of disaster in the most vulnerable parts of the world. The Sendai Framework for Disaster Risk Reduction in 2015 (United Nations, 2015) promoted the Build Back Better strategy, and post disaster needs assessments (PDNAs) now routinely report on opportunities to introduce it in all aspects of recovery, diversifying livelihoods, strengthening community-based organizations and rehabilitating ecosystems.

Most recently, the Comprehensive School Safety Framework (GADRRRES, 2017) builds on the Sendai Framework foundation, bringing together international initiatives under the Global Alliance for Disaster Risk Reduction and Resilience in the Education Sector and the Worldwide Initiative for Safe Schools. The framework defines three pillars of comprehensive school safety:

- Safe learning facilities;
- School disaster management; and
- Risk reduction and resilience education.

Further, the framework identifies risk awareness as the key foundation to implementation:

“The foundation of planning for Comprehensive School Safety is multi-hazard risk assessment. Ideally, this planning should be part of Educational Management Information Systems at national, sub-national, and local levels. It is part of the broader analysis of education sector policy and management that provides the evidence base for planning and action.”

Under the first of these pillars, setting design and safety guidelines for education facilities is a critical component. Locally-developed construction technologies may be appropriate but can be informed by international co-operation. UNICEF and the World Bank (see GFDRR’s Global Program for Safer Schools) in particular have broad experience in defining and implementing standards while taking account of local context. Individual initiatives such as the Safer Communities through Safer Schools program have developed tools for rapid vulnerability assessment of school buildings (see Annex 9), alongside training of building artisans and development of manuals on improved construction practices.

---

1 [http://www.gadrrres.net](http://www.gadrrres.net)
2 [http://www.unisdr.org/we/campaign/wiss](http://www.unisdr.org/we/campaign/wiss)
3 [https://www.unicef.org/education/index_56204.html](https://www.unicef.org/education/index_56204.html)
4 [https://www.gfdrr.org/global-program-for-safer-schools](https://www.gfdrr.org/global-program-for-safer-schools)
4.2 Cost and affordability of risk financing

Natural disaster risk financing can be highly cost-efficient, but only under certain circumstances. Ex ante risk financing in the development context, to support response, recovery and rebuilding of a devastated country and its vulnerable population, is generally viewed as expensive and un-affordable, but that is based on a counterfactual where the risk is not recognized as an ongoing liability, and (free) ex post humanitarian assistance will probably come anyway (though almost always late and inadequate).

For GPE and in the education context, the counterfactual is even worse: post-disaster funds often never arrive at all, or if they do, they are always inadequate. In addition to the huge negative impacts on education delivery (see Task 1 Report), lack of post-disaster funding for recovery also dis-incentivizes the contingency planning necessary to reap the benefits of early response and recovery (thereby actually reducing the ongoing liability the risk represents).

So, while risk financing, and particularly natural catastrophe risk transfer, may appear expensive and unaffordable to actors in the education sector, it is still clearly better than the alternative. Additionally, cat risk insurance in the development context is actually rather inexpensive when accessed through particular channels, and it can be made affordable by attracting new and targeted financing under one of a number of initiatives introduced in Annex 1 to the Task 1 Report.

4.2.1 Cost

The ultimate cost of risk transfer is most appropriately measured by the additional cost that risk transfer attracts over and above the cost of the risk itself (the “pure risk” in insurance terminology). As previously described, pure risk is measured as the average annual loss (AAL), the losses each year averaged over a long period of time (to remove the year to year volatility of losses characteristic of natural disaster risk). The margin above AAL which an insurer charges as premium covers the costs of operating the insurance vehicle and executing the transactions (including loss adjustment costs when operating an indemnity program), as well as the cost of holding enough capital to pay all claims which may or may not happen in any given policy period.

While traditional indemnity insurance policies for homeowners in the Caribbean against hurricane risk, for example, typically attracted margins of several hundred %, transfer of natural catastrophe risk on a parametric basis (including both excess and insufficient rainfall, hurricane winds and storm surge, and earthquake shaking, and across all parts of the developing world) has been undertaken at margins of a few tens of %. For example, risk transferred by sovereigns through ARC’s Africa RiskView-based parametric drought product for 2017 will attract a 25% margin (more than half of which contributes to build assets, and therefore sovereign ‘ownership’ interest, in the mutual underwriting insurer, ARC Ltd, so might not be considered part of the ultimate cost). Such rates compare very favorably with equivalent contingent credit facilities.

Thus, transferring education sector risk for a GPE partner country, if transacted through one of the existing sovereign risk pools and using their respective parametric platform, can actually be extremely cost-effective. Each of those pools has a mutual structure making the internal cost of capital very low (and effectively negative for CCRIF-SPC and PCRAFI which received grant capital), and support from the
international risk markets is both voluminous and attractively priced (due mainly to the diversifying effect of developing world risk, and the low uncertainty in the risk analytics, see section 4.3).

4.2.2 Affordability

Even the most cost-effective risk transfer mechanism possible must take into account the actual risk being managed, and that would effectively make it seem unaffordable, particularly to a sector such as education, where under-funding is chronic and investment returns take generations to fully materialize. Fortunately, at present, there are opportunities to attract additional funding to support investments in a structured and holistic risk management system, including, potentially, premium financing for risk transfer, as well as grant support for disaster risk reduction and contingency planning.

Many of GPE’s key donors are currently leading the way in supporting disaster risk financing initiatives, particularly the UK and Germany but also including other G7 countries (through the InsuResilience initiative), potentially additional G20 countries (through Germany’s introduction of disaster risk financing to the agenda during its chairing of the G20 in 2017), and additional UNFCCC Annex 1 countries within the framework of the Paris Agreement.

Given this context, it is important that any activities in this area supported by GPE are designed and implemented to be consistent with the overall aims and objectives of these programs, including particular conditions which may be put in place to qualify for premium financing, for example. Given that such conditions would capture best practice, they should anyway be met by any program supported by GPE, whether implemented by GPE itself, a partner country, or a GPE donor or civil society partner.

4.3 Capturing risk to education delivery, and cost implications

One remaining question before considering practical operational structures and presenting some options for piloting of risk financing mechanisms is whether or not the impacts of natural disasters on the delivery of education can be adequately captured in a risk modeling environment to limit basis risk to acceptable levels.

Basis risk is the unanticipated difference between the actual impacts, and needs, as ascertained on the ground after a disaster and the financing flowing to meet those needs from a risk financing solution.

Some differences will be anticipated, indeed some will be inherent in the design of a risk financing tool which, in this context, would be very unlikely to be financing all of the risk, so would not respond to all events nor to the full extent of some events.

