University of HUDDERSFIELD
Inspiring global professionals

Integrating education with consumer behaviour relevant to energy efficiency and climate change at the Universities of Europe, Russia, Sri Lanka, and Bangladesh (BECK)

Co-funded by the Erasmus+ Programme of the European Union

Research Degrees in Affiliated Research Centres

Offered by:

Global Disaster Resilience Centre,

School of Applied Sciences, University of Huddersfield – United Kingdom

Module Handbook – 2020-2021

Massive Open Online Course (MOOC) – PhD Module:

Disaster risk management, climate change and development

This handbook introduces the key information and the syllabus outline of the mentioned module.

This handbook has been prepared by the Global Disaster Resilience Centre (GDRC) in University of Huddersfield and BECK Centre under the EU Erasmus+ BECK Project.

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BECK – PhD MOOC Modules

Development of New Adaptive MOOC modules on Consumer's Behaviour Related to Energy Efficiency and Climate Change

Description

The aim of the BECK project is to create a suitable basis for education in the field consumer's behaviour related to energy efficiency and climate change in the built environment (BECK) by introducing integrated, multidisciplinary BSc, MSc, and PhD adaptive, recognised, and certificated MOOC modules to existing study programmes in European, Russian, Sri Lanka and Bangladesh universities.

Accordingly, the Global Disaster Resilience Centre (GDRC) of University of Huddersfield as one of the project partners has developed the following PhD MOOC Module adhering to the themes and guidelines of the project.

Disaster risk management, climate change and development (PhD Module)

The PhD programme is available with the GDRC to be open accessed via online.

GDRC Directors:
Professor Dilanthi Amaratunga / Professor Richard Haigh
d.amaratunga@hud.ac.uk / r.haigh@hud.ac.uk

Global Disaster Resilience Centre
Department of Biological and Geographic Sciences, School of Applied Sciences,
University of Huddersfield
Queensgate, Huddersfield HD1 3DH, UK
www.hud.ac.ak/gdrc

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1 Introduction

1.1 Integrating education with consumer behaviour relevant to energy efficiency and climate change at the Universities of Russia, Sri Lanka, and Bangladesh (BECK)

http://beck-erasmus.com/

Climate change is a result of modern human lifestyles and activities and leads to extreme weather events, such as storms, flooding, droughts, and heat waves. One of the possible solutions to these problems is the improvement of education on consumer behaviour related to energy efficiency and climate change. The main challenge is to consolidate a variety of diverse activities in education quality improvement, such as the delivery of extensive educational programmes and capacity building, the continued knowledge sharing, etc. To progress on these efforts, it is necessary to build the capacity and an associated network of experts and institutions.

Wider objective of the project is to upgrade the curricula with the 24 new harmonized study MOOC modules on consumer behaviour related to energy efficiency and climate change at the universities of Europe, Russia, Sri Lanka, and Bangladesh to increase their capacity to continually modernise, enhance the quality and relevance of education of students to the global labour market needs and to ensure international cooperation.

Main objectives of the BECK project:

1. To upgrade curricula to improve their quality for BSc/specialists, MSc, and PhD students by adding 24 new, harmonized, and standardized study MOOC modules on consumer behavior related to energy efficiency and climate change (BECK) at the universities of Russia, Sri Lanka, and Bangladesh (PC universities henceforth), to enhance the quality and relevance of education in PC and EU universities to global issues.
2. To transfer European practices in education (learning and teaching tools, methodologies and pedagogical approaches including learning outcomes and ICT-based practices) from participating EU universities to PC universities.
3. To assist competence development of teachers within PC universities.
4. To develop the Simulated Big Data Interuniversity Networked Affective Educational Centre to encourage use of ICT-based methodologies in education and research.
5. To strengthen educational and scientific networking among EU and PC universities in the BECK field.

The project in general terms also will spread and promote the awareness in the Partner Countries related to the EU policies referred to Energy Efficiency and Climate Change approach towards EU best practices, with specific reference to the “Environmental & Energy 20-20-20 targets”. The dissemination of the benefits of the curricular reform all over other HEIs will be performed as well.

GDRC, UoH according to the adopted Capacity Needs Assessment Methodology (CAPNAM) for Planning and Managing Education (United Nations 2013) has developed 2 PhD programmes under the climate change adaptation theme. The recognised and certificated MOOC module specifications and teaching materials are available for open access in the GDRC, UoH website.

2 Module Programmes and Qualifications

Doctor of Philosophy (PhD) (full or part-time)

2.1 Disaster risk management, climate change and development (PhD MOOC Module)

2.1.1 Aim of the module:

To explore the approaches and applications about climate change and the risk associated with unmanaged urban development.

Climate change-related risks, including weather induced natural disasters, are the result of a complex interdependency among natural hazards, like storm and flood conditions, and exposure of assets and their vulnerability, susceptibility to damage. While climate change increases the frequency and intensity of natural hazards, the exposure and vulnerability are determined by socio-economic development and human decision-making.

Disaster risk management needs a holistic view across the disciplines that consider various drivers of risk, and mitigation options ranging from structural measures to emergency management and risk transfer. Further, it requires a variety of approaches for the assessment of risk and evaluation of options, incorporating the methods from natural sciences, engineering, economics, ecology, and social sciences. An important basis of successful risk management lies in the application of an assessment of risk, and the analysis of risk management options within different stakeholders to identify economically optimal strategies.

The PhD programme on “Disaster risk management, climate change and development” will discuss a holistic view to the climate change associated risks in rapid unmanaged urban development.

2.1.2 Intended learning outcomes and assessment

Learning Outcomes of the course	Methods of studies	Assessment methods of student achievements	Assessment criteria of student achievements by assessment levels
1. Demonstrate knowledge and understanding in the field of climate change, weak governance, urbanization, growing population, eco system decline, poverty, displacement etc.	Background study Literature review Refer to primary & secondary data sources	Supervision monitoring Proposal submission	Supervisor review. Recommend submit / submitting after revisions Recommend training & skill development programmes
2. Demonstrate the ability to identify and formulate researchable issues with environmental and social science aspects which influence disaster risk reduction and urbanization (including geographical, political, economic, anthropological understandings).	Literature synthesis Problem framing Formulating aims & objectives	Supervision monitoring Progress monitoring – 1 (Report & Viva)	Supervisor review. Recommend submit / submitting after revisions Examiner’s review. Approve for the next stage Resub. of report Resub. of report & viva Transfer to M.Phil. Fail
3. Demonstrate competence in scholarly analysis, case studies and synthesis while assessing related phenomena, issues, and situations.	Identification of. Research approach Research strategies Research choice	Supervision monitoring	Supervisor review. Recommend submit / submitting after revisions

			Recommend training & skill development programmes
4. Evaluate the findings to generate new knowledge on common approaches to disaster risk reduction, including the problems and critiques associated with disaster prevention, mitigation, preparedness, response, and recovery in both industrialized and developing countries.	Research techniques for. Data collection Data analysis	Supervision monitoring Progress monitoring – 2 (Report & Viva)	Supervisor review. Recommend submit / submitting after revisions Examiner's review. Approve for the next stage Resub. of report Resub. of report & viva Transfer to M.Phil. Fail
5. Provide solutions to complex problems / contribute original knowledge including academic and professional/transferable skills of disaster risk reduction and urbanization, along with implications and limitations of research findings on this subject.	Methods of. Data collection Data analysis	Supervision monitoring Final report submission and viva	Supervisor review. Recommend submit / submitting after revisions Examiner's review: Accepted (Ph.D. offered / editorial changes / resub. minor changes up to 3 months / resub. major changes up to 6-12 months) Transfer to M.Phil./ Fail

2.1.3 Syllabus outline

1. Trends in disaster risk
2. Drivers of disaster risk
3. Disaster management and risk governance
4. Disaster risk reduction policy agenda
5. Convergence of disaster risk, climate change and development agendas
6. Case studies
7. Reading materials

1. Trends in disaster risk

The students are expected to comprehend the knowledge regarding the prevailing trends in the disaster risk and consequent impact. Specifically, in the fields of climate change, weak governance, urbanization, growing population, eco system decline, poverty, displacement etc which are identified as the key drives of disaster risk [1-5]. Disaster risk can be measured by analysing trends of previous disaster impacts. These trends can indicate if disaster risk reduction is being effective. Based on these trends, future losses of disaster impacts can be estimated by conducting a risk assessment.

I. Disaster risk

Disasters are considered shocks caused by extreme geophysical, hydrological, meteorological, climatological, biological, and extra-terrestrial causes. However, disaster risk results from the interaction between development process that generate conditions of exposure, vulnerability, and hazard. Disaster risk is therefore considered as the combination of the severity and frequency of a hazard, the numbers of people and assets exposed to the hazard, and their vulnerability to damage [6]. The disaster risk is classified into two categories based on its probability and impact (Figure 1).

a. Intensive risk

Intensive disaster risk refers to the risk associated with high-severity, mid to low-frequency disasters (earthquakes, tsunamis, large volcanic eruptions, flooding in large river basins or tropical cyclones). Intensive risk is comprised of 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 [7].

b. Extensive risk

Extensive risk refers to the risk associated with low severity, high-frequency (persistent) events, mainly but not exclusively associated with highly localized weather-related hazards (flash floods, storms, fires, and agricultural and water-related drought).

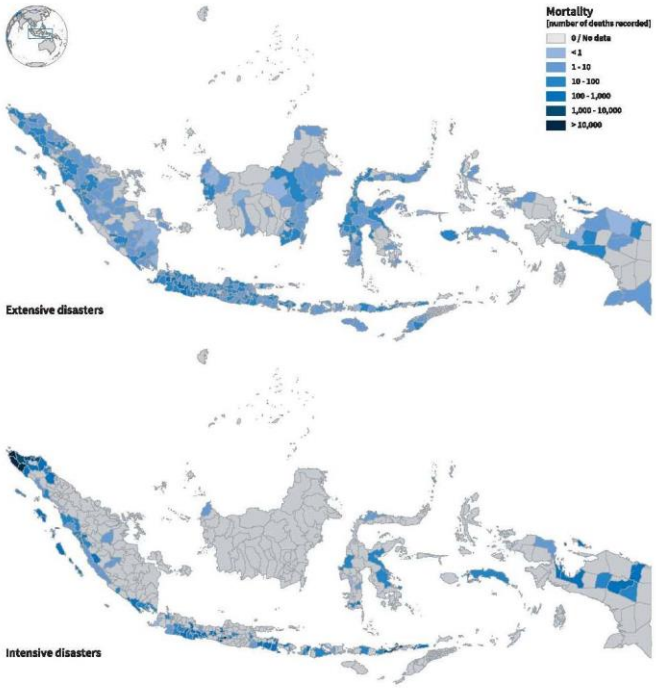


Figure 1: The different footprints of extensive vs intensive disaster loss in Indonesia, 1990-2013 (Source: UNISDR. 2016)

Following are the essential inherent characteristics when studying the disaster risk.

- Forward looking: the likelihood of loss of life, destruction, and damage in each period.
- Dynamic: increase or decrease according to the ability to reduce vulnerability.
- Invisible: comprised of not only the threat of high-impact events, but also the frequent, low-impact events that are often hidden.
- Unevenly distributed around the earth: hazards affect different areas, but the pattern of disaster risk reflects the social construction of exposure and vulnerability in different countries.
- Emergent and complex: many processes, including climate change and globalized economic development, are creating new, interconnected risks.

