Tools, data and methodology in climate forecasting risk analytics for the Risk and Resilience Portal

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How does the Risk and Resilience portal support climate resilience?

Through the Portal, ESCAP offers technical support to countries for their National Adaptation Plans (NAPs), Voluntary National Reviews (VNRs), Nationally Determined Contributions (NDC) and DRR strategies.

(1) Understand the risk hotspots for populations and sectors (infrastructure and health) under various climate change scenarios,

(2) estimate the current and projected economic and non-economic losses and vulnerability under climate change,

(3) customize key adaptation priorities and estimate cost of adaptation to support climate goals,

(4) increase policy action at the local level risk through subnational level inform risk index to build capacity of local government bodies for DRR.
Mapping hotspots of risk and estimating population and infrastructure exposure under multi-hazard climate risk scenarios

Using population and vulnerability data, the Portal shows where the most vulnerable populations live, and which countries have the most vulnerable populations and the most exposed infrastructure.
Estimation of losses under current and climate change scenarios shows the current and projected amount of economic loss and which hazard produces the highest economic losses.
Estimation of adaptation costs under climate change and customized set of adaptation priorities for SSWA subregion and countries.

Investments in the adaptation priorities can support achievement of disaster-related SDG Goals and Targets:

SDG 1, 2, 4, 6, 11, 13, 14, 15
The Analytical Ecosystem of the Risk and Resilience Portal

**DATA TYPES**

Vector data (.shp/shapefile)
- Point
- Line
- Polygon (area)

The vector model represents the location and shape of geographic features using points, lines and polygons (and for 3D data also surfaces and volumes), while their other properties are included as attributes (often presented as a table in QGIS) (qgis.org)

Raster data (.tiff/georeferenced tiff)

Delimited text layer data, from spreadsheet (.csv)
Measuring exposure and vulnerability

Overall methodology

- Drought
- Flood
- Cyclone
- Heatwave

- Disability-adjusted life year (DALY)
- Population counts
- Health care infrastructure
- Energy, transport and ICT infrastructure

- Subnational Human Development Index (HDI)
Calculating population exposure to hazard risks (example cyclones)

Hazard (1) * Related health hazard (1) * Population
Normalized Hazard (1) * Normalized DALY (1) * Population

Risk map – Population exposure to cyclones and related health hazard under current scenario:

Cyclone hazard 100-year return period

Set the threshold: all values>0

Cyclone hazard 100-year return period

DALY for cyclone per 100,000 population

Normalized cyclone for flood per 100,000 population

Population counts in 2020

RISK MAP: POPULATION EXPOSED TO CYCLONES under current scenario
To visualize the hotspots, we use natural hazard and/or climate-related hazard data, biological hazard, and HDI datasets to create bivariate map.

Bivariate map presents two map patterns, which enables to show where patterns overlap or diverge.

The first layer is called hazard with socio-economic vulnerability layer. By using ArcGIS, the hexagonal type of data in 100 x 100 km are prepared, by getting mean values for each hexagon from the normalized data for hazard, biological hazard and HDI.

Then, these three layers of data are summed up to get hazard with socio-economic vulnerability layer.

Finally, the population layer is added to the bivariate map, by preparing similar hexagonal type of data in 100 x 100 km from the Worldpop Population Counts. These two layers then overlaid, in order to get the hotspots of population exposure. By using natural breaks method, the values in bivariate maps are classified into 3 classes for each variable.

The vertical axis depicts on population (high, medium and low), and horizontal axis shows composite of hazard, DALY and SHDI in 3 categories (high, medium, and low).
AAL is the mean loss (the “expected value”) that occurs in any given year and represents a long-term average as a risk assessment for potential losses each year.

The risk assessment requires three analytical steps, as follows:

• Hazard assessment: For each of the natural phenomena considered, a set of events is defined along with their respective frequencies of occurrence which is an exhaustive representation of said hazard. Each scenario contains spatial distribution parameters that will permit the construction of the probability distributions for the intensities produced by their occurrence.

Definition of the inventory of exposed assets: An inventory of the exposed assets must be constructed, and this should specify the geographical location for each, and the following main parameters to classify them: a) Replacement value and b) Building class to that the asset belongs.

• Vulnerability of the exposed assets: Each building class must be associated to a vulnerability function for each type of hazard. This function characterizes the structural behavior of the asset during the occurrence of the hazard phenomena. The vulnerability functions define the loss probability distribution as a function of the intensity produced during a specific scenario. This is defined through a set of curves that relate the expected value of damage and standard deviation of damage with the intensities for each scenario. The hazard associated with a natural phenomenon is measured using its frequency of occurrence and its severity.

The damage susceptibility of every asset exposed to the considered natural hazards is modeled through vulnerability functions.

The loss is generally understood as the loss relative to the replacement value of the exposed element. In general, an exposed element is any object that is susceptible to suffer damage or loss because of the occurrence of a hazardous event. The calculation of the loss exceedance probability curve constitutes the most appropriated method to assess the risk. From this curve, it is possible to derive risk metrics such as the average annual loss (AAL) and the probable maximum loss (PML), that can be assessed for one or more return periods.
Measuring adaptation cost under climate change scenarios

Climate adaptation cost = Adaptation cost for climate-related hazard + Adaptation cost for health-related hazard

* Following a World Bank study, the cost of climate proofing, for example, is taken to be 20 per cent of the financial exposure to climate-related hazards. The Pacific small island developing States are an exception where the exposure is taken to be 40 per cent, given the higher infrastructure losses during disasters.

Adaptation cost for climate-related hazard = Climate related hazards (flood, tropical cyclone, drought) AAL under RCP 8.5 * Climate adaptation multiplier

Adaptation cost for health-related hazard = Biological hazards AAL under RCP 8.5 * Health adaptation multiplier

* Similarly, following a UNFCCC study, the health-related costs of adaptation are equivalent to one-third of health-related losses. For financial exposure and total losses, the proxy used is the average annual loss.
Measuring adaptation cost under climate change scenarios

**TABLE 4-2** Annual adaptation cost under RCP 8.5 by subregion, billions of US dollars

<table>
<thead>
<tr>
<th>Subregion</th>
<th>Climate-related hazard AAL (flood, tropical cyclone, drought)</th>
<th>Adaptation cost for climate-related hazards</th>
<th>Biological hazard AAL</th>
<th>Adaptation cost for biological hazards</th>
<th>Total climate adaptation cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>East and North-East Asia</td>
<td>640</td>
<td>130</td>
<td>180</td>
<td>61</td>
<td>190</td>
</tr>
<tr>
<td>North and Central Asia</td>
<td>9.2</td>
<td>1.8</td>
<td>0.66</td>
<td>0.22</td>
<td>2.1</td>
</tr>
<tr>
<td>South and South-West Asia</td>
<td>230</td>
<td>47</td>
<td>13</td>
<td>4.4</td>
<td>51</td>
</tr>
<tr>
<td>South East Asia</td>
<td>102</td>
<td>20</td>
<td>5.9</td>
<td>2.0</td>
<td>22</td>
</tr>
<tr>
<td>Pacific</td>
<td>21</td>
<td>4.5</td>
<td>2.2</td>
<td>0.74</td>
<td>5.2</td>
</tr>
<tr>
<td>Total</td>
<td>1000</td>
<td>200</td>
<td>200</td>
<td>68</td>
<td>270</td>
</tr>
</tbody>
</table>
Thank you

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