Disasters in ASEAN Countries: Current Status and Research Needs

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Outline

• Disasters: Global overview
• Disaster risk profile of ASEAN region
• Hydro-met disasters:
  – Global scenario
  – ASEAN region
  – Climate change
  – Responding to hydro-met disasters
• Sendai framework for DRR
• Challenges of managing hydro-met disasters
Disasters: Global overview

Natural loss events worldwide 2015
Geographical overview

(Source: NatCatSERVICE, Munich Re 2016)
Disasters: Global overview

Loss events worldwide 2015
Percentage distribution

Number of events: 1,060
- 6%
- 41%
- 42%
- 11%

Overall losses: US$ 100bn
- 7%
- 47%
- 28%
- 18%

Fatalities: 23,000
- 42%
- 10%
- 24%
- 24%

Insured losses: US$ 30bn
- 2%
- 69%
- 19%
- 10%

(Source: NatCatSERVICE, Munich Re 2016)
## Top 10 Global risks for 2015

<table>
<thead>
<tr>
<th>In terms of Likelihood</th>
<th>In terms of Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Large-scale involuntary migration</td>
<td><strong>1. Failure of climate-change mitigation and adaptation</strong></td>
</tr>
<tr>
<td><strong>2. Extreme weather events</strong></td>
<td>2. Weapons of mass destruction</td>
</tr>
<tr>
<td><strong>3. Failure of climate-change mitigation and adaptation</strong></td>
<td><strong>3. Water crisis</strong></td>
</tr>
<tr>
<td>4. Interstate conflict</td>
<td>4. Large scale involuntary migration</td>
</tr>
<tr>
<td><strong>5. Major Natural catastrophes</strong></td>
<td>5. Severe energy price shock</td>
</tr>
<tr>
<td>6. Failure of national governance</td>
<td>6. Biodiversity loss and ecosystem collapse</td>
</tr>
<tr>
<td>7. Unemployment or underemployment</td>
<td>7. Fiscal crises</td>
</tr>
<tr>
<td>8. Data fraud or theft</td>
<td>8. Spread of infectious diseases</td>
</tr>
<tr>
<td>10. Illicit trade</td>
<td><strong>10. Profound social instability</strong></td>
</tr>
</tbody>
</table>

(Source: World Economic Forum)
Disaster risk profile of ASEAN region

• Located between two oceans resulting in high risk of seasonal typhoons and tsunami
• Located between several tectonic plates with high risk of earthquake, volcanic eruption and tsunami

(Picture source: http://www.westcoastplacer.com)
Disaster risk profile of ASEAN region

<table>
<thead>
<tr>
<th>Country</th>
<th>Earthquake</th>
<th>Flood</th>
<th>Landslide</th>
<th>Drought</th>
<th>Storm (typhoon/cyclones)</th>
<th>Volcano</th>
<th>Forest Fire</th>
<th>Tsunami</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brunei</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
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<tr>
<td>Cambodia</td>
<td>X</td>
<td>XXX</td>
<td>X</td>
<td>XX</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
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<tr>
<td>Indonesia</td>
<td>XXX</td>
<td>XXX</td>
<td>XXX</td>
<td>XX</td>
<td>XX</td>
<td>XXX</td>
<td>XX</td>
<td>XXX</td>
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<tr>
<td>Laos</td>
<td>X</td>
<td>XXX</td>
<td>XX</td>
<td>XX</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Malaysia</td>
<td>X</td>
<td>XXX</td>
<td>XX</td>
<td>X</td>
<td>X</td>
<td>XX</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Myanmar</td>
<td>XX</td>
<td>XXX</td>
<td>XX</td>
<td>XX</td>
<td>XXX</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Philippines</td>
<td>XXX</td>
<td>XXX</td>
<td>XXX</td>
<td>XX</td>
<td>XXX</td>
<td>XX</td>
<td></td>
<td>X</td>
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<tr>
<td>Singapore</td>
<td>X</td>
<td>XX</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Thailand</td>
<td>X</td>
<td>XXX</td>
<td>XX</td>
<td>XX</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
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<tr>
<td>Vietnam</td>
<td>X</td>
<td>XXX</td>
<td>XX</td>
<td>XX</td>
<td>XXX</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>ASEAN</td>
<td>XX</td>
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<td>XX</td>
<td>XX</td>
<td>XX</td>
<td>XX</td>
<td>XX</td>
</tr>
</tbody>
</table>

