NRC NORWEGIAN REFUGEE COUNCIL
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THE RISK OF DISASTER-INDUCED DISPLACEMENT IN SOUTH-EAST ASIA AND CHINA

TECHNICAL PAPER

Norwegian Refugee Council (NRC)
Internal Displacement Monitoring Centre (IDMC)
Chris Lavell and Justin Ginnetti
October 2014

DISASTERS
CLIMATE CHANGE AND
DISPLACEMENT

EVIDENCE FOR ACTION

PARTNERS

THE NANSEN INITIATIVE
DISASTER-INDUCED CROSS-BORDER DISPLACEMENT

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ACKNOWLEDGEMENTS

This technical paper was written by Chris Lavell (independent consultant) and Justin Ginnetti (Senior Advisor, Research Methodologies and Evidence, Internal Displacement Monitoring Centre).

IDMC is grateful for insights and comments on drafts provided by: Hannah Entwisle Chapuisat (Nansen Initiative Secretariat); Nina Birkeland and Lena Brenn (NRC), Alexandra Bilak (IDMC).

Thanks to Tim Morris for editorial assistance.

For the purpose of this report, countries are defined as independent nation states. The inclusion of contested territories does not imply any political endorsement or otherwise on IDMC's part.

internal displacement monitoring centre

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This publication was printed on paper from sustainably managed forests.

A PROJECT FUNDED BY THE EUROPEAN UNION

This publication has been produced with the assistance of the European Union. The contents of this publication are the sole responsibility of the Internal Displacement Monitoring Centre and should in no way be taken to reflect the views of the EU.

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CONTENTS

ACRONYMS

AAL	Average Annual Loss
ASEAN	Association of Southeast Asian Nations
CCA	Climate Change Adaptation
CRED	Centre for Research on the Epidemiology of Disasters
DARA	Development Assistance Research Associates
DESINVENTAR	Disaster Inventory Management System
DiDD	Disaster-induced Displacement Database (of IDMC)
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
EM-DAT	Emergency Events Database (of CRED)
ERN-AL	Evaluación de Riesgos Naturales–América Latina
GAR	Global Assessment Report (of UNISDR)
GFDRR	Global Facility for Disaster Reduction and Recovery
GPID	Guiding Principles on Internal Displacement
GRID	Global Resource Information Database (of UNEP)
HFA	Hyogo Framework for Action
IDMC	Internal Displacement Monitoring Centre
ICCRR	Indicator of Conditions and Capacities for Risk Reduction
IPCC	Intergovernmental Panel on Climate Change
IRR	Indicator of Conditions and Capacities for Risk Reduction (of DARA)
PML	Probable Maximum Loss
PREVIEW	UNEP/GRID Project for Risk Evaluation, Information and Early Warning - commonly known as Global Risk Data Platform
UNEP	United Nations Environment Programme
UNISDR	United Nations International Strategy for Disaster Reduction
UN OCHA	United Nations Office for the Coordination of Humanitarian Affairs

PREFACE

This technical paper represents an initial attempt to assess the risk of disaster-induced displacement in the ten member states of the Association of Southeast Asian Nations (ASEAN) – Brunei, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, the Philippines, Singapore, Thailand and Vietnam – plus China. It presents results from the fourth of five planned analyses,[1] each of which corresponds with a sub-regional consultation of the Nansen Initiative. This is a state-led process that brings together representatives from governments, international organisations, civil society, think tanks and other key actors to develop a protection agenda for people displaced across state borders by disasters and the effects of climate change.[2]

The primary intended audience for this paper are those in national governments and regional organisations responsible for reducing and managing disaster risks and for protecting the rights of internally displaced persons (IDPs) and people displaced across international borders in relation to disasters. Given that displacement risk is largely influenced by human decisions, final outputs of the process discussed in this paper could potentially inform development decisions and reduce or avoid the risk of displacement. Humanitarian actors may also use this analysis to inform preparedness planning for disaster-induced displacement. For example, the paper could help determine evacuation centre capacity, temporary shelter needs or funding needed for activities to reduce displacement risk in particular countries.

Findings from five regional analyses will inform a consolidated report on the risk of disaster-induced displacement. Drawing on IDMC's annual *Global Estimates* and other relevant data on previously reported disaster-induced displacement, the consolidated report and the five regional analyses will provide evidence-based estimates and scenarios concerning the likelihood of future displacement and how it can be mitigated.

The analysis below is based on probabilistic risk. It models a methodology that has been widely used to assess the likelihood of disaster-related economic losses and fatalities. IDMC is testing this methodology to assess the likelihood of displacement, having already published assessments of displacement risk in Central America and the South Pacific.[3] This methodology will also be used to assess displacement risk in South Asia. A fifth technical paper, focusing on drought-induced displacement in the Horn of Africa, employed a methodology based on system dynamics modelling.[4] The aim of each report is to provide the best possible estimates of displacement risk given the available data. In this spirit of continuous improvement, IDMC invites relevant experts and interested readers to comment on and contribute to this innovative area of work.[5]

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1 The five regions are Central America, the Pacific, the Horn of Africa, South-East Asia and South Asia.

2 For more information, see http://www.nanseninitiative.org/

3 IDMC, 2013. Technical Paper: The risk of disaster-induced displacement – Central America and the Caribbean. Geneva: IDMC; and IDMC 2014. Technical Paper: The risk of disaster-induced displacement in the Pacific island states. Geneva: IDMC.

4 IDMC, 2014. Technical Paper: Assessing drought displacement risk for Kenyan, Ethiopian and Somali pastoralists.

5 The authors can be reached by emailing justin.ginnetti@nrc.ch.

EXECUTIVE SUMMARY

This technical paper provides evidence-based estimates of the likelihood of disaster-induced displacement in Brunei, Cambodia, China, Indonesia, Lao PDR, Malaysia, Myanmar, the Philippines, Singapore, Thailand and Vietnam. It attempts to better quantify human displacement risk. It brings together data from several sources – notably the *Global Assessment Reports* **(GARs) and the** *Asia-Pacific Disaster Report* **of the United Nations International Strategy for Disaster Reduction (UNISDR), national disaster loss inventory databases (DesInventar) and the Internal Displacement Monitoring Centre's (IDMC)** *Global Estimates* **– in order to better quantify human displacement risk. Applying a probabilistic risk model, it is one of the first attempts to assess how many people are at risk of being displaced by natural hazard-related disasters. It is the first attempt to do so for South-East Asia.**

A new way of thinking

The study reflects an awareness of the need to see disasters as primarily social, rather than natural, phenomena. This view acknowledges the fact that humans can act and take decisions to reduce the likelihood of a disaster occurring or, at the very least, to reduce their impacts and the levels of loss and damage associated with them. Disasters are thus no longer being perceived as 'natural' or 'acts of God' but instead as something over which humans exert influence and can therefore prevent.

This reconceptualisation of disasters signifies a shift from a retrospective, post-disaster approach to an anticipatory way of thinking about and confronting disasters. This conceptual development was reflected in a public policy objective: disaster risk reduction (DRR). Strengthening DRR became a global priority in the 1990s, the United Nations' International Decade of Natural Disaster Reduction. Following the 2004 Indian Ocean Tsunami, UN Member States adopted the 2005 Hyogo Framework for Action (HFA), a ten-year plan endorsed by the UN General Assembly which aims to reduce the risk of disasters globally. The objectives codified in the HFA are currently being updated in advance of a global conference scheduled for March 2015 in Sendai, Japan, at which Member States will renew their commitment to DRR. One important outcome of the HFA process is awareness that without ability to measure it is not possible to know if disaster risk has been reduced.

In the context of disasters, displacement includes all forced population movements resulting from the immediate threat of, or actual, disaster situation regardless of length of time displaced, distance moved from place of origin and subsequent patterns of movement, including back to place of origin or re-settlement elsewhere. Based upon existing information, and notwithstanding some notable exceptions, the vast majority of people displaced by disasters are assumed to remain within their country of residence, rather than to cross internationally recognised borders to find refuge.

Displacement is a disaster impact that is largely determined by the underlying vulnerability of people to shocks or stresses that compel them to leave their homes and livelihoods just to survive. The number of people displaced is, of course, related to the magnitude and frequency of extreme hazard events. The most significant factors are those that leave exposed and vulnerable communities without the means to be resilient in the face of such hazards.

Informed by this anticipatory way of thinking about disasters, the approach used in this study departs from most existing analyses in two ways.

First, while the efforts of many governments and other actors continue to emphasise post-disaster and post-displacement response and recovery this analysis is based on probabilistic risk modelling. This uses historical information available about past disasters to provide estimates that may inform policy and action to ideally prevent, or at least to prepare for, displacement before a disaster occurs.

Second, while displacement and disasters have traditionally been associated with humanitarian relief and human rights-based protection this study analyses disaster-induced displacement in the language of the disaster risk reduction and disaster risk management communities. In sum, this study attempts to provide entry points for humanitarian and protection actors while presenting information aimed at those responsible for disaster risk reduction and risk management and development.

Regional context

The 11 countries included in this study—ASEAN Member States plus China—account for approximately 28 per cent of the entire global population. Over the last six decades, the population of these 11 countries has grown and become increasingly urban. At least half the population of Brunei, China, Indonesia, Malaysia and Singapore are now estimated to reside in urban areas. While the region's population growth rate is slowing, urbanisation will continue apace: by 2050 the majority of the population of every country but Cambodia is expected to reside in urban centres.

South-East Asia's population growth is mirrored by economic growth which has concentrated people and economic activities in urban areas, often located in hazard-prone areas. Consequently, people and settlements in the region are exposed to multiple hazards, such as cyclones, floods, droughts, earthquakes, volcanoes and rain- and earthquake-triggered landslides.

Analysing these 11 countries reveals striking contrasts. Brunei and Singapore are both high-income countries with small territories and populations concentrated in urban areas. Brunei and Singapore have very little displacement risk and a high capacity to manage it. By contrast, Cambodia, Lao PDR, Myanmar and the Philippines are lower-income countries with large rural populations. They have much more risk and low capacity to manage it. China itself is a study in contrasts with several large urban areas as well as more than half a billion mostly poor people residing in rural areas.

Key Findings:

In the last six years along, nearly 30 million people have been displaced in the countries included in this study—18 per cent of the global total. Two countries in particular, China and the Philippines, account for a disproportionate share of the world's disaster-related displacement: more than eight million Chinese and half a million Filipinos are at risk of being displaced every year.

In South-East Asia, the risk of being displaced in relation to disasters is increasing, and it has been growing even faster than the population growth rate. Compared to the past, there are more people living in hazard prone areas than before, often in cities. Meanwhile, governments have not been able to reduce the vulnerability of these people enough to offset this increasing exposure.

Relative to the size of each country's population, displacement risk is unevenly distributed within the region. In Singapore, a high income country, the risk of being displaced in a disaster is one in a million. By contrast for every million Laotians and Filipinos that risk is more than 7,000 and 6,000 times higher, respectively. Laotians and Filipinos are also more than ten times more likely to be displaced than Indonesians, who are also exposed to multiple geophysical and weather-related hazards.

Wealth alone does not explain vulnerability. Per capita income in China is two to three times higher than in Vietnam. Vietnam's exposed population is ten times more vulnerable to hazards than that of China. Regardless of a country's wealth, governments can begin reducing vulnerability through smarter urban development and by enforcing building codes.

The majority of disaster spending is still being used to respond to – rather than to prevent – disasters. Spending on disaster response is less cost-effective than investments to reduce disaster risks and disaster relief does not always reach people who are displaced with family or friends rather than in official shelters or evacuation centres.

IDMC has not found evidence of significant cross-border displacement in relation to disasters within this region. The presence of transboundary hazards, such as riverine floods, means there is a risk of cross-border displacement for populations living and working along these borders.

1. INTRODUCTION

To understand disasters we must not only know about the types of hazards that might affect people, but also the different levels of vulnerability of different groups of people. This vulnerability is determined by social systems and power, not by natural forces. It needs to be understood in the context of political and economic systems that operate on national and even international scales: it is these which decide how groups of people vary in relation to health, income, building safety, location of work and home, and so on.[6]

This technical paper provides evidence-based estimates of the likelihood of disaster-induced displacement in Brunei, Cambodia, China, Indonesia, Lao PDR, Malaysia, Myanmar, the Philippines, Singapore, Thailand and Vietnam. It attempts to better quantify human displacement risk. It brings together data from several sources – notably the *Global Assessment Reports* (GARs) and the *Asia-Pacific Disaster Report* of the United Nations International Strategy for Disaster Reduction (UNISDR), national disaster loss inventory databases (DesInventar) and the Internal Displacement Monitoring Centre's (IDMC) *Global Estimates* – in order to better quantify human displacement risk.

Applying a probabilistic risk model, it begins to project how many people are at risk of being displaced by disasters by using evidence from reported situations of disaster-induced displacement. It builds upon the existing evidence base concerning disaster risk and disaster-induced displacement, particularly that which has been consolidated in the United Nations International Strategy for Disaster Reduction's (UNISDR) three *Global Assessment Reports* (GARs)[7] and the Internal Displacement Monitoring Centre's (IDMC) *Global Estimates.*[8] It provides forward-looking estimates at a spatial scale that we hope will be useful for planning and decision-making. For example, the amount of displacement risk in a particular area could determine evacuation centre capacity or temporary shelter needs.

This paper is primarily intended for those in national and regional government responsible for reducing and managing disaster risks or protecting the rights of internally displaced persons (IDPs). The study is particularly intended to inform the inter-governmental regional consultations of the Nansen Initiative,[9] a state-led process that focuses on cross-border displacement related to disasters and climate change. Given that displacement risk is largely influenced by human decisions – as opposed to natural hazards – the study may also be useful for informing development investment decisions that could reduce or avoid the risk of displacement. Humanitarian actors may also be interested in the findings as a means of informing preparedness planning for disaster-induced displacement.

This paper covers human displacement risk in the ten Member States of the Association of Southeast Asian Nations (ASEAN)—Brunei, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, the Philippines, Singapore, Thailand and Vietnam—plus China. It represents a first attempt to better quantify human displacement risk for this region.

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6 Wisner, B., Blaikie,P., Cannon, T. Davis, I. 2003. At Risk (2nd ed.). London: Routledge.

7 See http://www.unisdr.org/we/inform/gar

8 See http://www.internal-displacement.org/publications

9 See http://www.nanseninitiative.org/

The countries in this study are among those most affected by disaster-induced displacement. In 2013, they accounted for the three largest displacement events, as well as 11 of the top 14. In relation to the 30 largest displacement events of 2013, 72 per cent of the people were displaced in these countries.[10]

Compared to the rest of the world, South-East Asian countries face greater displacement risk due to the fact that a large number of people are exposed to multiple hazards, such as tropical cyclones, floods, earthquakes, landslides, wildfires, droughts, volcanoes and tsunamis. Owing to the vulnerability of people in this region, people often become displaced when these hazards occur.

According to the World Bank's income classification six of the 11 countries in this study are categorised as low or lower income. Cambodia, Lao PDR and Myanmar are all considered least developed countries. National economic data only hints at the conditions of vulnerability within these countries. In Cambodia and Lao PDR, more than a third of the households face multidimensional poverty, which means their impoverishment is composed of multiple deprivations, including low income as well as a lack of adequate housing, education and health.

Within several countries in this study, people have also been displaced by conflicts, violence and human rights violations, all of which exacerbate underlying conditions of vulnerability.

10 IDMC, 2014. Global Estimates 2014: People displaced by disasters. Geneva: IDMC.

2. DISPLACEMENT AND DISASTER RISK

2.1 APPROACHING DISPLACEMENT FROM THE PERSPECTIVE OF DISASTER RISK

This paper brings together data from several disparate sources in order to better quantify human displacement risk in island states in South-East Asia and China. The goal is to look beyond historic displacement figures towards what future displacement risks await different regions, countries and communities. As the fourth of five regional analyses based on a displacement risk methodology under development by IDMC, it:

- advances several considerations for modelling of displacement risk
- elaborates a new assessment methodology which is being refined for each of the five regional analyses
- seeks to yield results that are as accurate and certain as possible with available data
- brings to light the main sources of uncertainty and error
- informs continuing policy discussions related to the Nansen Initiative consultations on cross-border displacement related to disasters and climate change.

The findings presented here have benefitted from initial testing of the displacement risk methodology in Central America and the South Pacific. In each case, we have used the best available spatial and temporal evidence to generate displacement risk estimates. In the light of future economic, demographic and climate-related changes, these displacement risk estimates provide a look at potential, rather than historic, displacement in order to improve understanding of the implications of disaster-induced human displacement trends.

The results contained in this paper should be considered provisional. We will continue to improve the probabilistic risk model methodology and incorporate more historical data as it becomes available. A complete explanation of the methodology used in the analysis will be published once the methodology is forthcoming at the end of 2014. For those interested, especially in providing critical feedback, a draft is available.[11]

2.2 STRENGTHS AND WEAKNESSES OF THE 'RISK' APPROACH

The objective of this project is to generate probabilistic risk information that quantifies expected displacement based on both annual averages as well as the effect of disaster events of different return periods (for example, the expected number of displaced based on a 100-year return period flooding event). At this point, such a model is not possible due to various data limitations. These include:

- the level of capture of loss events within differing databases
- differences in methodologies between national databases
- exceedingly short sample periods for modelling longer return period events.

The study thus focuses on providing an empirical assessment of displacement risk, utilising primarily quantitative sources but also relying on qualitative input to help fill the gaps. The study identifies principal sources of bias and error involved in the initial quantitative measures in order to inform future revisions to the methodology.

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11 Email justin.ginnetti@nrc.ch.

GLOSSARY OF KEY TERMS[12]

Climate change is a change in the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external pressures, or to persistent anthropogenic changes in the composition of the atmosphere or in land use.[13]

Disaster is "a serious disruption of the functioning of a community or a society causing widespread human, material, economic or environmental losses which exceed the ability of the affected community or society to cope using its own resources."[14] Disasters result from a combination of risk factors: the exposure of people and critical assets to single or multiple hazards, together with existing conditions of vulnerability, including insufficient capacity or measures to reduce or cope with potential negative consequences.

Disaster risk is normally expressed as the probability of an outcome (e.g., the loss of life, injury or destroyed or damaged capital stock) resulting from a disaster during a given period of time. In this study, the disaster outcome in question is displacement. Disaster risk is considered to be a function of **hazard**, **exposure** and **vulnerability**.

Exposure refers to the location and number of people, critical infrastructure, homes and other assets in hazard-prone areas.

Vulnerability is the degree of susceptibility of these assets to experience damage and loss due to inadequate design and construction, lack of maintenance, unsafe and precarious living conditions and lack of access to emergency services.[15]

'Natural' hazards are events or conditions originating in the natural environment that may affect people and critical assets located in exposed areas. The nature of these hazards is often strongly influenced by human actions, including urban development, deforestation, dam-building, release of flood waters and high carbon emissions that contribute to long-term changes in the global climate. Thus, their causes are often less than 'natural'.

The United Nations' Guiding Principles on Internal Displacement (GPID) observe that **displacement** may occur as a result of, or in order to avoid the effects of, disasters.[16] Displacement includes all forced movements regardless of length of time displaced, distance moved from place of origin and subsequent patterns of movement, including back to place of origin or re-settlement elsewhere. This definition also encompasses anticipatory evacuations.

People are considered displaced when they have been forced to leave their homes or places of residence and the possibility of return is not permissible, feasible or cannot be reasonably required of them. Voluntary **migration** is at the other end of the spectrum of population mobility. 'Voluntary' does not necessarily imply complete freedom of choice, but merely that "voluntariness exists where space to choose between realistic options still exists."[17]

The general approach is to use the highest quality disaster loss data that is relevant to displacement risk to fine-tune trends and projections. The most directly relevant of these relates to either number of homeless or number of homes destroyed after a disaster. This also informs the study's principal methodological constraint: its application to disasters that do not destroy homes but which do lead to displacement. These are necessarily under-represented.

It is also exceedingly difficult to quantify displacement due to drought.[18] A further challenge is determination of the distance and duration of displacement, both of which are hard to quantify using purely loss data. Developing proxy indicators to measure the impact of loss of livelihoods will be necessary at some point. This is also true of attempts to quantify risks that loss data has not yet captured (such as sea-level rise or ocean acidification) which will also require a different approach.

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12 A more thorough glossary is included in the annex.

13 Adapted from Intergovernmental Panel on Climate Change (IPCC), 2012. Managing the Risks of Extreme Events and disasters to Advance Climate Change Adaptation, Special Report of the Intergovernmental Panel on Climate Change, Cambridge: Cambridge University Press, p.557.

14 UNISDR, 2009. UNISDR Terminology on Disaster Risk Reduction. Geneva: UN Office for Disaster Risk Reduction.

15 UNISDR, 2013. Glossary of Key Terms. In Global Assessment Report on Disaster Risk Reduction 2013 From Shared Risk to Shared Value: the Business Case for Disaster Risk Reduction. Geneva: UNISDR.

16 United Nations, 1998. Guiding Principles on Internal Displacement. Geneva: United Nations.

17 Kälin, W. 2013, Changing climates, moving people: Distinguishing voluntary and forced movements of people. In Changing climate, moving people: Framing migration, displacement and planned relocation, pp.38-43 Warner, K., Afif, T.,Kälin, W., Leckie, S., Ferris,B., Martin, S. and Wrathall, D. (eds.)]. Bonn, Germany: United Nations University Institute for Environment and Human Security (UNU-EHS).

