

## Chapter 2

# Climate Change Adaptation and Disaster Risk Reduction: Fundamentals, Synergies and Mismatches

Jörn Birkmann and Joanna Pardoe

**Abstract** The IPCC special report on Managing the Risks of Extreme Events to Advance Climate Change Adaptation (see IPCC, A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change, 2012a, p. 582) underscores the importance of linking disaster risk reduction and climate change adaptation. However, in reality, practical approaches in adaptation and risk reduction have primarily been developed in isolation, rather than as a part of a parallel and intertwined process. This chapter examines the options and concepts that allow for the strengthening of the link between Climate Change Adaptation (CCA) and Disaster Risk Reduction (DRR). In addition, barriers and mismatches between the two communities will be addressed. The chapter also discusses how limited cooperation between different institutions and ministries has hampered effective synergies between CCA and DRR in praxis. Finally, the chapter outlines recommendations and measures that need to be adopted in order to overcome existing barriers. In this regard criteria are formulated that should be applied in order to constantly monitor and evaluate adaptation strategies designed to simultaneously meet disaster risk reduction requirements.

**Keywords** Disaster risk reduction · Climate change adaptation · Synergies · Mismatches · Concepts

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The paper is based on key findings of the IPCC Special Report SREX and a study conducted by Birkmann and Teichmann for the DKKV which was also published in a peer-reviewed paper (see Birkmann and von Teichmann 2010).

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## 2.1 Introduction

The IPCC Special Report on Managing the Risk of Extreme Events and Disasters to Advance Climate Change Adaptation (see IPCC 2012a) as well as the discourse around the special programme of the United Nations Framework for the Convention on Climate Change on Loss and Damage (UNFCCC 2012) are two prominent examples of the emerging reality that the international community has recognised the need to discuss and develop both climate change and disaster risk strategies in a more coherent manner. Although the IPCC SREX report and the programme on Loss and Damage underscores the various synergies between both schools of thought, it must also be acknowledged that there are existing challenges and gaps that hinder an effective combination of adaptation and risk reduction strategies. Various challenges have been identified by different studies at all political levels (see Few et al. 2006; Red Cross/Red Crescent Climate Centre 2007; Commission on Climate Change and Development 2008a, b, c, 2009; O'Brien et al. 2008; Moench 2009; Schipper and Burton 2009; Tearfund 2009). This chapter will present a common concept and starting point for vulnerability and adaptation research in disaster risk reduction (DRR) and climate change adaptation (CCA), followed by an overview of areas that would benefit if DRR and CCA approaches were to be applied jointly and coherently. Based on existing synergies, the chapter will also examine key challenges when linking DRR and CCA by focusing on three key areas: different spatial and temporal scales, norm systems and knowledge types and sources.

## 2.2 Linking CCA and DRR

The first IPCC assessment reports were rather limited in terms of their approach to adaptation, reflecting a concern that a stronger emphasis on adaptation might detract from mitigation goals and efforts. However, when the third assessment report of the IPCC (2001a) drew the world's attention to the unavoidable impacts of human induced climate change, the need for adaptation moved onto the international agenda (IPCC 2001a, b). At present the fifth assessment report of Working Group II, which is underway and is expected to be finalised by the middle of 2014, takes a different perspective when compared to previous reports, emphasising and promoting the importance of climate change adaptation through four separate chapters that explicitly deal with the topic (IPCC 2012b). In addition, the actual meaning and content of adaptation has been discussed during various international conferences. Furthermore, special funds, such as the Least Developed Countries Fund and the Special Climate Change Fund, have been created to provide financial support to assist with the implementation of adaptation strategies. Today, there exists an overall consensus and acknowledgement that adaptation to climate change affects various sectors of society such as agriculture, health and infrastructure in which respective measures will have to be taken to safeguard the future. DRR is another key sector affected by climate change, although the relationship between DRR and adaptation