Disaster matrix by ASEAN countries. Disaster incidence ranges from XXX “high” to X “low”

(Source: UNISDR, 2010)
## Disaster risk profile of ASEAN region

<table>
<thead>
<tr>
<th>Country</th>
<th>City</th>
<th>Dominant disaster</th>
<th>Risk Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Philippines</td>
<td>Manila</td>
<td>Cyclone, flood, earthquake, volcanos</td>
<td>1</td>
</tr>
<tr>
<td>Indonesia</td>
<td>Jakarta</td>
<td>Earthquake, tsunami, wild fire</td>
<td>2</td>
</tr>
<tr>
<td>Thailand</td>
<td>Bangkok</td>
<td>Flood, cyclone, drought</td>
<td>3</td>
</tr>
<tr>
<td>Vietnam</td>
<td>Ha Noi</td>
<td>Cyclone, flood</td>
<td>4</td>
</tr>
<tr>
<td>Singapore</td>
<td>Singapore</td>
<td>Flash flood</td>
<td>5</td>
</tr>
<tr>
<td>Malaysia</td>
<td>Kuala Lampur</td>
<td>Flood, tsunami, cyclone</td>
<td>6</td>
</tr>
<tr>
<td>Myanmar</td>
<td>Naypyidaw</td>
<td>Cyclone, floods</td>
<td>7</td>
</tr>
<tr>
<td>Cambodia</td>
<td>Phnom Penh</td>
<td>Flood</td>
<td>8</td>
</tr>
<tr>
<td>Laos</td>
<td>Vientiane</td>
<td>Cyclone, flood</td>
<td>9</td>
</tr>
<tr>
<td>Brunei</td>
<td>Bandar Seri Begwan</td>
<td>-</td>
<td>10</td>
</tr>
</tbody>
</table>

(Source: UNISDR, 2010)
Hydro-met disaster?

**Processes or phenomena** of atmospheric, hydrological or oceanographic nature that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.

**Examples**
- Tropical cyclones (typhoons and hurricanes), thunderstorms, hailstorms, tornados, blizzards, heavy snowfall, avalanches, coastal storm surges, floods including flash floods, drought, heatwaves and cold spells.

Hydro-met conditions can also be a **FACTOR** in other hazards such as landslides, wildland fires, epidemics etc. and in the transport and dispersal of toxic substances and volcanic eruption material.
Hydro-met disasters: Global scenario

- In 2015, hydro-meteorological events (floods, storms, and landslides) account for (at a global scale)
  - 83% of total occurrence of natural disasters
  - 72% of the reported damages due to natural disasters
  - 48% of total affected
  - 41.4% of total deaths
Hydro-met disasters: Global scenario

- Examples of recent large floods
  - Mississippi Flood (2011)
  - Thailand Great Flood (2011)
  - Kashmir Flood (2014)
  - South India Flood (2015)
  - Missouri Flooding (2015-2016)

<table>
<thead>
<tr>
<th>Country</th>
<th>Year</th>
<th>Total Damage (M-US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>Sep-2008</td>
<td>10,000</td>
</tr>
<tr>
<td>Germany</td>
<td>Nov-2002</td>
<td>11,600</td>
</tr>
<tr>
<td>USA</td>
<td>Jun-1993</td>
<td>12,000</td>
</tr>
<tr>
<td>China</td>
<td>Jun-1996</td>
<td>12,600</td>
</tr>
<tr>
<td>Germany</td>
<td>May-2013</td>
<td>12,900</td>
</tr>
<tr>
<td>N. Korea</td>
<td>Jan-1995</td>
<td>15,000</td>
</tr>
<tr>
<td>India</td>
<td>Sep-2014</td>
<td>16,000</td>
</tr>
<tr>
<td>China</td>
<td>May-2010</td>
<td>18,000</td>
</tr>
<tr>
<td>Thailand</td>
<td>Jan-1998</td>
<td>30,000</td>
</tr>
<tr>
<td></td>
<td>Aug-2011</td>
<td>40,000</td>
</tr>
</tbody>
</table>

10 largest floods in the history (as of 2015)

Non-Economic Loss & Damage (NELD) not considered!
Hydro-met disasters: Global trend

Number of natural catastrophes worldwide, 1980 to 2014

Is climate change responsible for increased natural catastrophes?