18 Due to the difficulty of estimating drought-related displacement using existing methodologies, IDMC has developed a new methodology, based on a system dynamics model, to estimate drought-related displacement. An initial analysis piloting this methodology in the Horn of Africa was published in May 2014.

Figure 2.1: Commonly used elements and equation for disaster risk. The exact relationship is defined differently in varying models.

Risk = Hazard X Exposure X Vulnerability

For these reasons, this paper focuses principally on generating displacement estimates related to number of people expected to be displaced, using data relating to homelessness. It also uses other loss data, including the number of people affected and the number of people killed in each event to help fill in some of the gaps in loss reporting. It is hoped that as the methodology is advanced a more complex approach will help increase the predictive capacity of modelling displacement risk as well as reducing sources of uncertainty.

A key tool under development for the next stage of this methodology is a human displacement analogue for the Hybrid Loss Curve approach pioneered by Evaluación de Riesgos Naturales–América Latina (ERN-AL), a Latin American research organisation. This seeks to better quantify disaster risk (or, in this case, displacement risk) by joining empirical loss data for more frequently recurring events with modelled results for expected losses in the case of infrequently recurring events. After plotting the magnitude of displacement associated with individual disasters against the number of events with the given levels of displacement, we use these points to derive a continuous curve representing the expected frequency ('return period') for a given level of displacement per disaster. In order to estimate the entire range of displacement events over a given period of time, we derive this continuous 'hybrid' curve using two distinct methodologies – one for frequently recurring events for which we have ample data to generally follow actuarial models, and one for rare events for which we have much less data and thus must employ other statistical approaches.

2.3 'NATURAL' DISASTERS?

The standard nomenclature for calculating disaster risk is as a convolution[19] of hazard, exposure and vulnerability (see figure 2.1).

It is widely considered that disaster risk is generally increasing due to increases in exposure. For example, populations continue to grow in coastal areas, regardless of the fact that they are subject to hurricanes, storm flooding, tsunami risk and sea-level rise. The problem is not only that development forces more people to settle in exposed areas but also that those that are living in these exposed areas often do so in a highly vulnerable fashion, using inadequate masonry techniques in earthquake-prone areas and settling unstable hillsides surrounding coastal cities with high precipitation levels. This leads to landslides affecting extra-legal settlements and downstream flooding caused by development-driven reductions in permeable land upstream.

Climate change and other anthropogenic causes increase hazard levels. These increases are not just through increases in magnitude and frequency of extreme (or intensive) events[20], but also due to the changing averages that may significantly increase the number of non-extreme (or extensive) events that together lead to substantial aggregate losses.

Vulnerability levels are generally considered to be slowly declining on a global level, although not at a sufficient pace to keep increases in exposure in check. When looked at locally, this view often breaks down as vulnerability levels vary widely with some communities locked into cycles of extreme vulnerability, such as those facing flooding from sea-level rise. Disaster loss databases report increasing losses due, in particular, to hydro-meteorological events. Considering all three of these variables together – sustained high vulnerability levels with increasing exposure and hazard levels – helps put these increases into clearer context.

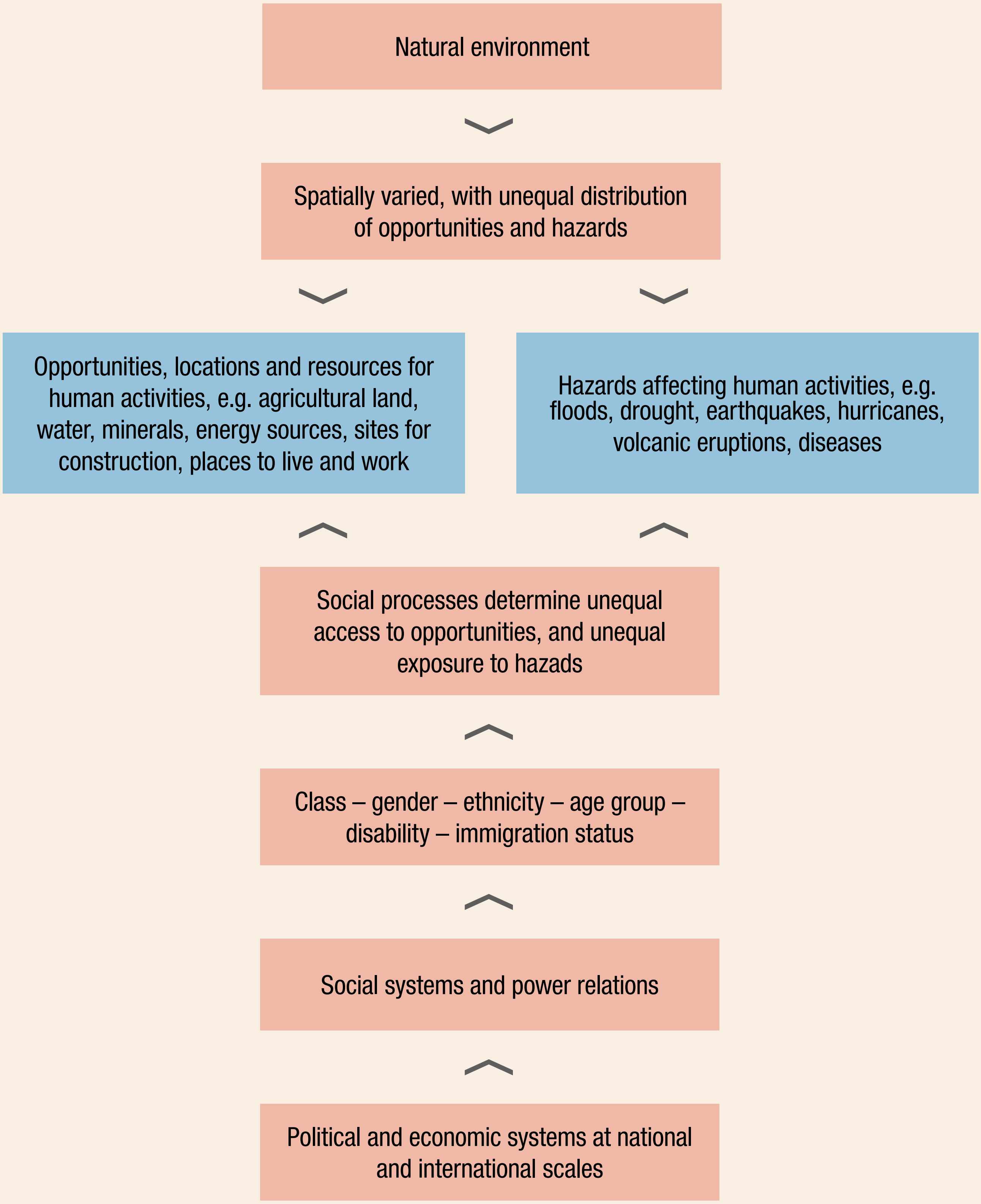
2.4 THE DISPLACEMENT DIMENSION: MANIFESTATION OF EXTREME DISASTER RISK

A disaster has historically been quantified in terms of the direct loss of life and capital stock that is depleted with the occurrence of the given natural event. Recently there has been greater focus on the secondary effects of disasters, which comes closer towards capturing the important component of livelihood in the disaster risk equation. However, even this newer focus has trouble capturing the plight of those most drastically affected by the consequences of these disasters: those that must leave their own communities and livelihoods in exchange for an otherwise intolerable level of uncertainty in an attempt to survive, and eventually to hopefully find a new home and livelihood until they can return (if that is possible).

19 By 'convolution' we mean that each variable in the equation in Figure 2 may be expressed by a function (rather than a constant value). The relationship between each of these, in turn, may be expressed by another function obtained by integration that explains their relationship.

20 The term 'fat tailed distribution' is commonly used to describe the shape of a loss frequency curve where events on the end 'tails' of the distributions (that is, very low recurrence) are actually more probable than previously expected and/or related to more losses than previously expected.

Figure 2.2: Factors and relationships that influence disaster risk (Source: Wisner et al., 2003)



Displacement itself is a driver of future disaster risks and it places people at a higher risk of impoverishment and human rights abuses while exacerbating any pre-existing vulnerability.[21] This is especially true where homes and livelihoods are destroyed and where displacement is recurrent or remains unresolved for prolonged periods. Forced from their homes or places of residence, people often face heightened or particular protection risks such as family separation and sexual and gender-based violence, particularly affecting women and children.[22]

People displaced by naturally triggered disasters are thus often among the most vulnerable populations. Their only coping mechanism is to leave home to seek a new living and/or to become dependent on assistance. Thus, those displaced by disasters are the proverbial 'canary in the coal mine' in terms of manifest levels of disaster risk: these are the people most impacted on an on-going basis by the effects of a disaster.

The study reflects emerging awareness of the need to see disasters as primarily social, not natural, phenomena. This implies that humans can act and take decisions to reduce the likelihood of a disaster occurring or, at the very least, to reduce their impacts and the levels of loss and damage associated with them. Displacement is seen as an extreme manifestation of disaster risk in which vulnerability levels and lack of resilience are so high that natural events (both extreme and non-extreme) compel people to leave their homes and livelihoods just to survive.

The magnitude of displacement is, of course, related to the magnitude and frequency of extreme as well as non-extreme natural events. However, the social variables are what allow the construction and configuration of risk in a form that leaves those most exposed and vulnerable with few tools with which to improve their resilience levels when faced with potentially damaging natural events.

Thus, the total number of people displaced by such events, both in relative and absolute terms, provides an important quantitative measure of their underlying vulnerability. The distance of the displacement, whether to another part of the same community or to a completely different country, is also an important gauge of the level of vulnerability and/or lack of resilience of affected communities.

2.5 RISK: SHIFTING THE FOCUS FROM THE PAST TO THE PRESENT AND FUTURE

This paper contributes to a large body of existing research that has reframed the way people and states have thought about disasters.[23] This has recognised that disasters are the result of both human and natural factors and that humans can act and take decisions to reduce the likelihood of a disaster occurring. Disasters are thus no longer being perceived as 'acts of God' but, instead, as something over which humans exert influence (Figure 2.2).

The reconceptualisation of disasters signifies a shift from a retrospective (i.e., post-disaster) approach to an anticipatory way of thinking about and confronting disasters. This conceptual development dates from the UN International Decade of Natural Disaster Reduction in the 1990s – the precursor to the current UN International Strategy for Disaster Reduction (UNISDR) – to the adoption in 2005 of the Hyogo Framework for Action (HFA). This aims by 2015 to achieve "the substantial reduction of disaster losses, in lives and in the social, economic and environmental assets of communities and countries."[24]

An important outcome of the HFA process is awareness that without the ability to measure, it is not possible to know if disaster risk has been reduced. Measuring disaster risk (especially the risk of economic losses) is the core business of insurance and reinsurance companies. The HFA has made it a public responsibility, and one that includes more than just economic losses. UNISDR has consolidated much information and research on disaster risks in its biennial Global Assessment Reports (GARs), making economic risk information more transparent and raising awareness of disaster mortality risk. We are augmenting this with a new methodology for enabling governments and others to more effectively assess, reduce and manage disaster displacement risk.

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21 UNISDR, 2013. Chair's Summary Fourth Session of the Global Platform for Disaster Risk Reduction Geneva, 21-23 May 2013. Geneva: UNISDR.

22 See the Guiding Principles on Internal Displacement, 1998 (http://www.idpguidingprinciples.org) and the *IASC Operational Guidelines on the protection of persons in situations of natural disasters*, 2011. Also, Cernea's Impoverishment Risks and Reconstruction approach analyses forced resettlement resulting from large-scale development projects and outlines eight basic risks faced by displaced people, which are also common to disaster-induced displacement: landlessness; joblessness; homelessness, marginalisation, food insecurity, increased morbidity, loss of access to common property resources and social disarticulation. Cernea, M. 1999, "Why Economic Analysis is Essential to Resettlement: A Sociologist's View", in Cernea, M. (ed.), The Economics of Involuntary Resettlement: Questions and Challenges, Washington, DC: The World Bank.

23 The history of this concept is summarised in Wisner et al. (2003), pp.10-11.

24 United Nations International Strategy for Disaster Reduction (UNISDR), 2005. *Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters*. Geneva: UNISDR. The HFA was endorsed by UN General Assembly Resolution A/RES/60/195 following the 2005 World Disaster Reduction Conference and adopted by 168 countries. A post-2015 agreement is currently being prepared for adoption at the Third UN Conference on Disaster Risk Reduction scheduled to take place in Sendai, Japan in 2015.

Disaster displacement risk has been a poorly understood and neglected issue, particularly in light of the fact that disaster-induced displacement has been increasing and is likely to continue to do so. As noted in IDMC's most recent editions of the *Global Estimates*, the trend is driven by three factors:

• population growth and increased concentration of people and economic activities in hazard-prone areas such as coastlines and river deltas are increasing the number of number of people exposed to natural hazards

• improvements in life-saving early warning systems and evacuation planning means that more people are expected to survive disasters even as their homes are destroyed

• climate change may increase the frequency and/or severity of some hazards (hydro-meteorological hazards account for 83 per cent of all disaster-induced displacements observed during the last five years).[25]

As with mortality and economic loss risks, it is beyond the ability of any government to eliminate disaster risks entirely. Is it thus important to know which displacement risks can be reduced so that resources can be allocated most effectively.

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25 Internal Displacement Monitoring Centre (IDMC) and Norwegian Refugee Council, 2013. *Global Estimates 2012: People displaced by disasters*. Geneva: IDMC; IDMC and Norwegian Refugee Council, 2014. *Global Estimates 2014: People displaced by disasters.* Geneva: IDMC.

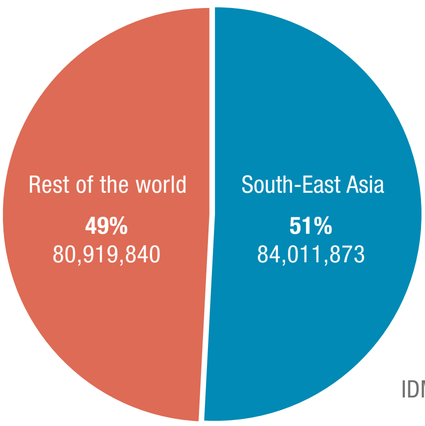
3. DISPLACEMENT RISK IN SOUTH-EAST ASIAN STATES AND CHINA

3.1 THE REGIONAL CONTEXT AND TRENDS

The amount of available data on disaster-related displacement varies widely between countries in the region. In China and the Philippines there are hundreds of reported displacement events, whereas in Singapore and Brunei there is almost no data – partly due to the fact that there has been such little displacement within these countries. Country-specific metrics are included in the annex to this study.

In 2013 alone, these countries accounted for the three largest displacements, as well as 11 of the top 14. Of the 30 largest displacement events, 72 per cent of the people were displaced in these countries. In the last six years, these countries have accounted for 51 per cent of the total reported displacement (Figure 3.1).

Figure 3.1: Displacement in South-East Asia compared to the rest of the world.



Source: IDMC DiDD

3.2 BEHIND THE TRENDS

Displacement risk within the region is concentrated in some countries, notably China and the Philippines. This is due to a combination of large numbers of relatively vulnerable people who are also exposed to multiple hazards.

3.2.1 Population growth and urbanisation

For the countries included in this study, the population has nearly tripled since 1950, growing by more than 20 per cent per decade until the 1990s.[26] The increase in population means that there are many more people and homes exposed to hazards than before, leading to an increase in the number of people affected—and displaced—by disasters.

Just as important as the population growth is the location of homes and settlements. Between 1950 and 2010, Asia's urban population has grown from 17 per cent of the total population to 44 per cent.[27] The urbanisation trend, which has been especially pronounced in China, Indonesia, Lao PDR, Malaysia and Thailand, is expected to continue into the future (Table 3.1).

In South-East Asia, this rapid urbanisation has concentrated large numbers of people in hazard-prone areas. Thus, South-East Asian cities are particularly affected by disasters, a trend that is also expected to continue well into the future. According to the Climate Change and Vulnerability Index (CCVI) 2013, five of the top-seven cities facing 'extreme risk' are in this region: Manila, Philippines (2nd), Bangkok, Thailand (3rd), Yangon, Myanmar (4th), Jakarta, Indonesia (5th) and Ho Chi Minh City, Vietnam (6th).

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26 Based upon IDMC analysis of: United Nations Department of Economic and Social Affairs, Population Division, 2014. *World Urbanization Prospects, the 2014 revision. New York: United Nations.*

27 ESCAP and UNISDR, 2012.

28 This graph indicates the issues encountered in generating displacement risk estimates: there is a clear break in level of coverage between the 1970s until the 1980s and from the mid-1980s to 2013.

Figure 3.2: Historic modelled displacement 1970-2013 (excludes China)

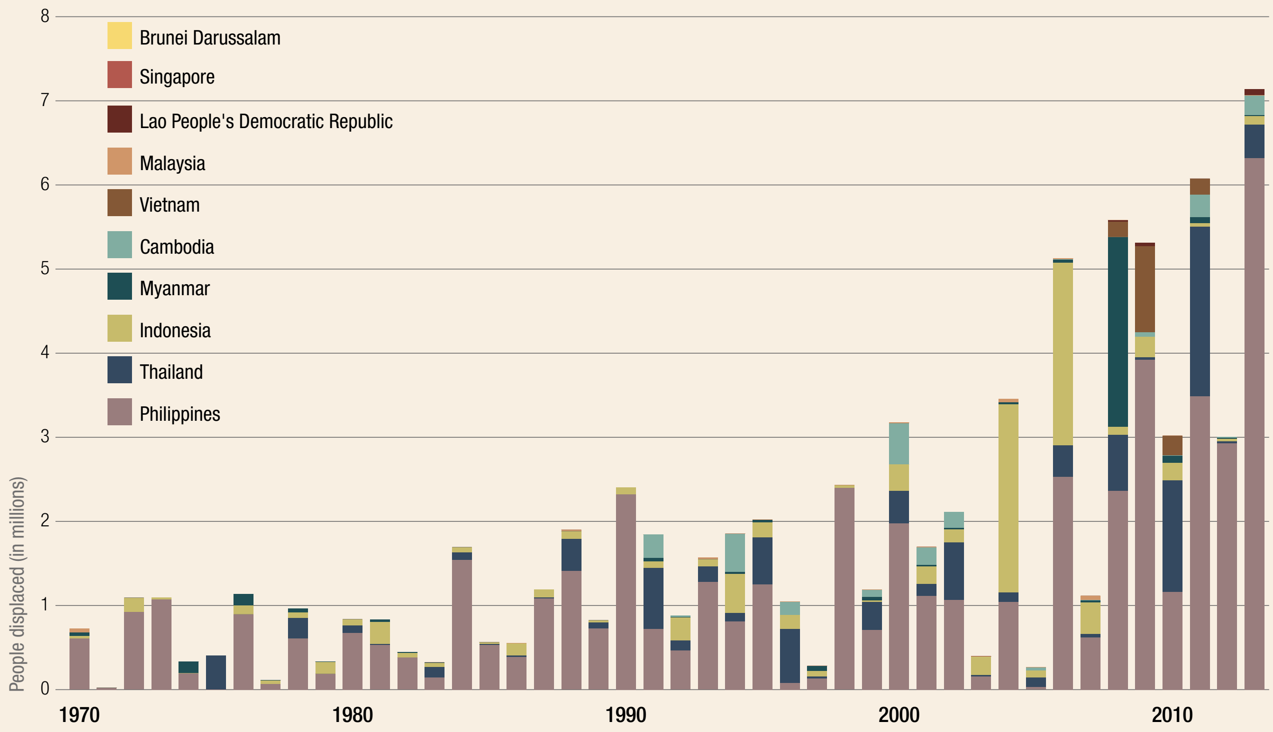

Figure 3.3: Historic modelled displacement 1970-2013 (China only)[28]

