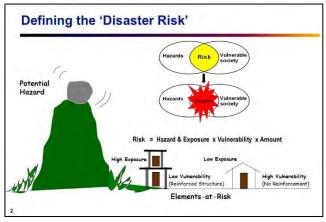
A Cloud-based Open-Source Platform for Multi-hazard Risk Assessment Dr. Manzul K. Hazarika, Ph.D.

Director, Geoinformatics Center Asian Institute of Technology (AIT), Thailand



Thank you very much. Thank you for inviting me to this important conference.

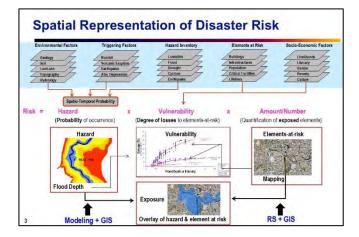
Today, my presentation is "A Cloud-based Open-Source Platform for Multi-hazard Risk Assessment".



• Defining the 'Disaster Risk'

- Disaster risk is a function of hazard, exposure, and vulnerability. Disaster risk is normally expressed as the probability of loss of life or destroyed or damaged assets in a given period of time.
- Hazard refers to hazardous events such as floods, storms, droughts, and earthquakes.
- Exposure refers to the location of people or economic assets in hazard-prone areas.
- Vulnerability is used to refer to their susceptibility to suffering damage and loss.

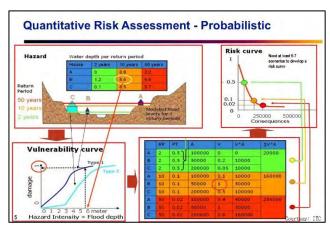
• Spatial Representation of Disaster Risk



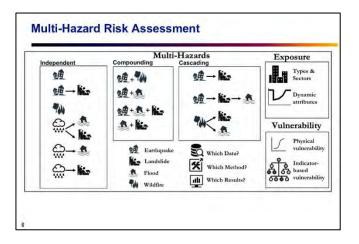
- Hazards maps are prepared using models showing the extent and intensity of a hazard for a given return period.
- Vulnerability functions show the level of damage for a given hazard intensity
- Exposure shows the elements-at-risk such as people, infrastructure, housing etc. located in hazard-prone areas.
- Quantitative (Absolute) Risk Assessment Asset

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Risk = Hazard		High Risk Zone to Settlement permitted) Vulnerability	<u> </u>	Amount (Building/Asset)	(Total Risk)
Risk = Hazard Risk _{it} = 0.1		Wigh Risk Zone to Settlement permitted) Vulnerability x 0.5	<u> </u>	Amount (Building/Asset) x 100,000	(Total Risk) = 5,000 US\$

- Risk = Hazard x Vulnerability x Amount of exposed elements-at-risk
- Risk mitigation measures could be adopted based on the risk level and the cost of mitigation measures.
- Quantitative Risk Assessment Probabilistic



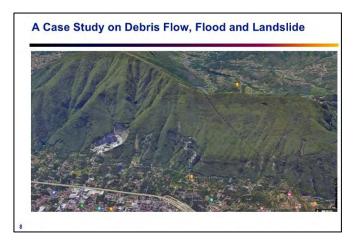
- Risk is dynamic, and it depends on hazard intensities, exposures, and vulnerabilities.
- Risk is expected to get worse due to climate change as we can expect extreme rainfall or drought conditions.
- To accommodate the effect of climate change and other factors, risk is estimated in a probabilistic manner.
- Multi-Hazard Risk Assessment



- Hazards may be independent (single), compounding (combined), or Cascading (sequential).
- Multi-hazard means a specific context where hazardous events may occur simultaneously, cumulatively, or cascadingly over time, taking into account the potential interrelated effects