(Source: NatCatSERVICE, Munich Re 2015)
Hydro-met disasters: Climate change

Effect of increase in average temperature on extreme temperature

Source: IPCC (2012)
### Hydro-met disasters: Recent trend

Record breaking meteorological events in the last decade

<table>
<thead>
<tr>
<th>Region</th>
<th>Meteorological record breaking event</th>
<th>Confidence in attribution to climate change</th>
<th>Impact costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>England and Wales (2000)</td>
<td>Wettest autumn since 1766</td>
<td>Medium</td>
<td>£ 1.3 Billion</td>
</tr>
<tr>
<td>Europe (2003)</td>
<td>Hottest summer in 500 years</td>
<td>High</td>
<td>Death toll &gt;70,000</td>
</tr>
<tr>
<td>Pakistan (2010)</td>
<td>Rainfall records</td>
<td>Low to medium</td>
<td>Worst flooding in its history; 3000 deaths; 20M people affected</td>
</tr>
<tr>
<td>Eastern Mediterranean and Middle East (2008)</td>
<td>Driest winter since 1902</td>
<td>High</td>
<td>Substantial damage to cereal production</td>
</tr>
<tr>
<td>4 US states (TX, OK, NM, LA) (2011)</td>
<td>Summer heat and drought since 1880</td>
<td>High</td>
<td>Wildfires burning 3 M acres (preliminary impact of $6 to $8 B)</td>
</tr>
</tbody>
</table>


1 Alexander and Jones (2001)  
2 Min et al. (2011)  
3 Kay et al. (2011)  
4 Luterbacher (2004)  
5 Della-Marta et al. (2007); Stott et al. (2004)  
6 Coumou et al. (in review); Hansen et al. (2012)  
7 Robine et al. (2008)  
8 Webster et al. (2011)  
9 Trenberth et al. (2012); Lau and Kim (2012); Hong et al. (2011); Hoerling et al. (2012); Ricardo et al. (2010); Rupp et al. (2012); NOAA (2011)
Hydro-met disaster : ASEAN region

- From 2000 to 2015

- Climate related disasters: 637
- Affected people: 200 million
- Death toll: 173,519
- Economic loss: $8 trillion

(Source: EM-DAT, 2016)
Hydro-met disaster : ASEAN region

Recent trend of disasters

In ASEAN countries during 2000-2015, Flood, drought, storm and landslide accounted for:

• **more than 80%** of total occurrences of natural disasters
• **48%** of total deaths due to disasters
• **More than 90%** of total affected persons

(Data Source: EM-DAT, 2016)
Projections for ASEAN: Flood frequency

The 100-year return period flood is expected to occur with 5- to 25-year return period in 21st Century in South and SE Asia for RCP8.5

Source: Hirabayashi et al. (2013)
Hydro-met disaster: Hydrological extremes in changing climate

**FIGURE 3.4** Bangkok Flood Hazard Relationship

![Graph showing flood hazard relationship with increased frequency and intensity.](image)

- Increased frequency
- Increased intensity
- ~39% increase
- 1/50-year
- 1/15-year
Hydro-met disasters: Thailand flood, 2011

- The 4th costliest disaster in the world (as of 2011); worst in last 50 years in Thailand
- Duration: 5 months (from July, 2011)
- Deaths: 800+
- Affected people: 13.6m
- **Estimated cost**: US$ 45.5 billion
  - 13% of national GDP in losses and damages (*World Bank, 2012a*)
- Cause: Heavy consecutive rainfall events in northern part for a longer duration, low drainage capacity, reservoir mismanagement
Responding to hydro-met disasters: disaster management cycle

(Flood) Disaster Management Cycle
Responding to hydro-met disasters: Experiences

**Vietnam**
- Structural measures: dams, dikes, sluices, and canals to protect crops and properties; but equal emphasis on implementation of non-structural measures
- “Living with flood” policy of flood risk management – has been a success in Vietnam
  - Philosophy: Flooding neither can nor should be completely controlled to protect people and maintain normal lives during inundation

**Thailand**
- Planned to spend US$10 B in 5 years on a new flood management project in the Chao Phraya Basin as a direct result of the 2011 great flood. It has:
  - **U/S measures**: reforestation and construction of reservoirs
  - **M/S measures**: construct retention facility with a capacity of 3 BCM; and rehabilitation of old river channels for flood diversion
  - **D/S measures**: construction of bypass channels and 2 main flood channels
Responding to hydro-met disasters: Need of a multi-pronged approach

**Hard-core approaches:**

- Construction of engineering structures (e.g. dams, levees etc.) to retain the flood and protect nearby areas