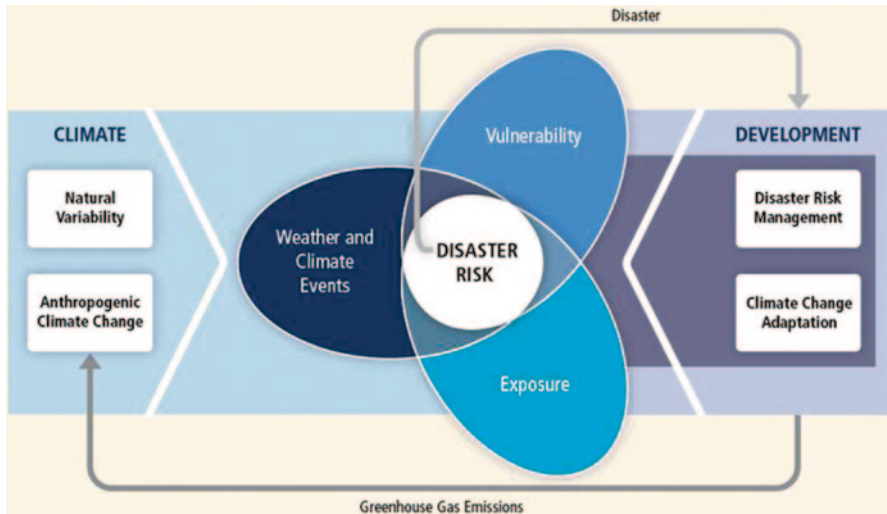


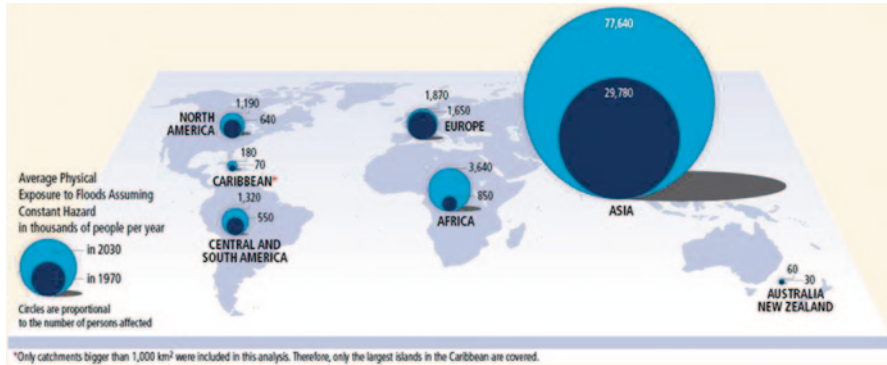
Fig. 2.1 Determinants of disaster risk. (Source: IPCC 2012a, p. 31)

to climate change has often remained relatively opaque, particularly concerning any practical cooperation between different institutions or ministries on the ground.

### 2.2.1 Conceptual Approaches: Determinants of Risk

The IPCC SREX framework differentiates three key factors tied to disaster risk. Disaster risk, according to the IPCC SREX is determined by physical events, such as weather and climate events on the one hand and the vulnerability and exposure of a system at risk on the other. In this regard the framework introduced in the SREX report emphasises that changes in the physical climate system due to natural variability and anthropogenic climate change need to be clearly separated from vulnerability and exposure of humans or ecosystems which is in turn influenced by development processes (see Fig. 2.1). In former approaches, the IPCC vulnerability definition encompassed issues concerning the frequency and magnitude of climate change, which clearly shifts vulnerability towards the understanding of risk in the Disaster Risk Research Community. In this regard the SREX report stresses the need to strengthen an understanding of the social construction of risk through the lens of vulnerability. Vulnerability is not a characteristic of physical phenomena; rather it is shaped by human and societal processes and patterns that are heavily influenced by different aspects of development.

In addition, Fig. 2.1 underscores that CCA needs to address vulnerability and exposure and that the respective understanding of adaptation cannot be solely based on the act of adapting to physical changes. Rather, DRR and CCA are embedded and closely linked to development processes and adaptation to climate change must, therefore,



**Fig. 2.2** Past and future exposure to floods (average physical exposure to floods assuming a constant hazard). (Source: IPCC 2012a, p. 241)

account for both adaptation needs due to changes in the physical climate as well as due to societal processes. Many adaptation strategies initially focused on different climatic conditions in the future and respective challenges for adaptation, while less emphasis was given to the question of how different scenarios that encompass societal vulnerability might look and how these scenarios generate challenges for adaptation as well.

