

The economics of investing in disaster risk reduction

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Executive summary

Economic costs of disasters remain high and are likely to increase in the future. Nevertheless, economic assessments face both technical and policy challenges. This working paper makes three suggestions for improving the economic effectiveness of investment decision-making for disaster risk reduction.

Section 1 sets out the renewed mandate for investing in disaster risk reduction which came out of the RIO+20 Conference in June 2012. The Rio+20 Outcome Document states that: “We reaffirm our commitment to the Hyogo Framework for Action 2005–2015” and “We invite governments at all levels, as well as relevant sub-regional, regional and international organizations, to commit to adequate, timely and predictable resources for disaster risk reduction.”

Section 2 highlights the high and rising economic costs of disasters. The global costs of disasters are generally in the billions of US dollars per annum and rising. It is clear that the economic costs of disaster remain both significant and worrisome for the countries and areas impacted.

Section 3 explores the challenges of estimating the economic costs of disasters. Direct economic impacts and indirect economic impacts as well as non-economic impacts need to be considered. Nevertheless, “thorny theoretical problems” “extreme data limitations” continue to make it most difficult to estimate the full economic costs of disasters. The section includes a case study on estimating disaster costs in Colombia.

Section 4 identifies the economic benefits of disaster risk reduction. Direct economic benefits and extended economic benefits need to be identified. The latter are particularly important and include the extended benefits arising from such activities as building flood protection structures and shelters, improving civil society networks and linkages, and undertaking proper planning processes. The section includes a case study on estimating the net benefits of housing retrofitting

Section 5 specifies the costs of disaster risk reduction activities which includes both the direct and indirect costs of risk-reducing action. Interestingly, the current literature has little to say on how to estimate these costs or, indeed, on the actual levels and trends of these costs over recent years.

Section 6 reviews the many challenges of making economic assessments. The decision-making calculation appears to be simple – if benefits are greater than costs, then governments should invest in disaster risk reduction. As noted above, however, it remains difficult to estimate both benefits and costs. Selecting the right discount rate for discounting future economic flows, particularly of distant benefits, is not straightforward. Risk and uncertainty also need to be factored into the calculation by adjusting the discount rate. Finally, an aggregate calculation of net benefits does not indicate the important distributional impacts of both benefits and costs to various stakeholder groups. The section includes a case study on applying benefit-cost analysis in Sudan.

Section 7 reviews the political economy challenges of disaster risk reduction policy making. The key challenges are short political time horizons, political costs and opportunity costs, the public good characteristics of disaster risk reduction, incentives to increase disaster risk, and the economic implications of democratic or autocratic processes. The section includes a policy study on the role of democracy in reducing disaster risks.

Section 8 makes suggestions for improving investment decision-making for disaster risk reduction. Three main suggestions are presented for addressing the technical and policy challenges. These are:

- List economic benefits & costs
- List key stakeholders & distributional economic impacts
- Learn from other economic assessments

The first two suggestions enable decision-makers to understand the economic implications of investing in disaster risk reduction activities in qualitative terms and, where possible and appropriate, also in quantitative terms. They also enable decision-makers to see the linkages between the disaster-risk investments and other priority policy objectives. The third suggestion proposes a role for international and regional programmes, such as UN ISDR, to strengthen national decision-making by sharing information on economic assessments undertaken in other countries and the lessons learned.

Section 9 provides a list of publically-available studies, reports and presentations which were used in preparing this working paper. They are organised thematically and in reverse chronological order. The documents can be downloaded from a prototype online library at: **<http://risk.earthmind.net>**.

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0. Overview

The aim of this working paper is to address the economics of disaster risk reduction in the post-HFA process leading up to the Global Platform in 2013. It is based on a review of recent literature on the economic costs of disasters, the benefits of disaster risk reduction, economic assessments of disaster-risk reduction, and key institutional and policy barriers and gaps, particularly literature since the HFA was adopted in 2005

The literature review indicates that the economic costs of disasters remain high and are likely to increase in the future. Hence, the renewed commitment at Rio+20 for investing in disaster risk reduction is warranted. The literature, however, also highlights that economic assessments of the benefits and costs of reducing disaster risk face both technical and policy challenges. Following an analysis of these challenges, the working paper proposes an initial set of three practical recommendations for improving the economic effectiveness of investment decision-making for disaster risk reduction.

1. The renewed mandate for investing in disaster risk reduction

At the June 2012 Rio+20 Conference, our governments renewed their commitment to investing in disaster risk reduction. The Rio+20 outcome document¹, entitled ‘The Future We Want’, states:

“We reaffirm our commitment to the Hyogo Framework for Action 2005–2015...”

“We call for disaster risk reduction and the building of resilience to disasters to be addressed with a renewed sense of urgency in the context of sustainable development and poverty eradication and, as appropriate, to be integrated into policies, plans, programmes and budgets at all levels and considered within relevant future frameworks.”

“We invite governments at all levels, as well as relevant subregional, regional and international organizations, to commit to adequate, timely and predictable resources for disaster risk reduction...”

“We stress the importance of stronger interlinkages among disaster risk reduction, recovery and long-term development planning, and call for more coordinated and comprehensive strategies that integrate disaster risk reduction and climate change adaptation considerations into public and private investment...”

This mandate clearly links investments in disaster risk reduction to the broader objectives of sustainable development and poverty eradication. It is also a call for resource mobilisation.

¹ UN General Assembly Resolution 66/288. (2012) *The Future We Want*. Paragraphs 186-18.

2. The high and rising economic costs of disasters

Unfortunately, the number of reported disasters remains high. The Centre for Research on the Epidemiology of Disasters (CRED)² lists the following number of reported disasters globally in recent years:

Year	Reported Disasters
2011	332
2010	386
2009	343
2007	414
2005	432
2004	355
2002	421
2000	413

The economic costs of these disasters are also high. For example, CRED³ reports the following estimates of the costs of the major disasters of 2011:

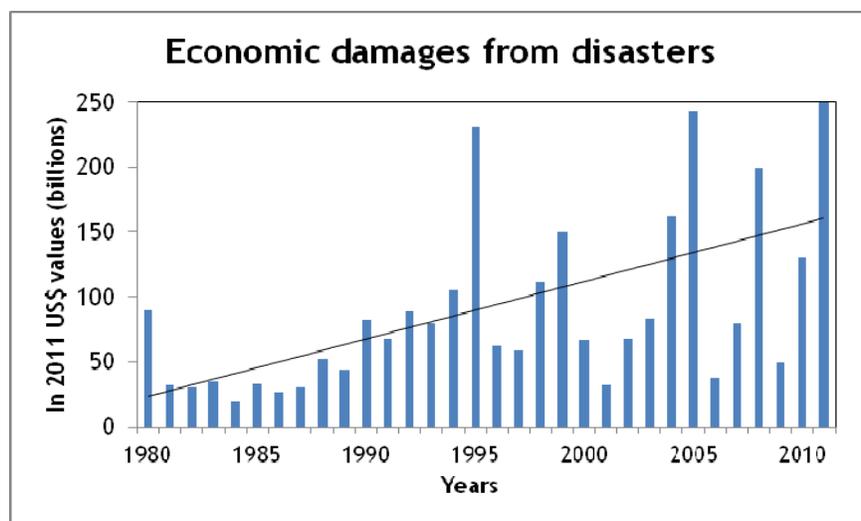
Countries	2011 Disasters	Costs (US\$)
Japan	Earthquake/Tsunami	210 billion
Thailand	Flood	40 billion
USA	Storms	25 billion
New Zealand	Earthquake	15 billion
China	Floods	10 billion
USA	Draught	8 billion
Bahamas, Dominican Rep, USA	Hurricane	8 billion

The global costs of disasters are generally in the billions of US dollars per annum and rising. This upward trend is evident in the following table based on data from CRED and UNISDR:⁴

² Below, R., Guha-Sapir, D., Ponserre, S., Vos, F. (2011) Annual Disaster Statistical Review 2011: The numbers and trends. *Centre for Research on the Epidemiology of Disasters (CRED)*: p 17.

