Special Topics

12 - Supporting DRR Investment Decision Making

Key words: scenario assessment, cost-benefit analysis, multi-criteria analysis, robust decision making approaches

Investments in prospective and corrective risk reduction, preparedness, response and recovery have multiple benefits that often exceed the potential reduction in direct and indirect losses arising from a disaster. Although the exact benefit-cost ratio (BCR) varies widely, the U.S. Federal Emergency Management Agency (FEMA) for example estimated an average BCR of approximately four in a review of over 4,000 DRR investment projects in the USA.[12] Investing in resilience- building activities such as ecosystem-based DRR interventions and community-based interventions can also yield significant economic, social and environmental co-benefits even in the absence of a disaster. However, the significant upfront costs required for investment in DRR and resilience-building activities, combined with the long time span required to witness their benefits, offer limited incentives for decision makers to invest proactively.[3]

DRR policy scenario assessment - evaluating welfare and disaster risk implications with and without DRR interventions - may be incorporated into national risk assessment to assist selection among alternative DRR policy and investment options. The common methodologies for evaluating DRR policy scenarios include Cost-Benefit analysis (CBA), Cost-Effectiveness Analysis (CEA), Multi-Criteria Analysis (MCA) and Robust Decision-Making Approaches (RDMA), with each having distinct applicability in a variety of decision contexts.[4]

- **Cost-Benefit Analysis (CBA)** supports decision-making based on the efficiency criteria, maximizing net benefits of investment over time, as measured in monetary terms. CBA has been the primary approach for prioritizing amongst risk reduction investment options in developed countries. Ideally, a CBA includes all relevant impacts, be they physical, social, economic or ecological, analyzing both direct or "stock" impacts, such as loss of life and property damage, as well as indirect or "flow" losses including unemployment and reduced income due to direct and indirect (multiplier

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effect) business interruption losses[5,6]. Given that CBA necessitates the monetization of every impact, a particular challenge lies in estimating the value of intangibles including the values of environment, community cohesion, and places of significant cultural or historical heritage values. It can also include co-benefits of DRR[7,8] Monetization of mortality and morbidity risks into a CBA is another key consideration; the common approach is the use of 'value of statistical life' (VSL) estimates, often quantified based on projections of lost future earnings; an approach not without moral or ethical controversies.

- **Cost-Effectiveness Analysis (CEA)** identifies least-cost options to meet a certain, predefined target or policy objective (which in effect represents the project benefit measured in monetary terms). CEA does not require the quantification of benefits, as the project costs are the key variable of consideration to be minimized. Project goals such as reducing disaster fatalities and losses to a certain level must be determined beforehand.

- **Multi-Criteria Analysis (MCA)** assesses how well DRR investments achieve multiple objectives such as economic, social, environmental, and fiscal goals, as well as co-benefits. Using selected criteria and indicators as verifiable measures for monitoring across time and space, MCA observes and evaluates DRR investment performance in quantitative or qualitative terms. Because MCA does not require the monetization of all values, it is seen as potentially more palatable and flexible than CBA and CEA).[9] A major challenge, however, is assigning weights to the criteria.

- **Robust Decision-Making Approaches (RDMA)** has received increasing emphasis recently, particularly in the context of climate change adaptation. RDMA approaches comprising both quantitative and qualitative methodologies draw focus away from optimal decisions (such as those supported with CBA and CEA) and aim to identify options with minimum regret, that is, minimal losses in benefits of a chosen strategy under alternative scenarios where some parameters are highly uncertain and impacts are potentially devastating or irreversible.[10] [11]

These various scenario assessment methodologies are routinely used to inform DRR investment decisions in both developed and developing countries, the below shows two recent examples of DRR policy scenario assessment, in which alternative scenarios - risk versus non-risk based and pre- and post- DRR investment- are compared to support public decision-making on wildfire and cyclone risk.

Wildfire DRR options analysis in Australia: a MCA approach

The state of Victoria in Southeast Australia is highly prone to wildfires, with recent devastating disasters claiming hundreds of lives. Wildfire fuel management - controlled burning of vegetation (fuel) - is a critical element of wildfire risk management. Following 2009 bushfire, the Victorian Government adopted a new policy target of prescribed burning applied to, at minimum, 5% of public land (known as the Victorian Bushfires Royal Commission (VBRC) recommendation 56). In 2013, however, the Bushfires Royal Commission Implementation Monitor (BRCIM) - an official body responsible for monitoring and reviewing the VBRC - found that this hecter-based target was "not achievable, affordable or sustainable" and subsequently proposed a wildfire DRR policy scenario assessment comparing two fuel management options. While the status quo approach prescribed the burning of a proportion of public land annually, the alternative prescribed burning to achieve a certain reduction in wildfire risk. The risk-reduction target is defined in comparison to the scenario of maximum fuel loads (i.e. before fuel management activities are undertaken), as estimated by computer simulation of wildfire behaviour in the landscape using the PHOENIX RapidFire Model.[12] The latter approach identified the specific areas for prescribed burning that are most effective at reducing risk, while the former simply identified the total areas to be burned.

As part of this review, external risk experts undertook a policy assessment using a multi-criteria analysis. The two policy options were assessed against their potential to meet 12 criteria assessing effectiveness (in terms of reduction in risk to human life, infrastructure, economic activities, and ecosystems, etc.), stakeholder and community engagement, policy sustainability, economic efficiency, and distribution and equity considerations. The alternative policy with the risk reduction objective was found to be superior, and the Victorian Government subsequently revised its fuel management target based on this recommendation.