Analysing trends of disaster risk helps to estimate the future impact of disaster events. The trend of any disaster risk demonstrates the fluctuation of the risk and can be used to interpret the frequency of the disaster event, anticipated losses and cascading effects that may cause during the disaster and post disaster period. The disaster trends interpretation can support the DRR (Disaster Risk Reduction) policy and practice initiatives. However, comprehending the up-to-date disaster risk trends and determining the statistical significance of the trend is important in the study of disaster risk assessment as the accuracy of these interpretations largely depend on the amount, quality and reliability of the data being gathered.

II. Components of risk assessment

The key to assess disaster risk is by recognizing that disasters are triggered by haphazard nature of development, excessive rate of resource consumption and related cascading effects.

"Risk assessments need to account for temporal and spatial changes in hazard, exposure, and vulnerability, particularly in rapidly urbanizing areas or where climate change impacts will be felt the most (Figure 2). A risk assessment that provides an estimation of evolving or future risk is a way to engage stakeholders in carrying out actions now to avoid or mitigate the risk that is accumulating in their city or country [8]".

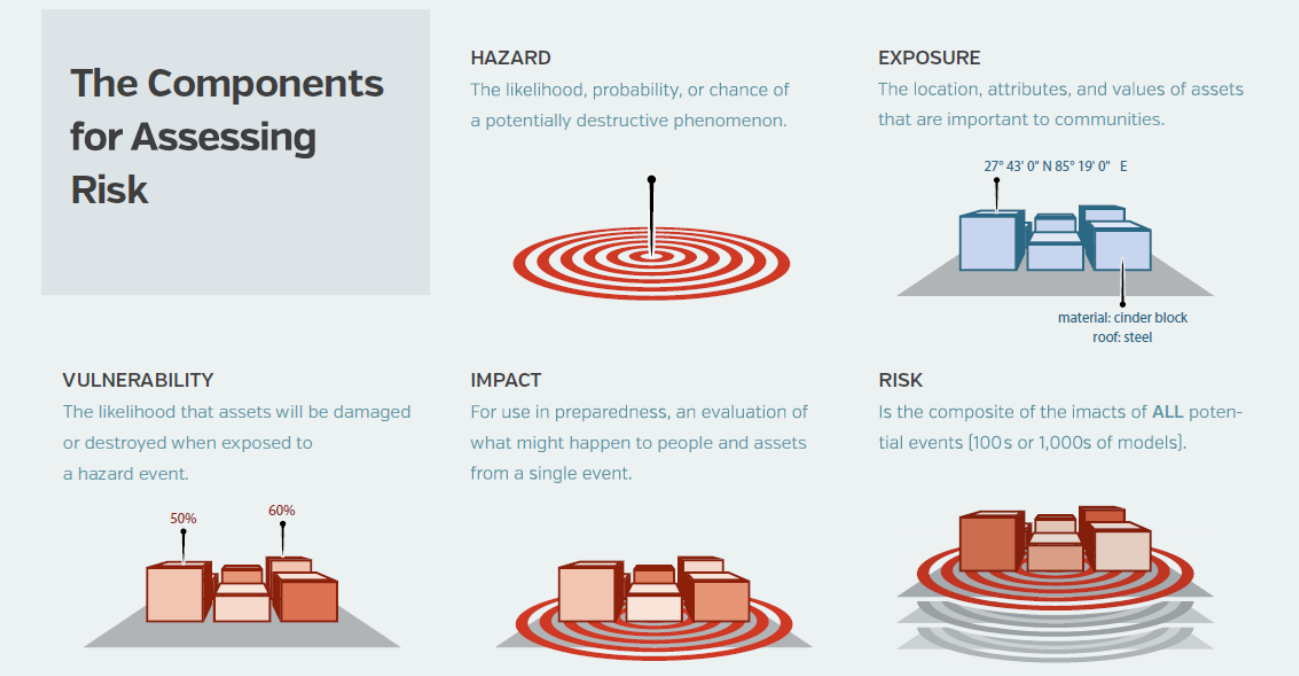
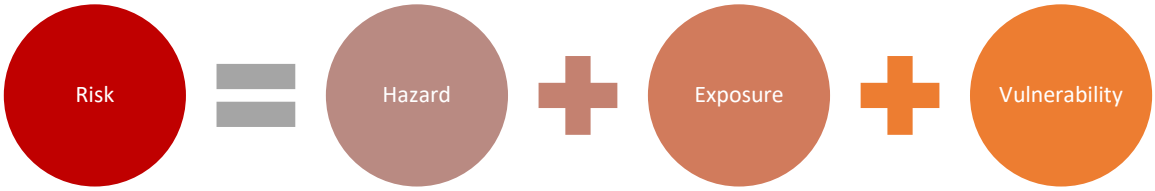


Figure 2: The components for assessing risk (Source: World Bank 2014)



Hazard *refers to the likelihood and intensity of a potentially destructive natural phenomenon, such as ground shaking induced by an earthquake or wind speed associated with a cyclone. Climate change and climate variability contribute to the evolution of hazard by altering the frequency, intensity, seasonality, and geographic coverage of these phenomena.*

Exposure *refers to the location, attributes, and value of important community assets that are exposed to the hazard, such as people, buildings, agricultural land, and infrastructure. Population growth, urbanization, and socioeconomic development drive the evolution of exposure, and have been the primary driver of disaster losses in recent decades.*

Vulnerability *is the potential extent to which physical, social, economic, and environmental assets may become damaged or disrupted when exposed to a hazard event. Physical vulnerability refers to the level of damage sustained by built structures due to the physical load imparted by a hazard event. Socioeconomic or social vulnerability refers to factors such as livelihood, social connections, and gender, which influence a community's ability to respond to, cope with, and recover from a disaster.*

Understanding disaster risk requires not only consider the hazard, exposure, and vulnerability but also society's capacity to protect themselves from disasters. The ability of communities, societies, and systems to resist, absorb, accommodate, recover from disasters, whilst at the same time improve wellbeing, is known as resilience. Disaster risk is a measure of the sustainability of development. Hazard, vulnerability, and exposure are influenced by several risk drivers, including poverty and inequality, badly planned and managed urban and regional development, climate change and environmental degradation. For example, risk assessment offers

an opportunity to quantify the change in future risk that arises from better enforcement of DRR measures, and hence to demonstrate the benefit of spending additional funds on DRR enforcement.

III. Identifying the future of risk and policy actions for building resilience

The three components of the disaster risk are influenced by various factors. Development intervention upon these factors can result in increased future risk or reduced future risk (Figure 3) [2, 9]. Past development trend has already caused for excessive climate change and has increased the disaster risk; however, decisions being taken today can still reduce the disaster risk in the future. By promoting actions that reduce risk and avoiding maladaptive actions that increase risk, the future disaster risk can be reduced. The drivers of future risk are within the control of decision makers today. The key factors in which policies can influence the evolution of disaster risk are climate change mitigation, management of land-use change due to urban expansion and changing socioeconomic activity, construction practices, ecosystem-based risk management, better planning of reconstruction, and targeted data collection to further improve risk modelling.

These factors can be used to quantify the present and future risk to support effective policy and planning decision making to reduce future risk. Disaster risk assessment for understanding risk in terms of expected population affected or losses incurred underpins disaster risk management (DRM) activities. The DRM influence the investment and planning of risk reduction activities, based on the dynamic nature of hazard, exposure, and vulnerability of the area. The ability to compare the two sets of results, including the business-as-usual scenario and DRR intervened scenario enables the risk management specialists to demonstrate how policy actions taken now and soon could affect the risk environment in the medium to long term.

Risk assessment must account for the evolution of risk by considering information that represents risk factors at different time periods in the past and include projections of those data into the future. This enables to quantify future risk with available models and tools, risk assessments and account for changing climate, population, urbanization, and environmental conditions. Therefore, risk assessment enhances the opportunity to highlight long-term, cost-effective options for reducing disaster risk and building resilience.

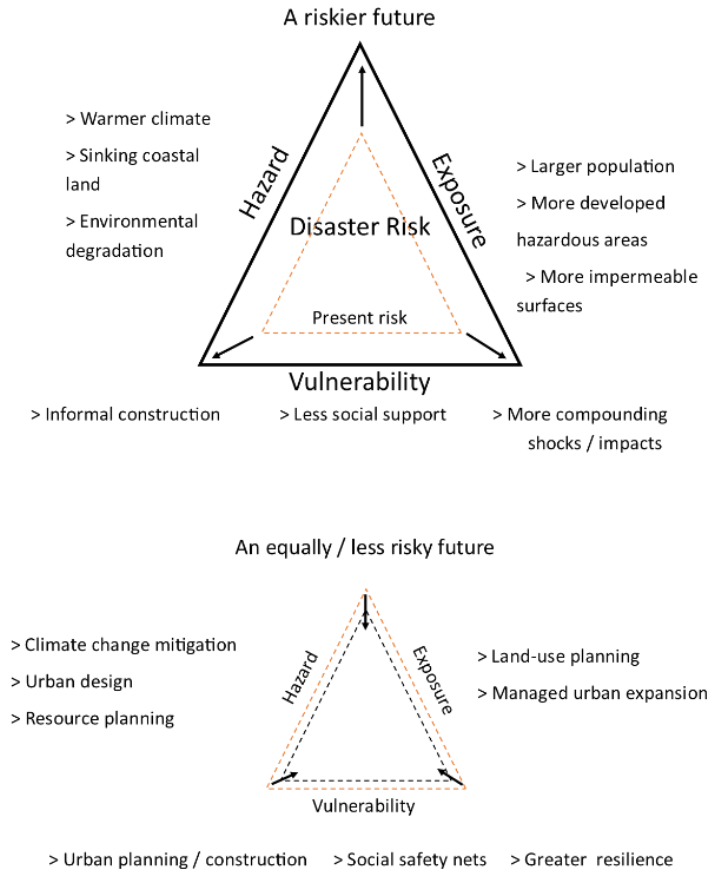


Figure 3:Factors affecting the three components of disaster risk

IV. Present trends in disaster risk

Disaster risk trends are a measure of the sustainability of development. Trend analysis helps to understand patterns of disaster risk and the effectiveness of DRR measures. The disaster trends can identify the necessary improvements for DRR policies and practices. However, the reliability of the trend (rising, falling, or fluctuating) is only as real as the amount, quality and reliability of the data used. Therefore, determining the statistical significance of the factors related to disaster risk is important, including the period over which they are measured in disaster risk reporting [2].

a. Increasing exposure of economic assets

Growth in exposure is one of the principal drivers of increasing disaster risk. Simply put, the concentration of individuals and produced capital in hazard-exposed areas today is greater by an order of magnitude than it was 40 years ago (Figure 4).

b. Global mortality losses are concentrated in intensive disasters

Between 1975 and 2008, 78.2% of disaster mortality was concentrated in only 23 events. Since 1990, more than 45% of total disaster mortality was concentrated in just four events:

- Cyclone Gorky (Bangladesh, 1991)
- The Indian Ocean Boxing Day tsunami (2004)
- Cyclone Narigs (Myanmar, 2008)
- Haiti earthquake (2010)

These events may give the impression that mortality is on the rise, but the trend is not statistically significant and would change depending on the time chosen and the specific intensive disasters occurring in that period (Figure 5).

c. Upward trend of mortality and economic losses from extensive risk in low and middle-income countries

Since 2007, a sustained effort to assist countries in systematically recording local disaster losses [10] has generated systematic and comparable evidence regarding the scale of extensive risk from over 80 countries (Figure 6).