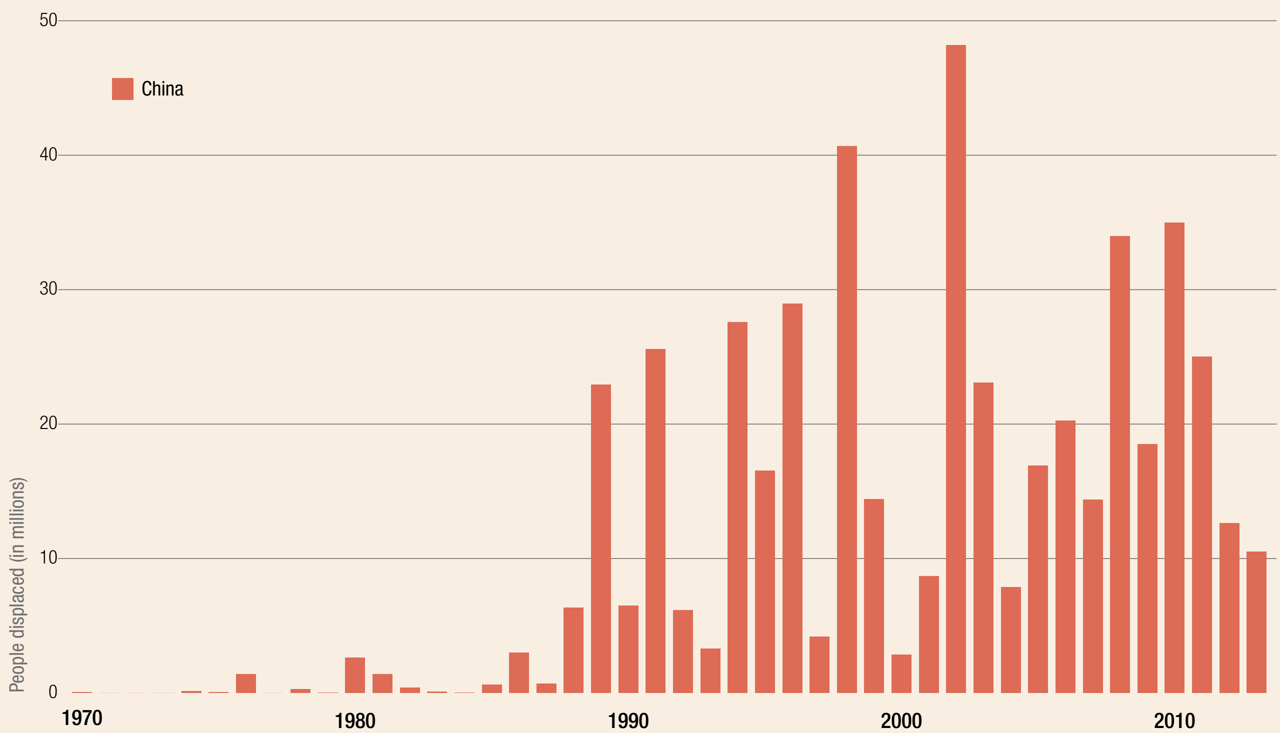

Figure 3.4: IDMC DiDD displacement estimates 2008-2013
(Note: There was no recorded displacement for Brunei or Singapore)

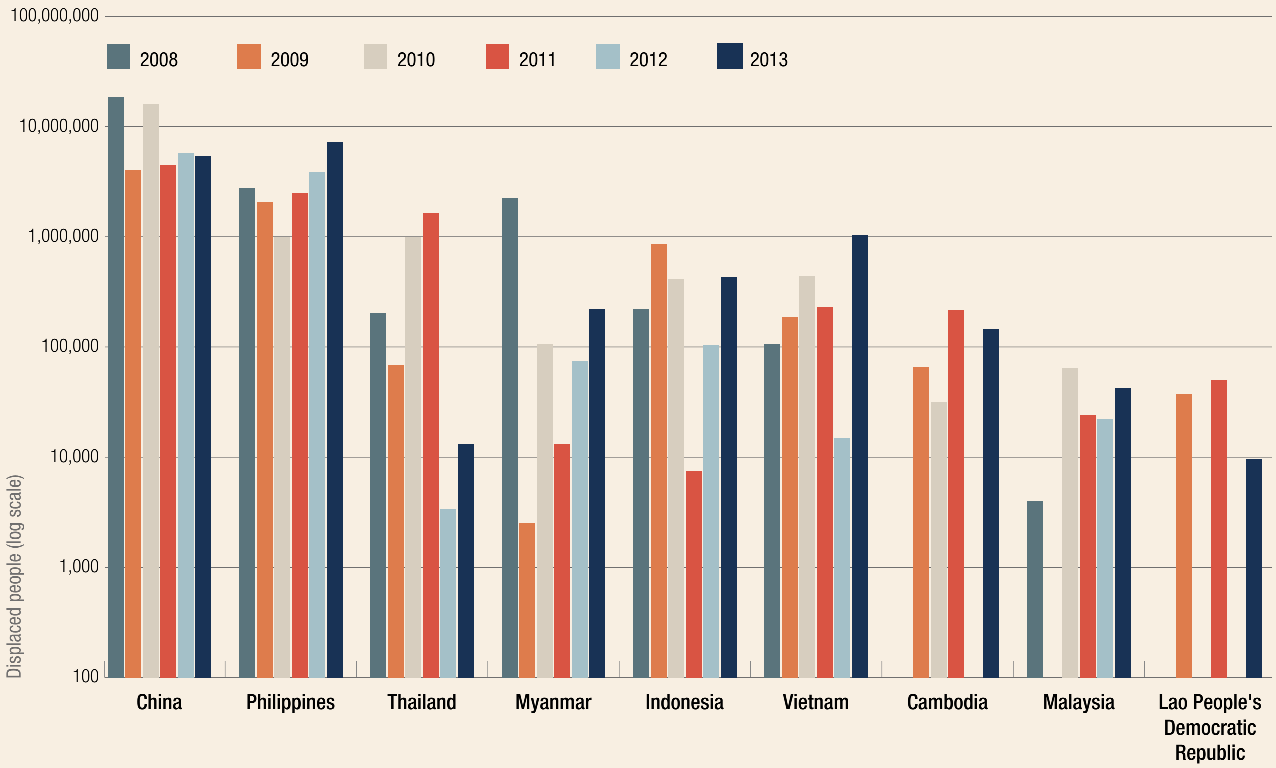

Figure 3.5: IDMC DiDD relative displacement estimates 2008-2013 (per million inhabitants)

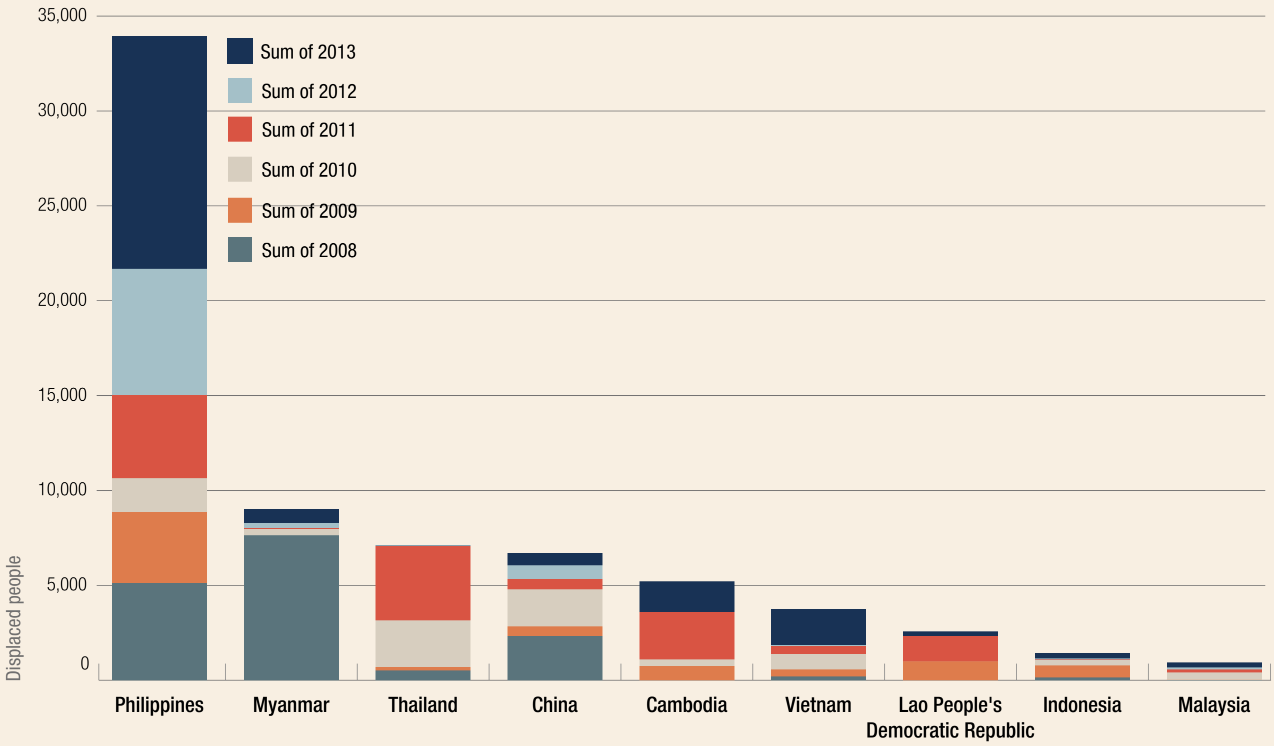

Table 3.1: Urbanisation trends in South-East Asia

	Percentage of population at mid-year residing in urban areas					
	1950	1970	1990	2010	2030	2050
Brunei Darussalam	26.8	61.7	65.8	75.5	80.7	84.0
Cambodia	10.2	16.0	15.5	19.8	25.6	36.2
China	11.8	17.4	26.4	49.2	68.7	75.8
Indonesia	12.4	17.1	30.6	49.9	63.0	70.9
Lao PDR	7.2	9.6	15.4	33.1	50.9	60.8
Malaysia	20.4	33.5	49.8	70.9	81.9	85.9
Myanmar	16.2	22.8	24.6	31.4	42.8	54.9
Philippines	27.1	33.0	48.6	45.3	46.3	56.3
Singapore	99.4	100.0	100.0	100.0	100.0	100.0
Thailand	16.5	20.9	29.4	44.1	63.9	71.8
Vietnam	11.6	18.3	20.3	30.4	43.0	53.8

Source: UN DESA, 2014

It is not just the size and location of urban centres that accounts for present and future risk. It is also the vulnerability of the people living in, and moving to, them. For example, in Cambodia and Lao PDR, the majority of urban residents live in slums. The World Bank estimates that Manila's population living in informal settlements is 800,000.[29] Poor living conditions and informal settlements magnify the inhabitants' multiple vulnerabilities to hazards, as well as becoming additional disaster risks themselves. In Cambodia and Lao PDR, slum dwellers often build informal structures on top of existing buildings. These rooftop slums are less visible and therefore less likely to invite destruction or eviction. They become high-risk locations: open stoves and unregulated electricity connections frequently cause fires which spread quickly through the highly flammable structures, often beyond the reach of fire fighters.[30]

Similarly, slums grow on marginal or wasteland locations that are unsuited for habitation and often dangerous. They are inhabited by the poorest segments of the population and are routinely faced by fire hazards, floods, landslides, storm and wind damage and toxic pollution. A government analysis of the 2011 floods that affected the Philippines' southern island of Mindanao found that 85 per cent of the homes damaged or destroyed could be considered informal settlements. Thirty five per cent of these homes were located in hazard-prone areas that had been designated as No Build Zones.[31]

3.2.2 Economic growth

Economic growth can either increase or decrease disaster risk. Economic growth reduces vulnerability to hazards but increases the number of people and assets exposed to hazards and changes where they are situated. Economic productivity attracts population growth, through migration and urbanisation. While concentrating businesses, knowledge and technology, and an educated labor force in urban areas can drive development, the trade-off is that these cities are often located in hazard-prone areas, in floodplains, along coastlines and rivers.[32]

This phenomenon can result from even rational decision-making – and becomes even more pronounced when one takes account of the fact that policy decisions are seldom taken on the basis of reducing disaster risk:

> *With perfect information, the population is more protected when it gets richer, the disaster probability decreases over time. But disasters become larger and larger when they occur. With myopic behavior, the interval between two disasters rapidly becomes larger than the memory of the probability estimation process, and there is over-investment in at-risk areas, making disasters more catastrophic.*[33]

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29 Jha, A.K., and Stanton-Geddes, Z. (Eds.), 2013. *Strong, safe, and resilient: a strategic policy guide for disaster risk management in East Asia and the Pacific*. Washington, DC: The World Bank.

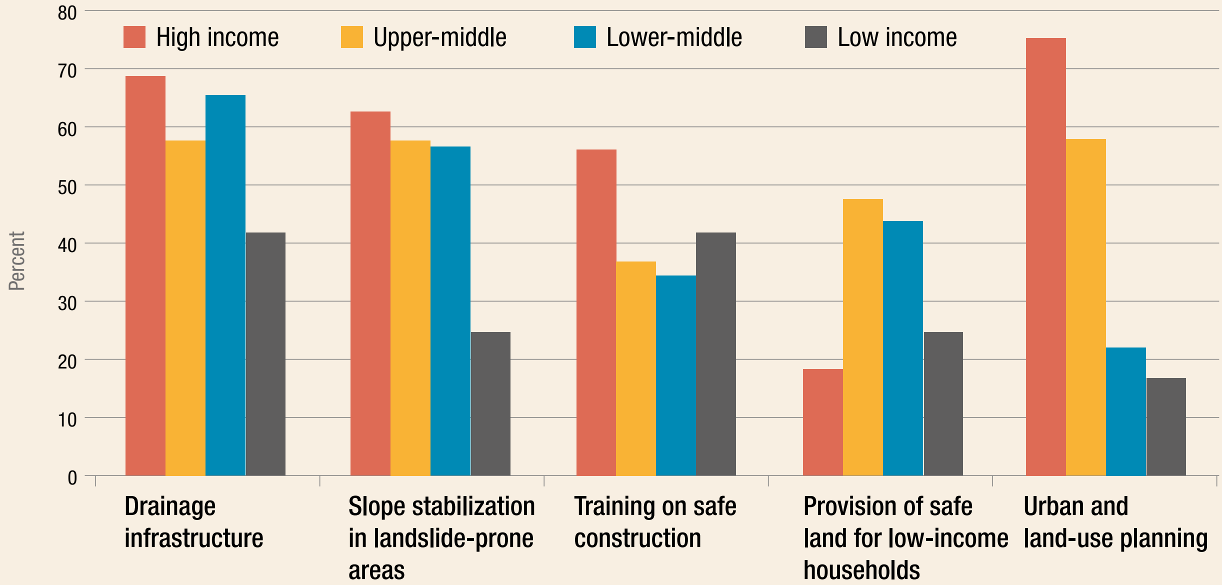
30 ESCAP and UNISDR, 2012.

31 IDMC, 2013. *Disaster-induced internal displacement in the Philippines: The case of Tropical Storm Washi/Sendong*. Geneva: IDMC.

32 Jha and Stanton-Geddes, 2013.

33 Hallegatte, S. 2010. How Economic Growth and Rational Decisions Can Make Disaster Losses Grow Faster Than Wealth. Policy Research Working Paper 5617. Washington, DC: The World Bank.

Figure 3.6: Investments in disaster risk reduction across World Bank income groups in Asia



Source: Jha and Stanton-Geddes, 2013

Until recently, South-East Asia's rapid, poorly planned economic growth created greater conditions of exposure more quickly than it reduced vulnerability, thereby increasing risk. IDMC found that a combination of illegal and poorly regulated logging and quarrying in the mountains of southern Philippines compounded the risks of those in coastal cities downstream.[34] Deforestation from logging increased the runoff and destabilised hillsides, resulting in landslides. It also swept cut trees, silt and boulders downstream, levelling thousands of homes located along riverbanks.[35]

3.2.3 Unequal distribution of wealth

As with wealth (Table 3.2), displacement risk is spread unequally among the countries studied: high income Brunei and Singapore have small populations exposed to hazards. At the other end of the spectrum, several countries in this study have large populations living in what the UN calls multidimensional poverty (47 per cent of Cambodia's population and 37 per cent of Lao People's Democratic Republic).[36] The 6.6 million Filipinos who experience multidimensional poverty represent a smaller percentage of the total population, but these people face a more intense and multidimensional poverty than people even in Cambodia and Lao PDR.[37]

Table 3.2: Countries grouped by World Bank income category

High income	Upper-middle income	Lower income	Low income
Brunei	China	Indonesia	Cambodia
Singapore	Malaysia	Philippines	Lao PDR
	Thailand	Vietnam	Myanmar

Investments in disaster risk management reflect – and exacerbate – these differences. Wealthier countries invest more in prevention and risk reduction than poorer countries (Figure 3.6). This means that when wealthy and poor are exposed to hazards, the wealthy avoid the disaster and the poor see their development gains put at risk.

Displacement risk is also distributed unequally within countries, concentrated among the poorest. Inequitable distribution of losses from disasters highlights how closely economic and social vulnerabilities are linked. As economies falter, the poor and the most vulnerable segments bear a disproportionate burden of the impacts and become even more vulnerable. For example, analyses of the 2011 Thailand floods and the flash floods in Cagayan de Oro, Philippines, found that the urban poor were overwhelmingly more affected compared to the overall population.[38]

34 IDMC, 2013.

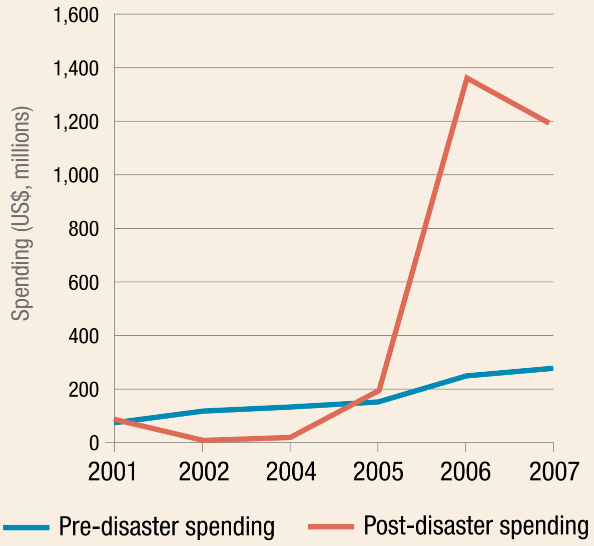
35 Ibid.

36 United Nations Development Programme (UNDP). 2014. *Human Development Report 2014. Sustaining Human Progress: Reducing Vulnerabilities and Building Resilience*. New York: United Nations Development Programme. Developed by Sabina Alkire and Maria Emma Santos, the Multidimensional Poverty Index (MPI) has been adopted by UNDP as a development metric. Unlike indicators based on nationally aggregated data, the MPI identifies multiple deprivations at the household and individual level in health, education and standard of living. It uses micro data from household surveys and includes all of the indicators in the same survey. The MPI reflects both the prevalence of multidimensional deprivation, and its intensity – how many deprivations people experience at the same time.

37 Ibid.

38 ESCAP and UNISDR, 2012.

Figure 3.7: Pre- and post-disaster spending in Indonesia



Source: Jha and Stanton-Geddes, 2013

3.2.4 Improved disaster responses: more lives saved and more displacement

ASEAN states have expressed strong political commitment to enact national disaster risk reduction legislation and establish national and regional plans and policies preparedness and planning. Uneven implementation has limited the effectiveness of some measures. Political and financial priorities also have an effect: recent Disaster Risk Management (DRM) spending and programming in South-East Asia have focused on live-saving measures and recovery. For example, Indonesia's spending on disaster risk management increased by fourfold between 2001 and 2007, but analysis reveals that these additional funds were allocated primarily for disaster response and recovery measures, rather than investments in risk reduction (Figure 3.7).[39] Reduced disaster mortality is an unequivocal improvement, but as more people become affected by disasters and survive, this leads to more displacement.

3.3 MEASURING DISPLACEMENT RISK

This paper estimates human displacement risk due to disasters and climate change as an index expressed as the number of persons expected to be displaced on average per year. Results are provided in both absolute and relative number of displaced. A separate qualitative measure expresses the general intensity of the typical displacement: how difficult the displacement and post-displacement conditions are for the people involved. The terms magnitude and amplitude can be used to convey these two dimensions of disaster-induced displacement.

The term 'magnitude' is used to refer to the total number of people expected to be displaced by natural disasters and climate change. The absolute magnitude measure provides the estimated number of people displaced per country, while the relative measure provides the estimated number of people displaced per million inhabitants. Rankings between the eleven countries in terms of absolute and relative expected displacement are also provided. Colour-coded representations are used in which green equals least modelled displacement risk and red the most (Table 3.3).

The displacement risk estimates were produced by using a combination of national-level disaster loss data from two of the principal loss databases combined with hazard, exposure, vulnerability and resilience proxies from several sources.[40] These produces estimates of annual average displacement risk for each of the ten reviewed countries. For loss data, EM-DAT[41] and national disaster loss databases were used, primarily for homeless/homes destroyed figures. Other disaster metrics, such as the number of people affected, were also used to estimate displacement risk as often these entries were more consistent than homeless data in both databases.

The displacement risk estimates described in this section are the result of the second prototype iteration of the model and, as such, all results should be considered purely as preliminary and very likely subject to change. Normalisation, as well as final ranks and scores, are currently only based on the ten countries that form the basis for this study. All results will need to be re-calibrated once a more extensive global analysis is done. This could lead to significant changes in final figures. The amplitude measure is provided solely as an example of how the final index may display results; calculation for this prototype is only handled in a very basic fashion.

All of these variables must be kept in mind when considering the necessarily coarse nature of using an index to quantify something as complex as displacement risk. Displacement risk estimates are necessarily limited in their ability to capture the true complexity of risk scenarios that can lead to displacement. For this reason, the country reports provide additional information with which to further assess displacement risk at national and sub-national levels.

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39 Jha and Stanton-Geddes, 2013.

40 Physical exposure data which integrates hazard and exposure elements was used from UNEP's GRID PREVIEW model. Human vulnerability values from the same model were also used for each country. Resilience was measured using DARA's 2012 Index of Conditions and Capacities for Risk Reduction (IRR).