³ Below, R., Guha-Sapir, D., Ponserre, S., Vos, F. (2011) Annual Disaster Statistical Review 2011: The numbers and trends. *Centre for Research on the Epidemiology of Disasters (CRED)*: p 17.

⁴ International Strategy for Disaster Reduction, US Agency for International Development, and the Centre for Research on the Epidemiology of Disaster (CRED). (2011) 2011 Disasters in Numbers. *EM-DAT: The OFDA/CRED - International Disaster Database*: p 1.



Further, as populations and economies continue to grow, larger numbers of people and more infrastructure are likely to be located in hazard-prone areas. Hence, future disasters in these areas are likely to be even more costly. The risk of increasingly high costs of disasters in highly populated, highly developed areas is evidenced in the following list of selected recent disasters from CRED and UNISDR data:

Year	Countries	Disasters	Costs (US\$)
2011	Japan	Earthquake/Tsunami	210 billion
2010	Chile	Earthquake	30 billion
2009	China	Earthquake	87 billion
2005	USA	Hurricanes	176 billion
2004	Japan	Japan	33 billion

It is clear that the economic costs of disaster remain both significant and worrisome for the countries and areas impacted. Thus, the clear reaffirmation at Rio+20 of the global community's commitment to the Hyogo Framework for Action 2005–2015 is most appropriate.

3. Estimating the economic costs of disasters

According to a recent World Bank paper⁵, estimating the direct costs of disasters is not sufficient. To establish the total cost of a disaster, its indirect costs also need to be estimated. Indirect costs include impacts on the economy including interruption of economic processes and reduced industrial output. Calculating both direct and indirect costs, however, in addition to non-economic impacts, can prove to be challenging. Parameters and appropriate tools to measure overall impact must also take into consideration sensitive topics such as loss of life.

A 2005 report by Environmental Resources Management (ERM) prepared for the UK Department for International Development (DFID)⁶ provides an example of current thinking on the various **direct economic impacts** of disasters:

⁵ Hallegatte, S. & Przyluski, V. (2010). The Economics of Natural Disasters: Concepts and Methods. Policy Research Working Paper 5507. The World Bank, Washington D.C.

⁶ Environmental Resources Management. (2005) Natural Disaster and Disaster Risk Reduction Measures: A Desk Review of Costs and Benefits: p 12.

“**Economic impacts** are experienced through the damages or destruction to assets or ‘stocks’, resulting from the disaster itself, or from events in the aftermath of a disaster. In the household sector, the main loss is the damage to houses and apartments and building contents. In the public sector the main impacts are on facilities such as schools, health facilities and other infrastructure such as transport (roads, bridges) and irrigation, drinking water, sewage installations and electricity. In the business sector there are damages to buildings, but most important is the loss of machinery and other productive capital.”

Direct impacts – all of which have an economic cost – includes damage to private residences, commercial and public buildings, vehicles, infrastructure including roads and public utilities, farmlands, recreation areas, and forests. Added to these are the costs of human injuries and the loss of life as well as the impacts on the ecosystems and wildlife. There are also the costs of emergency response measures and post-disaster clean-up operations.

A recent study from Resources for the Future⁷ makes clear that estimating the costs of even clearly identifiable direct impacts is difficult. The study states:

“The **thorny theoretical problems** involved in estimating the economic consequences of disasters are coupled with **extreme data limitations** that make actual estimates far from what would be the hypothetical ‘true’ disaster costs.” [bold italics added]

Regarding the ‘thorny theoretical problems’, the study uses the example of estimating the cost of a private home destroyed by a disaster. This cost could be based either on its pre-disaster market value or on its post-disaster replacement cost. Further, this cost estimate would need to be adjusted to account for any compensatory payments received from private insurance or from a government support programme. Other costs related to the loss of a home would also need to be considered such as the time required for rebuilding or the loss of personal belongings in the house.

Regarding ‘extreme data limitations’, the study identifies the lack of good data as a global challenge:

“Even in highly developed countries with generally good record-keeping, comprehensive disaster loss data are difficult to come by. The United States does not keep systematic records in one location of losses associated with natural hazards... Thus, all disaster numbers should be interpreted with some degree of caution.”

Estimating the costs of **indirect economic impacts** is even more challenging. Disasters bring about a lowering of the capital stock of an area including physical capital, financial capital, natural capital and human capital. The indirect impacts include interruption of commercial operations and public services, reduced economic productivity due to physical or emotional damage, reduced efficiency of damage structures, and the multiplier effect on reduced economic activity.

⁷ Kousky, C. (2012) Informing Climate Adaptation: A Review of the Economic Costs of Natural Disasters, Their Determinants, and Risk Reduction Options. *Resources for the Future*.

The indirect impacts of the disruption of commercial operations and public services and the associated economic multiplier effects of these impacts could be widespread and considerable. The costs of these indirect impacts, however, are even more difficult to estimate and quantify than costs of direct impacts. One major reason for this is that empirical data for such indirect costs is often simply not available and attempts to model these costs are difficult.

Though serious theoretical and data problems exist, economic methodologies can be used to at least roughly estimate all sorts of direct and indirect costs. There are, however, some ‘**non-economic impacts**’ including critical social and environmental impacts which probably should not be monetised. Most important of these are the costs of the loss of life. Though economists can technically put a price on a life – for example, by estimating the loss of earnings in a person’s lifetime – in most societies, such a valuation is considered to be inappropriate. A 2012 report from the International Federation of Red Cross and Red Crescent Societies (IFRC)⁸ observes that:

“The very decision to use an economic measure to assess the impact of humanitarian projects raises questions. Does it mean placing a monetary value on such things as psychosocial well-being, or indeed on life itself (which would be incompatible with Red Cross Red Crescent principles and values)? And how does one quantify social impacts such as the empowerment of women?”

Likewise, economists have also developed tools to estimate the costs of damaged ecosystems and their services and the loss of wildlife and natural habitats. Though there is an increasing interest in estimating the economic value of environmental goods and services, like the loss of human life, it is not always appropriate to try to put a price on nature.

Thus any assessment of the direct and indirect costs of a disaster needs at least to clearly state the significant non-economic social and environmental impacts which have not been included. Because loss of life and degradation of ecosystems and wildlife habitats are normally associated with disasters, this means that any estimate of the economic cost of disaster is like to be an underestimate and needs to be recognised as such.

Case study: Estimating disaster costs in Colombia

While calculations of predicted disaster costs are seemingly difficult, databases are moving forward towards more accurate predictions. One example is the use of a DesInventar database⁹ to calculate the likely losses from disasters over time. Such a calculation can provide governments with a clearer understanding of the likely economic costs of disasters.

One method for making such a calculation is to estimate a ‘loss exceedance curve’ which estimates probable maximum losses annually. Evaluación de Riesgos Naturales – América Latina (ERN) has developed this methodology and applied it to three countries – Colombia, Mexico and Nepal.¹⁰ The results for Colombia are as follows:

⁸ International Federation of Red Cross and Red Crescent Societies. (2012) Disaster risk reduction: a global advocacy guide: p 14.

⁹ The DesInventar databases are available at <http://www.desinventar.org/>.

¹⁰ Evaluación de Riesgos Naturales – América Latina. (2011). Probabilistic modelling of natural risks at the global level: the hybrid loss exceedance curve: development of methodology and implementation of case studies. Phase 1A: Colombia, Mexico and Nepal. *Global Assessment Report on Disaster Risk Reduction 2011*. 4: 28-29.

“The economic loss exceedance curves using the DesInventar database in the case of Colombia show that losses caused by hydro-meteorological events (based on a retrospective evaluation) have been equal or greater than US\$ 1 million at least 50 times per year, more than US\$ 7 million at least 10 times per year, more than US\$ 30 million at least once per year and more than US\$ 100 million at least once every six years. Including all events, it can be said that losses have occurred equal to or greater than US\$ 1 million at least 70 times per year, US\$ 10 million at least 10 times per year, US\$ 50 million once per year and US\$ 1 billion at least once every 25 years.

By looking at the costs of both large and small disasters over time, this approach is able to provide a clearer picture of the costs of disasters, some of which could be avoided through disaster risk reduction activities.