The challenges associated with climate change adaptation that are understood in the context of development processes can for example be illustrated by using the physical exposure to floods in the future. Based on work of Peduzzi et al. (2009) the IPCC SREX report underscores that major increases in the number of people exposed to floods will be seen in Asia as well as in Africa. Although the sheer number of people exposed in Africa is significantly lower than in Asia, the percentage change in exposure from 1970 to 2030 in Africa demonstrates a four-fold increase in the number of people at risk, compared to a two and a half fold increase in Asia. However, these figures must be considered carefully; the comparison of the average physical exposure to floods in 1970 compared to the 2030 scenario is based on an estimate of population increase, while the flood hazard is assumed to be constant (see Fig. 2.2). In other words, this means that the increase in exposure in Asia and Africa is primarily due to the expected increases in population growth and migration to flood prone areas. It is important to understand that even if the flood hazard does not change, increases in disaster risk are likely to materialise due to the increase in exposure linked to overall development patterns in Asia and Africa. If the increasing exposure is combined with a reduction in susceptibility, risk might remain the same or even decline. Both DRR and CCA have, so far, paid insufficient attention to the question of how macro-development trends, such as demographic changes and migration trends which have a considerable bearing on current exposure and future risk profiles, should be dealt with and can be addressed by different governance systems.

Linking CCA and DRR therefore requires an improved knowledge base describing how development trends influence disaster risk through vulnerability and exposure patterns over time (Schipper and Pelling 2006). In addition, attention needs to be paid to how DRR strategies and CCA concepts can influence development processes.

### 2.2.2 *Areas of Common Concern*

The IPCC SREX report clearly underscores that there is a wide range of complementary approaches spanning adaptation and risk reduction. Common entry points are, for example, linked to concepts and goals such as resilience building, the reduction of social vulnerability and the maintenance of healthy social-ecological systems. In this regard, both CCA strategies, such as National Adaptation Programs of Action (NAPAs), and programmes in DRR aim to improve preparedness and risk reduction initiatives and to inject adaptation to climate change into recovery and reconstruction processes following disasters. In addition, specific tools such as risk transfer mechanisms are mentioned as well as the more general goal of transformation (see Fig. 2.3).

While the IPCC SREX report and programme of the United Nations Framework for the Convention on Climate Change (UNFCCC) on Loss and Damage clearly refer to conceptual issues at the international level, several countries have adopted practical approaches to CCA and DRR at the national level. For example, the NAPAs provide a process for Least Developed Countries (LDCs) to identify areas in which urgent activities and projects are needed in order to adapt to climate change<sup>1</sup>. In developed countries in the north several major documents regarding national or sub-national adaptation programmes have been published. Examples include the German Adaptation Strategy (DAS) to Climate Change (2008) and the United Kingdom Climate Impacts Programme (UK-CIP) which was established in 1997 (see UK-CIP 2009). Whereas the German Adaptation Strategy, DAS, describes the effects that climate change might have on different societal sectors and suggests possible adaptation measures, the UK-CIP emphasises a cooperative effort with the scientific community to develop climate change scenarios. The UK-CIP also provides a tool for use by companies and organisations to assess their respective exposure to climate change and to derive individual adaptation and prevention measures based on the findings.

In spite of the practical approach of these national programs, DRR, as understood in the context of climate change and extreme events, often remains underdeveloped, particularly in terms of improved linkages between institutions and organizations responsible for CCA and those responsible for DRR. Although DRR was identified as an urgent problem by many of the LDCs, only 24 of the 38 LDCs that have submitted their NAPAs to the UNFCCC so far have called for immediate action in the field of disaster management and early warning. Of these 24 countries, only seven requested funding for projects that included capacity building and the development of preparedness measures (UNFCCC 2010). All other countries called for structural or technical measures (e.g. early warning systems) that primarily focus on natural hazards detection, rather than on broader policies, strategies and measures tied to DRR.