Other differences will be unanticipated; indemnity insurance programs have basis risk through the risk adjustment process and particularly for business interruption elements, while parametric programs have basis risk due to the inherent uncertainty in how physical processes during a natural disaster impact on the natural and man-made environment and the activities that take place in those environments.
While reducing basis risk is generally beneficial for a ‘client’ of risk transfer, in the case of an education system in a GPE partner country, there can be relatively high tolerance for basis risk (which anyway is difficult to measure as there is no benchmark against which to measure it.) Risk financing targeted at funding specific post-disaster activities (rather than covering all damage and loss), and scaling so that those activities can be increased as the need increases after a more severe and / or more widespread disaster occurs, contributes significantly to managing basis risk concerns, even in data-poor environments. Further, the risk-based pricing approach deployed for parametric risk transfer retains the value-for-money proposition of insurance, even in the presence of basis risk.

An important second factor supports the use of relatively simple, parametric insurance products to support risk financing in GPE partner countries, and that is the fact that global risk markets price parametric risk much more competitively than indemnity risk, particularly where there is low data availability of claims and losses, or exposure and vulnerability data is poor.

The sole variable in a parametric insurance payout calculation is the hazard, say wind speed; international risk markets understand tropical cyclone science, and feel confident in estimating the probability of a given wind speed affecting a certain point on the ground. That confidence translates to projecting losses on a parametric program, and leads to a low uncertainty load in the cost of risk transfer.

In contrast, for an indemnity program, where a risk taker is paying for actual losses, as assessed on the ground, there are many sources of uncertainty, and risk estimates themselves are thus highly uncertain, and pricing will be predicated on the worst view of risk by the risk taker, which leads to a high uncertainty load in the cost of risk transfer.

**4.4 Conditions precedent for access to risk financing for education**

As described above, there has been significant progress in recent years towards effective deployment of holistic disaster risk management approaches at the sovereign level, including risk financing. However, the focal points of that work have primarily been ministries of finance and agriculture, along with national disaster management implementing agencies. There has been little exposure to date for officials and decision-makers in ministries of education, particularly on risk financing.

There are now several avenues for accessing technical assistance with regard to risk financing, including the World Bank, the three regional sovereign risk pools, regional development banks, and donor-led initiatives such as the G7 InsuResilience program.

Many developing countries have already begun to put in place the building blocks of comprehensive disaster risk management, including through creation of dedicated ministries, agencies or other governance vehicles, alongside policy frameworks and regulations. Increasingly, such developments include reference to risk financing, though few have specific risk financing requirements. It is also rare for these activities to be mainstreamed within individual ministries such as education, so that a specific focus is required to make disaster risk management an integral part of education sector planning.

Individual ministry access to risk financing tools is additionally challenging as such tools would need to utilize the national treasury as the counterpart to any contracts controlling finance flows. Challenges have
been encountered in a number of cases where payouts under an insurance policy between the national treasury and one of the sovereign risk pools have been slowed by the lack of mechanisms within the financial management system to allow for off-budget flows from the treasury to line ministries to fund implementation of the pre-agreed response plans.

In some countries and regions, there are legal or regulatory barriers to sovereigns purchasing insurance or participating in other risk financing transactions. There are also substantial challenges in many countries to creating and maintaining contingency funds or contingency budget lines to cover the lower levels of a comprehensive risk financing structure; such challenges are magnified when considering such tools for an individual ministry.

It is certainly the case that successful implementation of comprehensive disaster risk management including risk financing for the education sector cannot happen in isolation. GPE’s approach in supporting effective implementation of education sector plans is well suited to facilitating investment of resources towards strategic disaster risk management, although actual modalities of support will vary with partner country context, nature of GPE’s grant-making and other partner investments, and many other factors.

### 4.5 Capturing the resilience dividend

Building resilience is critical to sustainable development across all sectors. Climate change is perhaps the highest profile of the risks to development that have led to the increasing prominence of resilience in development and humanitarian activities, but there are many other risks that also threaten developmental gains, from the sovereign level all the way to vulnerable individuals.

Risk financing is one tool that can contribute to building resilience. But it is only one tool, it cannot build resilience in isolation, and is most effective when incentivizing other resilience-building activities. As has been described in the companion Task 1 Report, building resilience requires developing an understanding of the risks, investing in reducing the risks where possible, and having plans and supporting financing to act quickly and effectively to manage the consequences of shocks when they do occur. Some of these tasks are most effectively done at the national level, but others require local, community-level actions, particularly in leading early and effective response following plans tailored to the specific circumstances of that community.

As outlined in a forthcoming paper\(^1\) commissioned by the German government to inform their presidency of the G20 in 2017, the three regional sovereign risk pools created in the past decade have provided very practical demonstrations of the value of risk financing to building resilience to natural catastrophes. Box 4.3 summarizes key practical examples of how disaster risk financing is already contributing to building sovereign resilience in many GPE partner countries, as an illustration of the potential advances that could also be made in the education sector.

---

Box 4.3  Risk financing as a catalyst for building resilience: practical examples

ARC: Early warning and contingency planning to drive risk reduction

ARC is aiming to capture the 4.4:1 benefit calculated for early and targeted response to drought through integration of four key elements; risk quantification, early warning, contingency planning and risk financing. ARC has developed an in-house software platform, Africa RiskView, to serve as both a risk quantification tool and an early warning information source. By developing knowledge of natural hazards and the risks they pose through Technical Working Groups convened in each ARC country, early warning information (currently for drought and cyclone) can be better understood, contextualized and communicated to decision-makers. ARC has also developed specific standards and guidelines for preparation of contingency plans, which are reviewed bi-annually by both technical experts and peer practitioners, and which are used as the basis for a second stage of planning once an insurance payout becomes likely, in which the specific use of the risk financing is itemized and against which the response activities are audited. Peer learning promotes best practice in both planning and implementation, leading to better outcomes and capturing an every-increasing resilience dividend through reducing both short-term and long-term socio-economic impacts of natural disasters.

CCRIF: Early funds to maintain government activities

As the first of the global sovereign risk pools, CCRIF concentrated on delivering the value of early and flexible financing for immediate response and to help maintain basic government services critical to effective recovery. After the Haitian earthquake in 2010, for example, the payout from the government’s insurance policy with CCRIF was the earliest financing received by the authorities with flexibility to use for the most practical needs; in this case, paying the salaries of police and other emergency service workers. Although the CCRIF payout totaled only a tiny fraction of the overall need, in the critical early recovery phase, it amounted to more than half of the total funding that the Government of Haiti received to maintain basic services, with almost all other humanitarian aid coming in the form of goods and services, and development assistance not yet materializing.

PCRAFI: Risk database to support DRM

In the Pacific, implementation of a risk pool was only considered once a comprehensive data collection and analysis project was completed, to build an understanding of the hazards and risks faced by each of the 15 participating island nations. Sovereign assets were located and characterized, state-of-the-art hazard analysis was completed, and the entire dataset was included in an accessible GIS database at the disposal of authorities in all of the islands as a basis for more informed disaster risk management, including land-use planning, development of building codes, emergency planning and risk education. The database also informed the parametric risk model used to cost-effectively transfer risk to the international markets.
5 Risk Transfer Deal Structure Options for GPE and Partner Countries

This section describes various modalities of risk financing and risk transfer which may be appropriate for GPE and its partner countries, both in the short term and potentially in the future as structured risk management becomes more deeply embedded in education sector planning and service delivery in individual GPE partner countries or across groups of countries.