4. Identifying the economic benefits of disaster risk reduction

The **direct economic benefits** of disaster risk reduction are for the most part the avoided economic costs of disasters as discussed above. Before the disaster occurs, these costs are only possible costs and their value is in part dependant on when a disaster might happen and how likely it is. This matter is taken up further later on in this working paper.

The literature also highlights a number of associated or **extended economic benefits** of undertaking disaster risk reduction activities. For example, an ERM report suggests the following extended benefits:¹¹

Disaster Risk Reduction Activity	Extended Economics Benefits
Flood protection structures	Provision of irrigation or potable water and hydro-electric power
Improvements in civil society networks and linkages	Improved governance and more organised social structures
Proper planning processes	Delivery of basic necessities (e.g. potable water, drainage, sewerage, power, and community facilities)
Shelters	Community facilities (e.g. clinics or schools) in non-disaster periods
Improved water supply systems in rural areas	Water supply systems improved regardless of a disaster occurring
Construction and use of drainage pipes	Improved irrigation practices, possibly improved agricultural practices
Community-based disaster preparedness	Improved women’s involvement in community level activities
Installing more resilient wireless communications	enhancing access to telephony and electronic data services
Training farmers to diversify the use of crops	Reducing vulnerability to poverty
Better monitoring of food supplies	Improving the food supply chain, possibly making it more cost-effective

¹¹ Environmental Resources Management. (2005) Natural Disaster and Disaster Risk Reduction Measures: A Desk Review of Costs and Benefits: pp 13-14.

In some cases, economists can estimate the economic value of such extended benefits. For example, the value of the provision of services such as water, electricity and shelter can be estimated. In other cases, monetising extended benefits could be seen as inappropriate, such as the improving women's involvement within communities. Nevertheless, such extended benefits need at the very least to be clearly stated in any assessment of the economic benefits of a disaster risk reduction programme.

Case study: Estimating the net benefits of housing retrofitting

Estimating the net benefits of undertaking disaster risk reduction actions – in this case, retrofitting houses to be earthquake resistant – requires looking at a number of variables. These include the underlying socio-economic conditions and the quality of the existing infrastructure. In a recent World Bank paper¹² on the benefit cost analysis of disaster risk reduction in developing countries, the different possible returns from housing retrofitting in the US and El Salvador are presented.

Looking first at houses built on earthquake-prone hillsides in Los Angeles, California, the average retrofit cost of these houses which included an anchored bracing system, was estimated at US\$ 14,000. With the likelihood of earthquake-induced damage at about 0.04 per cent per year and with the average cost of repair or replacement from an earthquake at about US\$ 100,000, “the payback on a \$14,000 investment is \$40 in terms of earthquake damage avoided, or a 0.28% real return.” In addition, there are the costs of damage household property and the costs of alternative accommodation while a house is being repaired or rebuild. Even if these additional costs are factored in, the real returns on disaster risk reduction remain well below 1 per cent.

By comparison, an estimate of the economic costs of a disaster in El Salvador where there are roughly 700,000 adobe house, the study estimates that there is “an upper-end estimate of a 29 per cent chance of the house being damaged or destroyed by an earthquake” and “the chance that an adobe house would collapse and kill someone was around two per thousand.” With at least 13 earthquakes over the last century, “the chance that an adobe house will collapse and kill someone is approximately 1 in 5,000.” If pre-disaster retrofitting is estimate at US\$ 250 per house, and a 10 per cent discount rate is use, the estimated cost per life saved would be about US\$ 121,000 which is higher return on retrofitting than in Los Angeles. The study concludes that:

“Net benefits of retrofit are also likely to be higher where initial building standards are lower – this will be the case in many developing countries.”

In developing countries, where the quality of existing infrastructure – housing, schools, hospitals, bridges, roads, etc. – is likely to be poor, the net economic benefits of disaster risk reduction activities may be substantial.

¹² Kenny, C. (2009). Why do People Die in Earthquakes? The Costs, Benefits and Institutions of Disaster Risk Reduction in Developing Countries. Policy Research Working Paper 4823, World Bank: 13.

5. Specifying the costs of disaster risk reduction activities

Disaster risk reduction actions from strategic planning to developing and implementing reduced-risk programmes are costly. Estimating the **direct costs of risk-reducing action**, however, are relatively straightforward as these include the costs of labour and materials as well as the cost of loans if borrowing is required. Such costs are generally more easily quantified using market prices.

Indirect costs of risk-reducing actions, however, can be more difficult to identify and to monetise. Risk-reducing strategies may have indirect impacts on economic, social or environmental strategies and action plans. Also, risk-reducing infrastructure may disrupt the established patterns of social and economic activities of affected communities. Such indirect costs are not as easy to estimate.

Finally, risk-reducing actions may be included in broader strategies and action plans for sustainable development making it more challenging to separate out the economic costs attributable directly to disaster risk reduction activities.

Interestingly, the current literature has little to say on how to estimate these costs or indeed on the actual levels and trends of these costs over recent years. Clarity on the costs of disaster risk reduction actions would facilitate improved decision-making on whether or not such actions should be undertaken.

6. The challenges of making economic assessments

An economic assessment for disaster risk reduction is usually based on a benefit-cost analysis. If the benefits exceed the costs then it makes economic sense to invest in reducing the risk of disasters. If the costs exceed the benefits, then the investment is not economically justifiable. This approach is summarised in the following box:

If $B_{\text{DRR}} > C_{\text{DRR}}$, then I	B – Benefits
	C – Costs
	I – Invest
	DRR – Disaster Risk Reduction

Benefit-costs analysis – also called cost-benefit analysis – continues to be highlighted in the recent literature on the economics of disaster risk reduction. For example, the current IFRC guidance document states that “This demand for evidence, as well as a desire by practitioners to better measure the impacts of their work, has increased the popularity of cost-benefit analysis (CBA).”¹³ Recent guidance from the private sector – i.e. Swiss Re – also explains that “risk mitigation considerations can be assessed through simple cost-benefit analyses.”¹⁴

¹³ International Federation of Red Cross and Red Crescent Societies. (2012) Disaster risk reduction: a global advocacy guide: p 13.

¹⁴ Anderson, T., Collich, G., Durante, J.J., Focke, K., and Marcel M. (2010) Natural Disasters Financial Risk Management. Technical and Policy Underpinnings for the Use of Disaster-Linked Financial Instruments in Latin America and the Caribbean. *Inter-American Development Bank & Swiss Reinsurance Company Ltd*: p 19.

Nevertheless, the challenges of using benefit-cost analysis, especially for highly complex policy decisions such as whether to invest in reducing disaster risks or to invest in climate change adaptation options¹⁵, are formidable. The literature identifies challenges such as the availability and reliability of underlying economic data and the difficulty of incorporating risk parameters into benefit-cost analysis has been known for some time and remain with us today.¹⁶ For decision-makers, four major challenges are as follows:

- **Estimating benefits and costs**

The various categories of benefits and costs first need to be determined, then when possible and appropriate these need to be monetised either through using known market values – e.g. the market cost of labour and materials – or through estimating values using various economic tools and techniques. As noted above, calculating robust estimates of the economic costs and benefits of reducing disaster risk is not trivial.

- **Selecting an interest rate**

Because a dollar today is preferred to a dollar tomorrow, the value of money is time dependent. This requires that future monetary values must be discounted to compare them properly to current monetary values. An interest rate has to be selected for **discounting future values**. The higher the interest rate selected, the lower the present value of the future values.

For disaster risk reduction, selecting the appropriate rate of interest to use is critical as the benefits of reducing risk are mostly further in the future while the costs of reducing risk are mostly nearer to the present. Selecting a higher interest rate will result in a larger discounting of the future benefits of reducing risk, and thus diminish the estimated net benefits of disaster risk reduction.

A useful approach to selecting an appropriate discount rate is actually to select several. One of these could be a zero rate which would imply that a dollar tomorrow is of equal value to a dollar today, which can be used to imply that benefits are equal for all generations over time. Another rate could be the current cost of borrowing money, especially if debt financing is required for the risk-reducing activities. By using several rates, the sensitivity of the net benefits to different rates can be assessed.