**Implications:** *high cost; controlling flood at one location may impact D/S*

**Soft approaches:**

- Continuous and participatory process
- Philosophy: Living with flood
- Focus on preparedness
- Transform: *at-risk communities* → *disaster-resilient communities*
Responding to hydro-met disasters: Need of a multi-pronged approach

- Multi-pronged soft-approaches required:
  - Science and Technology: Research; Monitoring system; Database; and Early Warning System (EWS)
  - Enabling environment (policies and institutions)
  - Capacity building
  - International cooperation

Various types of soft-approaches
Responding to hydro-met disasters: Need of a multi-pronged approach → Enabling Environment

- Policies and institutions
- Feedback mechanisms
- Public participation
- Awareness raising programs
- Risk sharing/transfer: disaster insurance
Responding to hydro-met disasters: Need of a multi-pronged approach → Enabling environment

- Example from Philippines: National Disaster Response Plan (NDRP) of Philippines (2014)
- It envisions having a close and effective 4Cs – coordination, collaboration, communication and cooperation – among all concerned responding government and non-government agencies

• **Build institutional capacity:** Ensure that DRR is a national and local priority with a strong institutional basis for implementation

• **Know your risks:** Identify, assess and monitor disaster risks and enhance early warning

• **Build understanding and awareness:** Use knowledge, innovation and education to build a culture of safety and resilience at all levels

• **Reduce risk:** Reduce the underlying risk factors through land-use planning, environmental, social and economic measures

• **Be prepared and ready to act:** Strengthen disaster preparedness for effective response at all levels
Sendai Framework for DRR (2015 – 2030)

• Sendai Framework: **1 Goal, 7 Global Targets, 13 Guiding Principles, 4 Priorities for Action, at 4 levels (Local, National, Regional and Global)**

• Sendai Framework focuses on **disaster risks** while the HFA focuses on **disaster losses**.

• Sendai Framework focuses more on “the how” while the HFA focuses more on “the what”

• Sendai Framework puts more emphasis on the means for implementation
Sendai Framework for DRR (2015 – 2030)

<table>
<thead>
<tr>
<th>Priority 1</th>
<th>Understanding disaster risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Priority 2</td>
<td>Strengthening disaster risk governance to manage disaster risk</td>
</tr>
<tr>
<td>Priority 3</td>
<td>Investing in disaster risk reduction for resilience</td>
</tr>
<tr>
<td>Priority 4</td>
<td>Enhancing preparedness for effective response, and to “Build back Better” in recovery, rehabilitation and reconstruction</td>
</tr>
</tbody>
</table>
Challenges of managing hydro-met disasters

- Reducing uncertainty in hydro-met forecasting of extreme events (several sources of uncertainties exists and they are inherent in nature)
  - Past is not a good indicator of future
  - Frequency, location, magnitude, duration of extremes may change
  - Chance of extreme event is not the same from one year to next and is strongly related to large-scale climate drivers like ENSO
- Early warning system with sufficient lead time (week vs season)
- Translating the impacts to societal implications (vulnerability and risks)
- Suitable climate change adaptation and mitigation strategies
Challenges of managing hydro-met disasters

Capacity building and financial support

- Building technical capacity at all levels and at all scales
- Enhancing the risk perception of stakeholders
- Science-policy dialogue
- Enhancing financial capacity
Challenges of managing hydro-met disasters

Enabling environment

• Risk governance and implementation of plans, policies, laws and regulation in practice
• Provision of hydro-met services
• Stakeholders participation

International cooperation

• Data, knowledge and information sharing
• Lack of technology and infrastructure in developing countries
• How global and local communities can more meaningfully be brought together?
Hydro-met extremes: Current research at AIT

- Analysis of climatological and hydrological extreme events in Upper Ayerawaddy River Basin, Myanmar
- Impact of climate change on design flood discharges: An application to Rasool Barrage, Jhelum River Basin, Pakistan
- Assessment of wetland vulnerability to climate change: A case study of Moeyungyi Wetland, Myanmar
- Effects of climate change on water scarcity in Hub River Basin, Pakistan
Concluding remarks

• ASEAN region is vulnerable to natural disasters
• Single approach cannot address disaster problems → multi-pronged approach is required
• Success in dealing with disasters also depends on success in implementing soft-approaches
• Addressing disaster challenges needs focus on:
  – Advancement of science and technology
  – Commitments of all stakeholders: for enabling environment
  – Investment in capacity building activities
  – A high level of international cooperation
Thank you very much
(msbabel@ait.asia)