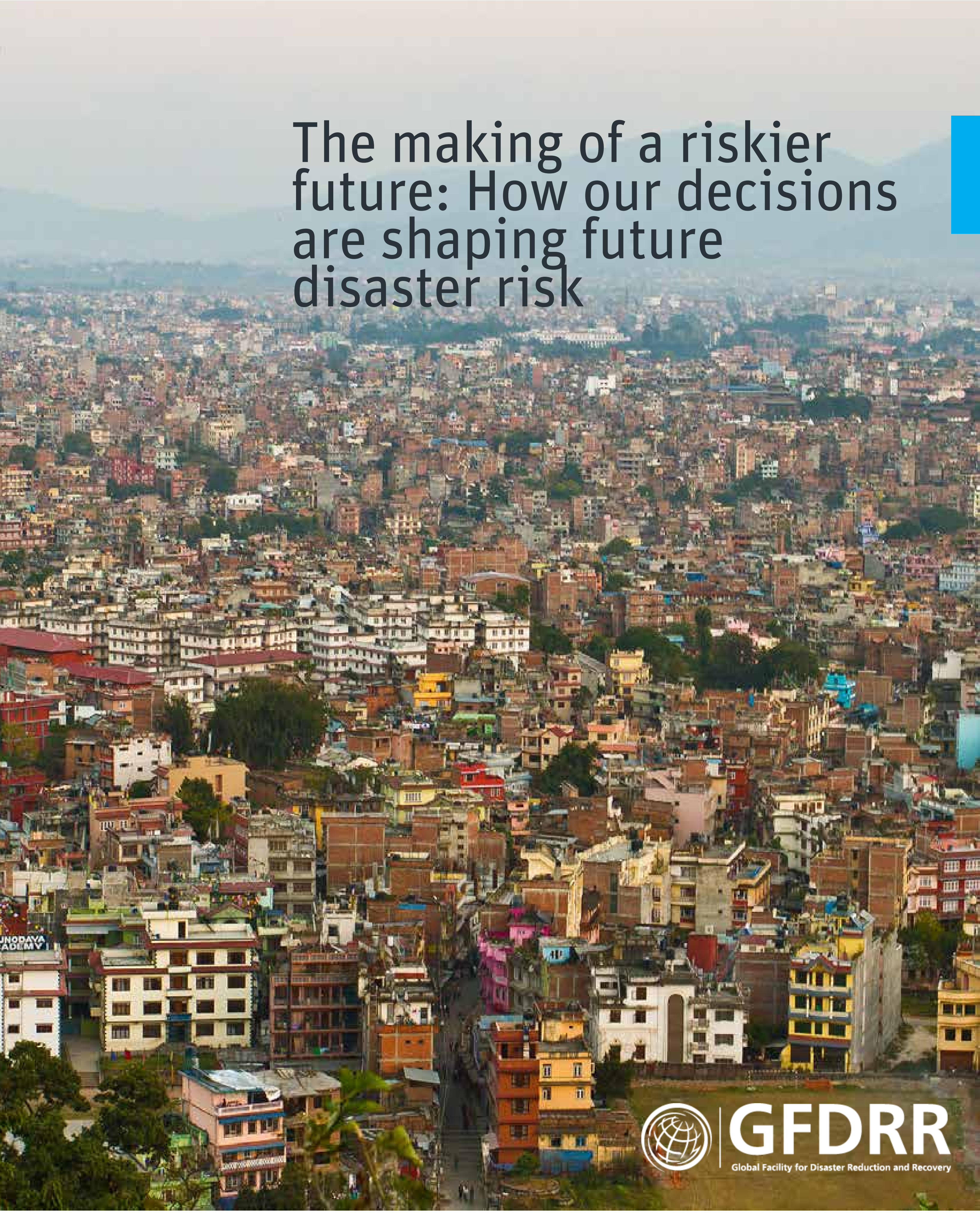
# The making of a riskier future: How our decisions are shaping future disaster risk



GFDRR

Global Facility for Disaster Reduction and Recovery

# Executive Summary

## Key messages from this report:

- **Most disaster risk assessment today is static, focusing only on understanding current risks. A paradigm shift is needed toward dynamic risk assessments, which reveal the drivers of risk and the effectiveness of policies focused on reducing risk.**
- **Global disaster risk is changing extremely fast, due to combined dynamics of hazard, exposure, and vulnerability.**
- **The drivers of disaster risk are in the control of policy makers, society, and individuals—but accurate assessment and continuous reevaluation of risk are required to enable effective risk reduction and prevent drastic increases in future losses.**

NEPAL

Partially collapsed house after the 7.8 earthquake hit Nepal on 25 April 2015.