- **Addressing risk and uncertainty**

How likely is it that a disaster will occur? And when is it likely to occur? It is precisely because disasters are uncertain that it is difficult to estimate when they will occur and thus to predict when any benefits from risk-reducing activities will possibly be realised. With the uncertainty of both the likelihood and the timing of disasters, it is also not easy to determine when it would be the economically optimal – now or sometime into the future – to invest in disaster

¹⁵ United Nations Framework Convention on Climate Change. (2010) Synthesis Report on Efforts Undertaken to Assess the Costs and Benefits of Adaptation Options, and Views on Lessons Learned, Good Practices, Gaps and Needs. *The United Nations: FCCC/SBSTA/2010/3*.

¹⁶ Kramer, R.A. (1994) Disaster Prevention for Sustainable Development, Chapter Four: Advantages and Limitations of Benefit-Cost Analysis for Evaluating Investments in Natural Disaster Mitigation. *International Decade for Natural Disaster Reduction*.

risk reduction. Nevertheless, uncertainties needed to be accounted for. One academic reviewer explains:

“Good practice requires that the analyst identify as many sources of uncertainty as possible and an attempt made to account for them rather than convey the impression that all benefit and cost values are fixed and guaranteed.”¹⁷

A practical way to incorporate uncertainty into a benefit-cost analysis is to apply a **risk premium** to the interest rate used to discount the future value of benefits. This premium, of course, will further reduce the estimated present value of these benefits relative to the costs of reducing risks. By using several premiums for uncertainty, the sensitivity of the net benefits to different risk premiums can also be observed.

- **Identifying the distributional impacts**

Benefit-cost analysis combines the array of estimated benefits and costs into a single numerical result – which can be positive or negative. If B_{DRR} minus C_{DRR} is positive, then the investment is justified. However, importantly, the distributional impacts of both the benefits and the costs are not transparent in this numerical calculation.

For most decision-makers, there is an interest in also knowing the potential impacts of a disaster on particular groups such as the poor or the vulnerable. Thus additional analysis of the distribution of potential impacts is required. This involves separating out the various benefits and costs for specific groups and calculating the net benefits for these groups. As one recent study on hazard mitigation grants¹⁸ points out:

“There are often large disparities in losses from natural hazards, with disadvantaged groups often bearing a disproportionate share, as dramatized most recently by the impacts of Hurricane Katrina. Thus, mitigation in general is likely to benefit lower income and other disadvantaged groups.”

Through undertaking **distributional impact analysis**, economists can show who the potential net beneficiaries of risk reduction activities actually are. They can also make clear whether any of these groups will be net losers. Decision-makers can then decide on whether the gains of the net beneficiaries justify the losses of any potential net losers. Such decisions cannot, of course, be based solely on economic analysis.

Case study: Applying benefit-cost analysis in Sudan

A recent case study from the IFRC¹⁹ provides an insight in the challenges and opportunities of using benefit-cost analysis – or cost-benefit analysis (CBA) as it is also known. The study explains that the:

¹⁷ Ganderton, P.T. (2004) Benefit-Cost Analysis Of Disaster Mitigation: A Review. *Economics Department, University of New Mexico*: p 20.

¹⁸ Bouabid, J., Dash, N., Eguchi, R., Ganderton, P.T., Godschalk, D., Huyck, C., Kiremidjian, A.S., McLane, T., Porter, K., Rose, A., Shaw, D., Taylor, C., Tierney, K., Tobin, L.T., West, C.T., Whitehead, J. (2007) Benefit-Cost Analysis of FEMA Hazard Mitigation Grants. *Natural Hazards Review @ ASCE*: p 110.

¹⁹ International Federation of Red Cross and Red Crescent Societies. (2012). Disaster risk reduction: a global advocacy guide. *International Federation of Red Cross and Red Crescent Societies*. 1-52: 16-17.

“Red Sea State, in northeastern Sudan, suffers regular droughts that are worsening the situation of the indigenous Beja people... For more than 20 years, the Danish Red Cross and the Norwegian Red Cross have supported longer-term programming of the Sudanese Red Crescent Society to reduce the vulnerability of the Beja and to protect, where possible, community assets in order to build their resilience. They have focused on food security and livelihoods, health, water, education and women’s development, with an integrated approach of multiple interventions within the same community. In 2009, a CBA was conducted of several of these activities.”

The activities include three livelihood interventions, all of which were undertaken by the local Beja people. These were:

- **Farming terraces** – Constructing farming terraces particularly for former marginalise herders; resulting in improved earnings from the sale of is fruit and vegetables;
- **Earth embankments** – Constructing earth embankments for controlling an capturing water of seasonal river; resulting in improved irrigation; and
- **Community vegetable gardens** – Developing pump-irrigated communal vegetable gardens; resulting in fruit and vegetable production throughout the year.

IFRC reports that:

“For these projects, the CBA revealed overwhelming benefits. The cost–benefit ratio was 1:61 for the farming terraces, 1:2.4 for the earth embankments, and for the vegetable gardens a remarkable 1:1800. As we have discussed, no price can be placed on life, but if donors are in search of value for money then a CBA can provide valuable reassurance that a project is as cost-effective as it appears.”

In the case of Sudan, cost-benefit analysis proved helpful in deciding to undertake certain projects. It is important also to note that this result was reached from an economic analysis which focused on a wide array of co-benefits including livelihoods, food security, health, education and women’s development.

7. The challenges of policy making

Each country has a unique set of strengths, weaknesses, opportunities and threats with respect to making economically-sound investment decisions for disaster risk reduction. Based on a review of the literature, this section presents an overview of five key policy-making challenges.

- **Short political time horizons**

In most governments, notably in democratic governments, political time horizons tend to be short. Political leaders generally focus on the immediate demands and needs of key constituencies and voters. The potential benefits of disaster risk reduction, on the other hand, tend to be distant and less apparent. Thus are likely to be of less interest to most politicians.

Accordingly, very few countries have established disaster risk reduction strategies. A notable exception is Turkey's new Earthquake Strategy and Action Plan 2012-2023 which states that:

“The principal objective of the Plan is to constitute new earthquake-resistant, safe, well prepared and sustainable settlements so that physical, economic, social, environmental and political harms and losses that may be engendered by earthquakes are prevented, or their effects reduced.”²⁰

One approach to mitigating the short time horizons of political decision-making is to more thoroughly articulate both the direct and extended benefits for investing in disaster risk reduction activities.

- **Political costs and opportunity costs**

Allocating resources to particular disaster risk reduction activities may negatively impact specific constituencies that are critical to a politician's support base. Therefore there may be tangible political costs associated with undertaking these risk reducing activities.

Also, the allocation of financial resources – which are always scarce – to disaster risk reduction activities may appear to have an opportunity cost with respect to alternative activities which could have been undertaken with these resources.

In order to mitigate political costs, a strategic and transparent analysis of potential distributional impacts is required. Mitigating the opportunity costs, however, can be more challenging as additional benefit-cost analyses of the alternatives may also need to be undertaken.

- **Public good characteristics**

A public good is one that once provided can be consumed freely by all. Such goods will tend to be underprovided by private companies because it is difficult to earn a return from a good that can be freely consumed. Hence, there is a case for such goods to be provided by governments. However, just because governments should provide such a good does not mean that they actually will do so.

Disaster risk reduction is a good example of a public good. The widespread public benefits of reducing disaster risks are not easily seen by citizens, and thus politicians may have little incentive to provide them. Rather, as is often the case, politicians will prefer to provide more visible post-disaster restoration and clean-up services instead.

Or worse, as a recent commentator explains, the money which could be used for the disaster risk reduction is misappropriated:

“Self-seeking expenditure manipulates funds, that otherwise could be applied to development, such as DRR work. Instead, these funds are put towards projects that benefit the manipulator or development expenditure is used as a vehicle for personal gain. Either process skews expenditure that could otherwise be applied towards raising

²⁰ Prime Ministry, Disaster and Emergency Management Presidency. (2012) National Earthquake Strategy and Action Plan 2012-2023. Ankara, Turkey: p 7.

the quality of life and reducing vulnerability for wider sectors of society or communities at large.”²¹

Increased transparency and public review of the array of potential direct and extended benefits of investing in reducing risks will help to address this challenge.