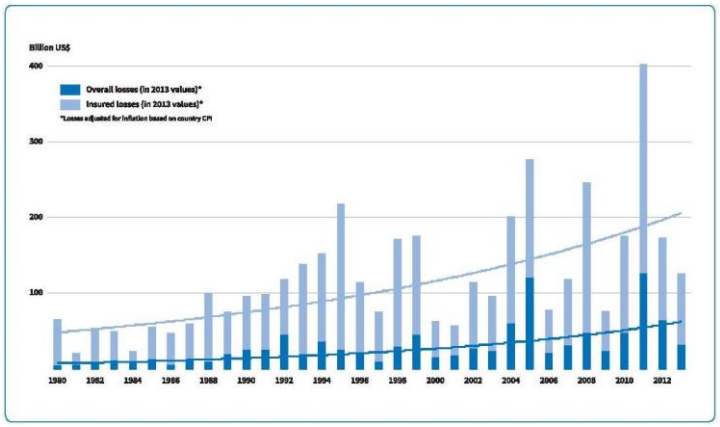
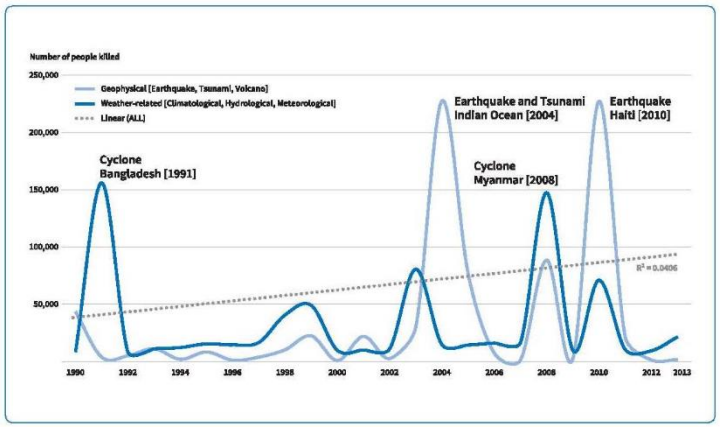


Figure 4: Increasing exposure of economic assets



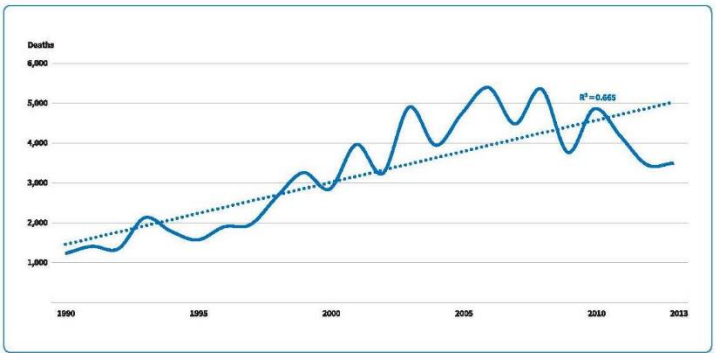


Figure 6: Upward trend of morality and economic losses

Across these countries, extensive disasters are responsible for only 14 per cent of total disaster mortality. However, since 1990 extensive mortality has increased almost fourfold in those countries that have consistent data spanning that period, and the trend is statistically significant. In global loss datasets, there is also a statistically significant trend towards increasing mortality in events with fewer than 100 deaths. Importantly, extensive disaster mortality is also increasing relative to population size.

d. Climate change is predicted to increase disaster risk in the Caribbean basin

With climate change, risk doubles in Honduras and increases fivefold in Trinidad and Tobago (Figure 7). In contrast, Mexico would see a reduction in risk, highlighting that the effects of climate change are not evenly distributed but will affect different countries in different ways.

Given that Caribbean countries are collectively responsible for only a small proportion of global greenhouse gas emissions, the additional AAL of US$1.4 billion raises important questions regarding accountability for risk generation and regarding who should pay for these additional losses.

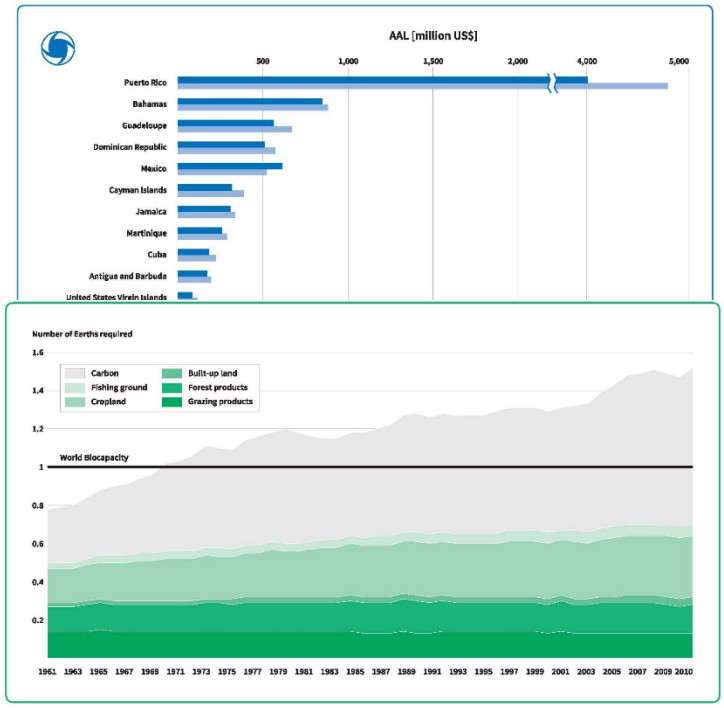


Figure 8: Over consumption of natural resources

e. Overconsumption of natural resources is driving disaster risk

The pursuit of unlimited economic growth has led to an increasing and unsustainable overconsumption of energy, fresh water, forests and marine habitats, clean air, and rich soil at the global scale. The ecological footprint from this overconsumption of energy and natural capital now exceeds the planet's biocapacity by nearly 50 per cent (Figure 8).

f. Progress in poverty reduction

Many countries have made significant progress in human development, in poverty reduction and in achieving the Millennium Development Goals (MDGs) (Figure 9). Between 1990 and 2010, the proportion of people living below the poverty line more than halved, dropping from around 43% to just over 20% (data from the World Bank). Since 1990, the number of people living on less than US$1.25 per day fell from 51% of the population to 30% in Southern Asia and from 56% to 48% in sub-Saharan Africa [11]. In the same period, under-5 mortality fell from 178 to 109 per 1,000 births in sub-Saharan Africa and from 116 to 61 per 1,000 births in Southern Asia [11].

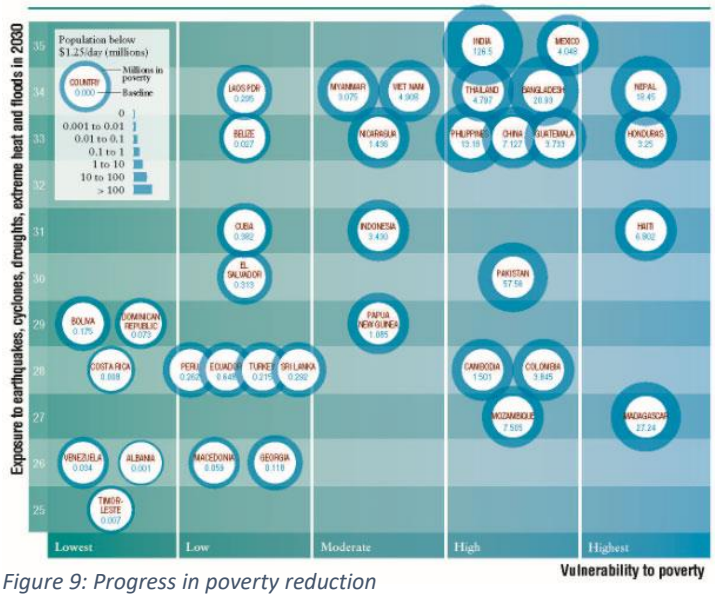


Figure 9: Progress in poverty reduction

g. Predicted poverty levels in hazard-prone countries in 2030

Up to 325 million extremely poor people will be living in the 49 most hazard-prone countries in 2030, the majority in South Asia and sub-Saharan Africa. By 2030, 11 countries will have high numbers of people in poverty, high multi-hazard exposure as well as inadequate capacity to minimise the impacts: Bangladesh (Figure 10), Democratic Republic of the Congo, Ethiopia, Kenya, Madagascar, Nepal, Nigeria, Pakistan, South Sudan, Sudan, and Uganda.

V. Disaster losses against the increasing risk

The current global patterns of increasing exposure, high levels of inequality, rapid urban development, and environment degradation cause for increased disaster risks at dangerous levels (Figure 11).