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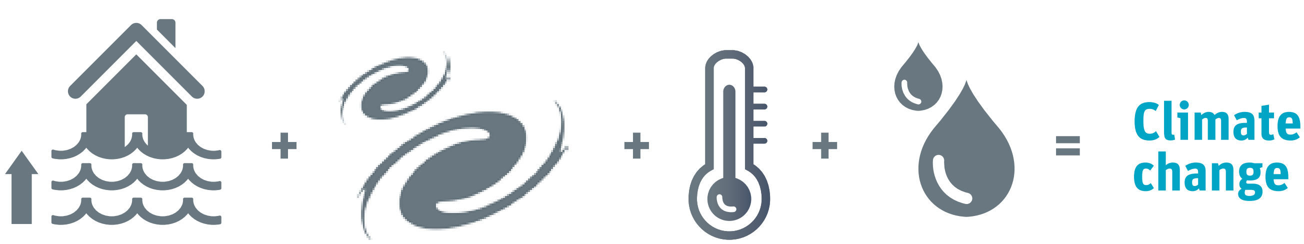
There is variability in annual losses and deaths from disasters, but annual total damage (averaged over a 10-year period) has increased tenfold between 1976–1985 and 2005–2014, from US$14 billion to more than US$140 billion.

Disaster risks are rapidly increasing around the world: many regions are experiencing greater damage and higher losses than in the past. There is variability in annual losses and deaths from disasters, but annual total damage (averaged over a 10-year period) has increased tenfold between 1976–1985 and 2005–2014, from US$14 billion to more than US$140 billion. Average population affected each year has risen from around 60 million people (1976–1985) to over 170 million (2005–2014).[1] Disaster risk is influenced by the occurrence of potentially dangerous naturally occurring events, such as earthquakes or tropical cyclones (hazard); the population and economic assets located in hazard-prone areas (exposure); and the susceptibility of the exposed elements to the natural hazard (vulnerability). All three of these components are dynamic, and change over time under natural and human influences (figure ES.1). But most risk assessments do not account for these changes, so they provide a static view of risk. As a result, risk management policy decisions based on such assessments do not take into account the continuous and sometimes rapid changes in the drivers of risk and so may underestimate risk.

Changes in hazard are driven by climate change, which raises sea levels, changes the intensity of the strongest storms and the frequency with which they occur, increases extreme temperatures, and alters patterns of precipitation. Global sea-level rise of up to 0.6 m this century will increase disaster risk significantly in coastal areas. In addition, subsidence (sinking land) will increase the likelihood of flooding locally. In some coastal megacities subsidence has a greater influence on flood hazard than sea-level rise; the former occurs at a rate of up to 100 mm/year, in comparison with up to 10 mm/year for the latter (Erkens et al., case study C).

Exposure increases as population grows in hazardous areas, and as improved socioeconomic conditions raise the value of assets. Between 2010 and 2050, estimated global population exposed to river and coastal flood is expected to increase from 992 million to 1.3 billion (Jongman, Ward, and Aerts 2012). Average annual GDP at risk of earthquakes in Turkey is expected to increase by five times between 2010 and 2080 due to socioeconomic growth (Murnane et al., case study G). Urbanization—encompassing both the movement of people from rural to urban areas and population growth within cities—results in larger concentrations of exposure. In Indonesia, river flood risk may increase 166 percent over the next 30 years due to rapid expansion

[1] D. Guha-Sapir, R. Below, and Ph. Hoyois, EM-DAT: International Disaster Database, www.emdat.be, Université Catholique de Louvain, Brussels, Belgium, accessed July 2015.



of urban areas, and coastal flood risk may increase 445 percent over that same period (Muis et al. 2015). Population is expected to increase by at least 40 percent in 14 of the 20 most populated cities in the world between 2015 and 2030, with some cities growing by 10 million people in that period. Many of the largest cities are located in deltas and are highly prone to floods and other hazards (Hallegatte et al. 2013), and as these cities grow, an ever greater number of people and more assets are at risk of disaster. Another feature of urban expansion, the increase in impermeable surfaces, also directly affects flood hazard.

