IIASA perspective on socio-economic disaster impact modelling

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SCIENTIFIC SEMINAR ON NATURAL DISASTERS: BRIDGING SCIENCE-BASED EARLY WARNING AND EARLY ACTION DECISION MAKING

7-8 November 2012, Brussels, Centre Albert Borschette
4 issues

1. Assessment of socio-economic impacts moving towards risk-based assessment of economic impacts, but uncertainties large

2. Increasing emphasis of vulnerability/adaptive capacity

3. Cascading/multi-hazard assessments being worked on

4. Making the economic case for DRM challenged by lack of robustness
Assessment framework: Direct and indirect risk

Risk as a function of Exposure, Hazard, Vulnerability

Hazard

Vulnerability
- Elements exposed
- Fragility
- Resilience

Risk

Event

Disaster

Economic
- Loss of assets
  - e.g. business interruption

Social
- Loss of life
  - Population affected
  - e.g. increase in disease

Environmental
- e.g. Loss of habitat
  - e.g. effect on biodiversity

Macroeconomic
- e.g. loss of GDP

Impacts on Assets
Impacts on Flows

Direct

Indirect
Costs of extremes

Issues

- Direct damage costs fairly well studied (in OECD countries)
- Little known about intangibles
- Indirect costs: are important, but less is known
- Recently, risk based approaches taking a probabilistic and forward looking approach emerging
Stronger focus on risk in disaster impact modelling as well as climate adaptation analyses

Exposure: population and capital stock exposed

Intensity vs. damage

Intensity and frequency

Risk triangle

Adaptation

Climate change
Efficiency of risk management instruments depends on occurrence probability.
EU impact costs assessments for weather related risks

- EU research projects (MICE, ESPON, MARS, ENSEMBLES, PESETA, ADAM, ClimateCost) have focussed on weather-related hazards and risks in Europe.


- PESETA project fills an important gap by conducting a European-wide assessment of current and future flood risks up to 2100 and estimated average annual values.

- IIASA based on ADAM flood and drought risk at a European scale identifying monetary economic losses, but estimated full probability distributions at different aggregation scales (see Mechler et al., 2010)
Towards probabilistic economic risk assessment for flood risk

Source: Hochrainer et al., 2011 based on Moriondo et al., 2010
IPCC-SREX: A changing climate leads to changes in extreme weather and climate events
Extreme event impact and risk assessments increasingly important for climate adaptation assessments

<table>
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<th>Approach</th>
<th>Description</th>
<th>Examples</th>
<th>Advantages</th>
<th>Issues</th>
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<tr>
<td>Economic Integrated Assessment Models (IAM)</td>
<td>Aggregated economic models. Values in future periods, expressed £ and %GDP and values over time (PVs) that provide outputs for Europe.</td>
<td>Global studies (e.g. de Bruin et al)</td>
<td>Provide headline values for raising awareness. Very flexible – wide range of potential outputs (future years, PV, CBA).</td>
<td>Aggregated and low representation of impacts, generally exclude extreme events and do not capture adaptation in any realistic form. Not suitable for detailed national planning.</td>
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<td>Investment and Financial Flows (I&amp;FF)</td>
<td>Financial analysis. Costs of adaptation (increase against future baseline)</td>
<td>Global studies (e.g. UNFCCC, 2007). National studies, e.g. Swedish Commission (2007)</td>
<td>Costs of adaptation in short-term policy time-scale. Easier to apply even without detailed analysis of climate change.</td>
<td>No specific linkage with climate change or adaptation (though can be included). No analysis of adaptation benefits or residual impacts.</td>
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<td>Impact assessment (scenario based assessment)</td>
<td>Physical effects and economic costs of CC with sectoral models in future periods, and costs and benefits of adaptation or in cost-effectiveness analysis</td>
<td>FESETA study (2007) and coastal analysis. National scale: UK Flooding (Thorne et. al. 2007)</td>
<td>More sector specific analysis. Provides physical impacts as well as economic values – therefore can capture gaps and non-market sectors.</td>
<td>Not able to represent cross-sectoral, economy-wide effects. Tends to treat adaptation as a menu of hard (technical) adaptation options. Less relevant for short-term policy.</td>
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<td>Impact assessment - shocks</td>
<td>Use of historic damage loss relationships (statistics and econometrics) applied to future projections of shocks combined with adaptation costs (and sometimes benefits)</td>
<td>Sector level, e.g. EAC study (2009) in the UK.</td>
<td>Allow consideration of future climate variability (in addition to future trends)</td>
<td>Issues of applying historical relationships to the future. Issues with high uncertainty in predicting future extremes.</td>
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<td>Impact assessment - econometric based</td>
<td>Relationships between economic production and climate parameters derived with econometric analysis and applied to future scenarios – and to consider adaptation</td>
<td>National level Household level or sector</td>
<td>Can provide information on overall economic growth and allow analysis of longer-term effects. Provide greater sophistication with level of detail.</td>
<td>Mostly focused on autonomous or non-specified adaptation. Very simplistic relationships to represent complex parameters. No information on specific attributes. Issues on whether relationships are applicable to future time periods.</td>
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<td>Adaptation assessments</td>
<td>Risks over a range of policy / planning horizons. Often linked risk management and adaptive capacity.</td>
<td>No real economic examples. Emerging number of adaptation assessments.</td>
<td>Stronger focus on immediate adaptation policy needs and decision making under uncertainty and greater consideration of diversity of adaptation (including soft options) and adaptive capacity.</td>
<td>Less explored in relation to economic assessment.</td>
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Source: Watkiss and Hunt, 2010
But uncertainties are large even today
Average annual flood losses (AAL)

Annual average losses including confidence bounds for minimum and maximum estimates.
Source: Based on Hochrainer and Mechler, 2009 and Lugeri et al. 2010
Flooding: risk and uninsured risk

Total annual average flood risk: 3.4 billion Euro

Total annual uninsured average flood risk: 2.3 billion Euro

Distribution of flood risk including the uninsured risk over Europe in absolute terms
Note: the uninsured risk comprises private and public assets, and the latter are generally uninsured.

Source: IIASA, 2011 for DG CLIMA study

Windstorm risk (hotspot countries and 200 year event only)

Total risk: 60.4 billion Euro

Uninsured risk: 22.4 billion Euro

Distribution of windstorm risk for the 200 year event including the uninsured risk over Europe in absolute terms

Source: IIASA, 2011 for DG CLIMA study

Drought risk

Distribution of drought risk including the uninsured risk over Europe in absolute terms

Source: IIASA, 2011 for DG CLIMA study

Modelling indirect risks
Key transmission mechanism is vulnerability

Increasing emphasis on enhancing “soft-resilience” shaped by socioeconomic factor vs. hard resilience

Source: Kohler et al., 2004
Example Estimating fiscal vulnerability

Source: IIASA CATSIM model
Hidden government disaster liabilities can be large.

Government fiscal deficits and hidden liabilities due to flood risk in selection of flood prone European countries
Source: Mechler et al., 2010
IIASA developing a methodology for assessing multiple hazards and cascading risks: MATRIX project

Disaster events can be triggered by multiple hazards and lead to cascading impacts across regions.
Making the economic case for DRM

- A lot of rhetoric regarding high economic returns to DRM, yet little solid evidence
- Generally: BC ratios may be up to 4
- But IPCC-SREX: “Rigorous CBA for managing extreme events seems limited based on limited evidence and medium agreement in the literature.”
- Other methods for decision-support of interest: MCA, robust approaches

Source: Mechler, 2012
Thank you for the attention, and apologies for not being able to attend!

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