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<sup>1</sup> The process of the development of NAPAs was initiated during the UNFCCC COP 7 conference in Marrakesh in 2001 and is funded by the least developed countries fund, which is based on voluntary contributions from developed countries and managed through the Global Environmental Facility.



**Fig. 2.3** Adaptation and disaster risk management approaches for reducing and managing disaster risk in a changing climate. (Source: IPCC 2012a, p. 6)

In addition, Strategic National Action Plans (SNAP) have been developed and in some cases approved based on recommendations found in the Hyogo Framework. Example plans include those of the Philippines, the Maldives and Cambodia (see National Committee for Disaster Management 2009 (Cambodia); National Disaster Coordinating Council of the Philippines 2009; Office of Civil Defense and National Disaster Coordinating Council of the Philippines 2009; UN/ISDR and World Bank 2009; UN/ISDR 2009). In the case of the Philippines, the NAPA and the SNAP are considered important toolkits for dealing more effectively with disaster risk and threats related to climate change (see Birkmann and von Teichman 2010). While the Philippines plan represents an important tool, it only contains a few DRR indicators that would allow for the evaluation of the plan's implementation over time (Benson 2009, p. 45). Within the German Adaptation Strategy (DAS) DRR is mentioned as one cross cutting issue—besides spatial planning—that should support adaptation processes in terms of facilitating risk communication and developing guidelines on preventive measures for businesses, especially those responsible for critical infrastructures (CIs). Besides these conceptual approaches there are no concrete suggestions on how to create effective synergies between CCA and DRR in practice, for example with regard to joint funding mechanisms. The same is found with respect to the UK-CIP. It only refers to flood risk as a topic to be linked with CCA, but no concrete measures are proposed.

Developing countries have also launched their own initiatives and national adaptation programmes, including, for example Indonesia and Vietnam (see Republic of Indonesia, State Ministry of Environment 2007; Socialist Republic of Vietnam 2008). While a general consensus seems to exist that linking CCA and DRR would be beneficial, the challenges associated with developing effective integrative processes at the national level remain due to mismatches between CCR and DRR and different or even uncoordinated responsibilities across ministries. A workshop in Hanoi in 2012 on the occasion of the national launch of the IPCC SREX report showed, among other issues, that the two ministries responsible for DRR and CCA in Vietnam still face major challenges in communicating and cooperating with each other. The lack of cooperation between different ministries and agencies involved in DRR and CCA is often an important barrier that hinders the realisation of practical synergies between both fields in various countries.

At the local level it often appears equally difficult to effectively take advantage of synergies between both fields. For example, the opportunities that disaster recovery and reconstruction processes offer as a catalyst for change (Birkmann et al. 2009a; Birkmann and Fernando 2008), including the development of climate-proof structures in the aftermath of an extreme event, is not sufficiently taken into consideration. The reconstruction of coastal areas affected by the Indian Ocean Tsunami in Sri Lanka and Indonesia is an example of this missed opportunity. However, various local communities often view risk reduction to extreme events, CCA and resilience building as three interconnected fields that need to be addressed simultaneously in order to improve the livelihood security of communities and people at risk.

Additionally, climate change-related risks are hardly considered when designing new standards for protection systems (e.g., early warning, dyke systems, etc.) and urban redevelopment (e.g., housing standards, urban planning after a disaster). A focus on a single hazard and on experiences drawn from the past often dominates the thinking of technical experts and collective action, whereas wider aspects of climate change adaptation-including scenarios for vulnerability—are rarely addressed (see Birkmann and von Teichman 2010; Birkmann et al. 2013).

Even though the IPCC SREX report was an important contribution to an improved level of cooperation between the DRR and CCA communities, including the identification of various areas for further cooperation and synergies—as outlined in the first part of this chapter—the existing shortcomings and persisting mismatches between DRR and CCA need to be identified and dealt with in specific contexts or case studies at various levels in order to ensure a more effective and in-depth cooperation between DRR and CCA in the future. The following sections will analyze the reasons for these shortcomings in more detail.