Vulnerability too changes with urban and socioeconomic development. Some people become less vulnerable because of improved construction and a more prosperous economic situation. But in many areas, structural vulnerability continues to increase because of unregulated building practices and unplanned development. For example, earthquake risk in Kathmandu (measured as the proportion of buildings that collapse in an earthquake) is expected to double to 50 percent by 2045 due to informal building expansion alone (Lallemant et al., case study D). Social vulnerability also changes over time, influenced by the occurrence of disasters, which disrupt lives and livelihoods, and by the effects of climate change, which could push over 100 million additional people back into poverty by 2030 (Hallegatte et al. 2015).

Increased exposure and changes in vulnerability have already affected disaster risk. A large proportion of recent increases in disaster losses are attributed to development occurring in hazardous areas (Bouwer et al. 2007). Concentrations of greenhouse gas in the atmosphere have risen in recent decades due to human activity, and recent years have seen extreme temperatures, and extremely damaging floods and cyclones. However, the changes observed so far are difficult to separate from natural variations in climate, and the greatest changes in climate extremes are projected to occur in the coming decades, meaning it may be several decades before the full effects of climate change are felt. Decisions being taken today are influencing future disaster risk—either reducing risk or increasing it. By promoting policies that reduce risk and avoiding maladaptive actions that increase risk, we can positively influence the risk environment of the future. The drivers of future risk are within the control of decision makers today: there is a huge opportunity today to manage the risks of tomorrow. Climate change mitigation by reduction of greenhouse gases remains key to preventing strong increases in climate-related hazard. In addition, a robust hazard protection strategy, one that includes ecosystem-based measures, can help to limit the harm caused by changes in frequency and intensity of hazard. Increases in exposure can be addressed by implementing and enforcing effective land-use policies that prevent urban expansion in hazard-prone areas. Finally, increases in vulnerability can be addressed by strengthening construction practices and improving disaster preparedness. All these policy measures rely on data and risk modeling: enhancements in data collection and risk assessment are therefore a crucial part of the policy-strengthening process.

Disaster risk assessment—vital for understanding risk in terms of expected population affected or losses incurred—underpins disaster risk management activities. In order to make policy and planning

**Hazard**
Natural phenomena

**Exposure**
Population and assets

**Vulnerability**
Structural and social

decisions that reduce future risk, present and future risk must be quantified. Thus risk assessments that inform disaster risk management must account for the dynamic nature of hazard, exposure, and vulnerability. By quantifying future risk with and without the effect of disaster risk management policies and comparing the results, risk management specialists can demonstrate how policy actions taken now and in the near future could affect the risk environment in the medium to long term.

Evolving hazard can be captured in disaster risk assessment through the implementation of climate change scenarios in global and regional climate models. This approach makes it possible to incorporate changes in intensity and frequency of extreme wind, temperature, and precipitation, along with sea-level rise, to project future flood, drought, cyclone, heat, and storm surge risk. Simulating the expansion of urban areas, projecting future population distribution, and implementing Shared Socioeconomic Pathways (SSPs) as scenarios of future socioeconomic conditions can be carried out to demonstrate the influence of changing exposure on disaster risk. Projection of future vulnerability has not been addressed extensively in risk assessments. It is possible to adjust estimates of structural vulnerability to reflect projected changes in construction, but the many interdependent factors that determine social vulnerability make it difficult to determine how social vulnerability will evolve into the future.