41 EM-DAT: The OFDA/CRED International Disaster Database. Louvain, Belgium: Université catholique de Louvain.

Table 3.3: Displacement risk: historical estimates

Disaster-induced displacement risk estimates					
		Magnitude		Magnitude	
Country	Population	Absolute - 2014-2018 average annual displacement (country total)	Regional rank	Relative - 2014-2018 average annual displacement (per million inhabitants)	Regional rank
Indonesia	248,053,392	106,988	6	431.3	9
Lao PDR	6,541,376	45,900	8	7,016.9	1
Malaysia	29,793,998	157,730	5	5,294.0	5
Myanmar	49,154,371	26,655	9	542.3	8
Philippines	98,291,040	623,908	2	6,347.6	3
Singapore	5,405,841	6	10	1.1	10
Thailand	70,148,844	374,837	3	5,343.5	4
Vietnam	90,657,099	365,432	4	4,030.9	6
AVERAGES/ TOTALS	1,974,659,889	10,647,338			

Generally, modelled displacement patterns in the first prototype model were found to be line with expected results on two fronts. The risk displacement estimates were generated without knowledge of the methodology used by IDMC's Disaster-induced Displacement Database (DiDD), yet the preliminary results are largely in line with DiDD figures. For the second and third prototypes of modelled historic displacement, trends were calibrated using IDMC's DiDD dataset, on a hazard by hazard basis.

Countries with higher Human Development Indexes and governance indicators also had better (that is, lower) relative displacement estimates. Countries with higher intrinsic hazard, exposure and vulnerability levels generally saw these factors reflected in higher estimated displacement. This meshes with findings from disaster risk studies focusing on vulnerability, exposure and resilience indicators.

3.4 ANNUAL DISPLACEMENT RISK MAGNITUDE ESTIMATES

Many of the hazards that trigger disasters in the region are of a recurring nature and/or become linked to other hazards (e.g., seasonal flooding and flood-induced landslides), driving frequent ongoing losses and displacement that are constantly eroding livelihoods and security. More often than not, these disasters are closely linked to underlying risk drivers that leave large numbers of people in exposed and vulnerable conditions. Many of the hazards that trigger disasters in the region are of a recurring nature and/or become linked to other hazards (e.g., seasonal flooding and flood-induced landslides), driving frequent ongoing losses and displacement that are constantly eroding livelihoods and security.

Table 3.4 lists the key metrics used in creating the displacement risk estimates for each of the countries. These include measures for the exposure level of residents to different hazards, the average levels of vulnerability and the average levels of resilience. This risk configuration data is then combined with historic modeled displacement trends generated from disaster loss data and calibrated using IDMC's DiDD displacement estimates database.

3.4.1 Future estimates

For detailed displacement risk information, as well as loss and risk figures per hazard type, refer to the national reports in the annex. Future methodological improvements, should data permit, include the disaggregation of displacement risk per hazard type. The preliminary disaster displacement numbers in Figure 3.4 lists the number of people on average expected to be displaced per year. It can be thought of as the actuarial analogue of the kind of average annual loss (AAL) calculation commonly used in the insurance industry.

3.4.2 Loss exceedance

We are in the process of adapting ERN's Hybrid Loss Curves methodology to complement average annual displacement risk figures. Average annual displacement

Table 3.4: Components of disaster-induced displacement risk

	Displacement risk configuration					Historic displacement	
	Total relative physical exposure (per million)	Vulnerability	Resilience	Risk configuration	Risk configuration (normalised)	Historic absolute displacement	Historic relative displacement (per million)
Brunei Darussalam	58	19.00	5.35	0.00	0.05	0.0	0
Cambodia	129,089	14.00	3.27	5.52	0.08	50,903.5	3,446
China	130,656	23.00	5.77	5.21	0.07	8,280,797.7	6,082
Indonesia	62,555	20.00	4.74	2.64	0.06	100,741.8	406
Lao PDR	74,350	25.00	3.74	4.97	0.07	42,792.0	6,542
Malaysia	1,750	19.00	6.40	0.05	0.05	150,186.5	5,041
Myanmar	52,340	27.00	3.01	4.70	0.07	24,879.5	506
Philippines	459,517	19.00	4.70	18.58	0.13	549,926.1	5,595
Singapore	904	22.00	4.68	0.04	0.05	5.9	1
Thailand	53,762	23.00	5.60	2.21	0.06	353,608.4	5,041
Vietnam	153,677	211.00	4.92	65.92	0.35	270,690.3	2,986
AVERAGES/TOTALS		38.4	4.68	9.99	0.10	9,824,532	4,975
Notes	See note 1		See note 2				

1 Grey value uses average of lowest two values due to lack of exposure data for Singapore
2 Grey value uses regional resilience average due to lack of resilience figures for Singapore

risk is calculated in a manner similar to insurance calculations for average annual loss (AAL). A key metric in dimensioning risk, it provides the most intuitive understanding of the risk of loss, often setting the baseline from which discussion may ensue. Our assessment of displacement risk has up to this point focused on this AAL approach to generate annual displacement risk estimates.

Another important component of risk relates to how the year-to-year variance in losses affect these averages. Loss exceedance, or probable maximum loss (PML), brings to life the range under which losses may be greater or less than the AAL. PML is usually expressed as a curve with loss levels (e.g., US$ billions) on one axis and return period for that given size of losses on the other (e.g., a one to 500-year range).

The concept of PML can be even further simplified to express the relationship between number of events recorded and specific amount of displacement. Figure 3.10 reveals the loss exceedance for the whole world. Since these graphs cover a 6-year period (2008-2013), if we divide the number of events for each given size by six, we will have a rough approximation of the average number of times per year that we expect displacement from a single event to exceed that given quantity (hence 'loss exceedance'). When applied to South-East Asia and China, we estimate that there would be approximately two events that would displace more than 1 million people and one event that would displace 2 million people.[42]

Disaster displacement estimate and risk research is highly hampered by the lack of sufficient quantity or quality of data on historic displacement. This is a problem that is shared by the international disaster risk community as well. ERN's Hybrid Loss Curves methodology is a recent approach at working around these data limitations. To generate a PML curve, they use a convolution of several functions: a model that relies on empirical data (i.e., disaster loss figures) for frequently recurring events (e.g., one- to 50-year return periods) and a model that relies on extrapolations and other modelled approaches to determine what specific low-frequency return period events would look like in terms of losses. reliance on modelled results for low-frequency events (e.g., 50- to 500-year return periods).

3.5 UNCERTAINTY

Within any risk model that utilises loss data of the nature that is available in disaster risk studies there is always a difficulty with reducing uncertainty to acceptable levels. Simply adding more datasets to an analysis where each dataset brings its own difficulties often compounds sources of error. An option is to utilise the additional data sources to create a separate model that either helps validate the first or else provides a complementary perspective. This is thus similar to the concept behind ERN's Hybrid Loss Curves: an attempt to reduce uncertainty by finding relationships with proxies that can help fill in gaps left behind by the data. On a rudi-

[42] This is only a very coarse approximation used for illustrative purposes; a more precise curve would require more data to produce.

Figure 3.8: Projected displacement risk by country 2014-2018

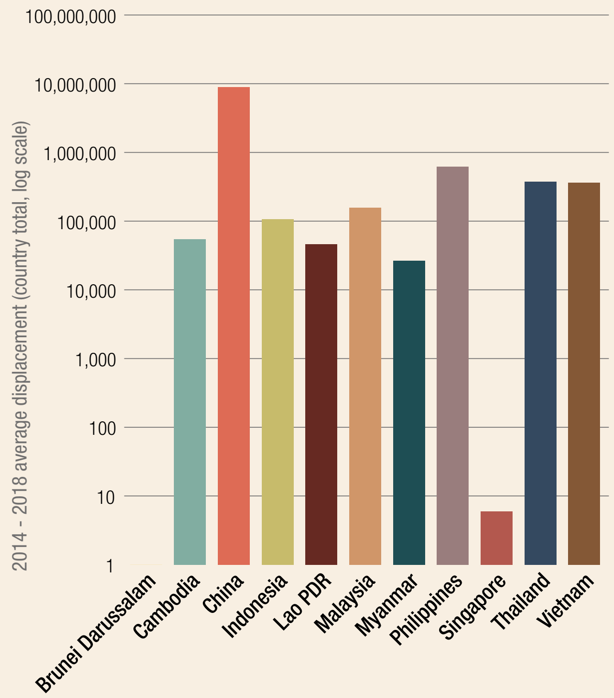
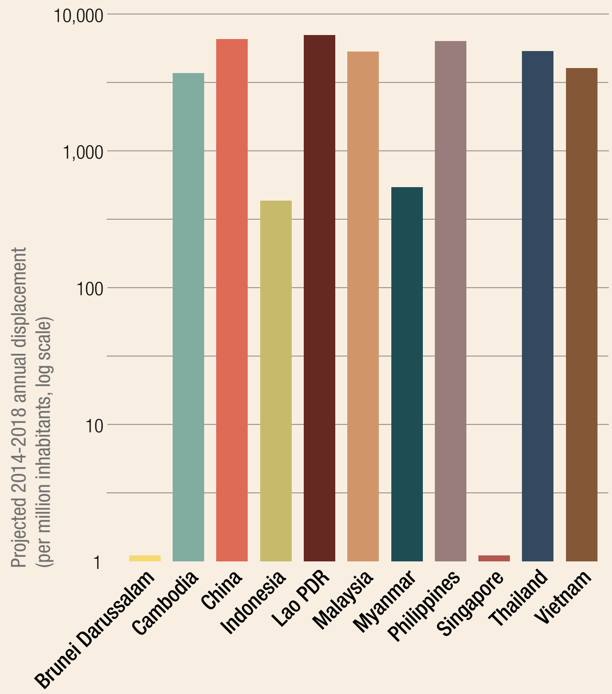


Figure 3.9: Projected displacement risk by country (per million habitants) 2014-2018



mentary level, the level of convergence between results can serve as a rough indicator of the levels of uncertainty intrinsic to each model.

The end goal of this project is to also apply a probabilistic framework of specific types of natural event magnitudes and durations at specific locations (by using hazard, exposure and vulnerability proxies) with an index constructed from available development and extensive/intensive risk indicators. This will allow the calibration of the resulting curve using historic displacement data to establish 'tipping points' at which displacement would be expected to occur if different types, frequencies and magnitudes of events were to occur.

Figure 3.10: People displaced per event (based on global data, 2008-2013)

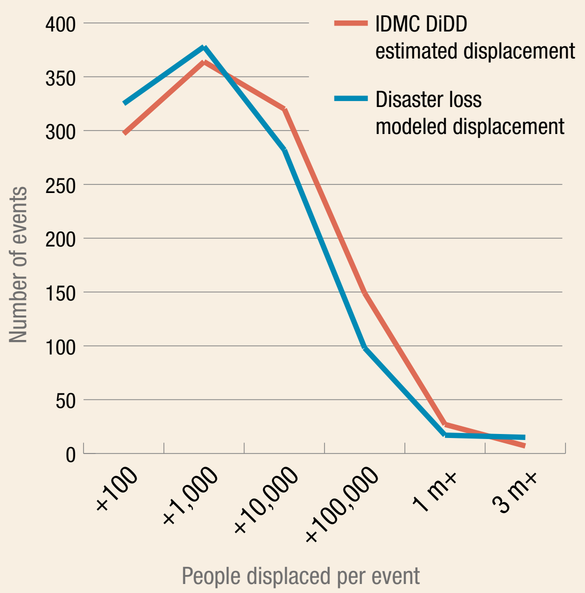


Figure 3.11: Regional Annual Absolute Population Exposed (in 1,000s of people)

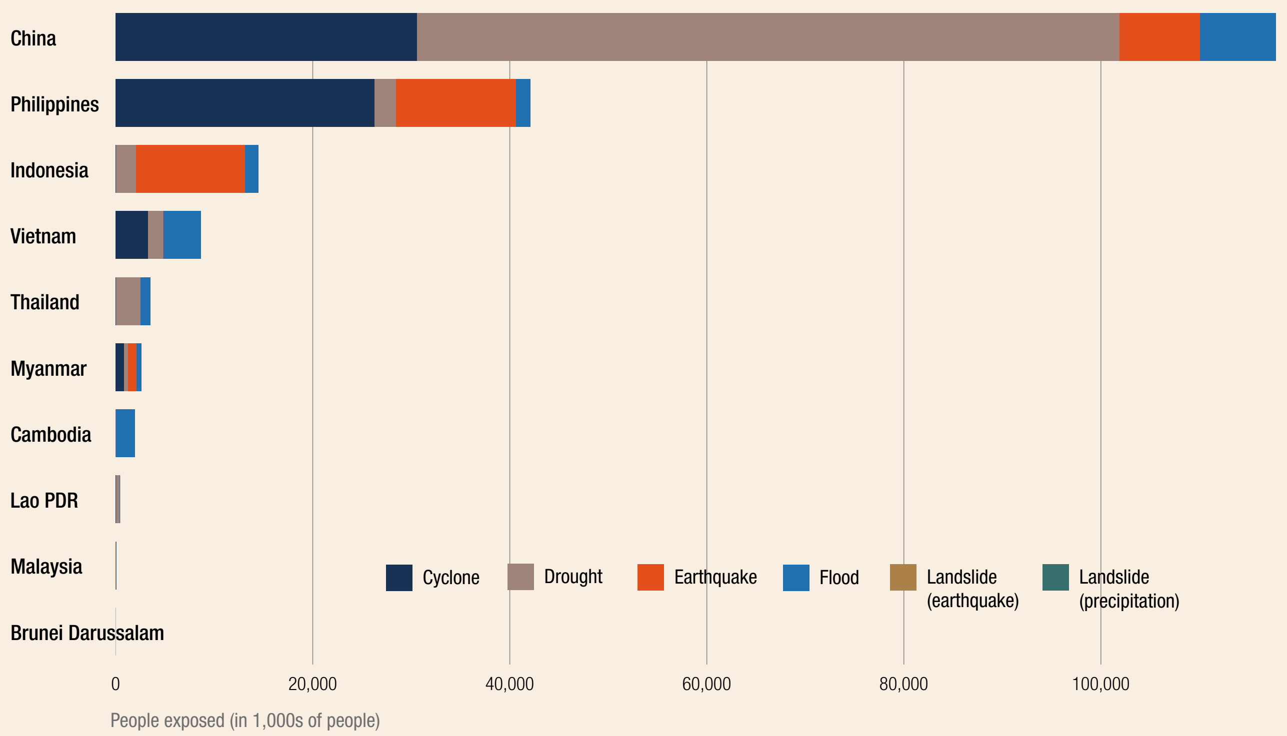


Figure 3.12: Regional Annual Relative Population Exposed (per million inhabitants)

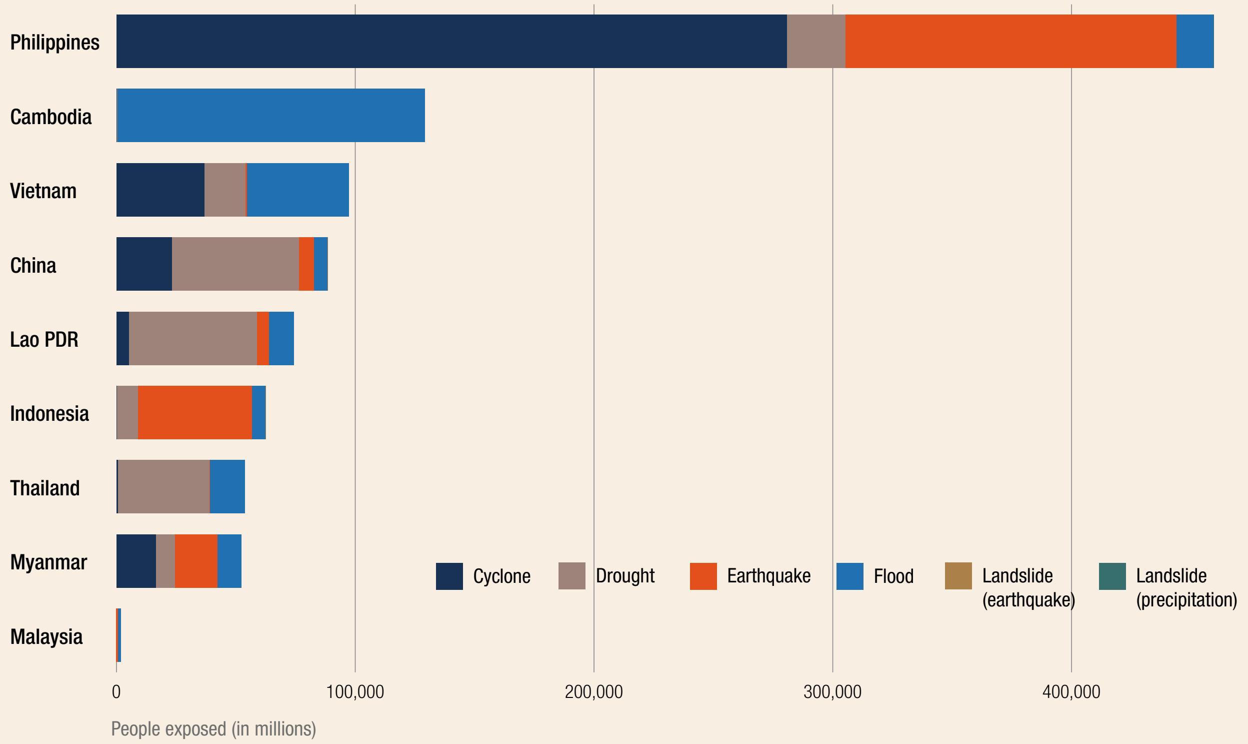


Figure 3.13: 2010 DARA's Indicator of Conditions and Capacities for Risk Reduction (IRR)
Note: Lao PDR data limited to IRR drivers 2 and 3.

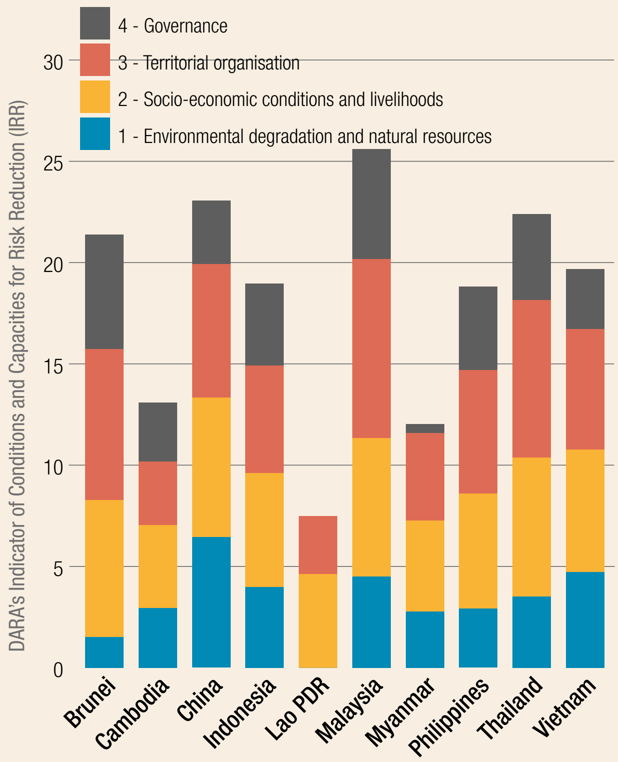
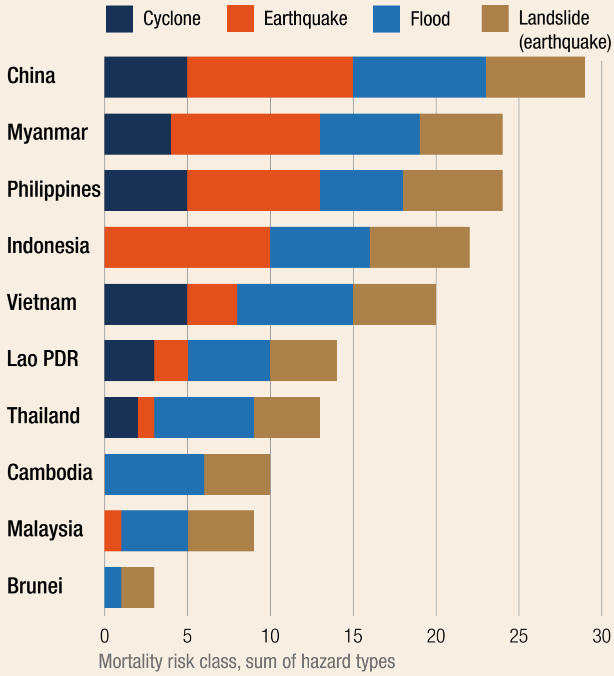


Figure 3.14: 2011 UNEP PREVIEW/GRID Model mortality risk class components



4. ANNEX: COUNTRY REPORTS

4.1 BRUNEI

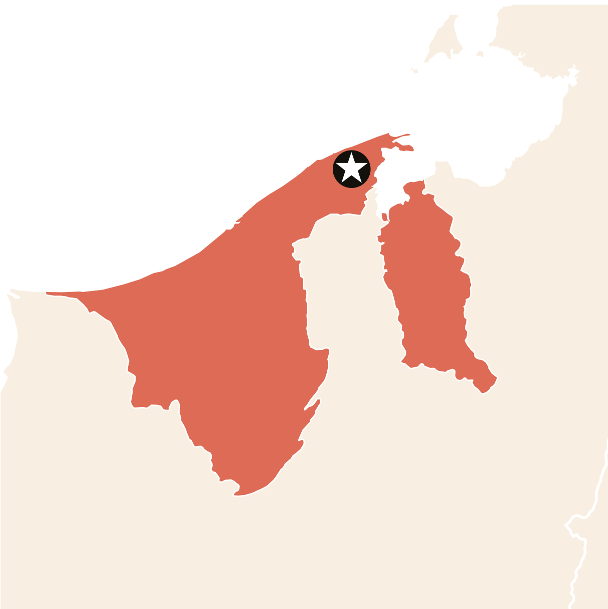


Figure 4.1: Brunei (Source: UN OCHA)

4.1.1 Displacement Risk Configuration

Brunei Darussalam is a constitutional monarchy and an independent sovereign sultanate located on the northwest coast of the island of Borneo. Brunei is a high income country with an estimated population of 414,000 whose per capita income is above US$ 70,000.[43] A relatively small number of people are exposed to natural forest fires, storms, floods and landslides but most Bruneians are not very vulnerable to them.