- **Incentives to increase disaster risk management**

Unfortunately, political leaders can be influenced by business interests and other pressure groups that want to undertake developments in areas and through ways which can actually increase the risks of disasters. Promoting urbanisation and industrialization in areas prone to flooding or earthquakes are far too common. One commentator²² highlights the following examples:

India	2010	Over-exploiting environmental resources for development, thereby augmenting environmental hazards.
Pakistan	2010	Illegal logging, increasing flood/landslide hazards plus the felled trees become another hazard when swept away by flood waters.
United Kingdom	2007	Placing housing on river flood plains, often due to greed from developers seeking quick tax revenues.
Japan	2005	114 new buildings, including 36 hotels, are deemed to be of inadequate construction for the hazard faced.
Germany	2002	Placing housing on river flood plains, especially greedy local authorities seeking development.

Increased transparency and public review of the potential economic costs and distributional impacts of risk-enhancing developments will help to address this challenge.

- **Economic drivers of democratic or autocratic processes**

Political decisions to invest in disaster risk reduction activities will be influenced by the political framework in which such decisions are made. A recent academic working paper from New York University²³ provides evidence of the importance of democratic processes for investing in risk reduction:

“Consistent with prior work and many anecdotal accounts, our analyses show that fewer people die from disasters in large coalition systems, such as democracies, than in more autocratic small coalition systems. We contend that these differences results from how political institutions shape survival incentives for political leaders...”

²¹ Lewis J. (2012) The Good, The Bad and The Ugly: Disaster Risk Reduction (DRR) Versus Disaster Risk Creation (DRC). PLOS Currents Disasters. 2012 Jun 21 [last modified: 2012 Jun 29]. Edition 1. doi: 10.1371/4f8d4eaec6af8: p 10.

²² Lewis J. (2012) The Good, The Bad and The Ugly: Disaster Risk Reduction (DRR) Versus Disaster Risk Creation (DRC). PLOS Currents Disasters. 2012 Jun 21 [last modified: 2012 Jun 29]. Edition 1. doi: 10.1371/4f8d4eaec6af8: p 6.

²³ Flores, A. Q., and Smith, A. (2010) Surviving Disasters. *Wilf Family Department of Politics, New York University*: pp 33-34.

Understanding the economic drivers behind political motivations is needed to see how and where the political case for investments in disaster risk reduction can be strengthened. These economic drivers are likely to differ significantly depending on the whether the country is democratic or autocratic.

Policy study: The role of democracy in reducing disaster risks

Political decisions to invest in disaster risk reduction activities will be influenced by the political framework in which such decisions are made. In a recent academic working paper²⁴, empirical evidence indicates the importance of democratic processes for investing in risk reduction. The paper reports that:

“Consistent with prior work and many anecdotal accounts, our analyses show that fewer people die from disasters in large coalition systems, such as democracies, than in more autocratic small coalition systems. We contend that these differences results from how political institutions shape survival incentives for political leaders...

In large coalition systems leaders need to retain the support of a large portion of the population. This incentivizes them to use public goods as a reward mechanism. In the context of disasters this means taking steps to avoid them and minimizing their impact when they happen...

In small coalition systems, the incentive for leaders to protect the citizens from disasters is much less than in a large coalition system. Preparing for disasters and providing assistance in their aftermath consumes resources. Leaders better enhance their survival by retaining these resources to buy the loyalty of their small coalition of supporters. Humanitarian assistance is not good politics: focusing on the welfare of the essential few in the coalition and ignoring the suffering of the masses is the efficient means of buying political support in a small coalition system...”

The paper explains that empirical test support these prediction. Indeed in large coalition political systems, “the occurrence of disasters has little effect on the level of protest or leader survival,” but these leaders are “sensitive to the number of fatalities.” On the other hand, in small coalition political systems, the “occurrence of disasters increases protest and reduces leader survival” while the number of deaths does not appear to be a significant factor. Hence, the study concludes that:

“Political motivations and not humanitarian concerns drive governments’ responses to disasters.”

Understanding the economic drivers behind political motivations is needed to see how and where the political case for investments in disaster risk reduction can be strengthened. These drivers are likely to differ significantly depending on the whether the country is democratic or autocratic.

²⁴ Flores, A. Q., and Smith, A. 2010. Surviving Disasters. Wilf Family Department of Politics, New York University: 33-34.

8. Suggestions for improving investment decision-making

The economic, social and environmental costs of disasters remain high and have continued to rise. With growing populations and prosperity leading to expanded developments in risk-prone areas, the costs of disasters are most likely to continue rising over the decades to come. Thus, there is a strong economic case for investing in disaster risk reduction, alongside the social and environmental reasons for undertaking these investments.

Nevertheless, the **technical challenges** of making a sound economic assessment to facilitate a decision to investing in reducing disaster risk remain and need to be addressed carefully. Further, the **policy challenges** are considerable as public good nature of disaster risk reduction, ironically, makes it especially difficult to secure much needed public investment.

Building on insights captured from a review of the recent literature, this section suggests two approaches which could help to strengthen the economic case for disaster risk reduction and improve investment decision-making at national and local levels. It also proposes one initiative for information sharing which could be implemented at the international or regional level.

- **List economic benefits and costs**

It may not always be easy or even possible to quantify the various benefits and costs associated with a potential investment in disaster risk reduction. However, it should always to be possible to produce an annotated list of the key benefits and costs of an investment. Where data is available some of these benefits and costs can also be quantified in monetary terms. The list should include the following:

<p>Direct Benefits</p> <ul style="list-style-type: none"> • Avoided Direct Disaster Costs • Avoided Indirect Disaster Costs • Avoided Non-Economic Disaster Impacts 	<p>Direct & Indirect Costs</p> <ul style="list-style-type: none"> • Planning • Construction • Labour • Materials • Opportunity costs of the allocation of resources
<p>Extended Benefits</p> <ul style="list-style-type: none"> • Increased livelihoods • Food security • Durable infrastructure • Environmental sustainability 	

In this respect, the US Federal Emergency Management Agency (FEMA) has provided guidance on how to undertake a *qualitative* benefit-cost analysis.²⁵ One method proposed by FEMA is called **Simple Listing**. It is described in the following box:

²⁵ Federal Emergency Management Agency. (2007) Using Benefit-Cost Review in Mitigation Planning State and Local Mitigation Planning How-To Guide Number Five. FEMA 386-5. US Department of Homeland Security: pp 8-9.

FEMA Simple Listing

The qualitative method described below helps the Planning Team judge the priorities of actions based on perceived pros and cons (i.e., benefits and costs).

The method is best used when it is not possible, or appropriate, to identify a quantitative measure of benefits and costs. Each action can have a unique advantage or disadvantage that can subsequently be used for prioritization.

Using this method ensures that special emphasis is given to Benefit-Cost Review by categorizing prioritization criteria (e.g., ease of implementation, technical effectiveness) as either benefits or costs.

Step 1: List identified actions

For each hazard, list the actions identified earlier in the plan.

Step 2: Identify benefits and costs

Identify all expected benefits (i.e., positive effects) and costs (i.e., perceived obstacles) of the actions and write these down in the benefits and costs columns, respectively...

Step 3: Assign priority

As a result of the Benefit-Cost Review, the Planning Team assigns a priority to each action. Priority can be expressed in many ways, such as:

- High, medium, low, accompanied by an explanation of what each term means.
- Priority 1, Priority 2, etc.
- Immediate, short-term, and long-term, accompanied by an explanation of what each category means (e.g., immediate = within a month, short-term = within 6 months, long-term = within 2 years).

Such a simple list can help decision-makers better understand the key economic dimensions of disaster risk reduction activities and to prioritise investments in these activities.