Despite the ability to quantify future risk (albeit with uncertainty), risk assessments typically fail to account for changing climate, population, urbanization, and environmental conditions. They thus reduce the opportunity to highlight long-term, cost-effective options for risk reduction. This is not due to an absence of appropriate methods; many risk assessment tools and methods exist, with differing complexity, and can be used to represent the evolution of risk if adequate data are available. Risk assessments most often fail to account for evolution of risk because they use information that represents risk factors at a single time point in the past, and do not include projections of those data into the future.

Advances in the risk management sector and relevant technologies mean that risk specialists are now better able than in the past to focus on assessing risk under future climate conditions. With improvements in data collection, we can obtain higher-resolution topographic and exposure data and can simulate trends in population movement and urbanization. At this stage, it is important both to review the range of efforts to quantify future risk, and to consider how to best apply this information in managing risk. This publication provides an introduction to the problem of evolving risk (chapter 1), a further background to disaster risk (chapter 2), and an overview of the factors driving the evolution of risk (chapters 3 to 5). Chapter 6 discusses some of the issues that complicate efforts to quantify evolving risk, and chapter 7 discusses a number of policy areas that can strongly affect future disaster risk. This chapter highlights steps that can be taken to mitigate the ongoing increase in risk and—like the publication as a whole—seeks to raise awareness among decision makers of the impacts planning and development decisions have on disaster risk. The report concludes with a series of studies that highlight, in more depth, some of the issues and approaches described in the earlier chapters.

## Risk assessments need to account for...

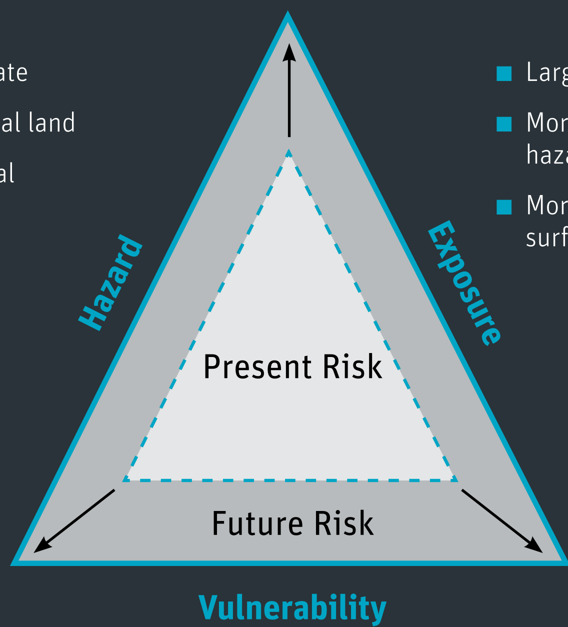
## Figure ES.1. The result of our choices

**Factors affecting the three components of disaster risk can increase future risk (top) or reduce (or mitigate increase in) future risk (bottom).**

### A RISKIER FUTURE

- Warmer climate
- Sinking coastal land
- Environmental degradation

- Larger population
- More developed hazardous areas
- More impermeable surfaces

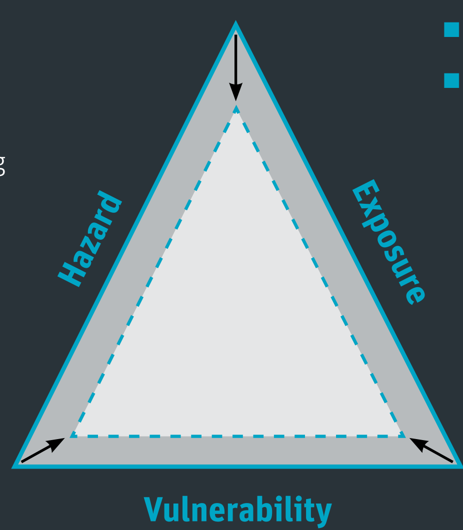



- Informal construction
- Less social support
- More compounding shocks/impacts

### AN EQUALLY/LESS RISKY FUTURE

- Climate change mitigation
- Urban design
- Resource planning

- Land-use planning
- Managed urban expansion




- Urban planning/ construction
- Social safety nets
- Greater resilience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