Apart from the coast along the South China Sea, Brunei's 5,765 square kilometres are surrounded by Malaysia. Seventy eight per cent of national territory is tropical rain forest. With average annual rainfall of 2,540mm and relative humidity that normally exceeds 75 per cent, Brunei's forests are not prone to fires, and even when fires do occur they are not be widespread.[44] In 1997 – 1998, a massive wildfire engulfed Indonesia, Malaysia and, to a lesser extent, Brunei and Singapore. The fires and resulting haze led to significant destruction and displacement in Indonesia and Malaysia, but impacts in Brunei were relatively minor: US$ 2 million damage in Brunei, and no reported displacement.[45]

4.1.2 Displacement Risk Results

In 1999, 2008, 2009 and 2014, Brunei experienced flash floods. In February 2009, more than ten centimetres of rain fell in a 24-hour period, causing the worst floods in 40 years. The flood and rain-triggered landslides damaged the homes and food supplies of 1,637 people and interrupted power and other services.[46] Newspapers reported that some people whose homes were damaged were forced to stay in hotels, evacuation shelters or with family or friends, but no official displacement statistics were available for these events.[47] In fact, Brunei is one of only a handful of countries in the world for which IDMC has not been able to find any disaster-related displacement.

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43 UNDP, 2014; and Brunei Darussalam Department of Statistics, 2011. *Brunei Darussalam Key Indicators*. Bandar Seri Begawan: Department of Statistics, Department of Economic Planning and Development and Prime Minister's Office.

44 Glanz, D. (ed.), 2002. *Framing Fires: A country-by-country analysis of forest and land fires in the ASEAN nations*. Jakarta: Project FireFight South East Asia.

45 EM-DAT: The OFDA/CRED International Disaster Database. Louvain, Belgium: Université catholique de Louvain.

46 Seri Begawan, B., 2009. Floods, landslides victims receive aid. *The Brunei Times*, 15 February 2009.

47 Souyono, S., 2014. Trial and tribulation of flood victims. *The Brunei Times*, 8 February 2014.

4.2 CAMBODIA

Figure 4.2: Cambodia (Source: UN OCHA)

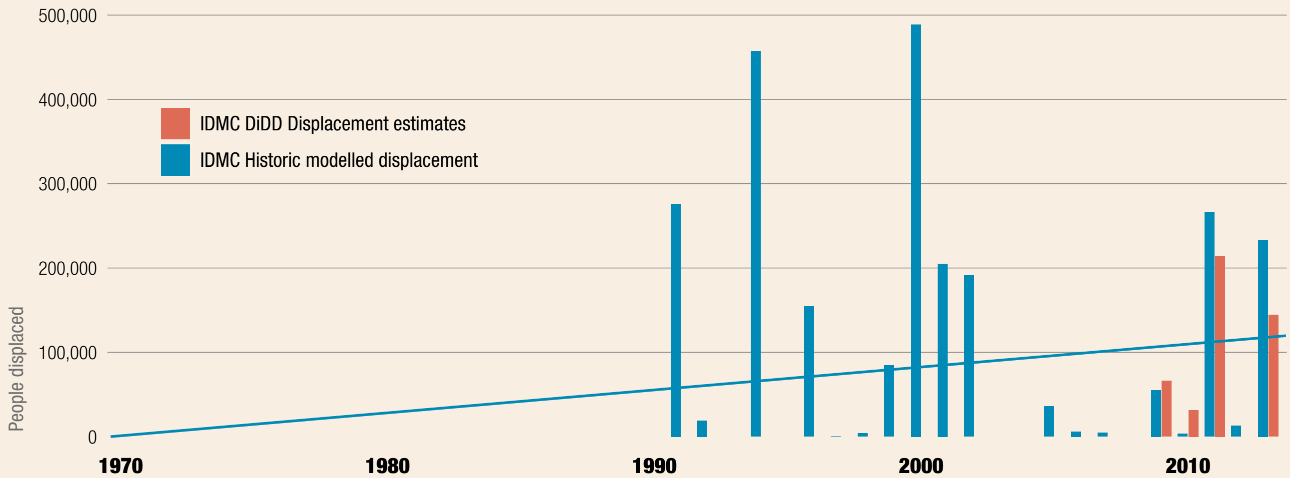
4.2.1 Displacement Risk Configuration

The Kingdom of Cambodia is the poorest country included in this study: some 47 per cent of the country's inhabitants, totalling more than 6.7 million people, face multidimensional poverty.[48] This means they lack income as well as access to adequate housing, education, health and other services.

Cambodia has an area of 181,040 km^2 and is bordered by Thailand, Lao PDR and Vietnam. Approximately 75 per cent of Cambodia is covered by tropical rain forest, and the country's topography is mostly low, flat plains. There are, however, three mountainous areas: in the south-west, along the northern borders with Thailand and Lao PDR.

The major hazards to which Cambodia are exposed are storms, floods and droughts. Cambodia is also exposed to forest fires and landslides. On average, more than 500,000 Cambodians are affected by disasters every year, often resulting in large-scale displacement. Since IDMC began collecting data on disaster-related displacement, Cambodia has experienced displacement in relation to typhoons Ketsana (2009), Mirinae (2009), Usagi (2013) and Rammasum (2014). Two of these disasters displaced more than 100,000 people. Between August and November 2011, floods displaced an estimated 214,000 people.[49] In September and October of 2013, 144,000 people across 20 of Cambodia's 24 provinces were displaced after widespread flooding that followed three weeks of heavy rains.[50] Heavy rains in August 1991 triggered floods that displaced 150,000, especially along the Mekong and Tonlé Sap Rivers, where the greatest concentrations of people exposed to flooding are located (Figure 4.4).[51]

Figure 4.3: Modelled historic displacement (1970-2013) & DiDD displacement estimates (2008-2013) for Cambodia



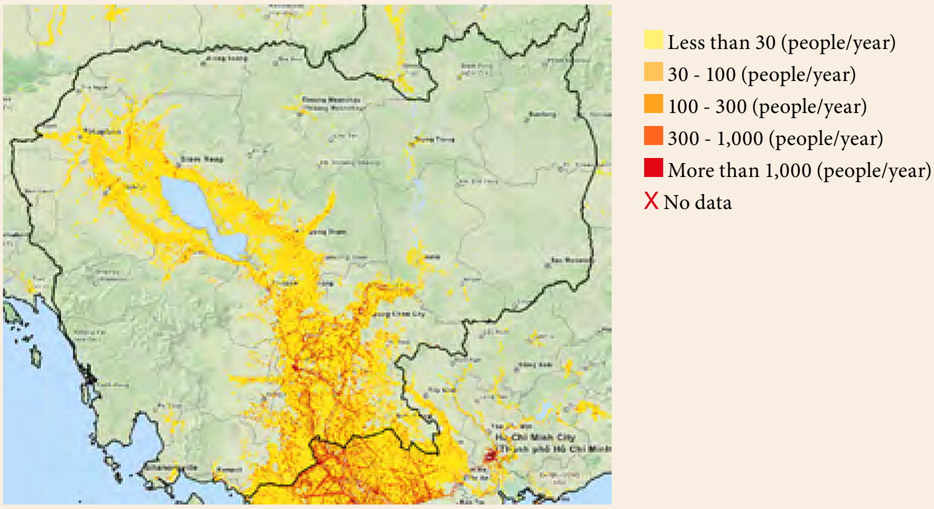
48 UNDP, 2014.

49 IDMC, 2012.

50 IDMC, 2014.

51 United Nations Disaster Relief Organization (UNDRO), 1991. *Cambodia—Flood Emergency Situation Report No. 2, 27 August 1991*. Geneva: United Nations Disaster Relief Organization.

Figure 4.4: Population exposed to floods in Cambodia



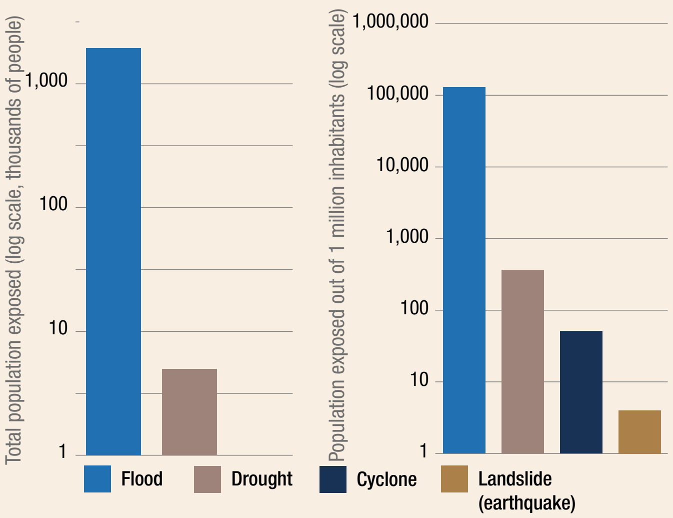
Source: UNEP/GRID-Geneva PREVIEW

Figure 4.5: Disaster-induced displacement risk estimates: Cambodia

Disaster-induced displacement risk estimates					
		Magnitude		Magnitude	
Country	Population	Absolute - 2014-2018 average annual displacement (country total)	Regional rank	Relative - 2014-2018 average annual displacement (per million inhabitants)	Regional rank
Cambodia	14,770,860	54,718	7	3,704.5	7

	Displacement risk configuration					Historic displacement	
	Total relative physical exposure (per million)	Vulnerability	Resilience	Risk configuration	Risk configuration (normalised)	Historic absolute displacement	Historic relative displacement (per million)
Cambodia	129,089	14.00	3.27	5.52	0.08	50,903.5	3,446

Figure 4.6: Absolute and relative population exposure to hazards: Cambodia



4.3 CHINA

Figure 4.7: China (Source: UN OCHA)

4.3.1 Displacement Risk Configuration

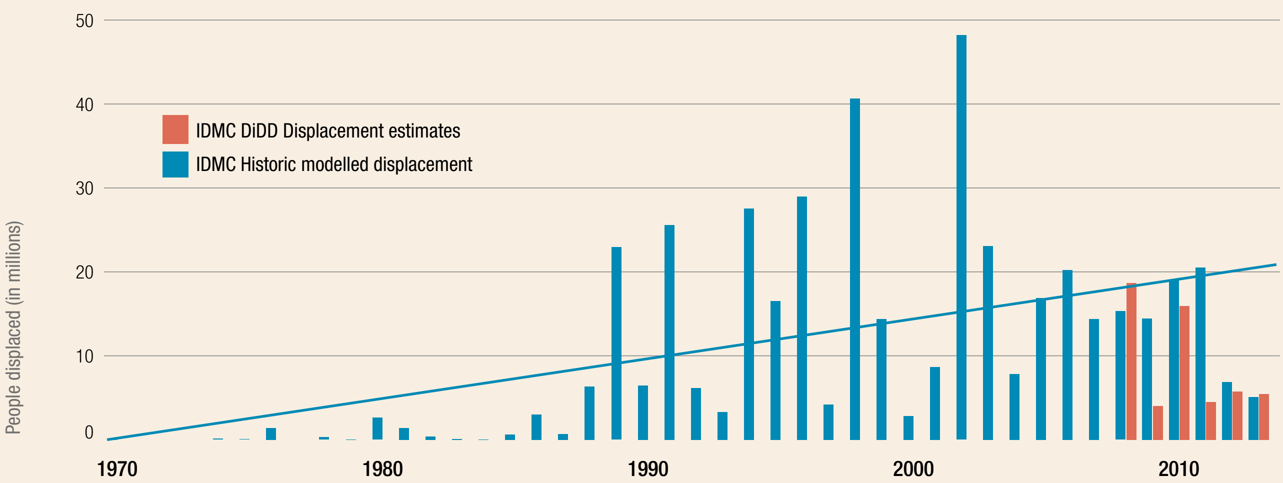
With an estimated population of more than 1.37 billion people, the People's Republic of China is the world's most populous country.[52] China's approximately 9.6 million square kilometres are divided into 22 provinces, five autonomous regions, four municipalities and two special administrative regions. China's population has experienced a burst of rapid urbanisation. Between China's 2000 and 2010 censuses, the country's urban population grew to 49.7 per cent of the total population, an increase of more than 13 per cent.[53]

Over the last decade, China's GDP has grown from US$ 1.4 to more than US$ 4.8 trillion dollars (measured in constant 2005 US$).[54] The economy has also become more concentrated in urban centres, especially those near coastal areas with access to international markets: cities with a population of 2.5 million or more people account for 95 per cent of China's urban exports. China's ten largest cities account for approximately 19 per cent of the country's total GDP.[55]

China is exposed to storms, floods, earthquakes, droughts and landslides. Demographic and economic changes have begun to concentrate some of these risks in urban centres. Most of China's flood- and storm-related displacement is concentrated in dense urban settlements along the country's coast (Figure 4.9). While China has avoided some of the worst aspects of rapid urban growth, such as extreme urban poverty and the growth of informal settlements, poor land use planning has degraded the environment, exacerbating some disaster risks.

Not surprisingly, many of the largest disaster-related displacements have occurred in China. Since 2008, China has experienced three disasters in which more than 3 million people were displaced, five disasters that displaced 1 to 3 million people and 34 disasters that displaced between 100,000 and 1 million people.[56] These mega-disasters are driven in part by China's significant exposure to geophysical hazards (Figure 4.10).

Figure 4.8: Modelled historic displacement (1970-2013) & DiDD displacement estimates (2008-2013) for China



52 National Bureau of Statistics of China, 2011. *Communiqué of the National Bureau of Statistics of China on Major Figures of the 2010 Population Census (No. 1)*. Beijing: National Bureau of Statistics of China.

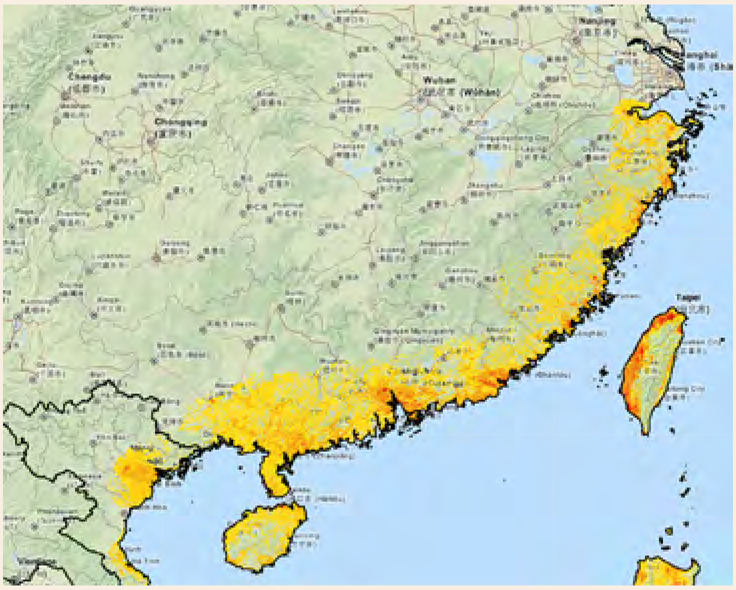
53 Ibid.

54 The World Bank, 2014. China. World Bank Data Portal. Washington, DC: The World Bank.

55 World Bank and the Development Research Center of the State Council, P. R. China, 2014. *Urban China: Toward Efficient, Inclusive, and Sustainable Urbanization*. Washington, DC: The World Bank.

56 IDMC, 2014.

Figure 4.9: Population exposed to tropical cyclones in China



Less than 10 (people/year)
10 - 100 (people/year)
100 - 1,000 (people/year)
1,000 - 10,000 (people/year)
More than 10,000 (people/year)
X No data

Source: UNEP/GRID-Geneva PREVIEW

Figure 4.10: Population exposed to earthquakes in China

Less than 5 (people/year)
5 - 50 (people/year)
50 - 500 (people/year)
500 - 5,000 (people/year)
More than 5,000 (people/year)
X No data

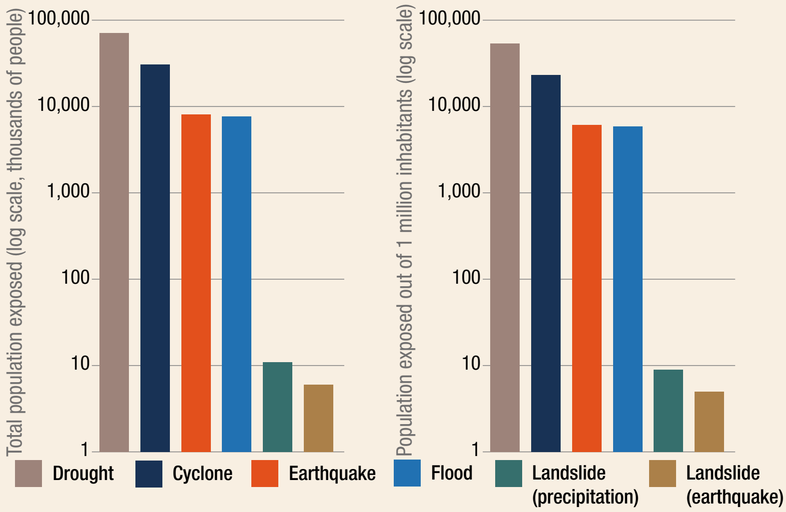
Source: UNEP/GRID-Geneva PREVIEW

Figure 4.11: Disaster-induced displacement risk estimates: China

Disaster-induced displacement risk estimates					
		Magnitude		Magnitude	
Country	Population	Absolute - 2014-2018 average annual displacement (country total)	Regional rank	Relative - 2014-2018 average annual displacement (per million inhabitants)	Regional rank
China	1,361,437,344	8,889,766	1	6,529.7	2

	Displacement risk configuration					Historic displacement	
	Total relative physical exposure (per million)	Vulnerability	Resilience	Risk configuration	Risk configuration (normalised)	Historic absolute displacement	Historic relative displacement (per million)
China	130,656	23.00	5.77	5.21	0.07	8,280,797.7	6,082

Figure 4.12: Absolute and relative population exposure to hazards: China



4.4 INDONESIA

Figure 4.13: Indonesia (Source: UN OCHA)

4.4.1 Displacement Risk Configuration

The Republic of Indonesia is an archipelago that consists of some 13,466 islands divided into 33 provinces and one special administrative region. With a population of approximately 250 million people, Indonesia is the world's fourth most populous country.[57]

The Indonesian archipelago is located in one of the most hazard-prone areas of the world, and Indonesia's population is exposed to multiple hazards, including storms, floods, droughts, earthquakes, tsunamis, landslides, volcanoes and forest fires. Indonesia has a large population exposed to earthquake and rain-triggered landslides (Figure 4.15).

Indonesia's national disaster loss database includes more than 12,700 individual disaster events between 2000 and 2012.[58] Indonesia's disaster mortality risk – the likelihood that people will be killed in a disaster – has increased since the 1970s, even for risks associated with low-intensity, frequently occurring hazards. This trend indicates that the country's population has grown more quickly than the government has been able to address the root causes of vulnerability.

Between 2008 and 2013, Indonesia experienced 20 disaster events that displaced 10,000 to 100,000 people.[59] Ten occurred in 2013 alone. And in the last ten years, Indonesia has experienced three disasters that displaced at least 100,000 people: the 2004 Indian Ocean Tsunami displaced more than 500,000;[60] the 2010 eruption of Mt. Merapi displaced 360,000;[61] and the February 2014 eruption of Mt. Kelud displaced approximately 100,200.[62]

57 The World Bank, 2014. Indonesia. World Bank Data Portal. Washington, DC: The World Bank.

58 Indonesian National Board for Disaster Management (BNPB), 2013. Indonesian Disaster Information and Data (DIBI). Jakarta: Indonesian National Board for Disaster Management.

59 IDMC, 2014.

60 Inderfurth, K.F., Fabrycky, D., and Cohen, S., 2005. The 2004 Indian Ocean Tsunami: One Year Report. Washington, DC: Sigur Center for Asian Studies.

61 IDMC, 2011. Displacement due to natural hazard-induced disasters: Global Estimates for 2009 and 2010. Geneva: IDMC.

62 International Federation of Red Cross and Red Crescent Societies (IFRC), 2014. *Final report. Indonesia: Volcanic Eruption – Mt. Kelud*. Geneva: International Federation of Red Cross and Red Crescent Societies.