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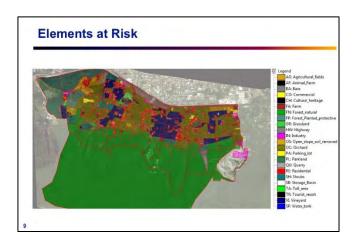
- Multi-Hazard ~ Analyze the risk for multiple natural hazards and their interactions.
- Multiple Assets ~ Analyze the risk for multiple asset types with varying spatial characteristics.
- Vulnerability Database ~ Inbuilt database of vulnerability curves.
- Multi-User ~ Different users can work on the same project.
- Compare Risk ~ Current risk can be compared with future scenarios and planning alternatives



• A Case Study on Debris Flow, Flood and Landslide

This case study shows the risk from debris flow, flood and landslide and amount of risk reductions from various risk reduction measures

• Elements at Risk



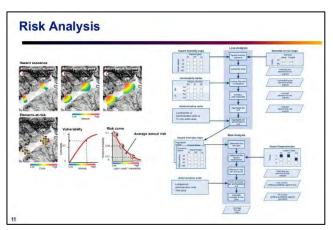
This map shows the elements at risk in terms of land parcels such as agriculture lands, forest areas, residential areas, commercial areas, cultural heritage areas etc.

• Vulnerability Functions

Hazard type	Intensity type	Buildings (BU)	Land parcels (LP)
Flood (FL)	Water depth	Physical vulnerability (PH)	Physical vulnerability (PH)
	(in cm)	Population vulnerability (PO)	Population vulnerability (PO)
Debris flows and	Impact pressure	Physical vulnerability (PH)	Physical vulnerability (PH)
mudflows (DF)	(in KPa)	Population vulnerability (PO)	Population vulnerability (PO)
Landslides (LS)	No intensity	Single vulnerability value per type	Single vulnerability value per type
x0		- Agricultural	
0//	1	Com me	cial
0	1-	Farm	Forest
	12	Grasslan	
	-	- Orchard	

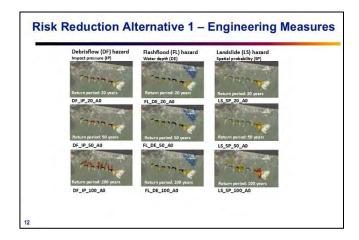
Physical vulnerability curves for differed land parcels. The graph shows the vulnerability from floods.

Risk Analysis



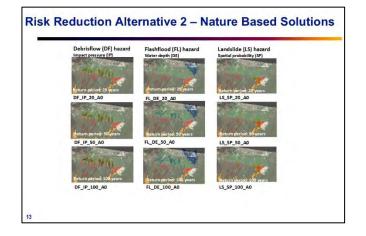
For multi-hazard risk assessment, loss from each hazards are estimated, and then aggregated to estimate the risk in terms of annual average loss.

• Risk Reduction Alternative 1 – Engineering Measures



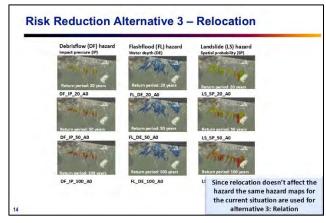
Engineering measures for risk reduction

• Risk Reduction Alternative 2 – Nature Based Solutions



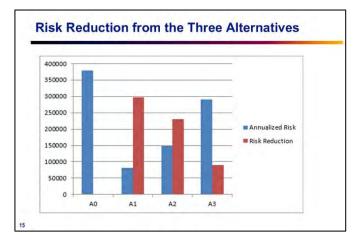
Nature-based solutions for risk reduction

• Risk Reduction Alternative 3 – Relocation



Relocation of settlement to avoid the risks.

• Risk Reduction from the Three Alternatives



Risk reduction accomplished from the three alternatives.

Conclusions

Conclusions The multi-hazard risk assessment is a holistic approach to understand risk at a given location. The RiskChanges is an open-source platform for multi-hazard risk assessment at the local level. It is a spatial decision support tool to help decision makers to compare available risk mitigation alternatives and select the best risk mitigation measures.

- The multi-hazard risk assessment is a holistic approach to understand risk at a given location.
- RiskChanges is an open-source platform for multi-hazard risk assessment at the local level.
- It is a spatial decision support tool to help decision makers to compare available risk mitigation alternatives and select the risk mitigation measures.



Thank you very much.