In particular, such a list should clearly articulate the **extended benefits**. Any public expenditure, including public investments in disaster risk reduction, is likely to have an array of extended benefits through its contribution to other policy objectives and political priorities. For example, reducing disaster risk can also improve the delivery of basic services such as water, sewage and power; strengthen civil society networks and the role of women in community preparedness; and build e-communication capacity.

The economic case for investing in disaster risk reduction can be better communicated to various stakeholders and interest groups by setting out the array of extended benefits from such investments in relation to their needs and priorities. In other words, investing in disaster risk reduction is beneficial not just for its own sake but because it can support other sustainable development outcomes.

- **List key stakeholders and distributional economic impacts**

Effective policies depend in part on the sensitivity of decision-makers to the potential distributional impacts on key stakeholders. The nature of the political system will, of course, shape which stakeholders are key to any political decision-making. This holds true as well for decisions about disaster risk reduction.

A complete listing of the key stakeholders related to a potential decision on disaster risk reduction will help to make clear who is potentially an interested party – directly or indirectly – in this decision. Further qualitative or quantitative assessment of the likely distribution of economic impacts – at least through the identification of key beneficiaries and key losers – will highlight the impacts across various communities and business sectors.

- **Learn from other economic assessments**

Economic assessments require the collection of extensive and reliable data. They also require that strategic decisions are made on a number of critical variables including the interest rate used for discounting future streams of benefits and costs and the risk premium. In short, economic assessments are costly. Hence, in many cases, countries may be able to improve the effectiveness of their decision-making by learning from the economic assessments undertaken by other countries.

In some cases, the empirical results of a particular economic assessment can be transferred from one situation to another. In so doing, a country might be able to make a cost-effective economics assessment by applying the results of research which was done elsewhere. Even where transferring the empirical results is not possible, useful insights about the range of benefits and costs, the selection of interest rates and risk premiums, the distributional impacts on key stakeholders, and potential political and opportunity costs can be learned from a review of economics assessments which were undertaken in other places.

In this regard, an international online clearinghouse of information²⁶ on the economics of disaster risk reduction could help to improve the effectiveness, and indeed the efficiency, of disaster risk reduction decision-making at the regional, national and local levels.

Though establishing such a clearinghouse, it will become clearer what further work needs to be done to address the various technical and policy challenges regarding the economic assessment of disaster risk reduction. Writing back in 1994, Professor R Kramer called for such a programme of research:

“An applied research effort combining experts from social and natural sciences should be initiated to develop a series of case studies to determine which of the methods described here would be most effective in project analysis. The case studies should be selected so as to gain experience from applying the methods in a variety of sectors and a variety of disaster vulnerabilities.”²⁷

²⁶ For an example, see: <http://www.preventionweb.net/english/themes/economics/>.

²⁷ Kramer, R.A. (1994) Disaster Prevention for Sustainable Development, Chapter Four: Advantages and Limitations of Benefit-Cost Analysis for Evaluating Investments in Natural Disaster Mitigation. *International Decade for Natural Disaster Reduction*: p 75.

The review of the recent publicly-available literature on the economics of disaster risk reduction indicates that decision-makers and experts would benefit from a more systematic collection and dissemination of relevant applied research and economic analysis.

In conclusion, the analytical framework of benefit-cost analysis – notably the identification of economic benefits and costs, key stakeholders and the distributional economic impacts, and the co-benefits generated for other priorities – can be most useful for improving decision-making about investments in disaster risk reduction.

As there are many variables involved and critical assumptions required for estimating a net benefit calculation, however, any attempts to do so should be done cautiously. Emphasis rather should be placed on using the analytical framework to ensure transparency of the economic benefits and economic costs associated with reducing disaster risks and transparency of the distributional impacts to key stakeholders. Decision-makers will make more informed decisions if the economic costs and benefits are visible.

9. Further reading

This annotated bibliography lists publically-available studies, reports and presentations which were used in preparing this working paper. They are organised thematically and in reverse chronological order. The documents can be downloaded from a prototype online library on the economics of disaster risk reduction which is available at: <http://risk.earthmind.net>.

- **Economic costs of disasters**

This section lists publicly-available papers and presentations on the economic costs of disasters, particularly since the adoption of the HFA in 2005. These include selected case studies. There is also a small section below on disaster statistics.

Anttila-Huges, J.K. and Hsiang, S.M. (2012) Destruction, Disinvestment, and Death: Economic and Human Losses Following Disaster. *Columbia University, School of International and Public Affairs and Princeton University, Woodrow Wilson School of Public and International Affairs*.

[Analyses the annual variation in the incidence of typhoons to identify the effect of environmental disaster on economic and health outcomes in Filipino households]

Kousky, C. (2012) Informing Climate Adaptation: A Review of the Economic Costs of Natural Disasters, Their Determinants, and Risk Reduction Options. *Resources for the Future*. RFF DP 12-28.

[Reviews empirical literature on the economic impacts of natural disasters and discusses risk reduction options in order to inform both climate adaptation policy and the estimation of potential climate damages]

Burbeck, P., and Kreibich, H. (2011) Costs of Natural Hazards: Modeling Direct Economic Costs. *Section Hydrology, German Research Centre for Geosciences (GFZ)*.

[Details the damages and costs associated with natural hazards, focusing on floods]

Desai, B., Harding, J., Ginnetti, J., Maskrey, A., Mohanty S., Serje J., et al. (2011) Global Assessment Report on Disaster Risk Reduction Revealing Risk, Redefining Development. Chapter Two: Revealing Risk. *Global Assessment Report on Disaster Risk Reduction: (2)*.

[Second chapter of the Global Assessment Report providing an analysis of the risks of hazard events and the economic costs associated with global disasters]

Evaluación de Riesgos Naturales – América Latina. (2011) Probabilistic modeling of natural risks at the global level: the hybrid loss exceedance curve: development of methodology and implementation of case studies. Phase 1A: Colombia, Mexico and Nepal. *Global Assessment Report on Disaster Risk Reduction 2011*.
[With case studies from Colombia, Mexico and Nepal, proposes risk assessment methodologies using loss exceedance curves]

Harmeling, S. (2011) Global Climate Risk Index 2012; Who Suffers Most from Extreme Weather Events? Weather-Related Loss Events in 2010 and 1991-2010. *German Watch*.
[Analysis that underlines that least developed countries generally are more affected than industrialized countries with weather-related loss events]

Hallegatte, S. & Przyluski, V. (2010). The Economics of Natural Disasters: Concepts and Methods. Policy Research Working Paper 5507. The World Bank, Washington D.C.
[Highlights the importance of estimating indirect as well as direct economics costs of disasters]

Hsiang, S.M. (2010) Temperatures and Cyclones Strongly Associated with Economic Production in the Caribbean and Central America. *Proceedings of the National Academy of Sciences*: vol. 107, no. 35.
[Argues that omitting the response of workers to thermal stress may underestimate the global economic costs of climate change]

Kunreuther, H. C. (2008) At War with the Weather Managing Large-Scale Risks in a New Era of Catastrophes. The World Bank - UN / Economics of Disaster Risks Seminar Series Presentation. *Operations and Information Management (OPIM) Dept. Risk Management and Decision Processes Center The Wharton School, University of Pennsylvania*.
[Identifies the monetary costs of recent catastrophes in the United States and discusses possible risk management strategies]

Concern Worldwide US. (2005) Approaches to Disaster Risk Reduction. *Concern Worldwide, Emergency Unit*.
[An overview of disaster risk reduction in the context of the Hyogo Declaration with analysis on hazard vulnerability, mitigation, and examples in Somalia, Pakistan and Southern Sudan]

Data & statistics

Below R., Guha-Sapir D., Ponserre S., and Vos F. (2011) Annual Disaster Statistical Review 2011, The Numbers and Trends. *Centre for Research on the Epidemiology of Disasters (CRED) and Institute of Health and Society (IRSS)*.
[Comprehensive review of disaster data from 2011, including regional distribution of hazard events, fatalities and economic losses]

Guha-Sapir D. (2011) Disasters in Numbers 2011. *CRED – UNISDR Press Conference*.
[Reports on the latest data on disaster trends including social and economic costs]

ISDR, US Agency for International Development, and the Centre for Research on the Epidemiology of Disaster (CRED). (2011). 2011 Disasters in Numbers. EM-DAT: *The OFDA/CRED - International Disaster Database*.