## 2.3 Major Challenges and Gaps Between DRR and CCA

A review of the literature, the analysis of current approaches and a series of interviews conducted with recognised experts revealed a range of practical barriers to effectively link DRR and CCA (see Birkmann and von Teichman 2010)<sup>2</sup>. The main barriers have been categorized and are described in detail in the following section. They can be categorised across spatial, temporal and functional scales; legislative, cultural and behavioral norms; and knowledge-based mismatches (see Birkmann and von Teichman 2010).

### 2.3.1 Scale Mismatches

When dealing with the development of appropriate strategies to reduce disaster risk, to respond to an actual disaster when it occurs and to develop appropriate adaptation strategies to climate change that are founded upon sound information, an understanding of differing spatial, temporal and functional scales is critically important.

#### 2.3.1.1 Spatial Scale Challenges

Mismatches at the spatial scale stem from the fact that climate change issues have primarily been analyzed on a global scale—even though downscaling approaches receive increasing attention—whereas disasters have been studied in the respective regions and localities where they occur (meso- or local/micro-scale). Climate scientists have mostly designed global models and predicted global trends based on universal laws, whereas the DRR community looks at local vulnerabilities and risks in specific areas, including groups of people potentially or actually affected. Local, down-scaled data on the effects of climate change or the localization of the impacts of extreme events in the future (e.g., heat waves, heavy precipitation, storms, floods etc.) is needed in order to facilitate the preparation of specific adaptation and DRR strategies, including scenario-based plans, to address one of the major concerns of risk reduction and adaptation managers. Climate impact forecasts regarding extreme events and scenarios regarding the effectiveness of adaptation strategies under different environmental and socio-economic conditions are uncommon at the local scale. Various impact studies tend to be designed for entire countries or regions (see German Adaptation Strategy to Climate Change 2008; Red Cross/Red Crescent Climate Centre 2007); but this is improving with some work being done to downscale global model outputs to the local level (Cooney 2012). Furthermore, vulnerability is also being considered on a larger scale as global

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<sup>2</sup> The following sections are based on the paper of Birkmann and von Teichman 2010 and complemented with additional findings of more recent reports.



vulnerability assessments such as the World Risk Index are produced (Birkmann et al. 2011; Welle et al. 2012). Thus linking CCA and DRR more effectively requires further improvements in the exchange and combination of different spatial scales on which the two communities primarily focus and act. This also requires an improved link between local adaptation and risk reduction measures with national adaptation programs (NAPAs).

To this vertical mismatch of spatial scales the horizontal spatial scale mismatch can be added, which occurs because the sources of climate change often lie in regions and countries other than those it ultimately affects. This mismatch between countries, some of whom are more responsible for climate change (e.g. developed and rapidly developing nations) and those that carry the burden of experiencing more extreme weather events, or threats to their very existence as a sovereign state (e.g. small island nations) could lead to political conflict and thus to questions of global justice and security (Huq and Toulmin 2006). Furthermore, horizontal spatial scale mismatches become increasingly visible when examining secondary effects and second order adaptation needs introduced by risk reduction and adaptation measures (see Birkmann 2011b).

### 2.3.1.2 Temporal Scale Challenges

DRR, particularly that delivered through humanitarian assistance agencies such as the Red Cross and the United Nations (e.g., UN/OCHA), as well as national donor programs, is often event-related and therefore tends to emphasize short-term interventions and procedures. Additionally, it is noteworthy that most of the countries requesting disaster aid, risk reduction and recovery support—especially after a disaster has occurred or in crisis situations—often issue work permits for such institutions and organizations for only a short period of time. In contrast, CCA strategies are (or should be) characterized by long-term perspectives that might also require the long-term presence of respective stakeholders in countries at high risk. However, the actors that promote vulnerability and risk reduction through the lens of CCA often face serious challenges (funding, work permits, access to conflict regions) when aiming to stay in such countries for the long-term. Thus, the establishment of a longer assistance timeframe and the development of supportive and enduring institutional structures that could effectively link DRR and CCA, for example in the aftermath of a crisis or disaster, are often not envisaged by the requesting country. In addition, temporal scale challenges between a short-term oriented strategy of dealing with the immediate consequences of climate related extreme events—such as air-conditioning to deal with the effects of heat waves in living spaces—and long-term adaptation and climate change mitigation goals has to be addressed more rigorously.