Figure 4.14: Modelled historic displacement (1970-2013)& DiDD displacement estimates (2008-2013) for Indonesia

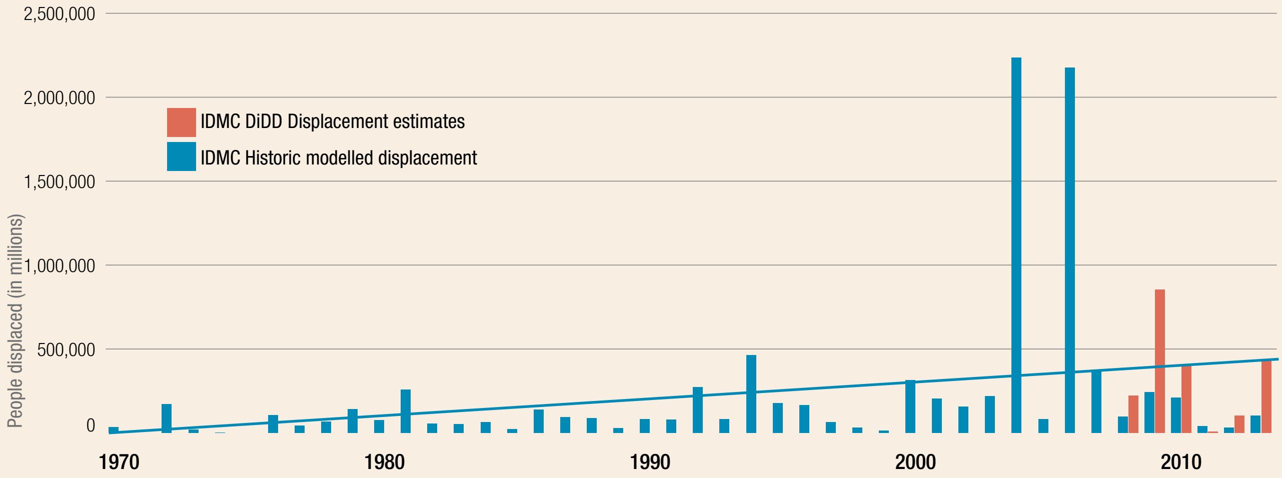
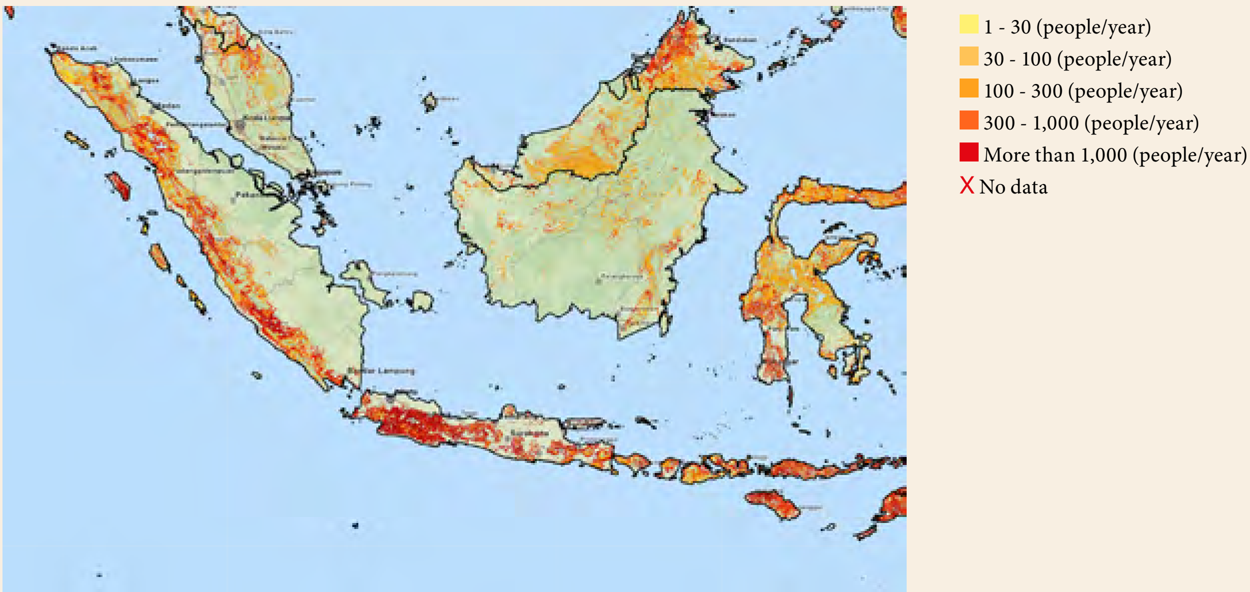


Figure 4.15: Population exposed to landslides in Indonesia



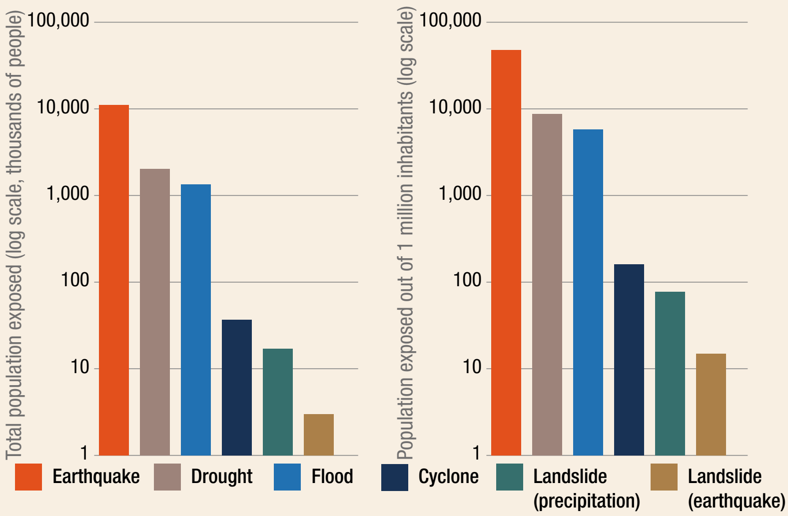
Source: UNEP/GRID-Geneva PREVIEW

Figure 4.16: Disaster-induced displacement risk estimates: Indonesia

Disaster-induced displacement risk estimates					
		Magnitude		Magnitude	
Country	Population	Absolute - 2014-2018 average annual displacement (country total)	Regional rank	Relative - 2014-2018 average annual displacement (per million inhabitants)	Regional rank
Indonesia	248,053,392	106,988	6	431.3	9

	Displacement risk configuration					Historic displacement	
	Total relative physical exposure (per million)	Vulnerability	Resilience	Risk configuration	Risk configuration (normalised)	Historic absolute displacement	Historic relative displacement (per million)
Indonesia	62,555	20.00	4.74	2.64	0.06	100,741.8	406

Figure 4.17: Absolute and relative population exposure to hazards: Indonesia



4.5 LAO PDR

Figure 4.18: Lao People's Democratic Republic

(Source: UN OCHA)

4.5.1 Displacement Risk Configuration

Lao PDR is a landlocked country bordered by Cambodia, China, Myanmar, Thailand and Vietnam. Lao PDR's 237,000 square kilometres are comprised of mountainous, forested terrain, with the Mekong River forming part of the country's border with Thailand.

Lao PDR is one of the three least developed countries included in this study, and approximately 37 per cent of the country's 6.7 million people face multidimensional poverty.[63]

The two most significant hazards Laos face are floods and droughts, though forest fires and rain-triggered landslides also occur. Approximately two thirds of the population are exposed to 1.5 floods or droughts each year. The Table 4.1 highlights this repeated exposure to floods:

Table 4.1: Major flood disasters in Lao PDR (2008 – 2013)

Year	Summary
2008	Flooding, wind and rain-triggered landslides associated with Tropical Storm Kammuri damaged or destroyed approximately 20,000 homes, mostly in Lao PDR's northern provinces.[64]
2009	Typhoon Ketsana caused US$ 58 million in damage, 55 per cent of which was borne by small and marginal farmers in the southern provinces.[65]
2011	Monsoon rains and Typhoon Nok Ten affected both northern and southern provinces, damaging 140,000 houses and displacing approximately 50,000 people.[66]
2013	Between June and September, floods affected 350,000 people, of whom approximately 8,000 were displaced, in northern, central and southern provinces.[67]

Of particular concern, with potential for cross-border displacement, is that most of the people exposed to riverine flooding are located near Lao PDR's western border with Thailand (Figure 4.22).

63 UNDP, 2014.

64 Mekong River Commission (MRC) Secretariat, 2008. Flood situation report, August 2008. MRC Technical Paper No. 21. Vientiane: Mekong River Commission Secretariat.

65 United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) and the United Nations Office for Disaster Risk Reduction (UNISDR), 2012. *Reducing Vulnerability and Exposure to Disasters: The Asia-Pacific Disaster Report 2012.* Bangkok: ESCAP and UNISDR.

66 Ibid.

67 International Federation of Red Cross and Red Crescent Societies (IFRC), 2013. Disaster Management Information System. Geneva: IFRC.

Figure 4.19: Modelled historic displacement (1970-2013) & DiDD displacement estimates (2008-2013) for Lao People's Democratic Republic

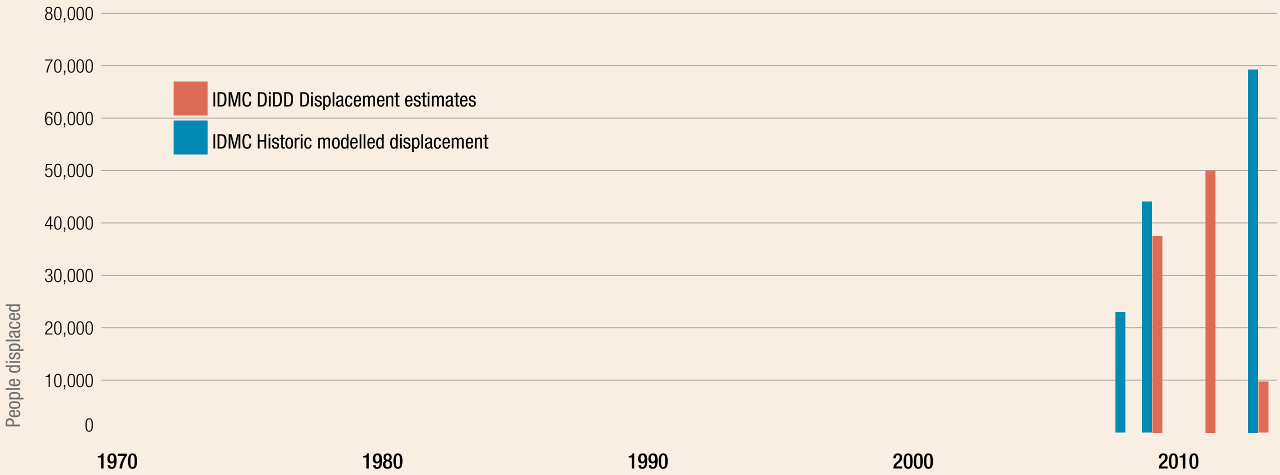


Figure 4.20: Disaster-induced displacement risk estimates: Lao PDR

Disaster-induced displacement risk estimates					
		Magnitude		Magnitude	
Country	Population	Absolute - 2014-2018 average annual displacement (country total)	Regional rank	Relative - 2014-2018 average annual displacement (per million inhabitants)	Regional rank
Lao PDR	6,541,376	45,900	8	7,016.9	1

	Displacement risk configuration					Historic displacement	
	Total relative physical exposure (per million)	Vulnerability	Resilience	Risk configuration	Risk configuration (normalised)	Historic absolute displacement	Historic relative displacement (per million)
Lao PDR	74,350	25.00	3.74	4.97	0.07	42,792.0	6,542

Figure 4.21: Absolute and relative population exposure to hazards: Lao PDR

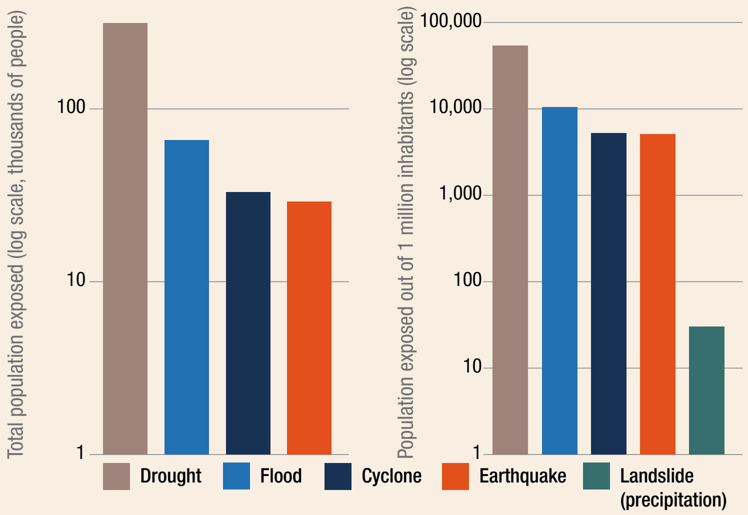
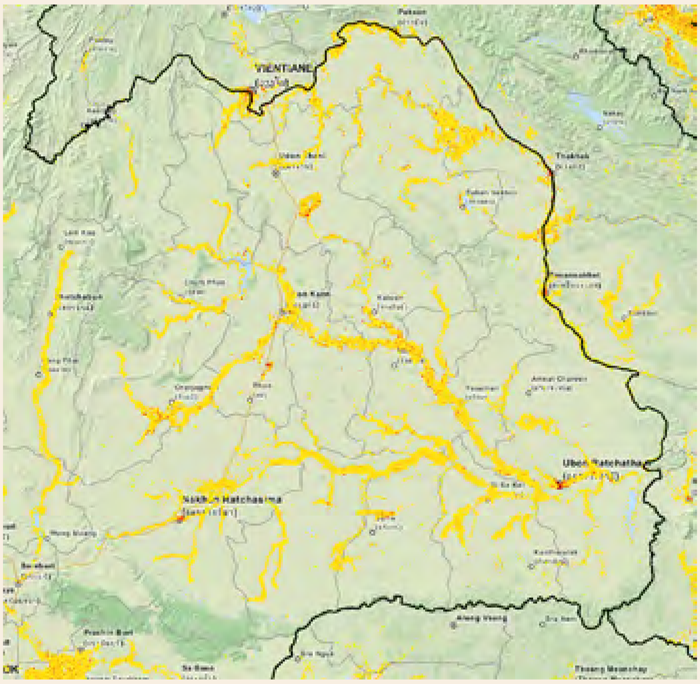


Figure 4.22: Population exposed to flooding near the border of Lao PDR and Thailand



Source: UNEP/GRID-Geneva PREVIEW

4.6 MALAYSIA

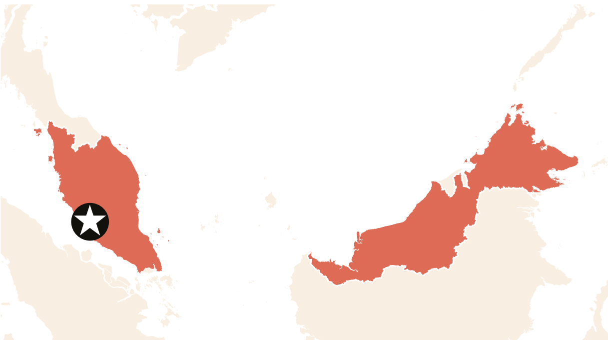


Figure 4.23: Malaysia (Source: UN OCHA)

A federal constitutional monarchy, Malaysia has a population of approximately 30 million people. Malaysia's 13 states and three federal territories are located in two regions separated by the South China Sea. Peninsular Malaysia is bordered by Thailand on the north and Singapore on the south. East Malaysia is located on the island of Borneo and shares borders with Indonesia and Brunei. Malaysia also has several small islands. Topographically, Peninsular and East Malaysia are characterised by coastal plains and densely forested mountains.

In the late 1990s, Malaysia was one of the countries affected by the Asian financial crisis. The crisis resulted in job losses and lost earnings, especially for the working class. This, in turn, exacerbated income inequality and reduced household spending and consumption as well as access to health care and education.[68]

Historically, flood disasters have affected and displaced more people in Malaysia than other hazards, but Malaysians are also exposed to droughts, earthquakes, storms, landslides and wildfires. Recurring floods have become an increasing problem for Malaysia as these events have begun to occur with greater frequency, nearly on an annual basis, with major floods reported in 1886, 1926, 1931, 1947, 1954, 1965, 1967, 1970 – 1971, 1988, 1993, 1996, 2000, 2006 – 2007, 2008, 2009, 2010, 2011 and 2013.[69] In December 2006 and January 2007, heavy rains caused extensive flooding in Peninsular Malaysia, and displaced more than 110,000 people.[70] Displacement associated with flooding also occurred in November 2009 (at least 16,000 people displaced);[71] January 2011 (approximately 30,000 people were displaced);[72] and December 2013 (at least 65,000 people displaced).[73] The state of Terengganu, in particular, has been affected by this repeated flood-induced displacement.

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68 UNDP, 2014.

69 Chan, N.W., 2012. Impacts of Disasters and Disaster Risk Management in Malaysia: The Case of Floods. In *Economic and Welfare Impacts of Disasters in East Asia and Policy Responses* [Y. Sawada and S. Oum (eds.)]. ERIA Research Project Report 2011-8. Jakarta: ERIA.

70 UN Office for the Coordination of Humanitarian Affairs, 2007. Floods Malaysia, December 2006 and January 2007. Bangkok: OCHA Regional Office for Asia Pacific.

71 Deutsche Presse Agentur, 2009. More than 16,000 evacuated as Malaysian floods worsen. Deutsche Presse Agentur, 24 November 2009.

72 Buqas, A., 2011. Floods in Malaysia force thousands of people to leave their homes. Kuwait News Agency, 31 January 2011.

73 Thai PBS, 2013. Flood situation remains dire, over 65,000 evacuated in 4 Malaysian states. Thai PBS, 9 December 2013.

Figure 4.24: Modelled historic displacement (1970-2013) & DiDD displacement estimates (2008-2013) for Malaysia

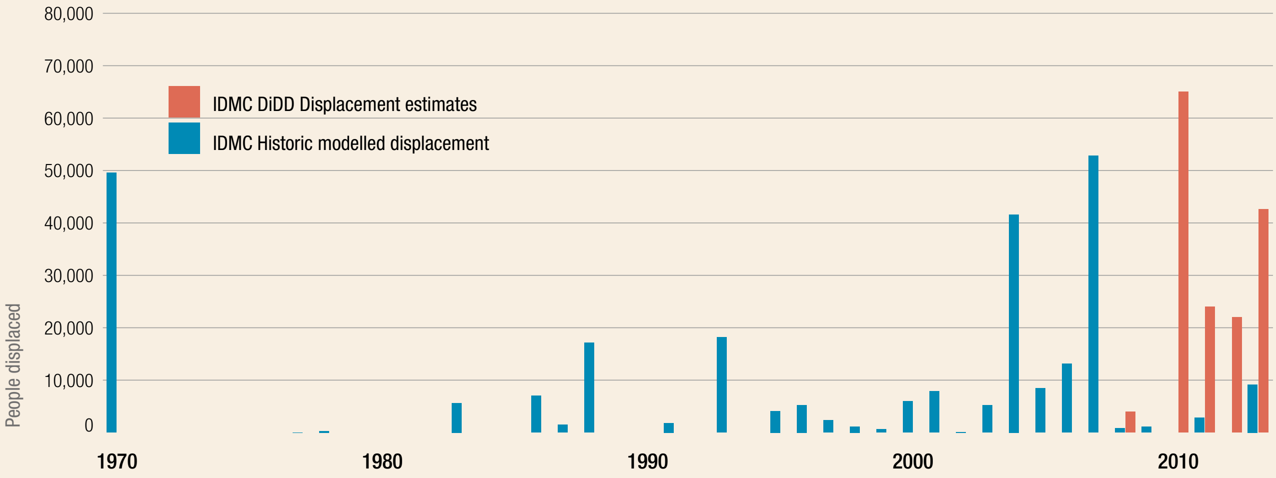
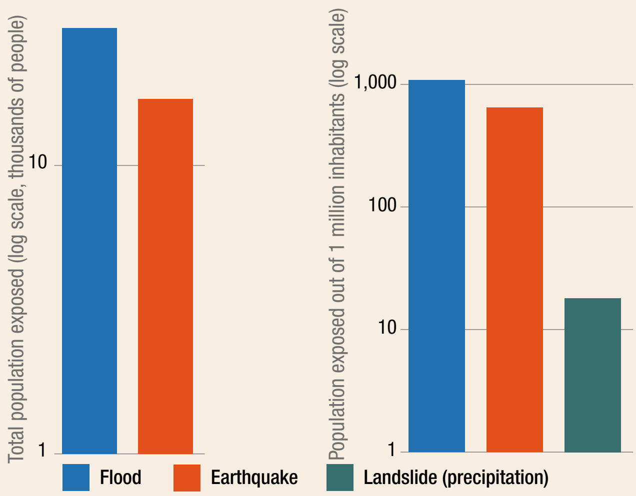


Figure 4.25: Disaster-induced displacement risk estimates: Malaysia

Disaster-induced displacement risk estimates					
		Magnitude		Magnitude	
Country	Population	Absolute - 2014-2018 average annual displacement (country total)	Regional rank	Relative - 2014-2018 average annual displacement (per million inhabitants)	Regional rank
Malaysia	29,793,998	157,730	5	5,294.0	5

	Displacement risk configuration					Historic displacement	
	Total relative physical exposure (per million)	Vulnerability	Resilience	Risk configuration	Risk configuration (normalised)	Historic absolute displacement	Historic relative displacement (per million)
Malaysia	1,750	19.00	6.40	0.05	0.05	150,186.5	5,041

Figure 4.26: Absolute and relative population exposure to hazards: Malaysia



4.7 MYANMAR

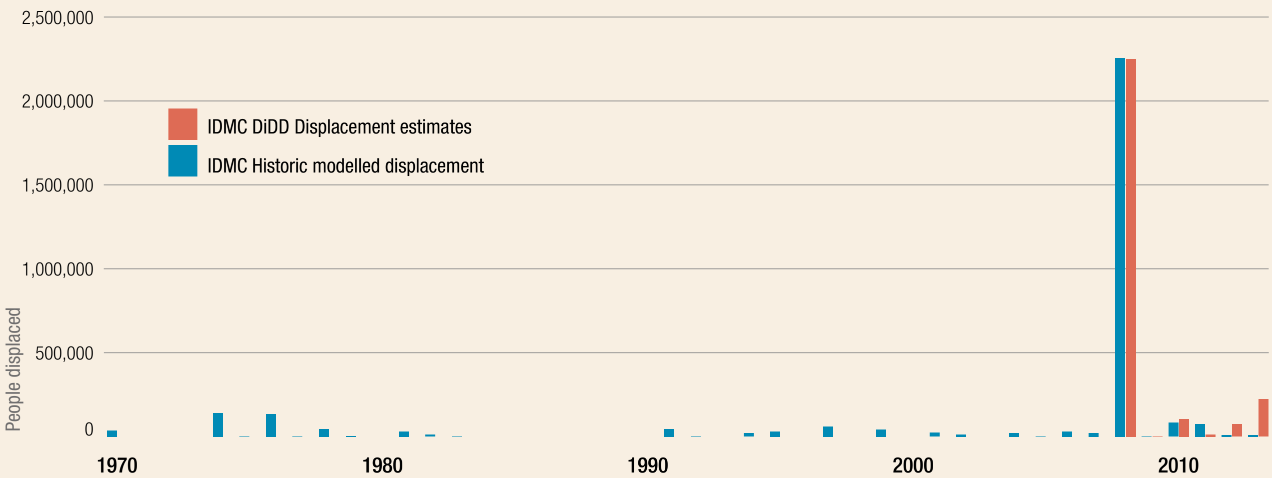
Figure 4.27: Myanmar (Source: UN OCHA)

Since 2010, the Republic of the Union of Myanmar has begun transforming from an authoritarian military regime to democratic government, from a centrally directed to a market economy and is seeking to resolve protracted internal armed conflicts, particularly along borders with Thailand and China. This has stimulated economic growth and encouraged other states to lift economic sanctions, as the country makes more effective use of its agricultural potential and natural resources.[74]

With a population of approximately 61 million people, Myanmar is divided into seven states and seven regions spread over 676,578 square kilometres, making it the second-largest country in mainland South-East Asia. It has one of the region's lowest population densities.

