Resilient Infrastructure: underpinned by robust and usable risk information

Alanna Simpson PhD
Innovation Lab
World Bank Group
Risk Information = Evidence Based Decision Making

Risk Assessment
- (current and future climate and socio-economic conditions)

Hazard Assessment
- (current and future climate)

Reducing **existing** risks

Preventing the creation of **new** risks

Resilient Infrastructure

Sectorial (national/sub-national)
- Asset level (incl. cost-benefit analysis)
- Critical infrastructure, including cascading impacts
- Decision making under deep uncertainty
- Building and infrastructure standards
- Disaster and Climate Screening
- “Soft” resilience measures

Critical infrastructure, including cascading impacts
Risk Information = Evidence Based Decision Making

Available Data, Tools and Information

DATA
- Climate Change Knowledge Portal
- National-Level Resilience Indicator
- GFDRR GeoNode
- Sectoral Climate Risk Management Tools (IFC)

INFORMATION
- Think Hazard!

TOOL/APPROACH
- Climate Change Screening Tool
- GeoSAFE (web-based impact scenarios)
- InaSAFE (GIS based deterministic models)
- Probabilistic hazard & risk modelling (current and future)
- Decision making under deep uncertainty

Increased complexity / resource requirements
<table>
<thead>
<tr>
<th>INITIAL SCREENING</th>
<th>DESIGN</th>
<th>IMPLEMENTATION/MONITORING</th>
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<tr>
<td>Think Hazard!</td>
<td>GeoSAFE and InaSAFE</td>
<td>Climate Finance Tracking /</td>
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<tr>
<td>Climate Change Screening Tool</td>
<td>Probabilistic hazard &amp; risk</td>
<td>Climate Resilient Finance</td>
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<td></td>
<td>modelling (current and future)</td>
<td>Metric</td>
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<td>Positive list of Adaptation</td>
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<td>Projects</td>
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<td>Climate Resilient Asset</td>
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<td>Guidance Notes</td>
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<td>Resilience Monitoring and</td>
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<td>Evaluation (ReM&amp;E)</td>
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<td>National-Level Resilience</td>
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<td>Indicator</td>
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<td>GFDRR GeoNode</td>
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**Project Phases**

- Risk Information = Evidence Based Decision Making
- Climate Change Screening Tool
- Sectoral Climate Risk Management Tools (IFC)
- Climate Change Knowledge Portal
- Decision making under deep uncertainty
- National-Level Resilience Indicator
- GFDRR GeoNode

**Tools and Metrics**

- Think Hazard!
- GeoSAFE and InaSAFE
- Probabilistic hazard & risk modelling (current and future)
- Climate Finance Tracking / Climate Resilient Finance Metric
- Positive list of Adaptation Projects
- Climate Resilient Asset Guidance Notes
- Resilience Monitoring and Evaluation (ReM&E)
- National-Level Resilience Indicator

**GFDRR**

- GeoNode
INITIAL PROJECT SCREENING
Contact: Ana Bucher
Enabling Resilient Growth
Climate change and disasters pose a growing threat to development progress. We have tools to help you screen for climate and disaster risks at early stages of project design and planning processes. Read More »
Contact: Alanna Simpson
www.thinkhazard.org
Thailand

River flood: High
Cyclone: High
Landslide: High
Earthquake: Medium
Water scarcity: Medium
Coastal flood: Very low
Volcano: Very low
Tsunami: No data available
Cyclone

Hazard level: High

In the area you have selected (Thailand) cyclone (also known as hurricane or typhoon) hazard is classified as high according to the information that is currently available. This means that there is more than a 20% chance of potentially-damaging wind speeds in your project area in the next 10 years. Based on this information, the impact of cyclones must be considered in all phases of the project, in particular during design and construction. Project planning decisions, project design, and construction methods should take into account the level of cyclone hazard. Note that damages can not only occur due to wind but also cyclone induced heavy rainfall and subsequent flooding as well as coastal floods in coastal areas. Further detailed information should be obtained to adequately account for the level of hazard.

Climate change impact: Global average tropical cyclone wind speed and rainfall is likely to increase in the future, and the global average frequency of tropical cyclones is likely to decrease or remain unchanged. It is possible that the frequency of the most intense tropical cyclones will increase substantially in some ocean regions (IPCC, 2013). The present hazard level in areas currently affected by tropical cyclones may increase in the long-term. Projects located in such areas should be robust to future increases in cyclone hazard.

Recommendations

- **INSURANCE:** For cyclone wind risks that cannot be mitigated, consider insurance products specifically aimed at alleviating the financial costs associated with wind risk. 
  