### 2.3.1.3 Functional Scale Challenges

Functional scale mismatches refer to the differential organisation and management of crises and adaptation by actors affiliated with different institutions<sup>3</sup> and the related distribution of responsibilities (see the discourse in the resilience community e.g., Cumming et al. 2006). Climate change issues have been tackled in various countries by the environmental ministries and meteorological services whereas disaster risk management often lies within the responsibility of the ministry of the interior, defense or development.

Tied to the challenges of responsibilities being shared across institutions, there are further challenges relating to funding mechanisms. Existing funding schemes, which are structured according to the objectives of the issuing institution or convention, hence not allowing for the integration of measures that are inconsistent with its respective scope of responsibility, provide evidence of this incoherent search for solutions. Therefore, various governmental organizations are often discouraged from including both adaptation strategies and DRR goals in their project proposals or workplans, since this would require inter-ministerial or inter-organizational coordination and cooperation that in some cases is not seen as advantageous by the respective ministry or agency.

## 2.3.2 Mismatches Regarding Norms

Norms—such as legislative, cultural or behavioural norms—decisively influence the functioning of human society as well as the interactive processes and dependencies between society and nature or within coupled social-ecological systems (Berkes et al. 2003; Folke 2006; Walker et al. 2006). It is not only individuals that are guided by certain rules, but also larger organisations and whole societies which follow standards that have been set by influential individuals or have evolved over time as a way to address new problems and seek agreed upon solutions. The different eras of climate change (see Huq and Toulmin 2006) provide an example of the dynamics that frame problems differently every time new developments become obvious and therefore new actors get involved in finding solutions. In the first era of climate change (1980s to 2000) climate change was seen as an environmental problem and the response emphasised the reduction of greenhouse gases. Even in this era, the discussion of climate change adaptation in the IPCC was seen, to a certain extent, as a threat to more rigorous climate change mitigation goals. The second era, beginning in 2000, was defined by the recognition that the effects of climate change are unavoidable and as such require humanity to adapt in the near term. As the negative impacts of climate change are primarily felt in poorer countries whereas their origin is attributed to industrialised countries, the issue of climate change was also linked to the question of “global justice” in what could be described as the third era.

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<sup>3</sup> Institutions refer to rules, norms and rights as well as the organisations that enforce them.

With the development and publication of the IPCC SREX report in 2012, a fourth era can be identified that places greater emphasis on actual cooperation and synergies between DRR and CCA in international negotiations (e.g., UNFCCC's program on Loss and Damage or the integration of climate change issues in the post Hyogo Framework discussion), national programs and local activities. However, it is still important to consider the different funding scales that these approaches and communities can access.

Overall, adaptation is sometimes seen as a cross-cutting issue that needs to be mainstreamed into other development programmes. In other cases, it is seen as a separate strand of activities that should be driven by its own set of institutions and funding strategies. In other instances adaptation is seen as an additional burden that developing agencies must now, on top of all other development sectors, integrate into their growing scope of work. In addition, indicators or metrics that could help to monitor and evaluate progress toward achieving combined adaptation and risk reduction goals are still in their initial development phase. Moreover, the different spatial and time scales which currently define CCA and DRR activities are also related to the norms of the different communities, further complicating their successful integration.

One of the most important challenges, however, is the fact that after disasters, the opportunity to rebuild in an adaptive way considering future climate change is in most cases not exploited. More commonly, infrastructure is rapidly re-built back to pre-disaster conditions and standards. This relates to the prevalent view that disasters and crises due to natural hazards and climate related events are primarily seen as a threat imposed by external forces. This perspective, including the closely associated notion of stability (as opposed to the more accurate notion of dynamism), leads to a lack of awareness and acceptance of the need to promote change, including transformative change (see Nelson 2009; Pelling 2010; O'Brien 2012).