We note that GPE’s current governance and operational model significantly restricts access to many of the potential risk financing structures described below. The selection, and ranking, of the potential pilot programs described in section 6 has been informed by GPE’s existing institutional arrangement which presently restrict GPE’s ability to transact risk financing deals on its own behalf or on behalf of its partner countries. The deal descriptions in this section set aside those restrictions to illustrate the range of potential modalities as GPE’s institutional arrangements evolve.

As has been described previously, many GPE partner countries have either participated in, or are eligible to participate in, risk financing transactions with one of the three sovereign risk pools. Although there are challenges with executing such transactions, those challenges are tractable, even for transactions undertaken by a ministry of finance / national treasury on behalf of a line ministry.

A second set of transaction modalities which GPE might engage in immediately are those involving the World Bank. The World Bank Treasury has recently received authorization to engage in risk transfer through both the conventional insurance markets (in the form of insurance) and through capital market instruments such as catastrophe bonds. It is able to engage in such transactions on behalf of the constituent entities within the World Bank (e.g. IBRD, IDA) and, as a hosted entity, GPE would likely be able to utilize WBT risk transfer tools. Challenges would still remain regarding funding of premiums and distribution of payouts should they occur, given that GPE has no balance sheet per se, but there may be ways to overcome those challenges.

Table 5.1 provides a summary of the various potential modalities.
<table>
<thead>
<tr>
<th><strong>Client (‘Insured’)</strong></th>
<th><strong>Risk Transfer Vehicle</strong></th>
<th><strong>Existing pool</strong></th>
<th><strong>World Bank / RDB</strong></th>
<th><strong>Private Markets</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>National Ministry of Education (via MoF / Treasury)</td>
<td>Leverages value of pooling, existing models and policy forms, sovereign experience with transaction type, can utilize existing systems to incentivize planning and rapid implementation, builds sustainability</td>
<td>Leverages WB / RDB relationship with MoF / Treasury, could attract TA funds for bespoke modeling and to support contingency planning, but unlikely to achieve best long term pricing and sustainability, and modeling would take time</td>
<td>Direct engagement possible with one or more of several big carriers (reinsurers) or via broker. Other avenues preferred in early phase given need for technical assistance, knowledge-building and pre-requisites (e.g. contingency planning)</td>
<td></td>
</tr>
<tr>
<td>GPE (via risk-holding vehicle)</td>
<td>Operating and governance structure of existing vehicles could be extended to be GPE-specific (e.g. segregated portfolio in CCRIF SPC), or GPE could procure modeling and operational capacity for stand-alone vehicle</td>
<td>WB could provide operational and risk pooling capacity, but likely complicated from governance / admin perspective and WB likely to want evolution to stand-alone entity (e.g. PCRAFI)</td>
<td>As above; possible but likely not cost-effective where existing pools exist</td>
<td></td>
</tr>
<tr>
<td>Shared global emergency fund for education</td>
<td>May be able to purchase portfolio cover for multiple countries in each pool. If not, licensing of existing models likely to be useful</td>
<td>WB has recent experience in setting up contingency fund leveraged through risk transfer – in form of Pandemic Emergency Financing Facility – could be model for education sector</td>
<td>Given known appetite for nat cat risk, direct market placement of cover above a contingency fund may be cost-effective, if parametric model basis can be agreed</td>
<td></td>
</tr>
<tr>
<td>NGO partner for response implementation</td>
<td>ARC has access window for NGOs already, other pools more difficult but likely possible</td>
<td>No clear advantages to using WB vs existing pools or direct to market, except possibly where pools don’t cover part of desired portfolio</td>
<td>Some NGOs already engaging directly with private markets; working through pools still has advantages where they already cover countries</td>
<td></td>
</tr>
</tbody>
</table>

**Table 5.1** Summary of risk transfer deal structure options.
5.1 Deal with the Ministry of Education in a GPE partner country

Under these structures, one Ministry of Education (or many in parallel, but acting individually) would effectively be the beneficiary party and hold the risk financing instrument, although in reality, the Ministry of Finance would effectively play that role given that it is the gateway to all financing for a Ministry of Education.

Existing risk pools have had some limited experience in risk financing, in the form of insurance payouts, flowing from a Ministry of Finance to a line ministry, and that experience demonstrates that any program implemented using this structure would need to include work on facilitating such flows of funding not only in terms of timeliness, but also ensuring that the money flows to the Ministry of Education and does not get diverted.

5.1.1 Purchased through existing pool

As previously described, risk pools exist in the Caribbean and Central America (CCRIF-SPC), Africa (ARC) and the Pacific (PCRAFI Facility). The most straightforward deal structure for sovereign protection, which would be subject to policyholder (the pools are all effectively or actually mutual insurers owned by sovereign policyholders) and, possibly, original donor agreement, would be to write a ‘Ministry of Education / Education Sector’ risk directly to the existing pool. It is likely that this would only be possible if the education sector risk could be adequately captured in the existing risk models of the pool; adding a new risk captured in a new model to the existing pool would likely be challenging.

If such agreement cannot be obtained, it may still be possible to piggy-back on the main pool’s reinsurance purchase; i.e. place the reinsurance for the pool and the GPE partner country(ies) together, obtaining better terms (i.e. lower profit loads) than would be expected for a small, independent placement.

5.1.2 Purchased via the World Bank (including Cat Bond)

The World Bank Treasury can assist in placement of cover in the traditional re/insurance markets and also by issuing a catastrophe bond via its Capital-at-Risk Notes Program. Catastrophe bonds have the advantage of negligible counterparty risk and are typically available for 3 to 5 years but historically they cost more than reinsurance, especially for non-peak risks such as the GPE portfolio, and have high frictional costs. The Capital-at-Risk Notes Program\(^1\) cuts fees to the minimum but with the reinsurance market being so competitive (and also now offering multi-year deals) it may be a hammer to crack a nut.

For the first four years of the PCRAFI Pilot, the World Bank Treasury acted as an aggregator of risk, taken on from each participating sovereign via an ISDA swap and passed in full as a single transaction (also done on ISDA swap terms) to the reinsurance markets.

For traditional re/insurance the World Bank deals with a very small group of companies; a reinsurance broker will obtain better terms even taking into account their fee.