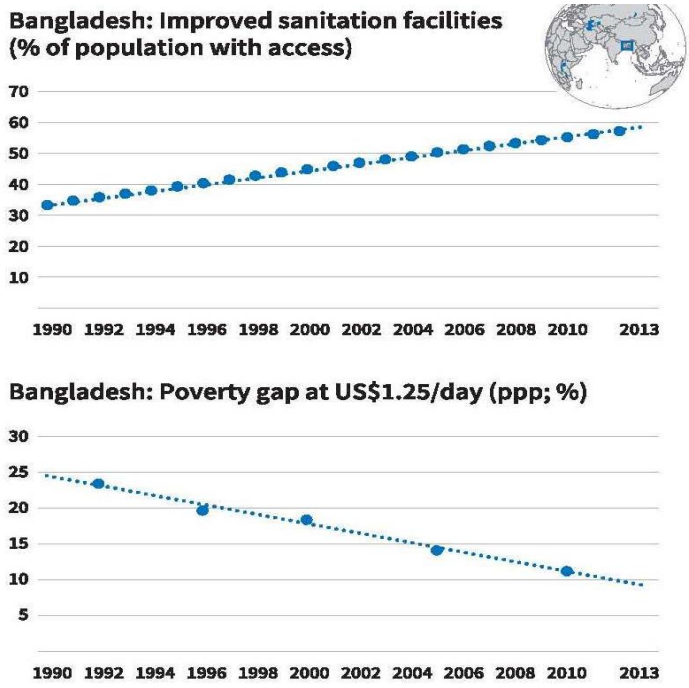


Figure 10: Poverty gap in Bangladesh

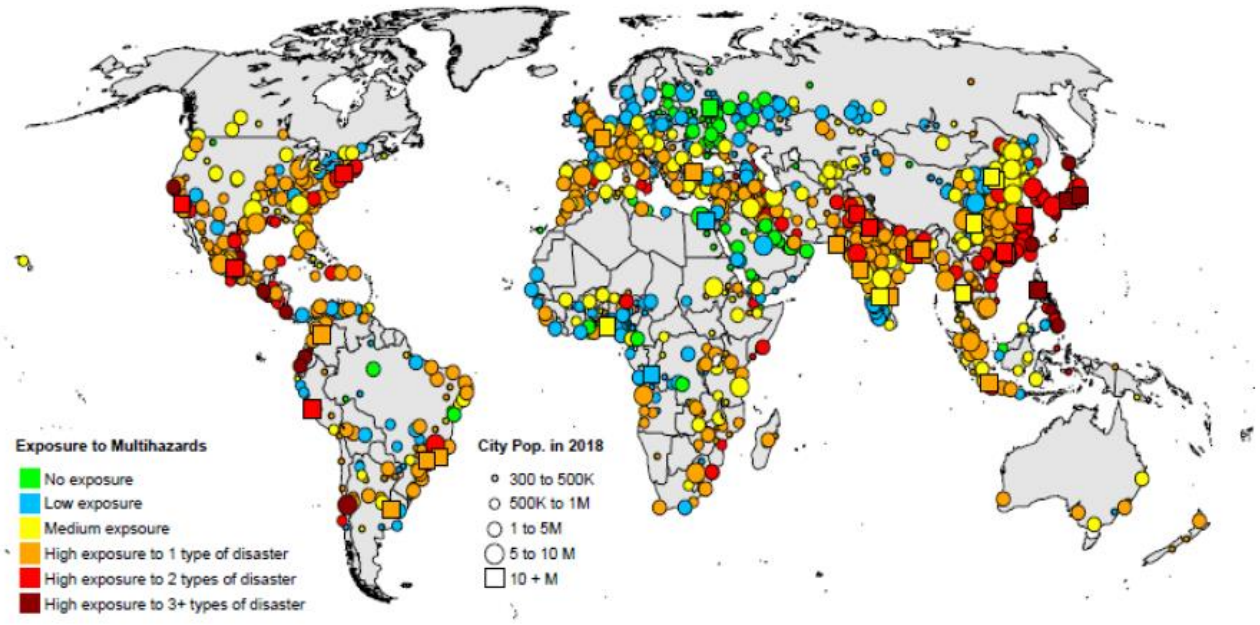


Figure 11: Location of cities by population size and level of exposure to natural disaster, (Source: World Urbanization Prospects: The 2018 Revision)

The direct losses from all disasters in the period 1998-2017 is estimated as $2.9 trillion, which is 2.3 times as much as the overall losses of $1.3 trillion in the period 1978-1997. Slightly over two-thirds of the total losses in the period 1978-1997 were caused by climate and weather related disasters and this share increased to three-fourths in the period 1998-2017 [3] (Figure 12). EM-DAT data shows China, the US, the Philippines, India, and Indonesia to be the five countries most frequently hit by natural hazards over the last ten years. China and India alone account for 62.4% (1.2 billion) of the 2 billion people estimated to have been affected by disasters since 2008. Seven of the worst-affected countries, in numbers of people affected, are in Asia [4].

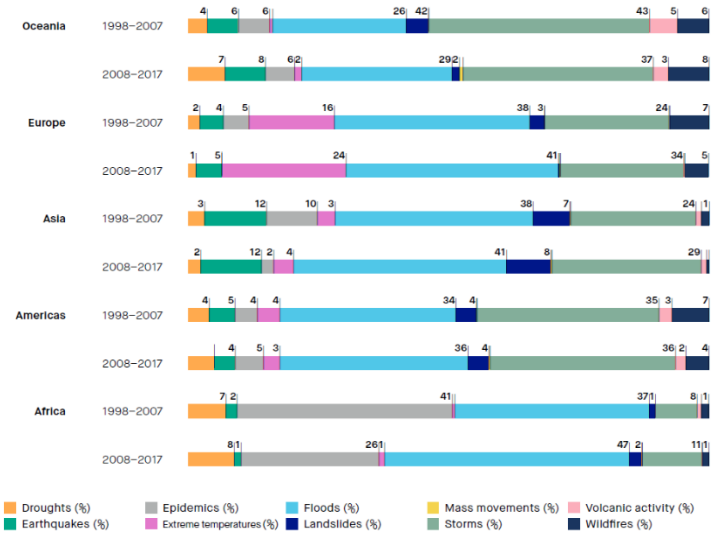


Figure 12:Types of disasters impact at each region as a percentage of total disasters, (Source: EM-DAT The Emergency Events Database)

In most economies 70-85% of overall investment is made by the private sector, which generally does not consider disaster risk in its portfolio of risks [12]. Across the globe, the concentration of high-value assets in hazard areas has grown. However, when disaster losses are compared with the income status of the country, low and middle-income countries appear to contain the greatest losses. Past several decades of research have demonstrated that disasters particularly affect the poorest and most marginalised people, whilst also exacerbating vulnerabilities and social inequalities and harming economic growth [13]. Disaster mortality risk is closely correlated with income level and quality of risk governance [14]. Although some countries have successfully reduced disaster deaths from flooding and tropical cyclones, evidence suggests that the numbers of deaths from extensive risks is increasing [14]. Increases in extensive disaster loss and damage is evidence that disaster risk is an indicator of failed or haphazard development, of unsustainable economic and social processes, and of ill-adapted societies. Disaster risk is therefore a problem for people, businesses, and governments equally.

2. Drivers of disaster risk

The drivers of disaster risk are identified as the processes or conditions, often development-related, that influence the level of disaster risk by increasing levels of exposure and vulnerability or reducing capacity. The UNISDR [7] defines the underlying disaster risk drivers as underlying disaster risk factors which include poverty and inequality, climate change and variability, unplanned and rapid urbanization and the lack of disaster risk considerations in land management and environmental and natural resource management, as well as compounding factors such as demographic change, non-disaster risk-informed policies, the lack of regulations and incentives for private disaster risk reduction investment, complex supply chains, the limited availability of technology, unsustainable uses of natural resources, declining ecosystems, pandemics and epidemics.

The drivers of disaster risk are in the control of policy decisions; however, accurate assessment and continuous revaluation of disaster trends is required to enable effective DRR policy initiatives. Therefore, the risk assessment process should be based on a dynamic paradigm focusing the changing nature of disaster risk drivers. A dynamic risk assessment process will reveal the drivers of risk and the effectiveness of policies focused on DRR [12, 15]. The factors which influence a dynamic risk assessment process are identified as mentioned below.

I. Climate change

Climate change is a significant driver of evolving hazard and a major factor in increasing disaster risk.

"A changing climate leads to changes in the frequency, intensity, spatial extent, duration and timing of extreme weather and climate events, and can result in unprecedented extremes" [16].

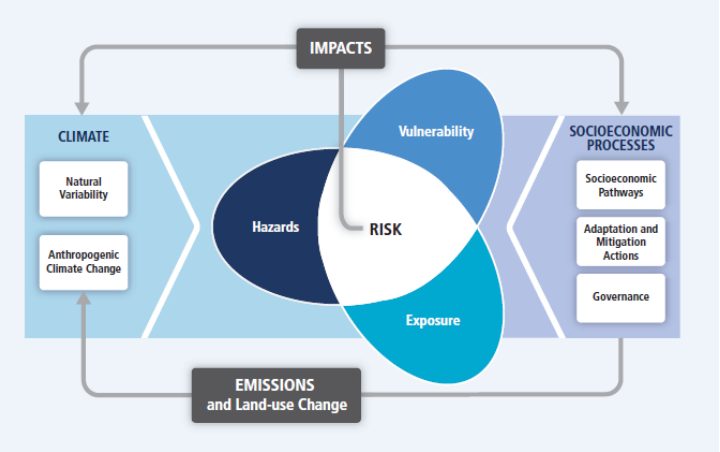


Figure 13: Risk of climate-related impacts

Climate change refers to a change in the climate that persists for decades or longer, arising from either natural causes or human activity. Risk of climate-related impacts triggered from the interaction of climate-related hazards (including hazardous events and trends) with the vulnerability and exposure of human and natural systems. Changes in both the climate system and socioeconomic processes including adaptation and mitigation are drivers of hazards, exposure, and vulnerability (Figure 13). Research into the mechanisms and risks of changing climate shows that disaster risk has already been influenced by climate change [17]. Projected impacts of climate change that will drive disaster risk include the following aspects.

- Decreasing agricultural yields in warmer environments due to heat stress, which has major implications for the livelihoods of the rural poor, and can also lead to migration to urban areas, which increases the population exposed to natural hazards in such locations.
- Rising sea levels, which increases hazards in low-lying coastal areas as the population of coastal areas has grown faster than the overall increase in global population.
- More severe and frequent extreme precipitation events, which intensifies existing patterns of extensive risk when combined with the increases in the population and assets exposed due to migration from rural areas.
- Changes in the geographic distribution of weather-related hazards, which may lead to new patterns of risk.
- Decreasing resilience, which is likely to disproportionately affect poorer countries and communities meaning that climate change is also a driver of poverty.

II. Weak governance

Evidence suggests that the rapidly urbanising cities are where the capacity is weakest for governance related factors; technical, financial, institutional etc. [18, 19]. Under the prevailing economic and population growth, urbanization is projected to expand by 56 to 310% from 2000 to 2030 [20]. The prolonged failure to produce a coordinated response to climate change continues to show that a concrete action is needed to adapt and mitigate climate change in urban areas. The key focus of urban governance needs to shift to building local capacity to respond to climate change [21]. Urban governance in the context of climate change needs to focus on the way that governance systems target the needs and well-being of poor and marginalised groups. Studies into the current governance practices, e.g. building codes, land subdivision regulation, land-use management, and infrastructure standards, need to explore the avenues for incorporating competent, capable, and accountable urban governments to adapt them to address the impact of climate change [22].

An effective national disaster risk assessment requires consultations, engagement, and contributions from a wide range of stakeholders: governmental bodies including line ministries, civil defence, the private sector, civil society, the scientific community, and the public [23]. It should be governed by the system of institutions,

operational modalities, policies, and a legal framework to guide, manage, coordinate, and oversee implementation [24]. The principles of good governance (inclusiveness, transparency, accountability, efficiency, and responsiveness) guide the implementation process.

To function effectively, the disaster risk assessment governance structure requires:

- Clarity and agreement on the division of the roles and responsibilities of each involved actor.
- Political legitimacy or mandate.
- Adequate resources.

Such a governance model is defined based on the high-level objective of national disaster risk assessment. The governance model should be suitable for implementing every step of the assessment from beginning to end, including [25]:

- Identifying and engaging stakeholders
- Budgeting
- Undertaking quality control
- Holding multi-stakeholder consultations
- Defining needed capacities
- Defining the methodology
- Identifying data management requirements
- Overseeing delivery of outputs

III. Urbanization

Urbanization is a complex socio-economic process that transforms the built environment, converting formerly rural into urban contexts. Major consequences of urbanization is a rise in the number, land area and population size of urban settlements and in the amounts of resource consumption and waste generation [11].

"Cities are expanding in a discontinuous, scattered, and low-density form which is not sustainable [18]."