- **INTERACTING HAZARDS:** Project planning, design, and construction practices should account for strong wind from potential cyclones in your project area.

**DATA SOURCES**

Impact Forecasting, UNISDR
River flood

Hazard level: **High**

In the area you have selected (Thailand) river flood hazard is classified as **high** according to the information that is currently available to this tool. This means that potentially damaging and life-threatening river floods are expected to occur at least once in the next 10 years. **Project planning decisions, project design, and construction methods must take into account the level of river flood hazard.** Surface flood hazard in urban and rural areas is not included in this hazard classification, and may also be possible in this location. The following is a list of recommendations that could be followed in different phases of the project to help reduce the risk to your project. Please note that these recommendations are generic and not project-specific.

Climate change impacts: Medium confidence in more frequent and intense heavy precipitation days and an increase in the number of extreme rainfall events. The present hazard level may increase in the future due to the effects of climate change. It would be prudent to design projects in this area to be robust to river flood hazard in the long-term.
In the area you have selected (Thailand) river flood hazard is classified as high according to the information that is currently available to this tool. This means that potentially damaging and life-threatening river floods are expected to occur at least once in the next 10 years. Project planning decisions, project design, and construction methods must take into account the level of river flood hazard. Surface flood hazard in urban and rural areas is not included in this hazard classification, and may also be possible in this location. The following is a list of recommendations that could be followed in different phases of the project to help reduce the risk to your project. Please note that these recommendations are generic and not project-specific.

Climate change impacts: Medium confidence in more frequent and intense heavy precipitation days and an increase in the number of extreme rainfall events. The present hazard level may increase in the future due to the effects of climate change. It would be prudent to design projects in this area to be robust to river flood hazard in the long-term.
Recommendations

- Location assessment: The high-level information available in this tool may indicate the presence of river flood hazard in your project area. Before committing significant resources to this issue, a study of the surrounding landscape can help you to assess whether more detailed assessment and/or intervention should be considered. More information

- Obtain pre-existing flood hazard information: The high-level information available in this tool may indicate the presence of flood hazard in your project area. However, because flood hazard can change dramatically over short distances, the exact geographical location of your project should be checked against pre-existing flood hazard information. More information

- Professional guidance: Consultation with professionals will provide a more detailed understanding of the risk posed to your asset by flooding. The level of guidance required will depend upon the level of hazard present, the vulnerability of the asset and local legislation that might apply. More information
Think Hazard! – *version 2 (release July 1)*

- Spanish and French language. API.
- Enhanced visualization of “aggregate” levels, and improved method for riverine flood
- Inclusion of urban flood, air quality, wildfire and extreme heat
- Higher resolution and more recent riverine flood, cyclone & earthquake data
- National level contact details for each peril
PROJECT DESIGN
Hazard datasets

We maintain a curation of hazard datasets at the global and country level. Tools like ThinkHazard! use these datasets in the backend.

- **Earthquake**: 212 datasets
- **Drought**: 11 datasets
- **River Flood**: 78 datasets
- **Tsunami**: 4 datasets
- **Coastal Flood**: 71 datasets
- **Strong Wind**: 42 datasets
- **Volcanic**: 1 dataset
- **Landslide**: 6 datasets
FL-GLOBAL-GLOFRIS-50
Geoscientific Information by GLOFRIS

FL-GLOBAL-GLOFRIS-25
Geoscientific Information by GLOFRIS
Analysis Results

In the event of tsunami (comco model / batticaloa, sri lanka) how many buildings might be flooded

<table>
<thead>
<tr>
<th>Building type</th>
<th>Number flooded</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>15,037</td>
<td>32,955</td>
</tr>
<tr>
<td>Commercial</td>
<td>998</td>
<td>2,000</td>
</tr>
<tr>
<td>Government</td>
<td>510</td>
<td>800</td>
</tr>
<tr>
<td>Hospital</td>
<td>31</td>
<td>122</td>
</tr>
<tr>
<td>Industrial</td>
<td>68</td>
<td>188</td>
</tr>
<tr>
<td>Other</td>
<td>570</td>
<td>2,026</td>
</tr>
<tr>
<td>Place of worship</td>
<td>489</td>
<td>1,000</td>
</tr>
<tr>
<td>Residential</td>
<td>11,909</td>
<td>25,825</td>
</tr>
<tr>
<td>School</td>
<td>284</td>
<td>493</td>
</tr>
<tr>
<td>Utility</td>
<td>178</td>
<td>501</td>
</tr>
</tbody>
</table>

Action Checklist:

- Are the critical facilities still open?
- Which structures have warning capacity (e.g. sirens, speakers, etc.)?
- Which buildings will be evacuation centres?
- Where will we locate the operations centre?