5.1.3 Purchased directly from market

It is possible to go direct to a re/insurer. Firms such as Swiss Re and Munich Re offer a professional service covering the full range of services from modeling, product creation, policy issuance and training, with the comfort of continuity of relationship. But such a service will come at a cost, a cost which a transaction reliant upon cheap premiums may find difficult to bear. Organizations such as the World Food Programme, which have previously engaged directly with reinsurers, have begun to use reinsurance brokers, as the majority of the private insurance market does, to cover catastrophe risk placement including CCRIF and ARC. Reinsurance brokers hold the greatest concentration of risk modeling and structuring expertise in the market and perform similar modeling, advisory and structuring services to a large reinsurer, but have the ability to obtain competitive quotations from the broad reinsurance and capital markets. For example, for ARC in 2016, over 40 reinsurers and capital markets expressed an interest, most offered capacity and 24 ultimately participated on the cover, reducing counterparty exposure to any one firm as well as driving prices to the lowest possible point. Large reinsurers like Swiss Re and Munich Re will also compete and participate on this basis.

5.2 Deal with GPE for multiple countries

Under these structures, GPE would be the beneficiary of the risk financing, on behalf of all or a subset of GPE partner countries. It is our understanding that while GPE could not currently accommodate such structures, future developments could include provisions such that GPE might be in a position to become an ‘insured party’.

5.2.1 Purchased through existing pool

The main value of a pool is diversification. If GPE acted as a risk aggregator, then it would capture those diversification benefits and could pass them on as it saw fit to its partner countries.

Under this model, it may be possible to create a GPE / Education-specific vehicle under the umbrella of one or more of the existing risk pools. CCRIF-SPC is specifically set up as a segregated cell company, and new cells can be created to cover new risks with different donor support. The original cell was for Caribbean Tropical Cyclone and Earthquake. In 2012 a new cell to cover Excess Rainfall in the Caribbean was created, and in 2015 a Central America cell was added, with additional capitalization by donors. But the best corollary is perhaps the Fisheries cell created in 2017 which, subject to funding and timing issues, will offer fisheries protection linked to sustainably fishing practices backed by a World Bank Trust Fund donated by the USA (and potentially additional donors in the future). This is a possible template for GPE.

ARC and PCRAFI Facility do not currently have the segregated cell structure but may have the flexibility to write the risk to their existing pool and / or create a new sister pool for this purpose. The domiciles in which ARC and PCRAFI Facility are regulated both allow for such segregated cell structures, although in both cases (as with CCRIF), it may need additional risk capital to be brought to the table to facilitate such adaptations to current corporate structures.

An alternative structure would be for GPE itself to set up a risk holding vehicle in partnership with the existing pools, or utilize the World Bank Treasury in that role (see below). It could sub-license modeling
from the existing pools and apply that modeling across all GPE partner countries covered by the models, to create a multi-regional pool which could attract both the diversification benefits of a global pool and the low uncertainty load on reinsurance costs (as risk would be defined by known parametric models.)

5.2.2 Purchased via WB (including Cat Bond)

Just as countries can approach the World Bank separately, they may also do collectively. At the moment a group of South American countries are considering a joint catastrophe bond under the auspices of the Pacific Alliance. GPE could act as the counterpart to World Bank Treasury in this case, although it would require GPE to form a risk aggregating vehicle itself.

5.2.3 Purchased directly from market

A reinsurer or reinsurance broker would both be very happy to deal with a group of countries wishing to buy re/insurance collectively. It is likely that each insurance would be independent but jointly placed (often known as a “bouquet”) to leverage the best terms for each party. It would also be possible to design a structure where there was a degree of risk sharing between the countries (“co-insurance”) as well as risk retention and risk transfer to the global reinsurance and capital markets.

Alternatively, GPE could set up its own pool structure, similar to the regional pools mentioned before but totally free-standing. Clearly there would be costs of creation and maintenance, but an outsourced model such as that followed by ARC and CCRIF is possible to reduce costs.

This facility would give GPE total control to structure the pool as it wishes, with one or many cells offering insurance to member countries. The cells individually or collectively would then retain some risk, reducing the need for, and reliance on, external re/insurance and so potentially reducing the cost for countries.

The pros and cons of going directly to a single re/insurer or via a reinsurance broker to the whole market are as before, but if affordability is the key driver then the brokered option is optimal.

5.3 Deal with GPE to leverage ECW or other contingency funds

Under this structure, GPE would use risk financing to leverage the capacity of an existing (or newly set-up) contingency fund supporting post-disaster financing. The UN’s CERF is an obvious example, and recent work has highlighted the potential role of risk financing to expand the scope of CERF (Filipp and Giudice, 2016). The World Bank’s Pandemic Emergency Financing Facility is envisaged in a similar way; a substantial contingency fund as the main financing source for emergency response, but with risk financing in place set to trigger for large events which require resources beyond the capacity of the contingency fund.

1 In its current structure, GPE could not be directly insured by the World Bank, so a separate vehicle would need to be set up which effectively collected risk from GPE partner countries participating in the program (through issuing insurance policies or similar instruments) and then itself transferred some (or all) of the collected risk to the World Bank.

2 http://fiftrustee.worldbank.org/Pages/pef.aspx
The purpose of risk financing in these cases is to expand the capacity of an existing response mechanism beyond that which can be reasonably retained on an ongoing basis in a ring-fenced contingency fund.

5.4 Deal facilitated by GPE but covering partner (NGO) to work at community level

5.4.1 Single NGO in single or multiple countries

ARC created the Replica Coverage product in 2016, although the product has not yet been utilized. Replica allows an NGO to purchase a copy of all or some of the insurances bought by a country from ARC. This not only had the advantage of creating a cost-efficient way for the NGO to begin to migrate from ex post to ex ante protection, but it also allowed (indeed ARC insisted) that their contingency plans had to dovetail with the government’s, providing operational efficiency and encouraging proper coordinated disaster response post-event.

However, to issue a replica cover there needs to be an original policy to replicate, and it may be that GPE is active and able to buy a policy where a country is unable to buy an original policy from ARC perhaps due to premium financing issues. However, it would be possible theoretically for an ARC-type policy, parametrized appropriately for GPE, and subject to the agreement of ARC Ltd and its shareholders (which here include donors as well as policy-holding countries) to be issued even where no original policy exists. If the policy is of the same form as the ARC policies and it includes similar risk management features, including contingency planning, the probability of ARC writing the contract is increased.

Of course, if GPE decides to create a new facility, within an existing pool or a new freestanding entity, then it can offer ARC type covers working directly with governments to develop contingency plans and/or work NGOs to fulfill the ARC Agency role of assistance in contingency planning and post-loss implementation – equivalent to Replica with or without the original policy.

Once again under these circumstances the resulting policies, either individually or collectively, could be protected via reinsurance/capital market protection direct with the World Bank Treasury, direct with a reinsurer or via a reinsurance broker.

5.4.2 Risk financing attached directly to investment in infrastructure

Building in long-term resilience of new infrastructure to natural disasters is a key element of disaster risk reduction investment programming. Locating infrastructure in less hazardous areas, and building less vulnerable structures is a key part of such programming, but supporting ongoing maintenance and coverage for damage should also be part of the financing package for such investments. Without this long-term consideration of risk, new infrastructure is added to the risk burden of the state without developing tools or capacity to appropriately manage or finance such risk.