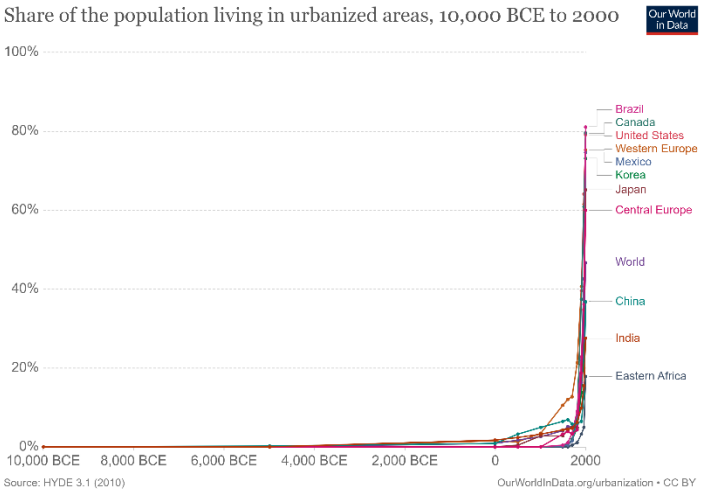


Figure 14: Historical urban fraction estimate per region (Source: HYDE 3.1 (2010))

The current pattern of urbanization both in developed and developing countries converges on one and the same model: low density suburbanization (Figure 14). Wasteful expansion of cities in endless peripheries is a major factor behind climate change. Beyond the physical threats from climate change, some cities stand to face an array of additional risks related to the provision of basic services and public goods (water supply, physical infrastructure, transport, energy, etc.), affecting industrial production, local economies, assets, and livelihoods. Climate change may have ripple effects across many sectors of urban life, affecting the potential for prosperity of the more vulnerable populations: women, youth, children, and ethnic minorities [26].

Recent research recognise that the urbanising cities of the developing world will experience the effects of climate change most profoundly. Cities will be forced to cope with increased incidents of flooding, air and

water pollution, heat stress and vector-borne diseases etc. Cities in developing countries are at particular risk because of population density, lack of drainage, concentration of solid and liquid waste, large informal settlements, and urban expansion onto risky sites [27]. Research highlights both the impact of climate change on towns and cities and the crucial role urban stakeholders play in developing adaptation and mitigation strategies. However, the experts simultaneously highlight the widespread problem of inadequate capacity of cities for coping climate change and disaster risk. These conditions drastically restrain the cities' ability for effective mitigation and adaptation measures in the face of climate change.

IV. Growing population

Between 1950 and 2018, the urban population of the world grew more than four-fold, from an estimated 0.8 billion to an estimated 4.2 billion. The average annual rate of change of the urban population during this period, estimated at 2.54%, was more than 50% higher than that of the world's population (1.62%). By 2050, global population is projected to increase to around 9.8 billion. It is estimated that more than twice as many people in the world will be living in urban (6.7 billion) than in rural settings (3.1 billion).

Striking differences in patterns of urbanization exist between the more developed regions and the less developed regions. While just under half of the population of the less developed regions currently lives in rural areas, the great majority in the more developed regions resides in urban areas. However, the urban population of the less developed regions has been growing considerably faster than that of the more developed regions, and as a result, its share of the world's urban population has been rising (Figure 15) [11].

"Urban growth has three components: natural increase, migration, and reclassification [11]."

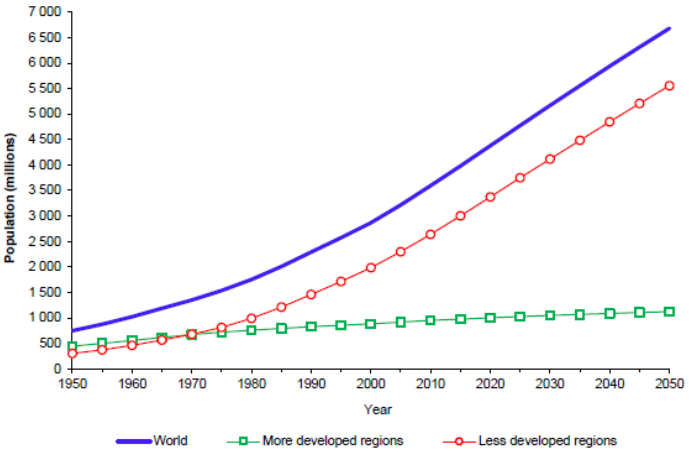


Figure 15: Estimated and projected urban populations of the world, 1950-2050, (Source: World urbanization prospects: the 2018 revision)

Natural increase of urban populations results from an excess of births over deaths in urban areas. The balance depends on levels of fertility (affecting the number of births) and life expectancy at birth (affecting the number of deaths), and on the distribution of the population by age (other things being equal, older populations tend to experience fewer births and more deaths).

Migration to cities from rural areas or from abroad contributes to urban growth whenever the number of in-migrants exceeds the number of out-migrants. Migrants are often younger, on average, compared to the populations living in areas of origin or destination.

Reclassification contributes to urban growth by enlarging the size of urban areas. When cities grow in area, they incorporate neighbouring settlements and their populations, which were formerly classified as rural. Population growth in rural areas may result in reclassification of settlements from rural to urban, thus accelerating the pace of urbanization.

Along with such unprecedented population growth several urban planning related issues are risen which are often resulted in environmental risks. Critical global concerns such as climate change and gender equality are increasingly identified among the issues related to population growth. Furthermore, significant inequalities within urban areas will be raised across many low-to-middle income countries a high share of the urban population live in slum households which lack access to all the basic resources. The planning policy concerns to address the population growth are identified in multi-sectors. Specifically considering the interrelationships

among housing, transportation, economic development, education. However, focus on integrated approaches to address the key issues with growing population often considered in informal housing, economic development, infrastructure, environmental sustainability, and the changing population dynamics are indispensable to address the afore mentioned wider issues.

V. Eco system decline

"Nature is declining globally at rates unprecedented in human history and the rate of species extinctions is accelerating with grave impacts on people around the world [28]".

The Report identifies that, since 1980, greenhouse gas emissions have doubled resulting in average global temperatures rise by at least 0.7 degrees Celsius. The climate change already impacting nature from the level of ecosystems to that of genetics impacts expected to increase over the coming decades. Most ecosystems have been intentionally or unintentionally modified to facilitate the growing demand of several services. However, an increase in the supply of services can frequently lead to declines in ecosystem functionality due to the excessive natural resource extraction. The pursuit of unlimited economic growth has led to an increasing and unsustainable overconsumption of energy, fresh water, forests and marine habitats, clean air, and rich soil at the global scale. Concentrating on the deeper, underlying causes of environmental degradation will allow the goals and targets set out in international, regional, and national agreements to be met in a more effectively.

Despite progress of global goals for conserving and sustainably using nature and achieving sustainability, transformative changes at the current trajectories across economic, social, political, and technological factors are needed for achieving long-term sustainability. Current negative trends in biodiversity and ecosystems undermine the progress towards 80% (35 out of 44) of the assessed targets of the Sustainable Development Goals, related to poverty, hunger, health, water, cities, climate, oceans, and land (SDGs 1, 2, 3, 6, 11, 13, 14 and 15). Loss of biodiversity is therefore shown to be not only an environmental issue, but also a developmental, economic, security, social and moral issue as well (Figure 16) [28].

Figure 16: Coastal development in Myanmar removes mangrove plantations (Source: UNEP, 2014)

To better understand and to address the main causes of damage to biodiversity and nature's contributions to people, understanding the history and global interconnection of complex demographic and economic indirect drivers of change, as well as the social values that underpin them are important. Key indirect drivers include increased population and per capita consumption, technological innovation, and issues of governance and accountability. To increase the policy-relevance, the attention on the following five direct drivers of change in nature with the largest relative global impacts are recommended. (1) changes in land and sea use; (2) direct exploitation of organisms; (3) climate change; (4) pollution and (5) invasive alien species [29]. Transboundary cooperation, including knowledge sharing, is important when natural areas are shared. Improved environmental governance is needed to reverse the environmental degradation and the unsustainable use of natural resources.

VI. Poverty

Globally, about 700 million people live below the US$1.90/day poverty line [8]. This substantial part of the world population is particularly vulnerable to external shocks, including those caused by natural disasters, such as floods and droughts. Particularly in low and low-middle income countries the rapid economic growth leads to accelerated disaster risk as the exposure of people and assets to natural hazards is growing at a faster rate than risk-reducing capacities are being strengthened (Figure 17) [30].

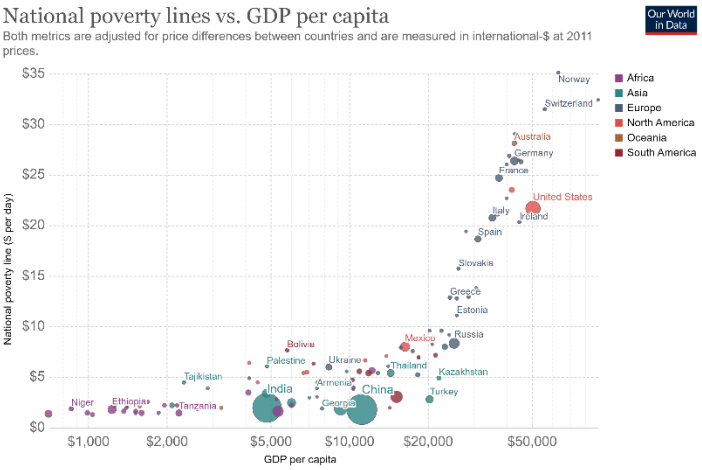


Figure 17: National poverty lines vs. GDP per capita (Source: World bank 2016)

Specifically, poor households are less resilient to loss and are rarely covered by insurance or social protection. Disaster impacts lead to income and consumption shortfalls and negatively affect long term welfare and human development. Climate change is already changing the geographic distribution, frequency and intensity of weather-related hazards and threatens to undermine the resilience of poorer countries and their citizens to absorb loss and recover from disaster impacts. This combination of increasing hazard and decreasing resilience makes climate change a global driver of disaster risk [2]. Poverty and disaster risk are also pervasive in urban areas. Generally, poor urban households derive most or all their income from work in the informal economy, meaning that precise figures on urban poverty are lacking. Urban poverty is now understood to have many additional dimensions - including 'voicelessness' and 'powerlessness', and inadequate provision of infrastructure and basic services [31].

Poverty and inequality drive vulnerability and limit the capacities to cope with disasters. Strengthening these capacities to address the needs of the disaster risk reduction can enable communities to recover from disasters. Enhancing resilience of households and society can break the cycle of disasters creating and being driven by poverty and ensure long term prosperity in the face of disasters [32, 33].

Livelihood strengthening can have many dimensions, including:

- Infrastructure development and basic services provision; watershed management, drought proofing, flood risk management, rainwater harvesting, cash for public works, construction of irrigation systems, canals, roads, disaster recovery and reconstruction, etc.
- Natural resource management; agroforestry, sensitive irrigation, watershed restoration, etc.
- Social assistance and protection; livelihood guarantee schemes, cash transfers, subsidies for public services, etc.
- Livelihood's diversification: alternative sources of income that are resilient to different hazards. etc.

Many countries have made substantial gains in poverty reduction and development goals, which have been linked with a reduction in disaster related mortality. Furthermore, during the Hyogo Framework for Action monitoring period (2005 to 2015), food and social welfare sectors have made considerable progress in addressing poverty and inequality - food security is improving in many regions, and social protection coverage is increasing. However, the ability to invest in social protection remains limited in many countries, with significant differences in the capacity of local governments to meet the needs of citizens.