[Two-page information sheet with graphs of disaster trends and statistics from 2011]

Visser H. (2011) A Trend is a Trend is a Trend: a Different View on Trend Estimation in Disaster Data. *PBL Netherlands Environmental Assessment Agency*.

[Presentation on disaster trends and analyses the various models, data and the associated uncertainties]

- **Economic benefits of disaster risk reduction**

The major benefit of disaster risk reduction is the risk-adjusted reduced costs from disasters. Risk reduction programmes have additional direct costs which also must be considered when determining the 'net' economic benefits of these programmes. This section provides publicly-available papers and presentations which address the net economic benefits.

Anderson, T., Mahul O., Runde, D., Setchell, C., Schwartz, A. H., Snider, R., et al. (2011) Economics of Disaster Prevention: Measuring the Costs and Benefits of Disaster Risk Reduction. Seminar transcript. *The Center for Strategic and International Studies (CSIS)*. Washington, D.C.

[Transcript of speakers from the World Bank, USAID, FEMA and the American Red Cross discussing the role of cost-benefit analysis in disaster management]

Briceño S. (2011) Economics of "Natural" Disasters – Bridging Disaster Risk Reduction and Climate Adaptation Efforts and Strategies. *International Strategy for Disaster Reduction*.

[Presentation promoting disaster risk reduction as an essential requirement for sustainable development and tool for climate change adaptation]

Desai, B., Harding, J., Ginnetti, J., Maskrey, A., Mohanty S., Serje J., et al. (2011) Global Assessment Report on Disaster Risk Reduction Revealing Risk, Redefining Development. Chapter 5: Investing today for a safer tomorrow. *Global Assessment Report on Disaster Risk Reduction (GAR)*.

[Fifth chapter of the Global Assessment Report, discusses the benefits of public investment in disaster risk management, using evidence from Colombia, Mexico and Nepal]

Kenny, C. (2009) Why do People Die in Earthquakes? The Costs, Benefits and Institutions of Disaster Risk Reduction in Developing Countries. Policy Research Working Paper 4823, World Bank.

[Working paper on disaster risk reduction in developing countries and the potential for significant social and economic benefits with more investment in public disaster risk management]

Bildan, L., Narasimhan R., and Subbiah A.R. (2008) Background Paper on Assessment of the Economics of Early Warning Systems for Disaster Risk Reduction. *Asian Disaster Preparedness Center*.

[Provides arguments for investing in an early warning systems (EWS)]

Benson C., Twigg, J., and Rossetto, T. (2007) Tools for Mainstreaming Disaster Risk Reduction: Guidance Notes for Development Organisations. *ProVention Consortium, Guidance Note 8*.

[Provides an economic analysis of disaster risk mitigation and guidance for implementing management strategies for development projects]

- **Economic assessment of disaster risk reduction**

This section provides a number of publicly-available papers and presentations on the use of economic analysis, particularly benefit-cost analysis, for deciding on whether to invest in disaster risk reduction programmes. The focus is on exploring the advantages of adopting a pragmatic approach to using economic analysis to better determine the net benefits of investing in disaster risk reduction.

Courbage, C. and Stahel, W.R., eds. (2012) Extreme Events and Insurance: 2011 Annus Horribilis. *The Geneva Association (The International Association for the Study of Insurance Economics)*.

[A report from a global insurance think tank calling for greater cooperation between public and private sectors to deal with the increasing economic costs of disasters]

Munich RE. (2012) Topics Geo Natural Catastrophes 2011: Analyses, Assessments, and Positions. *Munich RE*.

[Company magazine with articles on the earthquake, flood, and nuclear accident of 2011]

International Federation of Red Cross and Red Crescent Societies. (2012) Disaster risk Reduction: A Global Advocacy Guide. *International Federation of Red Cross and Red Crescent Societies*.

[Makes the case for increasing investment in disaster risk reduction, including steps for implementation and challenges to address]

Ahmed, S., Banerjee, S., Heyzer, N., Kumar, N., Hasan, A., et al. (2011) Economic and Social Survey of Asia and the Pacific. Sustaining Dynamism and Inclusive Development, Connectivity in the Region and Productive Capacity in Least Developed Countries. *United Nations Economic and Social Commission for Asia and the Pacific*.

[Regional economic and social analysis following the major natural disaster in Japan]

Anderson, T., Collich, G., Durante, J.J., Focke, K., and Marcel M. (2010) Natural Disasters Financial Risk Management. Technical and Policy Underpinnings for the Use of Disaster-Linked Financial Instruments in Latin America and the Caribbean. *Inter-American Development Bank & Swiss Reinsurance Company Ltd*.

[Discusses the technical and policy implications for using disaster risk reduction financial instruments in Latin America and the Caribbean]

Baker, J. and Shaw W.D. (2010) Models of Location Choice and Willingness to Pay to Avoid Hurricane Risks for Hurricane Katrina Evacuees. *International Journal for Mass Emergencies and Disasters*: Vol. 28, No. 1.

[Study which find that perceptions of risk and damages fade, and willingness to pay to obtain protection falls over time]

United Nations Framework Convention on Climate Change. (2010) Synthesis Report on Efforts Undertaken to Assess the Costs and Benefits of Adaptation Options, and Views on Lessons Learned, Good Practices, Gaps and Needs. *The United Nations: FCCC/SBSTA/2010/3*.

[Identifies remaining gaps and needs relating to both a necessity for more comprehensive assessments of costs and benefits, as well as to methodological gaps and needs encountered by adaptation researchers and planners when undertaking such assessments]

- Baker, J., Bell, D., Brody, S., Neilson, W., Riddle, M., Shaw, D., and Woodville, R.T. (2009) Explaining Subjective Risks of Hurricanes and the Role of Risks in Intended Moving and Location Choice Models. *Natural Hazards Review* © ASCE: Vol. 10, No. 3.
[Explores the perceptions of the risks of hurricanes and intended relocation decisions when faced with these risks.]
- Khan, F., Mustafa, D., D., Kull and The Risk to Resilience Study Team. (2008) Evaluating the Costs and Benefits of Disaster Risk Reduction under Changing Climatic Conditions: A Pakistan Case Study. Risk to Resilience Working Paper No. 7, eds. Moench, M., Caspari, E. & A. Pokhrel, ISET, ISET-Nepal and ProVention, Kathmandu, Nepal.
[A case study using both social and natural science tools to answer a set of basic questions on proactive risk reduction.]
- Bouabid, J., Dash, N., Eguchi, R., Ganderton, P.T., Godschalk, D., Huyck, et al. (2007) Benefit-Cost Analysis of FEMA Hazard Mitigation Grants. *Natural Hazards Review @ ASCE*.
[Summarizes the results of applying benefit-cost analysis to a nationwide statistical sample of FEMA-funded mitigation activities]
- Federal Emergency Management Agency. (2007) Using Benefit-Cost Review in Mitigation Planning. State and Local Mitigation Planning, How-To Guide. *U.S. Department of Homeland Security*.
[Guidance on methods to review benefits and costs, prioritize actions both qualitatively and quantitatively]
- Mechler, R., Moench, M., and Stapleton, S. (2007) Information Note No 3 Costs and Benefits of Disaster Risk Reduction. Global Platform for Disaster Risk Reduction, High Level Dialogue.
[Provides information on the costs and benefits of disaster risk reduction, especially as it relates to climate change, development, and growing urban areas]
- Benson, C., Kessler E., Koehler, H., Mechler R., Schaef T., Von Hesse M., et al. (2005) Kobe Report Draft: Cost-benefit Analysis for Disaster Risk Management. Session 3.7, Thematic Cluster 3. *International Strategy for Disaster Reduction*.
[Summarises key findings from the World Convention on Disaster Reduction in Hyogo, Japan.]
- Reinhard, M. (2005) Cost-Benefit Analysis for Natural Disaster Management: Methodological Background. Session and Presentation. *World Conference on Disaster Reduction*.
[Presentation identifying costs and benefits of disaster risk management with case studies in Peru and Indonesia]
- Concern Worldwide US. (2005) Approaches to Disaster Risk Reduction. *Concern Worldwide, Emergency Unit*.
[A general guide to assessment, measurement, analysis and planning tools for disaster risk management]
- Ganderton, P.T. (2004) Benefit-Cost Analysis Of Disaster Mitigation: A Review. *Economics Department, University of New Mexico*.
[A comprehensive, critical overview of using benefit-cost analysis as a viable method for evaluating projects and investing in disaster risk reduction]