The education sector is no different to other sectors in this regard, except that investments are more diverse and individually smaller than many public sector investment programs, often meaning that they get even less attention around long-term resilience.
GPE could support implementing partners and its countries through developing and implementing a risk financing platform to support cost-effective risk transfer for education infrastructure built or rehabilitated to current standards of resilience to natural hazards. Such a platform would almost certainly need to be indemnity-based, but could be attractive to the risk markets as the portfolio would comprise buildings with low vulnerability in known locations. By setting and monitoring entry criteria to such a portfolio, GPE would provide a substantial benefit through facilitating cost-effective risk transfer and building long-term resilience in the education sector.

While attaining the level of risk management sophistication of a school district exposed to natural hazards in the developed world (e.g. Miami-Dade County\(^1\)) is perhaps far in the future, embedding risk management and risk financing tools and products into new infrastructure development programs provides a strong foundation for such progress.

\(^1\) http://riskmanagement.dadeschools.net/pdf/disaster_recovery.pdf
6 Potential GPE Natural Catastrophe Risk Financing Pilots

The final section of this report describes four potential risk financing pilot projects for GPE to test the feasibility of risk financing under its existing institutional arrangements. Pilots A and B are regarded as being implementable immediately, although each will require a preparation period of up to a year. Annex 16 provides summary term sheets1 for these two pilot projects. Pilots C and D are more conceptual, and would take significant time and resources to implement, as well as changes to GPE’s operational model or creation of alternative vehicle(s) for transacting risk financing on an individual or pooled basis.

The descriptions below are informed substantially by the consulting team’s detailed knowledge of the three operating sovereign risk pools. However, it must be noted that those organizations have not been approached about design or potential implementation of these pilot programs, and one or more of them would need to be active partners for any of pilots A, B or C.

6.1 Pilot A: Maintaining attendance and learning after drought in sub-Saharan Africa

Food insecurity is a chronic condition across some areas of the Sahel in West Africa, particularly in Niger and Chad, and also in parts of the Horn of Africa as well as southern Africa. School feeding programs to mitigate such food insecurity are a powerful tool to both combat childhood malnutrition and to encourage school attendance and enhance learning. When drought occurs, the affected population rises dramatically, leading to a spike in child food needs and a plunge in school attendance rates2. Ability to scale up social protection systems is increasingly seen as a critical development tool, with expansion of school feeding programs a key vehicle. GPE grants already fund or have funded school feeding programs in sub-Saharan Africa and the Caribbean.

The African Risk Capacity (ARC) has pioneered disaster risk financing for drought across sub-Saharan Africa, promoting an integrated risk management system including early warning and contingency planning, as well as making available sovereign parametric insurance. ARC requires a pre-certified contingency plan prior to purchase of insurance coverage, and a detailed Final Implementation Plan (FIP) before release of a payout, which provides the financing for execution of the FIP. ARC made three payouts in early 2015 after mild to moderate drought impacted three countries in the Sahel. In Niger, scaling up of school feeding was one of the planned activities in the FIP; due to internal delays in flow of funds from the national treasury to the responsible line ministry, the short window for school feeding was missed so funds were utilized for other planned activities3.

---

1 A term sheet summarises the financial and other terms and conditions of a financial transaction, usually as the basis for an ‘agreement in principle’ to a transaction.
2 See, for example: http://reliefweb.int/sites/reliefweb.int/files/resources/mitigating_ethiopias_drought_impacts_on_children_through_education_may_2016.pdf
3 While ARC itself is working with member countries to address such issues through improved planning of financial flows, a GPE pilot would need to fully address flow of funds from an insurance payout to the Ministry of Education and onward to fund the specific program identified in a Final Implementation Plan (or equivalent) within the main Contingency Plan. Such planning would need to include the Ministry of Finance and/or Treasury, and may require changes to internal regulations.
GPE already supports school feeding programs in several countries in Africa, and ARC has government-endorsed drought impact models in place for 10 countries (with others in development). ARC is able to provide three potential modalities of delivery of insurance to directly support school feeding:

- Direct sovereign coverage (a portion of which could be assigned to school feeding in the event of a payout), either with an existing client or, potentially, with a new client (although this would need substantially more support from ARC than would an existing client);
- Replica coverage, in which an International Organization or NGO partner could include school feeding in the contingency plan for replica coverage (which mirrors sovereign coverage held by the government and in which use of payouts is coordinated with the government but activities are implemented by the IO or NGO holding coverage); or
- Coverage under the ARC Licensing for Development (L4D) initiative, which allows utilization of the ARC risk modeling platform and parametric policy form but which does not have a direct link to the sovereign government (though the program must demonstrate a clear development purpose.)

Given that the most straightforward transaction would be with an existing ARC country (either under the direct sovereign coverage or through replica coverage (which would require the selected country to have regular ARC coverage in place), the GPE target country or countries should be selected from the following options (tiered by increasing complexity\(^1\) in executing a risk transfer transaction):

- Tier 1: Senegal, Mali, Burkina Faso, Mauritania
- Tier 2: Niger, The Gambia
- Tier 3: Malawi, Kenya, Ethiopia, Mozambique

Other countries could be considered, so long as their drought risk profile could be developed within Africa RiskView, although considerably more work would be required than for the above-listed countries. Box 6.1 describes how a potential transaction with Somalia could have taken place and what the results would have been in terms of a possible payout and response implementation for the 2016/17 (ongoing) drought.

\(^1\) The listed countries are in various stages of their relationship with ARC; a GPE pilot will be easier to execute with partner countries having a more mature relationship with ARC and having already participated in multiple insurance transactions
Box 6.1 Coverage scenario for Somalia

Somalia is currently experiencing an acute food security crisis due to prolonged and deepening drought in the country\(^1\) and the food security crisis and emergency conditions are generating an education crisis. The humanitarian situation is rapidly deteriorating and the country is being driven towards a famine. Children are dropping out of school due to displacement and negative coping mechanisms. Ensuring children stay in school and supporting those out of school is critical to sustaining the gains made in education in recent years. Furthermore, lessons learnt from the 2011 famine show that many of the deaths of children caused by the drought could have been prevented if children had access to life-saving services at safe and protected schools. The GPE Secretariat undertook a mission to Somalia in February 2017 to meet with the Somalia Education Cluster and discuss with the respective governments and partners on the possibility of GPE support through accelerated funding. Somaliland has formally expressed interest to apply for accelerated funding for US$1.92 million and is currently preparing an application.

The African Risk Capacity’s Africa RiskView modeling platform includes Somalia, with default settings used to estimate the impact of low rainfall on food security in the country. ARV’s default settings are used as a starting point for country-led customization of the model prior to insurance coverage being accessible; without customization, the default settings are useful but should be treated with caution. In particular, the vulnerability information included in the default settings is often quite significantly out of date, particularly where population vulnerability and movement is volatile, such as is the case in Somalia. However, on a relative basis, the results from ARV are useful in placing a particular drought into historical context.