VII. Displacement

UNHCR recognizes that the consequences of climate change are extremely serious, including for refugees and other people of concern [34]. According to the Internal Displacement Monitoring Centre, there were 18.8 million new disaster-related internal displacements recorded in 2017. In 2019, around 1,900 disasters triggered 24.9 million new displacements across 140 countries and territories. This is the highest figure recorded since 2012 and three times the number of displacements caused by conflict and violence (Figure 18).

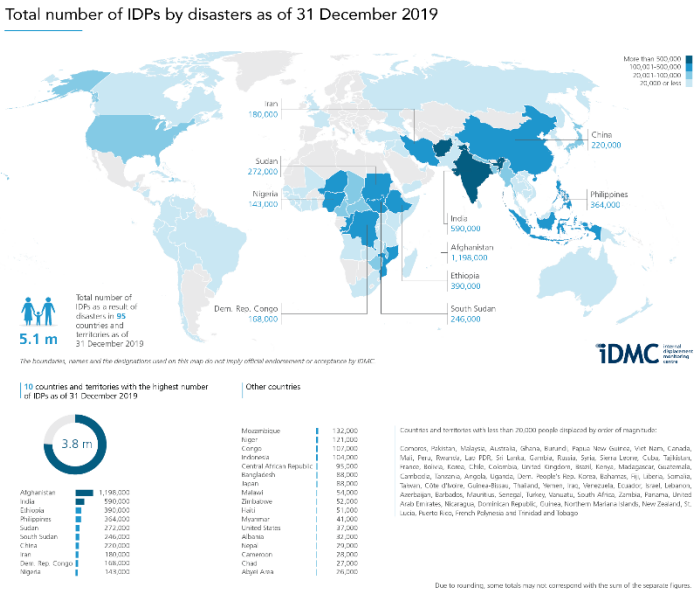


Figure 18: People internally displaced by disasters as of 31 December 2019, (Source: IDMC, 2019)

Most of the disaster displacement recorded in 2019 took place in this region, a result of monsoon rains, typhoons, and earthquakes. Conflict and violence also triggered displacement in Indonesia, Myanmar, the Philippines, and Papua New Guinea [35].

Disaster displacement was recorded in low and high-income countries alike. Cyclones Idai and Kenneth forced hundreds of thousands of people from their homes in Mozambique, Malawi, Madagascar, Zimbabwe and the archipelagos of Comoros and Mayotte. Hurricane Dorian's impacts on the Bahamas were unprecedented, and the storm also triggered displacement on neighbouring islands and in the US and Canada. Internal displacement cost the world about $20 billion in 2019. This economic burden is borne by displaced people themselves, the communities that host them, struggling frontline government agencies and an overstretched humanitarian system.

Most disaster displacement linked to natural hazards and the impacts of climate change is internal, with those affected remaining within their national borders (Figure 19). However, displacement across borders also occurs, and may be interrelated with situations of conflict or violence. UN General Assembly in December 2018 directly addresses this growing concern. It recognizes that climate, environmental degradation, and natural disasters increasingly interact with the drivers of refugee movements.

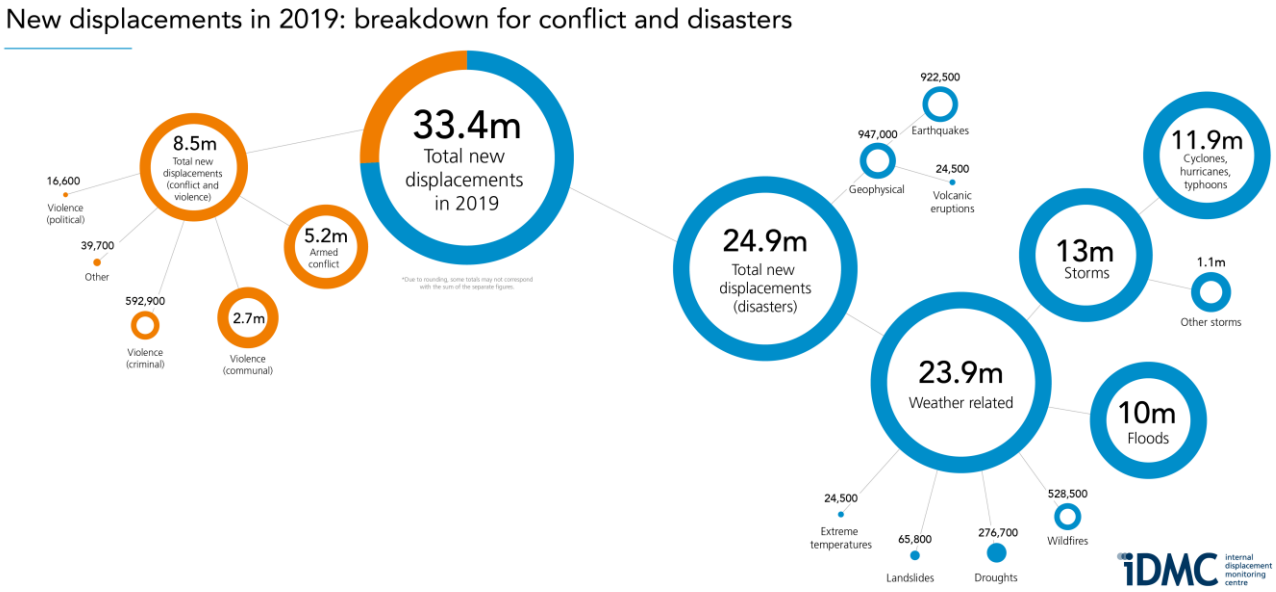


Figure 19: New displacements in 2019: Breakdown for conflict, violence, and disasters, (Source: IDMC, 2019)

The term "climate refugee" is often used in the media and other discussions. However, this phrase can cause confusion, as it does not exist in international law. The UNHCR endorse the phrase "persons displaced in the context of disasters and climate change" when referring to the people affected by climate change and displacements.

There were visible efforts to prevent and respond to internal displacement in 2019, and promising developments in several countries highlighted the key ingredients for success. New national initiatives showed greater levels of political commitment. Strengthened capacity across humanitarian and development sectors manifested in better coordination and increased investment. Improvements in the quantity and quality of data available also enabled better reporting and analysis, which in turn informs more effective responses and risk mitigation measures.

VIII. Nexus Dynamics

Recent history has borne witness to cross border movements in situations where conflict or violence has interacted with disaster or adverse effects of climate change. Yet, research on how destination States have used refugee law to provide international protection in these complex situations has traditionally been limited [36].

Figures for displacement associated with disasters in sub-Saharan Africa are lower than for conflict and violence, but they are still cause for concern. The 3.4 million new displacements recorded in 2019 represent one of the highest figures ever for the region. East Asia and Pacific accounted for most of the disaster displacement recorded worldwide in 2019, as it has done in previous years (Figure 20, Figure 21).

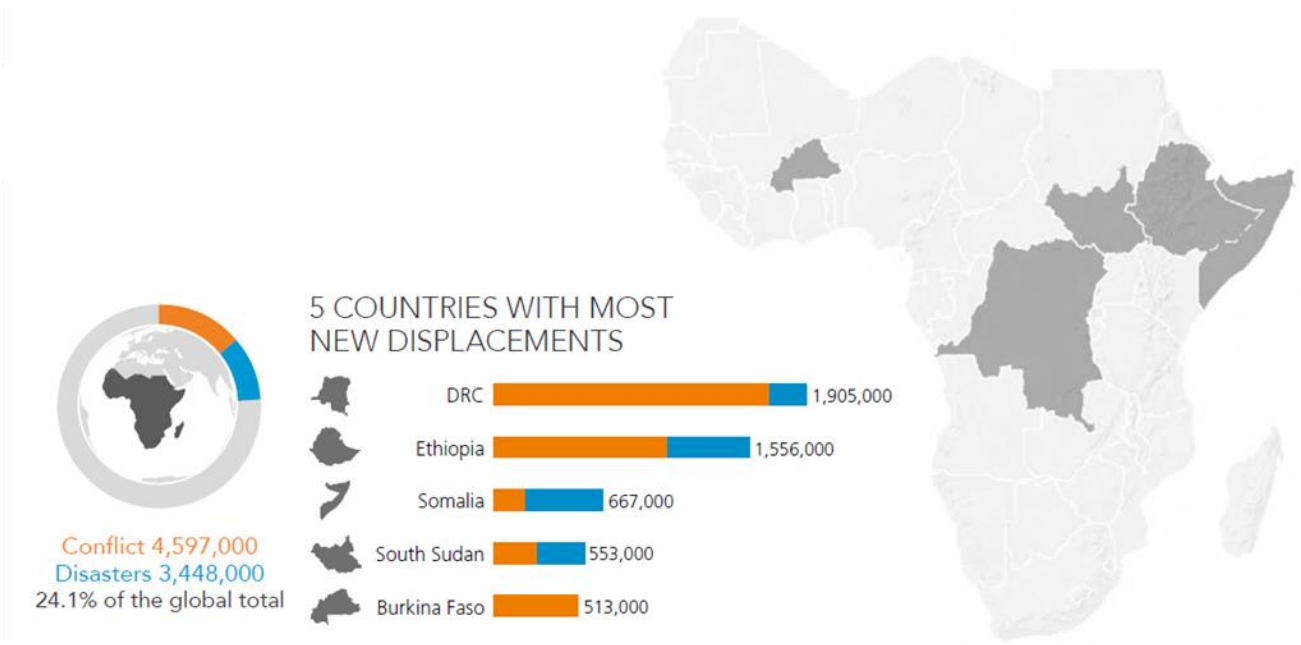


Figure 20: Sub-Saharan Africa was once again the region most affected by conflict displacement in 2019, (Source: IDMC, 2019)