Myanmar is exposed to several hazards, including tropical cyclones, floods, rain-triggered landslides, earthquakes and wildfires. In 2008, Cyclone Nargis killed more than 138,000 people, making it the third-deadliest storm since 1900.[75] The storm, which deposited heavy rains on much of the country (Figure 4.29), also displaced 102,000 people[76] and it had a US$ 4.0 billion impact on the economy, having caused US$ 2.8 billion in damage and losses to the productive sector.[77]

Figure 4.28: Modelled historic displacement (1970-2013) & DiDD displacement estimates (2008-2013) for Myanmar



[74] World Bank, 2014. Myanmar overview. Washington, DC: The World Bank.

[75] EM-DAT: The OFDA/CRED International Disaster Database. Louvain, Belgium: Université catholique de Louvain.

[76] IDMC, 2011.

[77] ESCAP and UNISDR, 2012.

Figure 4.29: Path of Cyclone Nargis across Myanmar (Source: United Nations, Penn State University, University of Georgia-ITOS; and the Center for International Earth Science Information Network)

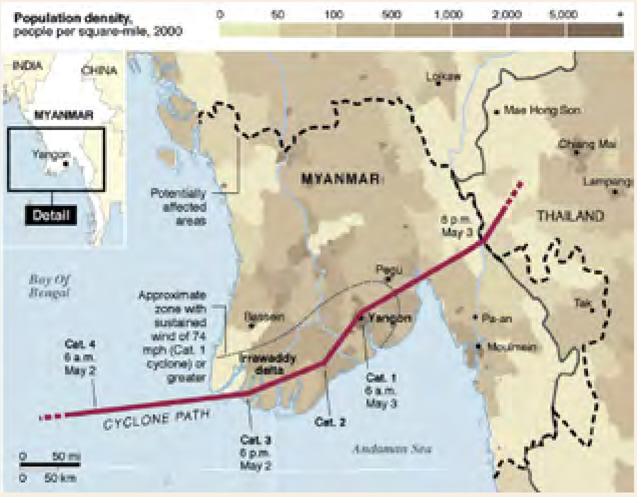
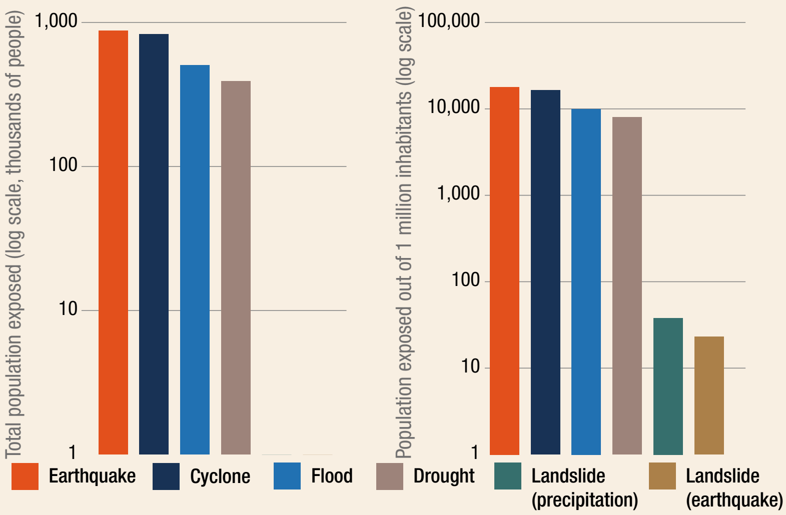


Figure 4.30: Disaster-induced displacement risk estimates: Myanmar

Disaster-induced displacement risk estimates					
		Magnitude		Magnitude	
Country	Population	Absolute - 2014-2018 average annual displacement (country total)	Regional rank	Relative - 2014-2018 average annual displacement (per million inhabitants)	Regional rank
Myanmar	49,154,371	26,655	9	542.3	8

	Displacement risk configuration					Historic displacement	
	Total relative physical exposure (per million)	Vulnerability	Resilience	Risk configuration	Risk configuration (normalised)	Historic absolute displacement	Historic relative displacement (per million)
Myanmar	52,340	27.00	3.01	4.70	0.07	24,879.5	506

Figure 4.31: Absolute and relative population exposure to hazards: Myanmar



4.8 PHILIPPINES

Figure 4.32: Philippines (Source: UN OCHA)

4.8.1 Displacement Risk Configuration

The Republic of the Philippines is an archipelago consisting of more than 7,100 islands (of which approximately 800 are inhabited), which are divided into three groups: Luzon, Visayas and Mindanao. The population was estimated to have reached 100 million in July 2014.[78] The country has 17 regions, one of which – the Autonomous Region in Muslim Mindanao – has its own elected assembly.

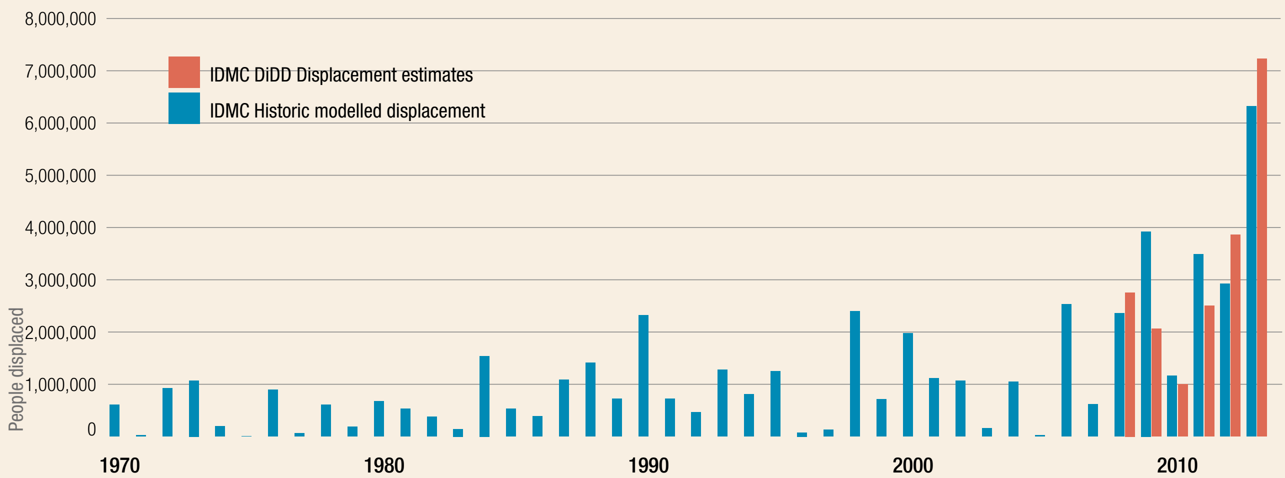
The Philippines is considered one of the nations most at risk of disasters due to its geographic location astride both the typhoon belt and the Ring of Fire; a high degree of ecological degradation and socio-economic vulnerability due to the large number of people and economic assets exposed to multiple recurring hazards such as cyclones, floods, earthquakes and landslides.

The Philippines has been ranked the tenth-most-vulnerable country to climate change based on an analysis of more than 40 social, economic and environmental factors. The capital, Manila, is ranked by the Climate Change Vulnerability Index (CCVI) as the second-most vulnerable to climate change of the world's 20 "high growth cities."[79] Filipinos are vulnerable due to conflict, unregulated and precarious settlement patterns and a reliance on agriculture, which have contributed to the country's multidimensional poverty: there are nearly million Filipinos whose poverty is characterised by low income, inadequate housing and poor access to education and health services.

In terms of disaster-related displacement, the Philippines has been one of the countries most affected. In 2013, the two largest disaster-induced displacement events both occurred in the Philippines. The larger, Typhoon Haiyan, displaced more Filipinos than were displaced by disasters in Africa, the Americas, Europe and Oceania combined in 2013.[80]

The explanations for the Philippines displacement trends are, again, large exposure and vulnerability (Table 4.2). Not only are large numbers of Filipinos exposed to these and other hazards, they are concentrated in the same places.

Figure 4.33: Modelled historic displacement (1970-2013) & DiDD displacement estimates (2008-2013) for Philippines



[78] United Nations Population Fund (UNFPA), 2014. 100M PH population an opportunity to invest in the future. Manila: United Nations Population Fund.

[79] Maplecroft, 2013. Climate Change Vulnerability Index (CCVI) 2013. Bath: Maplecroft.

[80] IDMC, 2014.

Table 4.2: Population exposed to multiple hazards in the Philippines

Hazard type	People exposed per year
Tropical cyclones	36.1 million
Floods	1.4 million
Earthquakes	12.2 million

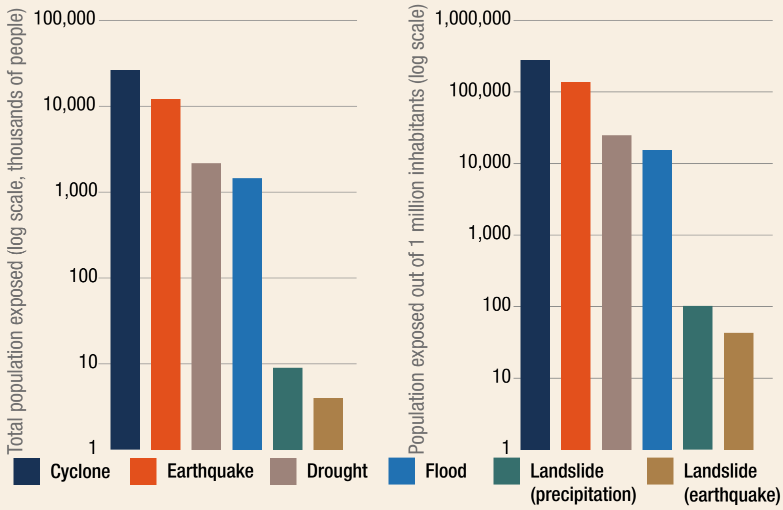
Source: UNEP/GRID-Geneva PREVIEW

Figure 4.34: Disaster-induced displacement risk estimates: Philippines

Disaster-induced displacement risk estimates					
		Magnitude		Magnitude	
Country	Population	Absolute - 2014-2018 average annual displacement (country total)	Regional rank	Relative - 2014-2018 average annual displacement (per million inhabitants)	Regional rank
Philippines	98,291,040	623,908	2	6,347.6	3

	Displacement risk configuration					Historic displacement	
	Total relative physical exposure (per million)	Vulnerability	Resilience	Risk configuration	Risk configuration (normalised)	Historic absolute displacement	Historic relative displacement (per million)
Philippines	459,517	19.00	4.70	18.58	0.13	549,926.1	5,595

Figure 4.35: Absolute and relative population exposure to hazards: Philippines



4.9 SINGAPORE

Figure 4.36: Singapore (Source: UN OCHA)

The Republic Singapore consists of one main island and several smaller islands located in the Johore Straits off Malaysia's southeast coast. With a population of 5.4 million and a total land area of 716 km^2, Singapore has a population density of 7,540 people per square kilometre – the second densest in the world.[81]

In terms of exposure to natural hazards, Singapore's primary concern is flooding linked to heavy precipitation events. Singapore receives abundant rainfall all year and extreme rainfall events have occurred in every month. In terms of flash flood risk, the largest single-day rainfall totals have occurred in November (198.6 mm), December (512.4 mm) and January (216.2 mm), though every single month has at least one recorded even of 100 mm within a 24-hour period.[82]

Despite Singapore's high population density and exposure to flooding, it has experienced the fewest disasters and the least amount of disaster-related displacement among the countries included in this report. This is due to Singapore's high development and low vulnerability to hazards. Most Singaporean householders are insured and building codes are robust. When floods occur, they primarily disrupt traffic rather than destroy buildings.

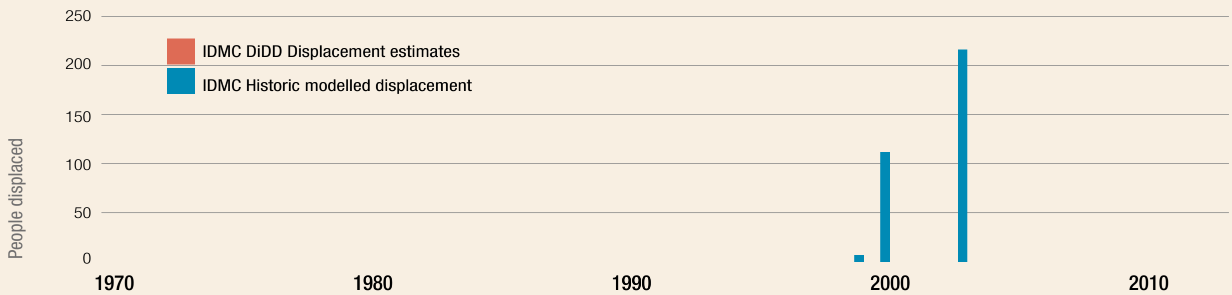
Due to Singapore's small population size and low vulnerability to natural hazards, there are only a few recorded disasters and scant evidence of disaster-related displacement over the past four decades. This small data set makes it difficult to estimate historic displacement and to analyse the underlying variables used in the risk model, such as physical exposure to hazards. We have included the risk estimates for Singapore, which are significantly below any reasonable threshold, to highlight this limitation. Figure 4.38 underscores this lack of data: for Singapore, IDMC's DiDD displacement estimate database does not contain a single entry, and the historic loss model only includes three very nominal entries over the 43-year sample used in the analysis.

Figure 4.37: Disaster-induced displacement risk estimates: Singapore

Disaster-induced displacement risk estimates					
		Magnitude		Magnitude	
Country	Population	Absolute - 2014-2018 average annual displacement (country total)	Regional rank	Relative - 2014-2018 average annual displacement (per million inhabitants)	Regional rank
Singapore	5,405,841	6	10	1.1	10

	Displacement risk configuration					Historic displacement	
	Total relative physical exposure (per million)	Vulnerability	Resilience	Risk configuration	Risk configuration (normalised)	Historic absolute displacement	Historic relative displacement (per million)
Singapore	904	22.00	4.68	0.04	0.05	5.9	1

Figure 4.38: Modelled historic displacement (1970-2013) & DiDD displacement estimates (2008-2013) for Singapore



81 Singapore Department of Statistics (DOS), 2014. Latest data. Government of Singapore Department of Statistics, 18 August 2014, Singapore; and World Bank, 2014. Population density (people per sq. km of land area). Washington, DC: The World Bank.

82 Singapore National Environment Agency (NEA), 2014. Weather statistics. Singapore: Government of Singapore National Environment Agency.

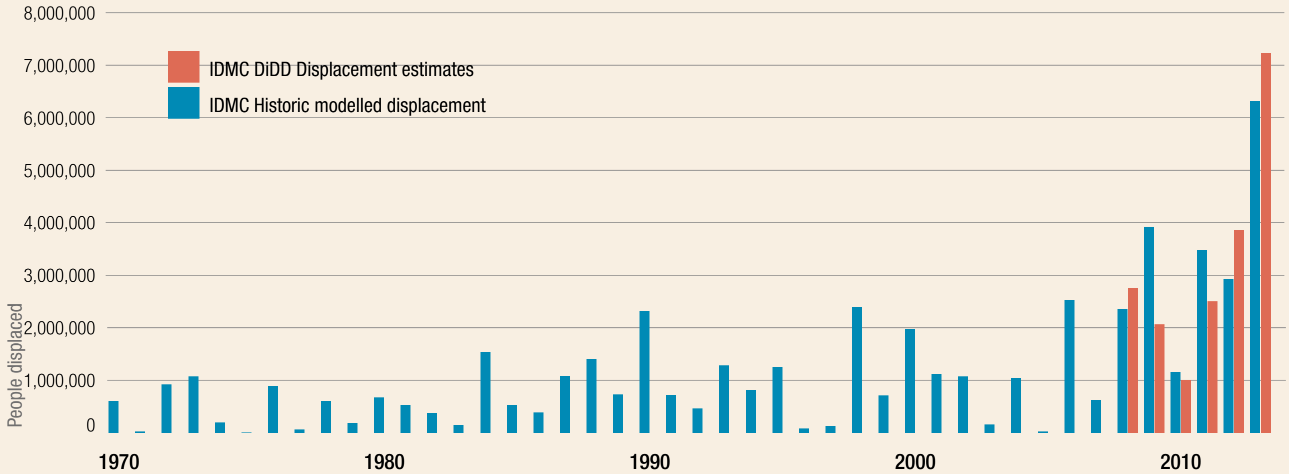
4.10 THAILAND

Figure 4.39: Thailand (Source: UN OCHA)

The Kingdom of Thailand is a constitutional monarchy. Its democratic parliamentary system has been interrupted by periods of martial law, the latest of which was declared in May 2014. Situated between the Gulf of Thailand and the Andaman Sea, Thailand is bordered by Myanmar, Lao PDR, Cambodia and Malaysia. It has 77 provinces covering 513,120 square kilometres[83] and a population of approximately 67.0 million people.[84]

Thailand is affected by floods, droughts and, to a lesser extent, storms, earthquakes and landslides. In 2010 and 2011, Thailand experienced two floods and a drought that rank as the three biggest disasters in the country's history in terms of people affected. The October 2010 floods displaced an estimated million people and the August 2011 flooding linked to Typhoon Nok Ten displaced 1.5 million.[85] Between July and October 2013, floods inundated 817,290 homes, affecting three million people in 47 provinces.[86] Most Thais exposed to flooding – some million people per annum – are concentrated in floodplains along the Chao Phraya River, where 40 per cent of the population lives (Figure 4.42).[87]

Figure 4.40: Modelled historic displacement (1970-2013) & DiDD displacement estimates (2008-2013) for Thailand.



83 UN Data, 2014. Thailand. New York: United Nations Statistics Division.

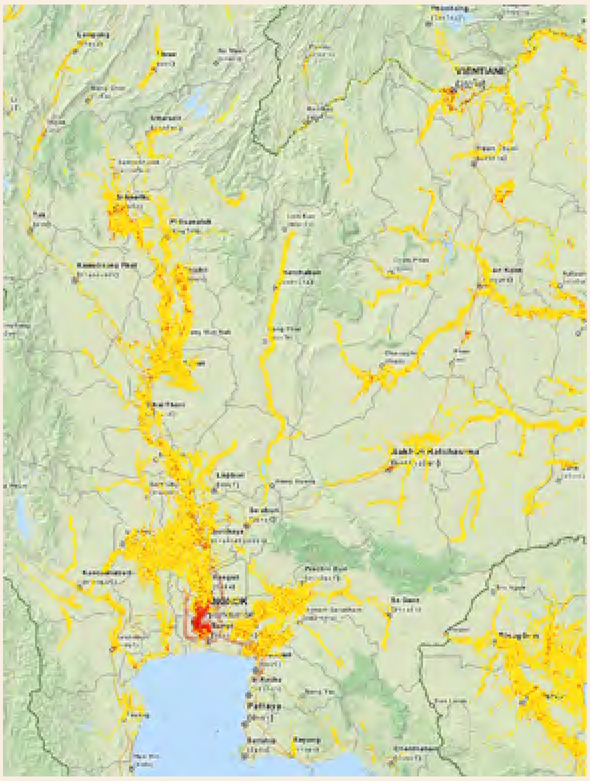
84 UNDP, 2014.