Somalia is represented in ARV through two growing seasons (Gu, the main season, in the middle third of the calendar year and the secondary Deyr late in the year) and for each growing season for one crop (Maize in the Gu, Soughrhum in the Deyr) and for rangeland. The Deyr rangeland season is about to end, and will be at or very close to the severity of the 2010/11 drought in terms of affected population (using a constant population and vulnerability dataset). The Deyr Soughrhum season ended at the end of January and was just below the severity of the 2010/11 season. The preceding (2016) Gu season was average for both Maize and rangeland, although it is notable that the Gu season preceding the 2011 drought in Somalia was the best in the last 15 years.

ARC’s parametric drought insurance policies are designed to finance early, pre-agreed actions, which provides a more than 4 to 1 benefit in ultimate outcomes for food insecure populations relative to the traditional humanitarian appeals-based response model. The risk for drought is high in Somalia, so insurance is commensurately expensive. A US$5 million policy from ARC covering the Deyr season for 2016/17 would likely have paid out US$20 million (assuming reasonable coverage conditions), and that payout would be ready to be paid in full in early April 2017, immediately after the end of the rangeland growing season, with an earlier partial payout likely to have been available. Any payout from ARC Ltd is subject to approval of a Final Implementation Plan; for a pre-agreed school feeding program, such approval would likely happen very quickly and could have been in place by the time the payout became due, with advanced planning allowing for almost immediate implementation. So, for US$5 million premium, an early-implemented school feeding program to the tune of US$20 million (which, assuming US$40 per person cost, would mean feeding for half a million children) would likely save US$80 million to US$100 million in delayed response cost, and much more in lost schooling for those children kept in class by being nourished and secured.

\(^1\) http://www.irinnews.org/analysis/2017/03/28/famine-somalia-twice-six-years
6.1.1 Transaction summary

Sovereigns taking parametric drought coverage from ARC Ltd complete three key steps before purchasing coverage for that policy year:

- **Customization of ARV**: This is reviewed each year and adjusted by each country, through a Technical Working Group, to generate the most appropriate risk profile for affected population based on historical experience. The affected population number is converted to a dollar amount through a per-person response cost, set by each country at a level commensurate with the estimated cost of providing for food-insecure populations through one lean period (3-4 months). Once customization is signed-off by the country, it is locked for that policy year, and the parametric insurance model uses the locked customization as the model through which actual rainfall data is fed to calculate the modeled drought response cost. Replica coverage utilizes the exact same customization as is in place for the sovereign insurance policy.

- **Contingency Planning**: This is undertaken every two years and must be certified through a peer review mechanism prior to issuance of a Certificate of Good Standing (which allows purchase of insurance from ARC Ltd). In the case of possible GPE-related coverage, a school feeding program would be identified as one of the potential actions to be implemented should a payout occur; each contingency plan includes a description of actions, and their scale, that might be taken under three drought scenarios, representing mild, moderate and severe droughts. Under a replica policy, a Replica Partner, the IO or NGO holding the insurance policy, develops a separate – but coordinated – contingency plan which is endorsed by the replicated government and must be consistent with the Standards & Guidelines for Contingency Planning developed by ARC (but does not have to go through the peer review and formal approval process.) So long as the government endorsed such a plan, a GPE-related replica policy could cover just school feeding as would be laid out in the replica contingency plan.

- **Selection of Coverage Conditions**: ARC coverage is not intended to be the sole risk financing strategy, and should not cover the entire drought risk for any particular country. Coverage conditions are put in place to scale down the actual risk quantum being transferred to ARC Ltd through the insurance policy in any given year. Coverage conditions comprise a trigger level of loss (usually the loss which would be endured every 2 to 5 years – so more frequent events will not reach the trigger point and no payout would flow), a total coverage limit (currently set at US$30 million, with most countries taking less), and a ‘ceding percentage’, which is a scaling factor to allow for only a portion of the risk in the risk transfer window (the part of the risk profile above the trigger level and within the coverage limit) to be transferred. Once coverage conditions have been selected, a pure risk amount can be calculated (equating to the expected annual payout under those coverage conditions averaged over a long time period), from which the premium is calculated (at a fixed multiple of the pure risk.)

It is anticipated that GPE, either through a GPE partner country or through an IO or NGO partner taking replica coverage, would take an insurance policy directly with ARC Ltd and would likely receive pricing at the same rate as the sovereign country participants. ARC Ltd would itself manage any need for additional reinsurance as a result of a GPE-related transaction. Substantial interaction with ARC would be required to facilitate such a transaction, although all of the different elements of such a transaction have been either tested or at least considered already.
A key component of the ARC system, which would have to be replicated for direct or replica coverage, and could be for coverage under L4D, is the preparation of a 'Final Implementation Plan' (FIP) which itemizes use of an actual payout once one is triggered. Further, ARC requires close adhesion to the FIP in the execution of the response funded by an ARC payout, and conducts both process and financial audits to ensure compliance and learn lessons for future implementations.

6.1.2 Coverage cost and potential benefits

To establish some approximate costs and benefits for a school feeding program implemented using risk financing through a GPE-sponsored insurance policy with ARC Ltd, we provide here relevant information from Niger, which featured school feeding in its Final Implementation Plan (FIP) for use of the payout it received in early 2015 following a mild drought in some areas of the country during the 2014 Sahel growing season (May – November).

- Niger purchased the full coverage limit available, US$30 million, for a premium cost of US$3 million, with the policy trigger level set at a 1 in 5 year return period (so the policy was set to trigger once every 5 years on average.)
- The school feeding program included in its FIP covered 5 months of nutrition support at a cost of ~US$35 per beneficiary.
- For each US$1 million of premium, almost 300,000 potential beneficiaries would be covered for 5 months of school feeding for an extreme (1 in 50 year) drought. Actual beneficiary numbers would be lower for smaller events, with a trigger point at a 1 in 4 to 1 in 5 year event.

6.2 Pilot B: Covering cyclone risk to education at the local level in Madagascar

Madagascar’s east coast runs for almost 1,000 miles across the main path for tropical cyclones in the Southwest Indian Ocean (SWIO). The northern third of that coast faces amongst the greatest extreme wind hazard of any land area in the world and, on average, two to three cyclones make landfall in Madagascar every year. Cyclone Enawo, which made landfall in northeastern Madagascar in early March 2017, was the most damaging storm in a decade, and is further described in Box 6.2.