Benson, C. and Clay, E. (2004) Understanding the Economic and Financial Impacts of Natural Disasters: Disaster Risk Management, working paper series. No. 4. *World Bank*.
[Final version of the ODI report below, comprises a state-of-the art review and three country case studies]

Benson, C., and Clay, E. (2003) Economic and Financial Impacts of Natural Disasters: as Assessment of Their Effects and Options for Mitigation: Synthesis Report. *Overseas Development Initiative and Disaster Management Facility, World Bank*.
[Comprises a state-of-the art review and three country case studies]

Falit-Baiamonte, A., Zerbe, R.O. (2001) The Use of Benefit-Cost Analysis for Evaluation of Performance-Based Earthquake Engineering Decisions: *Pacific Earthquake Engineering Research Center, University of Washington*.
[An overview of benefit-cost analysis for performance-based earthquake engineering framework and discusses the economic implications]

Kramer, R.A. (1994) Disaster Prevention for Sustainable Development, Chapter Four: Advantages and Limitations of Benefit-Cost Analysis for Evaluating Investments in Natural Disaster Mitigation. *International Decade for Natural Disaster Reduction: 4*.
[Using various models and a case study of agriculture in St. Lucia, provides evidence that disaster mitigation can support the goals of sustainable development]

England R.W. (1988) Disaster-Prone Technologies, Environmental Risks and Profit Maximizations. *Kyklos: Vol 41*, Face 3.
[Economic analysis on profit-maximizing firms' decisions to invest in disaster mitigation]

- **Key institutional/policy barriers & gaps**

Each country has a unique set of strengths, weaknesses, opportunities and threats with respect to making economically-sound investment decisions for disaster risk reduction. This section lists papers and presentations on key institutional/policy barriers and gaps.

United Nations General Assembly Resolution 66/288. (2012) *The Future We Want*. Paragraphs 186-18.
[Outcome statement from RIO+20 including a re-commitment to investing in disaster risk reduction]

Aguayo, J.V., Bittner, P., Cocchiglia, M., Rego, A., Scott J., Valdés, H.M., et al. (2012) How to Make Cities More Resilient. A Handbook for Local Government Leaders. *International Strategy for Disaster Reduction*.
[Provides government leaders with the essentials on why disaster risk reduction is necessary and how to implement effective management strategies in varying regions in order in to support urban resilience]

Lee, B. and Preston, F. with Green, G. (2012) Preparing for High-Impact, Low-Probability Events: Lessons from Eyjafjallajökull. *A Chatham House Report*.
[Analysis of the nature of decision-making and coordination before, during and after ash cloud; the impact of scientific uncertainty; the economic consequences and the role of communications]

- Lewis J. (2012) The Good, The Bad and The Ugly: Disaster Risk Reduction (DRR) Versus Disaster Risk Creation (DRC). PLOS Currents Disasters. 2012 Jun 21 [last modified: 2012 Jun 29]. Edition 1. doi: 10.1371/4f8d4eaec6af8.
[Demonstrates the extent to which “vulnerability drivers” emanate from greed, the misuse of political and commercial power, mismanagement and incompetence]
- Prime Ministry, Disaster and Emergency Management Presidency. (2012) National Earthquake Strategy and Action Plan 2012-2023. Ankara, Turkey.
[Sets out a national strategy and programme for reducing the risk of earthquakes]
- Noy, I. (2012) Investing in Early Warning Systems: A Global Fund for Disaster Preparedness. Paper prepared for the Copenhagen Consensus Project. *Department of Economics, University of Hawaii & School of Economics and Finance, Victoria University in Wellington*.
[Analyses the political barriers of disaster risk reduction and advocates investment in early warning systems, suggesting strategies to create incentives and encourage funding]
- International Strategy for Disaster Reduction. (2012) Factsheet on the Secretariat of the International Strategy for Disaster Reduction (UNISDR).
[Explains the mandate and responsibilities of the ISDR Secretariat]
- Williams, G. (2011) Study on Disaster Risk Reduction, Decentralized and Political Economy. The Political Economy of Disaster Risk Reduction. *United Nations International Strategy for Disaster Reduction Global Assessment Report on Disaster Risk Reduction*.
[Investigates the political and economic variables that affect incentives for effective disaster risk reduction]
- Guha-Sapir, D. (2011) EMDAT and Trends in Natural Disasters. Presentation. *Centre for Research on the Epidemiology of Disasters*.
[Presentation by the Centre for Research on the Epidemiology of Disasters showing trends of natural disaster occurrences and the relationship of climate events and populations]
- Garrelts, H. and Lange, H. (2011) Path Dependencies and Path Change in Complex Fields of Action: Climate Adaptation Policies in Germany in the Realm of Flood Risk Management. *AMBIO: A Journal of the Human Environment*: Vol. 40, Issue 2.
[Reviews two cases studies highlighting the pivotal role of the state in making critical decisions in response to disaster]
- International Strategy for Disaster Reduction. (2011) Business Partnerships: Disaster Risk Reduction is Everybody’s Business.
[Brochure on building business partnerships]
- Flores, A.Q., Smith, A. (2010) Surviving Disasters. *Wilf Family Departments of Politics, New York University*.
[Empirical analysis of the political drivers for investing in disaster risk reduction]
- International Federation of Red Cross and Red Crescent Societies. (2010) World Disasters Report 2010: Bridging the Urban Risk Divide. Presentation.
[An overview of disaster risks faced by the growing urban sector and the role of local governments in managing and reducing risk]

- Adam, B., de la Fuente, A., Ramachandran, S., Sahin, S., Sanghi, A., Martina Tonizzo, et al. (2010) Natural Hazards, Unnatural Disasters. The Economics of Effective Prevention. *The United Nations and the World Bank*.
[Details the many strategies that both the private and public sectors can take to prevent natural hazards from becoming catastrophic disasters]
- Berger, R. and Chambwera, M. (2010) Beyond Cost-Benefit: Developing a Complete Toolkit for Adaptation Decisions. *International Institute for Environment and Development*.
[Briefing note advocating development of a ‘toolkit’ that helps users choose from a variety of evaluation methods]
- AusAid. (2009) Investing in a Safer Future: A Disaster Risk Reduction Policy for the Australian Aid Program. *Australian Agency for International Development (AusAid)*.
[Development assistance policy aimed at reducing vulnerability and enhancing the resilience of countries and communities to disasters]
- Guevara, O.J. (2009) The Economics Disaster Risk Reduction: Risk Transfer Instrument. Presentation. *IDRMS*.
[Presentation from the Integrated Disaster Risk Management Society on risk transfer and the role of economics in disaster risk management]
- Hellmuth M.E., Osgood D.E., Hess U., Moorhead A. and Bhojwani H, et al. (2009) Index Insurance and Climate Risk: Prospects for Development and Disaster Management. *Climate and Society No. 2; International Research Institute for Climate and Society (IRI)*.
[Explores how a new type of insurance – index insurance – offers new opportunities for managing climate risk in developing countries]
- Wildasin, D.E. (2008) Disaster Policies: Some Implications for Public Finance in the U.S. Federation. *Public Finance Review: Volume 26 Number 4*.
[Analysis of flood losses in Louisiana showing that rare but exceptionally large disasters account for a large share of all disaster losses]
- Mitchell, M., Schnarwiler, R. (2008) Disaster Risk Financing: Reducing the Burden on Public Budgets. Focus Report. *Swiss Reinsurance Company Ltd*.
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