The policy scenario assessment was designed to fit the needs of decision-makers in terms of policies being assessed (status quo and viable alternative), criteria (derived from existing mandates), and transparency of process (clear and easy to follow). This case study highlights the way in which decision-support methods can be effectively incorporated into a wider policy dialogue.

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Cyclone retrofit options analysis in Indian Ocean Commission countries: a CBA application

As part of UNISDR/ISLANDS Joint Programme on Financial Protection Against Climate and Natural Disaster Risks, 'forward-looking' probabilistic cost and benefit analysis of cyclone retrofitting options were conducted for Madagascar and Mauritius using newly compiled hazard, exposure and vulnerability data. Spatially explicit data regarding the probability and intensity of cyclone winds were combined with those of location and construction materials of private and public infrastructure and buildings using the open source CAPRA software, to yield baseline estimates of economic damage due to cyclones. These estimates were then revised assuming the likely benefit of housing retrofitting options (i.e. improvement of wooden and unrefined masonry houses from low to medium design quality in Madagascar and iron concrete and wooden houses from medium to high design quality in Mauritius[13,14]) to yield the economic damage after DRR intervention. The benefit of DRR intervention - i.e. the differences between economic damages before-and-after DRR is then compared with the cost of DRR intervention, using an appropriate discounting rate, which yielded decision metrics such as Net Present Value (NPV), Benefit Cost (B/C) Ratio and Internal Rate of Return (IRR). For example, assuming retrofitting options cost 10% of the total housing value, cyclone wind-proofing at a discounting rate of 5%, yielded the B/C ratio of 2.02 while that of unrefined masonry was estimated at 1.04 in Madagascar.[13] This case study demonstrated that the probabilistic cost-benefit analysis can be conducted easily with the newly collected risk information and similar assessments were conducted using 'backward-looking' probabilistic cost-benefit analysis based on recently collected DesInventar disaster damage and loss database for Comoros, Seychelles and Zanzibar.

It is generally not advisable that scenario assessment tools be used strictly in a prescriptive manner. Instead, analyses utilizing the tools described above should be used as part of a larger process of national disaster risk planning involving all relevant stakeholders. Stakeholders can and should be involved at all stages of disaster risk assessment such as problem definition and objectives setting, identification of alternative investment options, quantification of impacts and analysis and prioritization (Floods Working Group 2012). To ensure transparency and accountability of scenario assessment processes, a number of countries have adopted common analytical tools and/or a system of third-party review such as FEMA's BCA Software developed the United States, and a series of 'second opinions' provided by Netherlands Central Planning Bureau (CPB).

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Resources for further information

- The Society for Benefit-Cost Analysis. https://benefitcostanalysis.org/
- MCA4climate. http://www.mca4climate.info/about/
- The Society for Decision Making Under Deep Uncertainty. http://www.deepuncertainty.org/welcome/

Other substantial peer-reviewed guidelines

- CPB (2013) General Guidance for Cost Benefit Analysis https://www.cpb.nl/en/publication/general-guidance-for-cost-benefit-analysis
- OCED (2009) Integrating Climate Change Adaptation into Development Co-operation: Policy Guidance http://www.oecd.org/dac/environment-development/integrating-climate-change-adaptation-into-development-co-operation-policy-guidance-9789264054950-en.htm
- FEMA Benefit Cost Analysis: https://www.fema.gov/benefit-cost-analysis
- Floods Working Group (2012) Flood Risk Management, Economics and Decision Making Support http://ec.europa.eu/environment/water/flood_risk/pdf/WGF_Resource_doc.pdf
- UK Environment Agency (2010) Flood and Coastal Erosion Risk Management appraisal guidance https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/481768/LIT_4909.pdf
- C. Benson and J. Twigg T. Rossetto (2007) Tools for Mainstreaming Disaster Risk Reduction: Guidance Notes for Development Organisations http://www.preventionweb.net/files/1066_toolsformainstreamingDRR.pdf
- Mechler 2005 Cost-benefit Analysis of Natural Disaster Risk Management in Developing Countries http://maail1.mekonginfo.org/assets/midocs/0003131-environment-cost-benefit-analysis-of-natural-disaster-risk-management-in-developing-countries-manual.pdf

Toolboxes and other useful resources

- Econadapt toolbox. http://econadapt-toolbox.eu/methods/cost-benefit-analysis
- Provia / mediation adaptation platform http://www.unep.org/provia/portals/24128/Guidance_Prototype/home.html
- Econshaz: economics knowledge base http://www.ecoshaz.eu/site/knowledge-toolkit-2/economics-knowledge-base/

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Open source tools

- http://documents.worldbank.org/curated/en/765581468234284004/pdf/714870WP0P124400JAKARTA0CAN0THO0WEB.pdf

Successful and well documented national hazard and risk assessment which have incorporated this topic and with results used in DRR

- Australian Business Roundtable for Disaster Resilience and Safer Communities (2013)Building our nation's resilience to natural disasters http://australianbusinessroundtable.com.au/assets/documents/White%20Paper%20Sections/DAE%20Roundtable%20Paper%20June%202013.pdf

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http://delwp.vic.gov.au/__data/assets/pdf_file/0009/302220/Publication-IGEM-2015_Review-of-performance-targets-for-bushfire-fuel-management-on-public-land_WEB.pdf

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[14] UNISDR (2015b) Review of Mauritius, UNISDR Working Papers on Public Investment Planning and Financing Strategy for Disaster Risk Reduction. http://www.preventionweb.net/publications/view/43523