Contact: Vivien Deparday
Probabilistic Risk Assessment

- **Aim:** Provide estimates of potential costs and benefits of a set of possible risk reduction measures, and mainstream disaster risk into project design and implementation.

- **Current and future climate**
- **Drought, flood, avalanche and earthquake**
Aim: Provide estimates of potential costs and benefits of a set of possible risk reduction measures, and mainstream disaster risk into project design and implementation.

Current and future climate

Drought, flood, avalanche and earthquake

Table 3.33: CBA calculations for Kabul and Panj Amur case studies (details in appendix B)

<table>
<thead>
<tr>
<th>Description</th>
<th>Economic growth rate</th>
<th>IRR</th>
<th>Investment</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>7.0%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cash Flow</td>
<td></td>
<td></td>
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<tr>
<td>Agriculture area Kunduz (20 years)</td>
<td>9.140</td>
<td>13.5%</td>
<td>(3,200)</td>
<td>301</td>
</tr>
<tr>
<td>Puli Khumri (20 years)</td>
<td>8.152</td>
<td>29.0%</td>
<td>(990)</td>
<td>223</td>
</tr>
<tr>
<td>Fayzabad (20 years)</td>
<td>3.918</td>
<td>22.0%</td>
<td>(694)</td>
<td>113</td>
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<tr>
<td>Fayzabad (20 years) +</td>
<td>3.275</td>
<td>12.1%</td>
<td>(1,337)</td>
<td>113</td>
</tr>
<tr>
<td>Kabul Flood wall</td>
<td>21.043</td>
<td>138.4%</td>
<td>(398)</td>
<td>523</td>
</tr>
<tr>
<td>Puli Khumri (20 years) +</td>
<td>8.059</td>
<td>26.9%</td>
<td>(1,083)</td>
<td>223</td>
</tr>
<tr>
<td>Kabul Flood proofing (1/20)</td>
<td>9.639</td>
<td>12.2%</td>
<td>(3,890)</td>
<td>330</td>
</tr>
<tr>
<td>Kabul Flood proofing (1/50 + 20 years)</td>
<td>9.288</td>
<td>10.3%</td>
<td>(4,712)</td>
<td>341</td>
</tr>
<tr>
<td>Kabul Flood proofing (1/20 + 20 years)</td>
<td>9.640</td>
<td>12.2%</td>
<td>(3,889)</td>
<td>330</td>
</tr>
<tr>
<td>Kabul Flood proofing (1/50 + 50 years)</td>
<td>133.914</td>
<td>10.3%</td>
<td>(4,712)</td>
<td>341</td>
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<tr>
<td>Kabul Flood proofing (1/100 + 100 years)</td>
<td>4.439.744</td>
<td>9.6%</td>
<td>(5,273)</td>
<td>359</td>
</tr>
</tbody>
</table>
Asset Level Analysis

- Roadmaps (guidelines) under development to build resilience to climate change into:
  - Urban water supply and sanitation systems
  - Hydropower
- Focused on development specialists and investors
- Action orientated advice on the design and maintenance of hydropower and water supply investments
- Highlights the importance of decision making under uncertainty when climate models lack consensus on trends related to rainfall and heat.

Contact: Laura Bonzanigo
What will the future be?

What is the best near-term decision?

How sensitive is our decision to our predictions?

What are the available strategies?

Identify vulnerabilities of these strategies

Develop strategy adaptations to reduce vulnerabilities

“Predict Then Act”

Decision Making Under Uncertainty Runs the Analysis Backwards

Decision Making Under Uncertainty (DMU)
Prioritizing Interventions

• Aim: Improve rural accessibility and agricultural production through resilient road access
• Assessment enables the prioritization of districts for transportation investment
• Flood maps considered low, medium, high climate scenarios over 10 return periods
Prioritizing Interventions

Investment 3 (bridges and culverts) is the best option in 98% of scenarios and has a BCR >1 in 95%.

It has the highest saved trips/dollar ratio.

Contact: Julie Rozenberg
Stephane Hallegatte
To develop or not to develop in Colombo

Let’s focus on infrastructure so that we can build hotels in the wetlands!

Let’s protect the wetland to reduce flood risks
To develop or not to develop in Colombo

Contact: Julie Rozenberg
Stephane Hallegatte