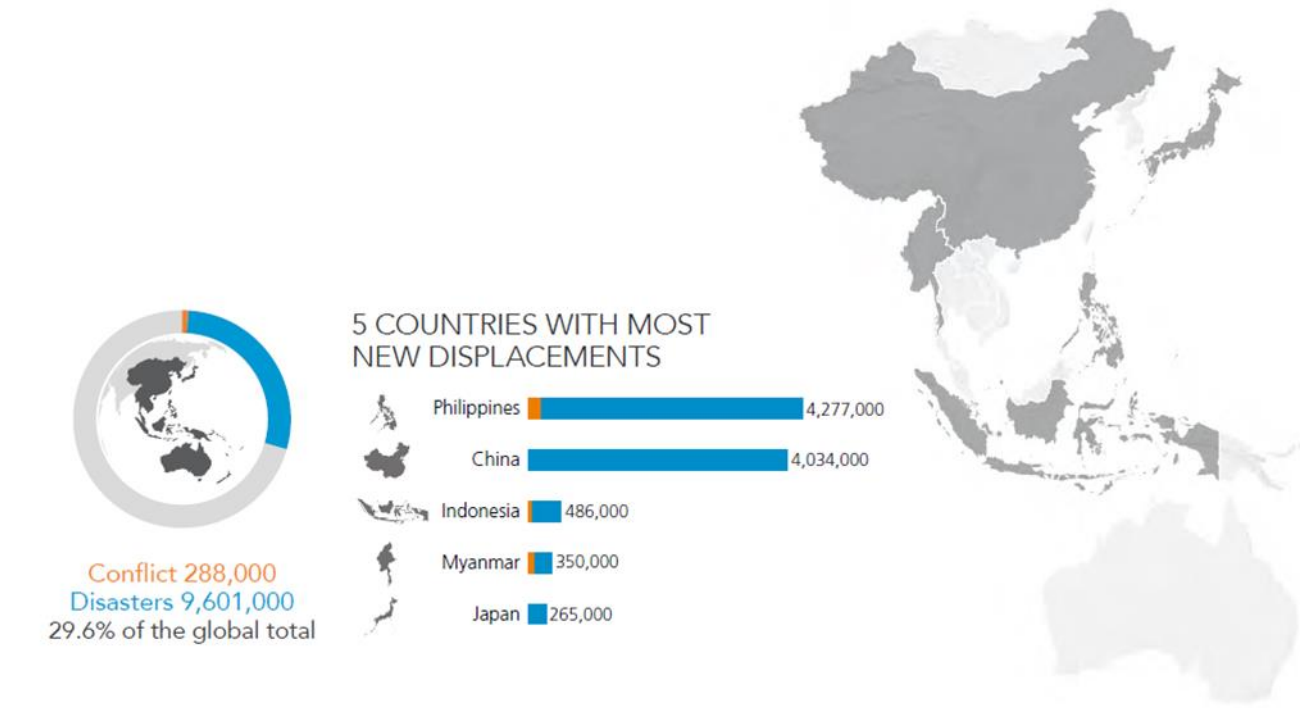


Figure 21: East Asia and Pacific accounted for most of the disaster displacement recorded worldwide in 2019, (Source: IDMC, 2019)

To address this knowledge gap and to identify policy and practical solutions to strengthen the implementation of refugee law based international protection when cross-border movements occur in the context of nexus dynamics, in 2018 UNHCR undertook the study to strengthen the international protection in the context of nexus dynamics (witness to cross-border movements in the context of conflict and/or violence and disaster and/or the adverse effects of climate change). In all cases, people displaced by disasters have needs and vulnerabilities that must be addressed. People already displaced for reasons other than disasters linked to natural hazards – including refugees, stateless people, and the internally displaced – often reside in climate

change 'hotspots' and may be exposed to secondary displacement. Moreover, similar impacts on their home areas can inhibit their ability to safely return.

While understanding the above-mentioned key trends of disaster risk the students are expected to identify and formulate researchable issues with reference to the environmental and social science aspects which influence disaster risk reduction and urbanization (including geographical, governance, economic, anthropological understandings, etc.). The disaster risk governance describes the links between DRR and governance and positions DRR into development through 'mainstreaming' and climate change adaptation. Yet, the practical guidance to mainstream disaster risk reduction and climate change adaptation remains with a great knowledge gap and scientific research inputs specifically into the convergence fields of disaster risk, climate change, and development agendas.

3. Disaster management and risk governance

The policy objective of anticipating and reducing risk is called disaster risk reduction (DRR). Although often used interchangeably with DRR, disaster risk management (DRM) can be thought of as the implementation of DRR, since it describes the actions that aim to achieve the objective of reducing risk. Governance refers to the different ways in which governments, the private sector and in general all individuals and institutions in a society organize themselves to manage their common affairs [37].

Risks are always managed within a broader context of relationships between governments, citizens, civil society, and private business, relationships that shift and evolve over time with changing political currents and economic conditions [14]. Over the past thirty years, a broader practice of "governance" has been identified towards a potential shift to the handling of natural. The characteristics of what has been termed "new governance" include the emergence of multilevel governance processes and a denial of the exercise of centralised authority. The new governance involves the multiplicity of private sector and civil society actors, the creation of new forms of authority and control, and changing distributions of responsibilities between the state and other actors, including individual citizens. Disaster risk reduction (DRR) at all levels is also dependent upon institutional innovation in governance [38, 39]. To move towards "good governance" in DRR, there is a need for institutional systems and administrative arrangements that link public, private, and civil society sectors, and build vertical ties between local, district, national and global scale actors [40].

I. Strengthening governance to reduce disaster risk

Strengthening governance has been identified as essential to reduce disaster risk. Addressing fundamental issues that underpin risk, including risk governance, creates a global platform for mainstreaming of risk for daily political and civil life. There is a need to identify mechanisms of implementation for the key elements of DRR governance [41]. It is also important to explore good practices related to multi-stakeholder participation, compliance, and enforcement of DRR policies, transparency and accountability, responsiveness to stakeholders, consensus orientation, equity, effectiveness and efficiency, accountability, and strategic vision for reducing disaster risks. Appropriate structures, stakeholder participation, collaboration, flexibility, learning, accountability, and transparency are all indicative of good governance and are enablers of long-term DRR and adaptation.

Obtaining long-term political commitment for a national disaster risk assessment is of great importance, because the assessment informs strategic decisions on risk management that require long-term political and financial commitment for their implementation. Besides, the assessment itself is an iterative process that can stretch across a political term of office and requires long-term sustainability.

II. "Innovation curve" – from destructive to regenerative approaches

The regenerative potential of the social and natural systems envisaged in the aligned intergovernmental agendas will be better understood, and progress will be accelerated, by incorporating systemic risk and

systemic opportunity into the design of policies and investments across all scales [2]. Similarity of the characteristics of systemic risks in different domains suggests that as attempts are made to understand the effects of endogenous triggers and critical transitions, there will be more patterns apparent in different domains, which will allow the development of a consistent understanding of the fundamental characteristics of systemic risks (Figure 22).

Accelerated action and ambition is needed to translate from one paradigm to another from managing disasters to managing risk and from managing "conventional" hazards to engineering an improved understanding of the dynamic interactions with systemic risks. Following are a few key innovations in the risk managing dynamics.

- To fully realize the challenge and call of the Sendai Framework, major renovations of approaches to risk assessment and analysis are needed.
- Scenario building and stochastic simulation need to be included in risk modelling to facilitate thinking and decision-making in complex systems.
- A new paradigm for understanding and living with uncertainty and complexity is required – one that activates the power of human social and contextual intelligence, and where possible, leverages it through appropriately designed artificial intelligence.
- Greater focus is required on place-based solutions that emerge from the collaborative development of contextual warm data based on self-organizing around actions that are co-created, with local ownership of data, risks, and solutions. Local capacity can be significantly increased by drawing from collective intelligence and mutual learning.
- A better understanding of the interactions and interdependencies between urban and rural areas is essential to reduce or prevent the creation of risk. This requires a functioning urban/rural (city region) data metabolism to process information at appropriate scales to understand the systems implications.
- Private sector financial institutions need to integrate DRM into their business models and practices through disaster risk-informed investments.
- Structures and approaches to bringing forward information are needed that present the contextual interlinking of the potential systemic risk impacts as they are felt at the individual, microscopic level within larger global, macroscopic contexts.

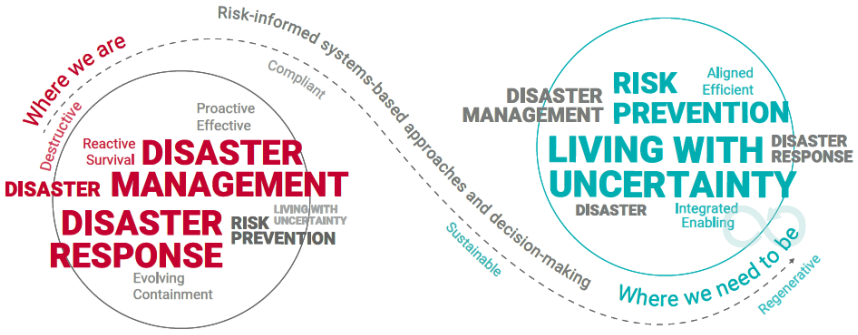


Figure 22: "Innovation curve" – from destructive to regenerative approaches, (Source: UNDRR 2019)

III. Reforming governance to manage disaster risks

While countries will continue to require a dedicated and specialized disaster management sector to prepare for and respond to disasters, managing disaster and climate risks in development requires a new approach. It requires strengthened governance arrangements in sectors and territories to minimize the discounting of future risk as well as transparency and accountability as risks are generated, transferred, and retained.

In contrast, managing disaster risks makes it necessary to strengthen sector and territorial governance arrangements. Rather than specialized arrangements for disaster risk governance, the key question is how governance in general can be enhanced to minimize the discounting of future risk as well as transparency and accountability as risks are generated, transferred, and retained. This implies the need to relax and dispel the notion that disaster risk management must be a sector and to shift the focus towards weaving risk management into development. This has several implications.

- Firstly, the capacity of countries to manage their disaster risks will depend on the overall quality and strength of governance.
- Secondly, it implies that the priority given to managing disaster risk will be closely associated with the priority given to addressing the underlying risk drivers.
- Thirdly, if disaster risk is driven into previously unknown orders of magnitude and into new domains the ability to manage known risks will be only one pillar of effective risk management.

The management of disaster risks needs to be part of a broader approach to risk management that also looks at biological, technological, financial, and other risks. In addition, robust social accountability can be strengthened through public information and transparency. Greater synergy needs to be generated between the management of disaster risk and that of climate change, and between those two areas and sustainable development. These general principles will need to be interpreted in the light of constitutional, political, and administrative arrangements in each country.

4. Disaster risk reduction policy agenda

Disaster risk reduction and resilience-building require strong leadership and policies to mitigate negative hazard impacts in any society. As the DRR policy agendas progresses from previous plans into the global and national strategic action plan a vast range of opportunities arise for the government and relevant stakeholders to focus on improving such governance, policies, and actions. The governance arrangements required to manage disasters are not the same as those required to manage risks. The management of disasters as events disaster warning, preparation and response is a specialized area of governance for which, with important caveats, many of the institutional and legislative arrangements developed over the last thirty years or so are appropriate.

I. Identifying and understanding risk: the foundation of risk reduction

Awareness, identification, understanding and measurement of disaster risks are all clearly fundamental underpinnings of disaster risk management [14]. Disaster risk reduction is about decisions and choices, including risk information in the following five key areas of decision making:

a. Risk identification

Because the damages and losses caused by historical disasters are often not widely known, and because the potential damages and losses that could arise from future disasters (including infrequent but high-impact events) may not be known at all, DRM is given a low priority. Appropriate communication of robust risk information at the right time can raise awareness and trigger action.

b. Risk reduction

Hazard and risk information may be used to inform a broad range of activities to reduce risk, from improving building codes and designing risk reduction measures (such as flood and storm surge protection), to carrying out macro-level assessments of the risks to different types of buildings (for prioritizing investment in reconstruction and retrofitting, for example).

c. Preparedness

An understanding of the geographic area affected, along with the intensity and frequency of different hazard events, is critical for planning evacuation routes, creating shelters, and running preparedness drills. Providing a measure of the impact of different hazard events—potential number of damaged buildings, fatalities and injuries, secondary hazards—makes it possible to establish detailed and realistic plans for better response to disasters, which can ultimately reduce the severity of adverse natural events.

d. Financial protection

Disaster risk analysis was born out of the financial and insurance sector's need to quantify the risk of comparatively rare high-impact natural hazard events. As governments increasingly seek to manage their sovereign financial risk or support programs that manage individual financial risks (e.g., micro-insurance or household earthquake insurance).

e. Resilient reconstruction

Risk assessment can play a critical role in impact modelling before an event strikes (in the days leading up to a cyclone, for example), or it can provide initial and rapid estimates of human, physical, and economic loss in an event's immediate aftermath. Moreover, risk information for resilient reconstruction needs to be available before an event occurs, since after the event there is rarely time to collect the information needed to inform resilient design and land-use plans.

