Disaster Risk Assessment:
Understanding the Concept of Risk

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Training Workshop on Drought Risk Assessment for the Agricultural Sector – Ljubljana, Slovenia, Sept.20-24, 2010
Session Outline

• What is Risk?
• How to describe it?
• How to rank/evaluate it?
• How to categorize it?
• How to classify it?
Risk Triangle

Risk = Hazard x Exposure x Vulnerability
Hazard are NOT Risk!

Risk = 0

No construction

Risk = 0

No construction

Risk = 0

No construction
Development Generate Risk!

Risk = 0
No construction

There is risk
Bad construction
No planning

Very low risk
Good construction
Good planning

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Hazard may **NOT** cause Disaster!

Risk = 0

Disaster risk
- Difficult to control

Minor risk
- Controllable

We, with our decisions, increase or reduce the risk

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Reducing the Risk

\[
\text{Risk} = \text{Hazard} \times \text{Exposure} \times \text{Vulnerability}
\]

If we want to reduce the risk (ALARP): \( R \rightarrow 0 \)

- **Hazard** \( \rightarrow 0 \) (Impossible if hazard cannot be controlled)
- **Exposure** \( \rightarrow 0 \) (Impossible if the exposed object is needed)
- **Vulnerability** \( \rightarrow 0 \)

**NOTE:** It is also possible to increase the risk!
Risk = Likelihood/probability/chance

Risk = Expected casualties, damage or loss

Risk = Others (i.e. exposure, conditions)

Risk = Combined Measurement or expression or product of consequence and probability

Risk = Event or Hazard or threat

Risk = Uncertainty
What is Risk?

Risk is Potential Loss!

Risk is referred to as potential losses associated with a hazard or an extreme event to a given place within a given period of time, which can be defined in terms of the adverse consequences (damage/losses) and the probability of occurrence.
Composition of Loss

- Physical Damage
- Socio-Economic impacts
- Functioning Disruption
Total Loss of 1987 Earthquake in Ecuador

Ecuadorian Oil pipeline – 1987 Earthquake

Damage to the oil pipe

Environmental Impact

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GRIP - Global Risk Identification Programme, UNDP Bureau for Crisis Prevention and Recovery, +41 22 9178399, info@gripweb.org, www.gripweb.org
Total Loss of 1987 Earthquake in Ecuador

Ecuadorian Oil pipeline – 1987 Earthquake

**Physical Damage** = 60 km Pipeline, $$?

**Functioning Disruption** = 6 months no oil export

= 70% annual revenue, $$$

**Macro-Impact** = 5 year economic recession, $$$$$$
Risk is increasing…

- The pipeline crosses seven national parks and protected areas, including a World Bank Global Environment Facility biodiversity reserve.
- The oil exports’ revenues now play an even larger role in the country’s economy.

Ecuadorian Oil pipe – November 2002
Loss/impacts of Volcanic Ash Disaster

Iceland Volcano Eruption

• Physical damage: minor
• Functioning Disruption (by April 19, 2010, EASO):
  - Around 30 countries’ airspace closed or restricted
  - 313 airport closed or paralyzed
  - 63,000 flights cancelled
  - 6.8 million passengers stranded
• Impacts:
  - important socio-political occasions cancelled or affected
  - Decrease in economic growth rate by 1-2% in EC
  - Kenya flower export lost 2 million US$/per day

• Total Direct Loss = 1.7 billion US$ globally (IATA)
How to Understand Risk?

Understanding Risk

- How likely is it?
- What can happen?
- What are the impacts?

Risk Assessment Foundation

- Historic experience
- Analytic methods
- Knowledge & intuition

(Source: Mitchell, 2004)
How to describe risk?

A classic description of a risk:
A flood event with an annual probability of occurrence of 10% will cause 1 million $ loss to the agriculture Sector in next 5 years.
How to rank/evaluate risk?

• By taking both the possibility and the possible consequences into consideration in a compound estimation

• By focusing on the possibility of one or several negative outcomes

• By focusing on the possible consequences

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Simple Risk Ranking Formula

\[ \text{Risk} = \text{Loss} \times \text{Probability} \]

\[ \text{Expected Value} = \text{Loss} \times \text{Probability} \]
The Social Dimension of Risk

• Risk affects different people differently;
• Impacts of risk may cross the territory;
• Risk perception and concern is different from people to people, from community to community, and from municipality to municipality due to their different thinking, feeling and action;
• Needs for and capacity of risk reduction is different from people to people.
Fallacy of the standard formula

(Haimes, 2005)

Example:

Non disaster scenario (R1):
Probability = 10%, Loss = 10,000 $

Disaster scenario (R2):
Probability = 0.1%, Loss = 1 million $

Expected Value: R1 = R2 = 1000 $

Disaster risk = Non-disaster risk

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Frequent, non-disastrous event:

- Expected Value: $1000 \times 1$
- Social-political, psychic impacts:

Rare, disastrous event:

- Expected Value: $1 \times 1000$
- Social-political, psychic impacts:
Modified Risk Ranking Formula (Schneider, 2006)

\[ EV = L \cdot P \cdot f(L) \]

Where

- \( EV \) – Expected Value
- \( L \) - Loss;
- \( P \) - Probability;
- \( f(L) \) - Risk aversion factor
Generalized Risk Ranking

Formula

\[ EV = P \cdot L^x \]

Where \( x \) is a power that depends on a number of factors, e.g. Social, economic, politic, psychic etc., but whose numerical value is always greater than 1. [Smith (2001); Whyte and Burton (1982)]
Risk Ranking Formula: Examples

Switzerland (Ammann, 2006)

\[
 f(L) = L^{0.8}
\]

\[
 EV = L \cdot P \cdot L^{0.8} = L^{1.8} \cdot P
\]

Schneider (2006)

\[
 EV = P \cdot L^2
\]

Where \( P \)-probability; \( L \)-loss; \( f(L) \)-risk aversion factor
How to categorize risk?