At the national level, cyclone risk is relatively well understood, with discussions having taken place between development agencies, particularly the World Bank, and government officials for at least a decade. The enactment of cyclone-resistant building codes in 2010 was a key step forward in embedding risk reduction into national planning. The role of disaster preparedness has gained increasing prominence in the communities along the central and northern part of the east coast, with significant gains having been made in saving lives, including through dissemination of early warning, pre-disaster planning, and pre-positioning of vital supplies to aid early response.
Enawo was the fifth named storm and the third event of the 2016/17 Southwest Indian Ocean cyclone season to threaten land, following Carlos (which skirted Mauritius) and Dineo (which made landfall along the east coast of Mozambique). It formed as a storm to the east of Madagascar on 3 March, becoming a Tropical Cyclone with estimated wind speeds above 63 km/h on 5 March, two days before making landfall in Madagascar with peak winds in excess of 200 km/h.

Heavy rains and strong winds were experienced across much of the country resulting in coastal storm surge, flooding, landslides and some wind damage to infrastructure.

The Government of Madagascar estimated that almost half a million people were directly impacted by Enawo, around half of whom were displaced, at least temporarily. More than 40,000 houses were damaged, and education was suspended for 100,000 children.

Since 2016, the African Risk Capacity (ARC) has monitored tropical cyclone activity in the Southwest Indian Ocean through Africa RiskView (ARV), a disaster risk modeling and early warning platform that uses remotely-sensed, ground-based and modelled climate hazard information, both before and after climate events, to estimate population affected and economic loss from those events. These modelled losses are the underlying basis of parametric insurance policies issued by ARC Ltd, the financial affiliate of ARC Agency, which pools risk across the continent. ARC, through ARV, monitored Enawo from its inception and released regular updates on the current status of the cyclone and estimated peak wind and storm surge footprints based on forecasts from monitoring meteorological agencies. These updates (issued at the same frequency as new forecast information became available) provided wind and storm surge footprint maps, forecasts of population affected at the Province-level, and a timeline of forecast wind speed and storm surge height at selected locations (cities, airports, ports, etc.).

The ARC TC Model estimated that over 2.2 million people were affected by Enawo’s hurricane-force winds (i.e. winds above 73 mph (118 km/h)). The preliminary post-storm run of ARC’s tropical cyclone loss model produced government losses in Madagascar of almost US$53 million, ranking Enawo as the fourth most damaging tropical cyclone to impact Madagascar in the past 20 years.
Through the efforts of the Indian Ocean Commission (IOC) under the ISLANDS project and with the creation of the African Risk Capacity (ARC), disaster risk financing has become part of the conversation in recent years, and state of the art models for cyclone risk have been developed for SWIO. During 2016, ARC launched a parametric cyclone insurance program for SWIO countries in the African Union, including Madagascar, with coverage pooled with drought risk from across Africa to provide cost-effective rates for sovereign coverage.

ARC’s program includes comprehensive contingency planning requirements to ensure best use of payout funds when triggered, and ARC has developed Standards & Guidelines for Contingency Planning\(^1\) for sudden-onset disasters, which guide and set the bar for national contingency planning, with an emphasis on ensuring that the most vulnerable communities and households receive assistance at the earliest possible opportunity. ARC’s cyclone model has an early warning component, providing impact estimates (wind speed and storm surge height, population affected and losses) based on regional cyclone track and intensity forecasts, which support planning and early response. Insurance payouts are calculated within a couple of days of an event’s impact and, when triggered, financing can flow within a couple of weeks to support early recovery.

### 6.2.1 ARC cyclone coverage for the education system

Although the Government of Madagascar has not yet purchased cyclone coverage from ARC, the risk profiling and pricing analysis has been completed by ARC’s insurance company affiliate, ARC Ltd, providing a solid basis for developing a parametric insurance program specifically to cover damage and disruption in the education sector.

Disaster preparedness, planning and early recovery are also embedded at the community level in the education system (e.g. GPE-funded “Projet d’appui d’urgence à l’éducation pour tous”\(^2\); Cartier Foundation\(^3\); UNICEF\(^4\)), and with frequent cyclone impacts, strategies for quick response and recovery have been tested and lessons learned. However, post-cyclone recovery of the education system, driven from the community level, is still largely at the mercy of ex post emergency appeals funding, which is unreliable, slow to arrive and, oftentimes, funds programs which are not integrated with the Education Sector Plan.

Linking insurance-based post-disaster financing to contingency plans at the community level, developed as part of the ESP, and falling under ARC’s existing rules for use of funds (or a similar set of rules for this specific program), thus has both a demonstrated need and a credible delivery mechanism.

### 6.2.2 Capturing risk to the education sector

ARC Ltd operates a parametric insurance program, which has proven to be the most cost-effective mechanism for transferring natural catastrophe risk at the sovereign / sub-sovereign level in a development setting. Although data needs (in terms of exposure and vulnerability information) are lower

---

4. [unicef.org/madagascar/eng/emergencies.html](http://unicef.org/madagascar/eng/emergencies.html)
for parametric insurance programs, establishing a good proxy for the losses which are to be mitigated within a hazard or risk model remains important in designing a robust and cost-effective risk transfer solution. It should also be noted that parametric insurance is not necessarily suitable for financing small or frequent losses, which are both difficult to capture in a model environment and attract relatively high frictional costs (compared to the opportunity cost of annual budgeting of contingency funds to cover such events).

As has been described earlier in this report, capturing natural disaster risk in a model requires three elements, hazard, exposure (type, location and value) and vulnerability. In the ARC model used for sovereign risk in Madagascar, the exposure and vulnerability elements are generalized, operating on a 1-km grid and across four exposure types, each of which has a range of potential vulnerability. Data to feed the exposure and vulnerability modules is collected remotely, from population distribution, land cover and economic datasets, and the overall purpose is to reasonably replicate national level losses including both public and private sectors, and both direct damage and broader economic losses.

Within the ARC modeling framework, two approaches could be deployed to tune the parametric model to represent risk to and impact on the education sector, as follows:

- Simple scaling approach, which would downscale the national losses to losses impacting the education sector, a process which could be informed by education spend relative to GDP, or by comparison of documented education sector losses relative to national losses for historical events; or
- Introducing a specific education exposure and vulnerability dataset, on which the existing ARC hazard module would be overlaid to produce a full risk model, again calibrated with actual historical education sector losses.

We have investigated the availability of education sector data on infrastructure location, vulnerability and value for Madagascar and, while some work has been done in this regard, it is not systematic across the area at risk, it is of variable quality (especially in terms of vulnerability) and updating the information is not embedded within Ministry of Education systems and processes at present. So, while additional work could yield a dataset that was sufficient for the proposed purpose, and would be a worthwhile investment in building understanding of education sector vulnerability and guiding resilience investments, we prefer the simpler approach in the current context, in order to quickly pilot a risk financing program and start learning lessons. Should better data become available, the modeling approach could be modified.