85 IDMC, 2011; and IDMC, 2012.

86 NNT, 2013a. Heavy rainfalls in 25 districts leave rice fields flooded. National News Bureau of Thailand, Bangkok, 1 October 2013; and NNT, 2013b. 47 provinces in total affected by flood this year. National News Bureau of Thailand, Bangkok, 25 October 2013.

87 ESCAP and UNISDR, 2012; and UNEP/GRID-Geneva PREVIEW, 2011.

Figure 4.41: Population exposed to flooding in central Thailand



- Less than 30 (people/year)
- 30 - 100 (people/year)
- 100 - 300 (people/year)
- 300 - 1,000 (people/year)
- More than 1,000 (people/year)
- X No data

Source: UNEP/GRID-Geneva PREVIEW

Figure 4.42: Disaster-induced displacement risk estimates: Thailand

Disaster-induced displacement risk estimates					
		Magnitude		**Magnitude**	
Country	**Population**	**Absolute - 2014-2018 average annual displacement (country total)**	**Regional rank**	**Relative - 2014-2018 average annual displacement (per million inhabitants)**	**Regional rank**
Thailand	70,148,844	374,837	3	5,343.5	4

	Displacement risk configuration					Historic displacement	
	Total relative physical exposure (per million)	Vulnerability	Resilience	Risk configuration	Risk configuration (normalised)	Historic absolute displacement	Historic relative displacement (per million)
Thailand	53,762	23.00	5.60	2.21	0.06	353,608.4	5,041

4.11 VIETNAM

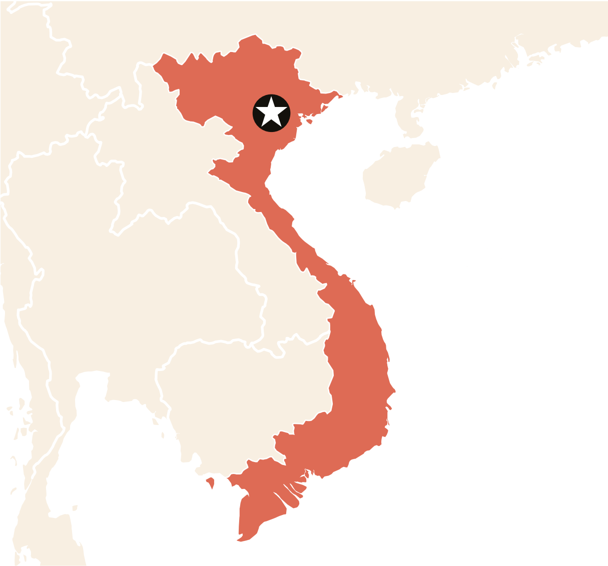


Figure 4.43: Vietnam (Source: UN OCHA)

4.11.1 Displacement Risk Configuration

The Socialist Republic of Vietnam is, like China and Lao PDR, a single-party communist state. Vietnam is bordered by China on the north, by Lao PDR and Cambodia on the west and the South China Sea to the east and south. Vietnam is divided into 58 provinces and five municipalities, covering 331,000 square kilometres, and its population is estimated to be 89 million people.[88]

Like China, Vietnam began to liberalise its economy in the mid-1980s, beginning with a series of reforms called Doi Moi. Since 1980, Vietnam's per capita income has increased by an average of more than ten per cent per year, with development rising most quickly during the 1990s.[89] As quickly as Vietnam has developed, it nevertheless lags behind China and its South-East Asian neighbours in several areas, and income inequality continues to be a challenge.[90]

Since IDMC began monitoring disaster-related displacement more people have been displaced in relation to disasters in Vietnam than in the United States. This is despite the fact that the US population is 3.5 times greater than that of Vietnam.[91]

Vietnam is exposed to tropical cyclones, floods and rain-triggered landslides and, to a lesser extent, droughts, earthquakes and landslides resulting from earthquakes. Most disaster-related displacement in Vietnam has been linked to heavy precipitation events. In 2008, floods submerged thousands of homes in the southern part of the country, highlighting exposure to riparian flood risk in the Mekong River delta (Figure 4.45).

In September 2009, flooding displaced approximately 109,000 people, in August 2010, floods and rain-triggered displaced an estimated 242,000 people.[92] In 2011, Typhoon Nok Ten damaged or destroyed 175,000 homes as well as 99,000 hectares of agricultural land, leaving some 200,000 displaced.[93]

In 2013, Vietnam experienced three disasters that displaced at least 100,000 people. In late September and early October, flooding displaced 106,000 people, more flooding in mid-October displaced 109,000 additional people and in November, flooding linked to Typhoon Haiyan resulted in 800,000 Vietnamese being displaced.[94] All three floods occurred in the central part of the country, where the largest number of people is exposed, with some provinces being affected twice in eight weeks (Figure 4.46).

88 General Statistics Office of Vietnam, 2014. Land use (As of 1 January 2012). Ha Noi: Government of Vietnam.

89 UNDP, 2014.

90 Ibid.

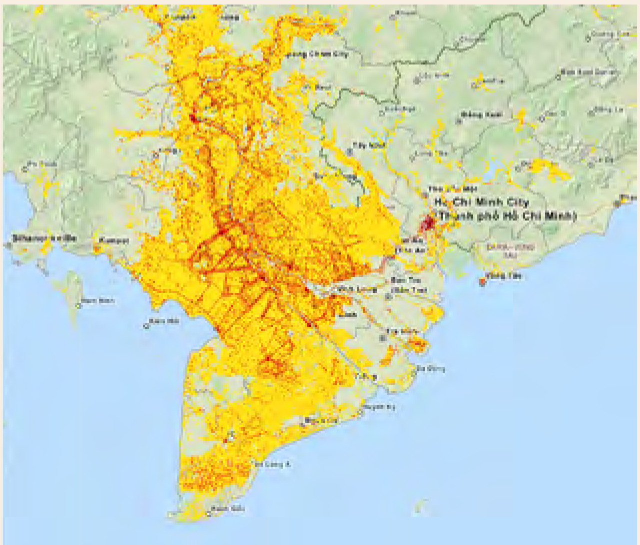
91 Based upon analysis of IDMC-collected figures from 2008 – 2013.

92 IDMC, 2011.

93 IDMC, 2012; and ESCAP and UNISDR, 2012.

94 IDMC, 2014.

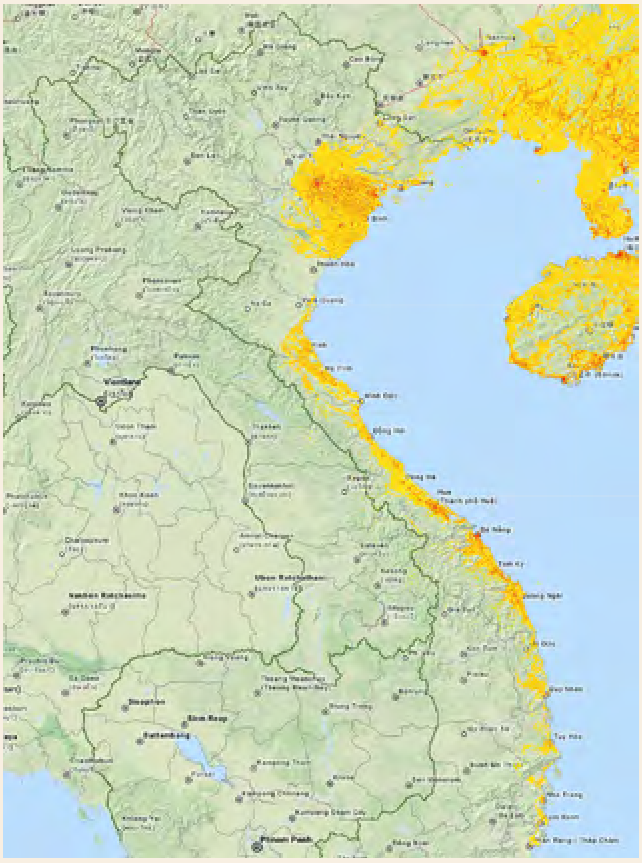
Figure 4.44: Population exposed to flooding in the Mekong River delta



- Less than 30 (people/year)
- 30 - 100 (people/year)
- 100 - 300 (people/year)
- 300 - 1,000 (people/year)
- More than 1,000 (people/year)
- X No data

Source: UNEP/GRID-Geneva PREVIEW

Figure 4.45: Population exposed to storms in central and northern Vietnam



- Less than 10 (people/year)
- 10 - 100 (people/year)
- 100 - 1,000 (people/year)
- 1,000 - 10,000 (people/year)
- More than 10,000 (people/year)
- X No data

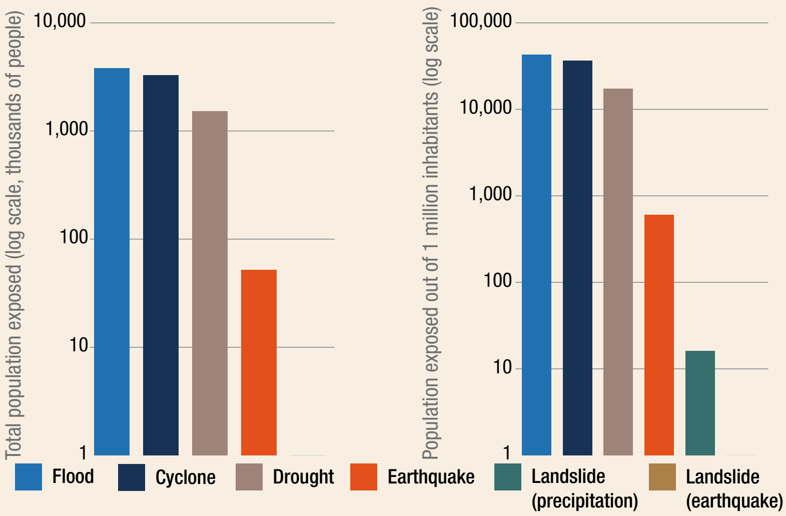
Source: UNEP/GRID-Geneva PREVIEW

Figure 4.46: Disaster-induced displacement risk estimates: Vietnam

Disaster-induced displacement risk estimates					
		Magnitude		Magnitude	
Country	Population	Absolute - 2014-2018 average annual displacement (country total)	Regional rank	Relative - 2014-2018 average annual displacement (per million inhabitants)	Regional rank
Vietnam	90,657,099	365,432	4	4,030.9	6

	Displacement risk configuration					Historic displacement	
	Total relative physical exposure (per million)	Vulnerability	Resilience	Risk configuration	Risk configuration (normalised)	Historic absolute displacement	Historic relative displacement (per million)
Vietnam	153,677	211.00	4.92	65.92	0.35	270,690.3	2,986

Figure 4.47: Absolute and relative population exposure to hazards: Vietnam



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KEY TERMINOLOGY

The following terms are all highly relevant for this paper. Definitions are provided for the benefit of those not already familiar with the common lexicon of disaster and climate change risk management. For further information on these terms and the underlying concepts, please refer to: UNISDR (2009) *Terminology on Disaster Risk Reduction*[95]; UNISDR (2013) *Global Assessment Report*[96]; IPCC (2012) *SREX*[97] and the *Hyogo Framework for Action* (2005).[98]

The following terminology lays out the basic framework for disaster risk, its human displacement component, the constituent elements of disaster risk assessment, analysis and reduction and human displacement risk:

Disaster

"A serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources." – ISDR (2009)

This project uses the Disaster Typology used by IDMC to categorise disasters into 'rapid' and 'slow' onset; see figure #7.1.

Climate change

"A change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings, or to persistent anthropogenic changes in the composition of the atmosphere or in land use." – IPCC (2012)

"The IPCC definition can be paraphrased for popular communications as 'A change in the climate that persists for decades or longer, arising from either natural causes or human activity.'" – ISDR (2009)

Human Displacement

"Displacement addressed in this report is a result of the threat and impact of disasters. It also increases the risk of future disasters and further displacement. Being displaced puts people at a higher risk of impoverishment and human rights abuses, creating new concerns and exacerbating pre-existing vulnerability. This is especially true where homes and livelihoods are destroyed and where displacement is recurrent or remains unresolved for prolonged periods of time… The non-voluntary nature of the movement is central to the definition of displacement." -- IDMC (2013)

Risk

"The combination of the probability of an event and its negative consequences. This definition closely follows the definition of the ISO/IEC Guide 73. The word "risk" has two distinctive connotations: in popular usage the emphasis is usually placed on the concept of chance or possibility, such as in "the risk of an accident"; whereas in technical settings the emphasis is usually placed on the consequences, in terms of "potential losses" for some particular cause, place and period. It can be noted that people do not necessarily share the same perceptions of the significance and underlying causes of different risks." – ISDR (2009)

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95 See: http://www.preventionweb.net/english/professional/publications/v.php?id=7817&utm_source=pw_search&utm_medium=search&utm_campaign=search

96 See: http://www.preventionweb.net/english/hyogo/gar/2013/en/home/index.html

97 See: http://ipcc-wg2.gov/SREX/

98 See: http://www.unisdr.org/2005/wcdr/intergover/official-doc/L-docs/Hyogo-framework-for-action-english.pdf

Figure 7.1: Typology of natural hazards

	Geophysical	Meteorological	Hydrological	Climatological
		Weather and climate-related		
Events/shocks (rapid-onset)	**Earthquakes:** ground shaking, fault ruptures, landslides, liquefaction, subsidence, tsunamis and flooding	**Storms:** tropical storms (cyclones, hurricanes and typhoons), extra-tropical/winter storms, local storms (tornadoes, blizzards and snow storms, sand storms, hail storms, lightning)	**Floods:** land-borne or riverine floods (caused by heavy rains, snow melt, and breaking of banks), sea-borne or coastal floods (caused by storm surges and breaking of levees), flash floods (caused by snow melt run-off, dam bursts and sudden water release)	**Wildfires:** brush, forest, grass and savannah
	Volcanic eruptions: explosive or effusive, lava flows and mud flows, falling ash and projectiles, toxic gases, floods, landslides and local tsunamis		**Wet mass movements:** landslides, avalanches and sudden subsidence	**Extreme temperature:** cold snaps and extreme winter conditions, heat waves
	Dry mass movements: rock falls, landslides, avalanches, sudden subsidence and sink holes			
Processes/ stressors (slow-onset)	Long-lasting subsidence		Coastal erosion	Drought
				Desertification

This table provides a non-exhaustive list of the types of hazards included in IDMC's displacement estimates and historical trend model. They are those loosely classified as rapid-onset events, shocks or triggers of displacement. This list also mentions some of those hazards not included, in particular drought. Specific hazards are often part of a series of sub-events that may take place over hours or months as part of a disaster, such as aftershocks and other secondary hazards that follow a major earthquake, or floods and landslides during or after a period of heavy rainfall. Classification for the purpose of this report refers to the original or primary hazard that triggered the disaster and displacement.

Categories are based on the classification system used by the International Disaster Database (EM-DAT), maintained by the Centre for Research on the Epidemiology of Disasters (CRED) in Brussels.

Disaster risk

"*The potential disaster losses, in lives, health status, livelihoods, assets and services, which could occur to a particular community or a society over some specified future time period. The definition of disaster risk reflects the concept of disasters as the outcome of continuously present conditions of risk. Disaster risk comprises different types of potential losses which are often difficult to quantify. Nevertheless, with knowledge of the prevailing hazards and the patterns of population and socio-economic development, disaster risks can be assessed and mapped, in broad terms at least.*" – ISDR (2009)

Probabilistic Risk Analysis

"*In its simplest form, probabilistic risk analysis defines risk as the product of the probability that some event (or sequence) will occur and the adverse consequences of that event [i.e. expressed by the equation Risk = Probability x Consequence]. This likelihood is multiplied by the value people place on those casualties and economic disruption… [For Disaster Risk] All three factors – hazard, exposure, and vulnerability – contribute to 'consequences.' Hazard and vulnerability can both contribute to the 'probability': the former to the likelihood of the physical event (e.g., the river flooding the town) and the latter to the likelihood of the consequence resulting from the event (e.g., casualties and economic disruption).*

In [disaster risk reduction] practice, probabilistic risk analysis is often not implemented in its pure form for reasons including data limitations; decision rules that yield satisfactory results with less effort than that required by a full probabilistic risk assessment; the irreducible imprecision of some estimates of important probabilities and consequences; and the need to address the wide range of factors that affect judgments about risk." - IPCC (2012).

Risk assessment

"*A methodology to determine the nature and extent of risk by analyzing potential hazards and evaluating existing conditions of vulnerability that together could potentially harm exposed people, property, services, livelihoods and the environment on which they depend.*

Risk assessments (and associated risk mapping) include: a review of the technical characteristics of hazards such as their location, intensity, frequency and probability; the analysis of exposure and vulnerability including the physical social, health, economic and environmental dimensions; and the evaluation of the effectiveness of prevailing and alternative coping capacities in respect to likely risk scenarios. This series of activities is sometimes known as a risk analysis process." – ISDR (2009)

Hazard

" A dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage. The hazards of concern to disaster risk reduction as stated in footnote 3 of the Hyogo Framework are "… hazards of natural origin and related environmental and technological hazards and risks." Such hazards arise from a variety of geological, meteorological, hydrological, oceanic, biological, and technological sources, sometimes acting in combination. In technical settings, hazards are described quantitatively by the likely frequency of occurrence of different intensities for different areas, as determined from historical data or scientific analysis." – ISDR (2009)

Exposure

"People, property, systems, or other elements present in hazard zones that are thereby subject to potential losses. Measures of exposure can include the number of people or types of assets in an area. These can be combined with the specific vulnerability of the exposed elements to any particular hazard to estimate the quantitative risks associated with that hazard in the area of interest." – ISDR (2009)

Vulnerability

"The characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard. There are many aspects of vulnerability, arising from various physical, social, economic, and environmental factors. Examples may include poor design and construction of buildings, inadequate protection of assets, lack of public information and awareness, limited official recognition of risks and preparedness measures, and disregard for wise environmental management. Vulnerability varies significantly within a community and over time. This definition identifies vulnerability as a characteristic of the element of interest (community, system or asset) which is independent of its exposure. However, in common use the word is often used more broadly to include the element's exposure." – ISDR (2009)

Resilience

"The ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions." -- ISDR (2009); IPCC (2012)

"Resilience means the ability to "resile from" or "spring back from" a shock. The resilience of a community in respect to potential hazard events is determined by the degree to which the community has the necessary resources and is capable of organizing itself both prior to and during times of need." – ISDR (2009)

Capacity

"Capacity refers to the combination of all the strengths, attributes, and resources available to an individual, community, society, or organization that can be used to achieve established goals. This includes the conditions and characteristics that permit society at large (institutions, local groups, individuals, etc.) access to and use of social, economic, psychological, cultural, and livelihood-related natural resources, as well as access to the information and the institutions of governance necessary to reduce vulnerability and deal with the consequences of disaster. This definition extends the definition of capabilities referred to in Sen's 'capabilities approach to development' (Sen, 1983)." -- IPCC (2012)

Extensive Risk

"The widespread risk associated with the exposure of dispersed populations to repeated or persistent hazard conditions of low or moderate intensity, often of a highly localized nature, which can lead to debilitating cumulative disaster impacts. Extensive risk is mainly a characteristic of rural areas and urban margins where communities are exposed to, and vulnerable to, recurring localised floods, landslides storms or drought. Extensive risk is often associated with poverty, urbanization and environmental degradation." ISDR (2009)

Intensive Risk

"The risk associated with the exposure of large concentrations of people and economic activities to intense hazard events, which can lead to potentially catastrophic disaster impacts involving high mortality and asset loss. Intensive risk is mainly a characteristic of large cities or densely populated areas that are not only exposed to intense hazards such as strong earthquakes, active volcanoes, heavy floods, tsunamis, or major storms but also have high levels of vulnerability to these hazards." ISDR (2009)

DISASTERS
CLIMATE CHANGE AND
DISPLACEMENT

EVIDENCE FOR ACTION

This is a multi-partner project funded by the European Commission (EC) whose overall aim is to address a legal gap regarding cross-border displacement in the context of disasters. The project brings together the expertise of 3 distinct partners (UNHCR, NRC/IDMC and the Nansen Initiative) seeking to:

1 › **increase the understanding** of States and relevant actors in the international community about displacement related to disasters and climate change;

2 › **equip them to plan for and manage** internal relocations of populations in a protection sensitive manner; and

3 › **provide States and other relevant actors tools and guidance** to protect persons who cross international borders owing to disasters, including those linked to climate change.

iDMC internal displacement monitoring centre

Internal Displacement Monitoring Centre
Norwegian Refugee Council
Chemin de Balexert 7-9
CH-1219 Châtelaine (Geneva), Switzerland

www.internal-displacement.org

NORWEGIAN MINISTRY OF FOREIGN AFFAIRS

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Agency for Development and Cooperation SDC