II. Disaster risk reduction policy

The Sendai Framework for Disaster Risk Reduction: 2015–2030, adopted at the Third UN World Conference for Disaster Risk Reduction, lays out the priorities of action necessary at both the national and sub-national levels, to reduce mortality and direct, disaster-related economic losses (including damage to critical infrastructure). The goal is to increase the number of national and local DRR strategies by 2020. These strategies and plans need to be available across different timescales, with targets, indicators and time frames all aimed at preventing the creation of risk, as well as reducing existing risk and strengthening economic, social, health and environmental resilience (Figure 23) [6].

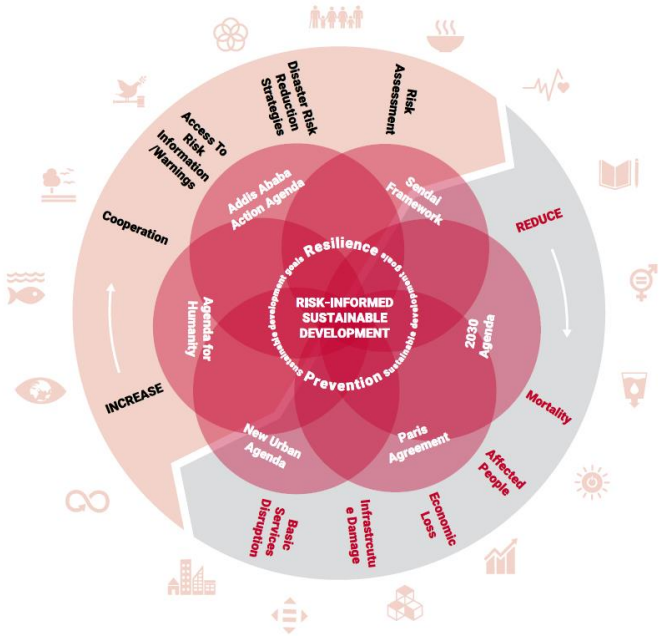


Figure 23: Risk-informed sustainable development, (Source: UNDRR 2019)

2015 also marked the signing of the Paris Agreement. Unlike the Sendai Framework and SDGs, the Paris Agreement is legally binding under international law. The Paris Agreement refers only once to the Sendai Framework in its preamble, 'welcoming the adoption' of SFDRR and other international agreements. However, various dimensions of risk from climate change are mentioned within Article 8. The Paris Agreement does not strongly link to DRR nor to the Sendai Framework, yet it accepts the necessity of DRR. Article 7 of the Paris Agreement states, 'Parties hereby establish the global goal on adaptation of enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change [42].'

The New Urban Agenda was adopted at the United Nations Conference on Housing and Sustainable Urban Development (Habitat III) in Quito, Ecuador, on 20th October 2016. It focuses on managing urbanisation towards achieving sustainable development. Aligning with sustainable development goals, the New Urban Agenda works towards building sustainable cities through an urban paradigm shift, grounded in the integrated and indivisible dimensions of sustainable development: social, economic, and environmental. There are several transformative commitment areas:

- Sustainable urban development for social inclusion and ending poverty.
- Sustainable and inclusive urban prosperity and opportunities for all.
- Environmentally sustainable and resilient urban development.

Adhering to these, building the urban governance structure, establishing a supportive framework, planning, and managing urban spatial development and the means of implementation, are detailed under the implementation framework [43].

[6, 10, 44, 45] Governments need to invest in the collection, management, and dissemination of risk information, including disaster loss and impact statistics, hazard models, exposure databases and vulnerability information. At the same time, they need to put standards and mechanisms in place to ensure openness and transparency so that users not only have access to the information they need but are aware of its underlying assumptions and limitations [6]. The generation of understandable and actionable risk information needs to be particularly sensitive to extensive risk, which, because it is configured to a large extent by social, economic and environmental vulnerability, can be reduced effectively through risk management and sustainable development practices [14].

5. Convergence of disaster risk, climate change and development agendas

Resolutions and reports adopted at the international level in the last few years provide that a more consistent and sustainable alignment between climate change adaptation (CCA) and disaster risk reduction (DRR) is today considered a global priority [46-48]. As commonly stated in the literature, the basic connection between CCA and DRR lies in the overarching goals of both sectors, namely reduction of losses due to climate-related hazards (including both slow-onset and extreme events) and the improvement of communities' resilience (Figure 24).

There are two main potential responses to climate change: mitigation and adaptation. While the mitigation addresses the root causes, by reducing greenhouse gas emissions, adaptation seeks to lower the risks posed by the consequences of climatic changes. DRR primarily aims to reduce the damage caused by "small-scale and large-scale, frequent and infrequent, sudden and slow-onset disasters caused by natural or man-made hazards, as well as related environmental, technological and biological hazards and risks through an ethic of prevention" [14].

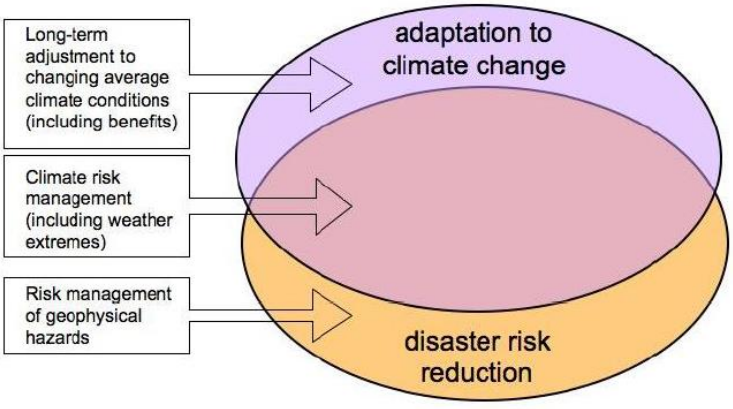


Figure 24: Overlap between DRR and Climate Change Adaptation

I. Linking CCA and DRR alongside of the converging aims and gaps

The alignment of aims and areas of intervention are determined by the fact that the two sectors have partially diverging backgrounds, methodologies and scopes of action has also been considered by relevant literature.

A commonly referred aspect is the types of hazards respectively addressed: the scope of action by DRR practitioners is wider than CCA, as the former also considers geophysical (e.g., earthquakes, tsunamis, volcanic eruptions, and landslides) and technological (e.g., nuclear radiation, toxic wastes, dam failures) hazards. Moreover, despite gradual incorporation of scientific advances, members of the DRR community mainly stem from the humanitarian sector and practitioners may be, therefore, more focused on learning from past experiences and undertaking risk assessments as a benchmarking exercise, thus putting more emphasis on local communities and localised needs. Conversely, climate adaptation experts ostensibly tend to consider long-term projections and predicted effects, including changes in ecosystems and loss of biodiversity, and therefore their scientific perspectives are more future-oriented.

On the contrary, it should help in identifying how and where synergies start and stop, and mutual benefits can be achieved. A full understanding of the specific shortcomings and differences between DRR and CCA identified so far, can help to explain why integrated "climate-smart disaster risk management" remains underdeveloped. According to the findings provided by the extensive literature on the topic, these can be grouped in three categories: a) physical and temporal gaps (e.g., different spatial and temporal scales); b) cultural gaps (e.g., differences in the management of knowledge, communication, and information); and c) institutional gaps (e.g., different sources of authority or norm systems).

a. Physical and temporal gaps

While DRR is commonly framed in a local dimension, being based on how a disaster is expected to affect a specific human community, climate change is a challenge that has historically been addressed at the global scale. While CCA is more inclined to longer-term perspectives and planning, it has often been the case that political attention and resources for disaster risk reduction activities are more pronounced in the aftermath of disasters and therefore are generally based on more event-related perceptions.

b. Cultural gaps

A wide range of stakeholders (including scientists, NGOs, policymakers, the private sector, and educators) is potentially involved in any attempt to align CCA-DRR perspectives. Despite growing links between such professional disciplines, unharmonized expertise and different ways in which scientific knowledge, statistical data, traditional and local-indigenous knowledge, and technical information are collected, processed, and communicated have been detected as a barrier.

c. Institutional gaps

Divergences also relate to the way in which CCA and DRR activities are respectively framed by relevant bodies, both at the national and international level. In terms of global governance, the lack of systematic and long-term strategic planning for the integration of CCA and DRR knowledge and actions has been reported as an issue, and the two sectors are still coordinated and considered by different intergovernmental fora and institutions. Consequently, different external financing systems for domestic action could also represent an element of fragmentation.

II. Commonly identified recommendations for aligning CCA and DRR

A commonly referred aspect is the scope of actions by DRR practitioners is wider than CCA when addressing hydrometeorological hazards, where DRR needs to take account of changing hazards, and adaptation needs to build resilience to their impacts. Moreover, despite gradual incorporation of scientific advances, members of the DRR community mainly stem from the humanitarian sector and practitioners may be, therefore, more focused on learning from past experiences and undertaking risk assessments as a benchmarking exercise, thus putting more emphasis on local communities and localised needs. Based on the considerations outlined above and drawing from the relevant academic and practitioner literature on how to achieve holistic management of climate-disaster risks, an array of previously identified recommendations can be followed under the

following four main topics: a) cross-sectoral coordination and governance; b) implementation strategies; c) funding; and d) information management.

a. Cross-sectoral coordination and governance

Stimulating national coordination between different ministries, agencies and platforms respectively engaged in CCA and DRR activities is widely recognised in the literature as one of the key methods for the accomplishment of effective and context-specific coherence.

b. Implementation strategies

CCA and DDR practices and objectives should be combined by means of the adoption of converging policies aimed at reducing gaps between their temporal and spatial scales.

c. Funding

Monetary resources for integrated strategies could come from public budgets, international actors (multilateral and regional funds) or private donors. A major engagement of the private sector and public-private partnerships could be considered both at the national as well as international/ intergovernmental level.

d. Information management

Governmental decision-making and related normative frameworks should be based on an adequate understanding of exposure, vulnerability, and resilience, especially considering their continuously shifting dimensions.

6. Case Studies

- Impacts of Disaster to SMEs in Malaysia [49]
- Reducing risks and building resilience at the local level: A global review of local DRR strategies [50]
- The upstream-downstream interface of Sri Lanka's tsunami early warning system [51]
- Systematizing Community-Based Disaster Risk Management (CBDRM): Case of urban flood-prone community in Thailand upstream area [52]
- Building urban and infrastructure resilience through connectivity: An institutional perspective on disaster risk management in Christchurch, New Zealand [53]
- Holistic Disaster Risk Evaluation for the Urban Risk Management Plan of Manizales, Colombia [54]
- Reducing disaster risk by managing urban land use [55]
- Developing Disaster-Risk Resilience in Cities [56]
- Building urban resilience through disaster risk reduction in Asia and pacific [57]
- Building Urban Resilience, Managing the Risks of Disasters in East Asia and the Pacific [58]

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