In order to downscale the existing ARC cyclone model so that it reasonably represents impacts to the education system in Madagascar, we have identified the following datasets:

- Various damage and loss estimates for cyclones between 2004 (Gafilo) and 2017 (Enawo);
- AIR Worldwide SWIO-RAFI exposure database and model historical loss estimates;
- ARC model historical loss database;
- Education spend as a portion of GDP at the national level; and
- Education exposure, damage and loss values as a portion of total national values.
Annex 14 provides the actual data collected in this regard and specific to Madagascar (noting that the analysis presented in section 3.3 of this report is more generalized in nature. We conclude that direct damage to education infrastructure likely represents up to 5% of national damage and loss as estimated in the ARC tropical cyclone model, but that post-disaster needs in education exceed that, and are at least 10% of national needs\(^1\). Thus, we suggest that 10% of the national losses as calculated in the ARC parametric cyclone model would be a suitable baseline for evaluating an education-specific parametric cyclone coverage.

### 6.2.3 Transaction summary and projected costs / benefits

As described in section 6.1, a transaction with ARC could take any of three potential forms; a ring-fenced portion of sovereign coverage, dedicated replica coverage, or coverage through L4D. In all cases, this would likely be a new transaction for ARC and Madagascar (although Madagascar could conceivably purchase cyclone coverage for the 2017/18 season later in 2017.) In all but the last (L4D) scenario, a contingency plan meeting, or consistent with, ARC’s Standards & Guidelines would be required.

Using 10% of the ARC modeled national loss as the basis for evaluating coverage options, the following preliminary guidance on risk, pricing and potential payouts can be provided:

- Total annualized loss to the education system is ~US$2 million, with a 1 in 50 year loss of US$15.5 million.
- For coverage triggering once every 5 years and with a maximum payout for a 1 in 50 year event, the rate on line would be around 10%.
- For US$1 million annual premium, coverage of US$9.4 million could be purchased, with a ceding percentage of 73%. Thus, for all losses above the trigger level (US$2.7 million), the payout would be 73% of the additional loss, up to a maximum of US$9.4 million.
- For cyclone Enawo (see Box 6.2), the ARC full national modeled loss was just under US$53 million which, under the coverage conditions described above, would have led to a payout of US$1.9 million, or 75% of the funding requested for education in the emergency appeal.

\(^1\) National losses include some element of private sector losses, while needs are public sector only, and the education sector comprises a relatively larger portion of the public sector exposure than of the national exposure. Also, education sector needs are highly distributed (i.e. many small needs rather than a few large needs), so will generally be more costly to address relative to the loss captured in a model.
6.3 Pilot C: Pooled cover for multiple perils in small island ACP states

GPE partners with multiple small island developing states in the Caribbean, Africa and Pacific, as well as with several other African and Central American countries, all of which are covered by risk modeling for multiple sudden-onset natural perils including earthquakes and tropical cyclones. These risk models are operating as the basis for sovereign parametric insurance contracts under the auspices of CCRIF SPC (for the Caribbean and Central America), ARC (for the Southwest Indian Ocean countries) or PCRAFI Facility (for the Pacific).

Annex 15 lists GPE partner countries which are covered by modeling under these schemes and includes the covered perils, whether or not sovereign parametric insurance is being purchased already (as of end-2016), and includes status as Small Island Developing States (SIDS) and Africa-Caribbean-Pacific member states (both groupings having particular status under various bi- and multi-lateral funding arrangements, particularly for natural disaster risk.)

It would be relatively straightforward, assuming collaboration from all three risk pools as well as the included GPE partner countries, for GPE to purchase (or at least channel funding for purchase), directly from each pool, parametric insurance for the Ministry of Education in that country, using a fixed portion of the existing national losses (e.g. 10% as proposed for Madagascar in section 6.2) and either replicating existing coverage conditions in each country (for those that are already purchasing coverage) or applying constant coverage conditions across all countries (e.g. 75% ceding percentage with 1 in 5 year attachment and 1 in 50 year exhaustion levels) or on an ad hoc basis.

Such funding for insurance purchase should be tied to contingency planning in the case of a payout, to incentives for risk reduction embedded within ESPs, and should be underpinned by holding of contingency funds by GPE which could be deployed in a more flexible manner to cover smaller events and basis risk in the parametric models.

A more complex construct which would maximize the risk diversification benefits of covering all of these countries, or some significant subset of them, would be for GPE to set up its own risk financing vehicle\(^1\) and license the respective parametric models, so that it could effectively insure each of the ministries of education within the portfolio, and then reinsure on a portfolio basis. While theoretically attractive, this construct would require significant work to both set up and operate on an on-going basis, with potential diversification benefits likely to be rather limited in pure financial terms (assuming insurance policies from the each pool would be priced in the same way as the sovereign coverage currently being offered), though independence of operations would be a significant benefit to this approach.

\(^{1}\) In the public sector, existing multi-national risk pools have used a variety of structures to facilitate risk financing, including ownership of an insurance entity via a special purpose trust (CCRIF) or a charity / foundation (PCRAFI), or setting up a mutual insurance entity (ARC Ltd). In the private sector, so-called ‘captive’ insurance vehicles are commonplace; these are regulated insurers that are wholly-owned by an individual company or an affinity group (trade association, for example), and write policies only for that company or group. For natural catastrophe risks, such vehicles are often minimally capitalized and rely on reinsurance to bear most of the risk.
6.4 Pilot D: Natural catastrophe coverage in an un-modeled environment

This pilot aims to test risk financing in one of the large Asian countries where GPE and its partners have substantial investments in education systems, and where natural catastrophes have recently devastated, and will continue to impact, the delivery of education services.

Four potential targets for such a pilot are flooding in Pakistan, flooding or tropical cyclone impacts in Bangladesh, flooding in Myanmar, and earthquake impacts in Nepal. None of these countries has natural catastrophe modeling in place suitable for underpinning a parametric insurance program, and while the national risk profile for these hazards is quantified to a reasonable degree (except for flooding in Myanmar, which is poorly quantified to date), the risk to education systems is largely unknown, with little data available to undertake the necessary analysis.

The overall requirements for risk modeling have been described earlier in this report, and a specific project to quantify risk and set up a parametric model (or meet the demands of the market for considering an indemnity insurance program) on a stand-alone basis for any of these four countries would be a substantial undertaking, even if focused purely on the education sector. Piloting in a single region of one of these countries could reduce the up-front investment needs, but would not support the building of resilience across the full education sector nationally.

There are sovereign disaster risk financing conversations taking place in all four of these countries, involving World Bank, Asian Development Bank, ASEAN and others. One potential avenue for moving this possible pilot forward would be to involve the Ministry of Education directly in these sovereign conversations (which generally include Ministry of Finance and the agency responsible for disaster risk management), link LEGs to disaster risk management departments and committees particularly for contingency planning purposes, and coordinate risk reduction activities in the education sector being undertaken under GPE and partner funding to national programs and commitments.

In this way, the education sector could provide an opportunity for sovereign government and its partners to pilot structured disaster risk management and financing, bringing with it new financing which the education sector might not otherwise receive.

However, this potential pilot is by a significant degree the most involved, and would take significant resources to bring to market, before any of the lessons of a live program could start to be learned.
References