- By hazard
  - Earthquake risk, flood risk, etc.
- By target system
  - National risk, urban risk, community risk
- By the severity of the consequences
  - Disaster risk, major risk, minor risk
- By the frequency of occurrence
  - Rare, occasional, frequent risk
- By other factors
  - Individual/collective, acceptable/unacceptable, voluntary/involuntary risk
How to classify risk? (1)

Risk Matrix (1)

<table>
<thead>
<tr>
<th>Risk Level</th>
<th>Minor</th>
<th>Moderate</th>
<th>Major</th>
<th>Serious</th>
<th>Disastrous</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very likely</td>
<td>5</td>
<td>20</td>
<td>45</td>
<td>80</td>
<td>125</td>
</tr>
<tr>
<td>Likely</td>
<td>4</td>
<td>16</td>
<td>36</td>
<td>64</td>
<td>100</td>
</tr>
<tr>
<td>Medium likely</td>
<td>3</td>
<td>12</td>
<td>27</td>
<td>48</td>
<td>75</td>
</tr>
<tr>
<td>Unlikely</td>
<td>2</td>
<td>8</td>
<td>18</td>
<td>32</td>
<td>50</td>
</tr>
<tr>
<td>Very unlikely</td>
<td>1</td>
<td>4</td>
<td>9</td>
<td>16</td>
<td>25</td>
</tr>
</tbody>
</table>

Risk Level:
- Very high risk
- High risk
- Moderate risk
- Low risk
- Very low risk

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How to classify risk? (2)

- **Disaster risk**: Potential loss that has an implication of disaster to a community.

- **Major risk**: Potential loss that doesn’t imply a disaster to a community, but is serious.

- **Chronic (minor) risk**: Small potential loss that occurs frequently.
How to classify risk? (3)

Risk Matrix (2)

- Very likely
- Likely
- Medium likely
- Unlikely
- Very unlikely

- Minor
- Moderate
- Major
- Serious
- Disastrous

- Intolerable & unacceptable, risk reduction required (ALARA)
- Tolerable but unacceptable, emergency plans essential

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## Classification of Severity

<table>
<thead>
<tr>
<th>Class</th>
<th>Rank</th>
<th>Fatality</th>
<th>Injury</th>
<th>Critical Facility</th>
<th>Critical Instr.</th>
<th>Property (houses)</th>
<th>Envi. Impact</th>
<th>Socio-Economic Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catastrophic</td>
<td>5</td>
<td>&gt;50</td>
<td>&gt;100</td>
<td>Long-term disruption</td>
<td>Long-term interruption</td>
<td>Widespread &amp; Severe</td>
<td>Widespread &amp; Severe</td>
<td>Long-term &amp; widespread</td>
</tr>
<tr>
<td>Disastrous</td>
<td>4</td>
<td>10-50</td>
<td>50-100</td>
<td>Loss of 50% capacity</td>
<td>Interruption Of a month</td>
<td>Localized &amp; severe</td>
<td>Localized &amp; severe</td>
<td>Extended &amp; widespread</td>
</tr>
<tr>
<td>Serious</td>
<td>3</td>
<td>5-10</td>
<td>10-50</td>
<td>Closure of a week</td>
<td>Interruption Of a week</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Widespread</td>
</tr>
<tr>
<td>Moderate</td>
<td>2</td>
<td>2-5</td>
<td>5-10</td>
<td>Closure of A few days</td>
<td>Interruption of a few days</td>
<td>Localized damage</td>
<td>Localized damage</td>
<td>Temporary &amp; widespread</td>
</tr>
<tr>
<td>Minor</td>
<td>1</td>
<td>&lt;2</td>
<td>0-5</td>
<td>Temporary disruption</td>
<td>Temporary interruption</td>
<td>Minimal damage</td>
<td>Minimal damage</td>
<td>Temporary impact</td>
</tr>
</tbody>
</table>
Summary

• Risk is referred to as potential losses associated with a hazard or an extreme event to a given place within a given period of time, which can be defined in terms of the probability of occurrence of the event and the adverse consequences (damage/losses).

• Risk can generally be ranked by the product of the possibility of occurrence and the possible consequence. However, depending on the type of risk, it can also expressed by focusing on the probability of occurrence or focusing on the consequence.

• Risk has dual dimensions - objective (physically measured) and subjective (socially-evaluated).

• Natural risk is a function of natural hazard, exposure of risk receptors, and their vulnerability to the hazard.
Any Questions?