### **2.3.3 Knowledge Mismatches**

Within the general sphere of knowledge, important barriers and constraints can also be identified. One of the core challenges in this context is the competition between different types and sources of knowledge and the weak links between different types of data and work applied by climate and risk scientists and practitioners, which hinders straightforward communication, collaboration and joint programming across larger governance networks. The failure to effectively communicate scientifically acquired knowledge about climate change in a practical way and the lack of substantial guidance on how to deal with uncertainty provide major challenges for practitioners. An important aspect of knowledge (referred to as guiding knowledge) is an awareness of the limits of our knowledge and hence, the necessity to make decisions under conditions of uncertainty and possible surprise. Alternative ways of dealing with the limits of knowledge, such as scenario based planning and policy making, are not sufficiently discussed between both communities and are

only just emerging as issues in both research fields. Furthermore, some important information is not yet available. For example, social and economic census data in addition to data on governance issues, especially in dynamic areas with high fluctuations of people and economic as well as political instability, would be essential in order to assess changing vulnerabilities and develop appropriate adaptation strategies. However, appropriate methodologies to detect such changes and transformations as well as the databases are not sufficiently developed yet. The development of scenarios for vulnerability at different scales might be a promising first approach to better account for potential dynamics in socio-economic conditions and in societal vulnerability.

In addition, the use of local and indigenous knowledge needs to be improved. For example, deep, locally held knowledge also reveals much about the capacities of local societies that might be difficult to assess from the outside. In other cases indigenous knowledge might also be marginalised by so-called technical experts in policy processes. Local and indigenous knowledge needs to be valued and considered in DRR and CCA. Local and indigenous knowledge is, however, often based on experiences in the past and hence may be insufficient for addressing new challenges or new hazards linked to climate change. Overall, the systematic consideration of different knowledge types is important and a pre-requisite for inclusive adaptation and risk reduction strategies.

## 2.4 Recommendations

Based on the discussion of selected key findings of the IPCC SREX report (IPCC 2012a) and the challenges identified for linking CCA and DRR along the categories of scale, norms and knowledge, a range of recommendations have been formulated and are discussed next.

While linking CCA and DRR concepts and strategies, it is important to utilise the synergies between both communities and approaches resulting in more effective disaster risk management in the context of climate change. However, as the IPCC Special Report SREX points out, this can only be achieved by an appropriate framing of the problem that takes into account the wider implications of climatic changes, particularly of climate variability and anthropogenic climate change, and their impacts on certain hazards and environmental stressors. This needs to be done from the outset.

In addition, adaptation and risk reduction strategies must be grounded on sound data tied to the vulnerability and exposure of societies, communities and social-ecological systems. In this context vulnerability and exposure also have to be viewed and understood within the broader context of development processes and interactions between DRR and CCA. Consequently, linking DRR and CCA depends on the acknowledgement of the importance of climate change and societal changes and the interactions between the two.

Compared to the conceptual linkages and the joint research reports of the DRR and CCA communities, such as the IPCC Special Report SREX, the actual cooperation between agencies and ministries responsible for DRR on the one hand and CCA on the other is often limited. Finding appropriate mechanisms to stimulate and improve the cooperation between different ministries and agencies responsible for DRR and CCA is essential. Cooperative agreements would benefit from a situation where criteria and funding for adaptation and risk reduction programmes required collaboration among DRR and CCA stakeholders and agencies. The new UNFCCC program on loss and damage, for example, could facilitate such a process if respective criteria and joint activities between different ministries or agencies were a prerequisite for funding.

Beside these points, important challenges remain with regard to spatial, temporal and functional scale mismatches. Discussions of these issues are found in DRR political science literature and agenda setting literature. This literature points towards the need for a more efficient way of combining different adaptation strategies and DRR at different spatial and temporal scales. For example, it is questionable to fund mainly national adaptation programmes, if one of the key factors that contribute to vulnerability is the failure of governance at the national level. Particularly, countries which face major challenges due to climate change and extreme events, such as Somalia or Haiti, for example, would clearly have to be targeted differently. Involving local and national stakeholders and decision-makers in such programmes will be essential in order to enhance the effectiveness and coherence of risk reduction and adaptation strategies across spatial scales. Temporal scale mismatches can be minimised if respective strategies and programmes for adaptation, risk reduction or both include different timescales and clearly define different targets for different periods. Many adaptation strategies reviewed so far, often lack a management oriented goal and strategy discussion. This means that targets are often not systematised into different time phases or time horizons. Improving the consideration of different timescale and different actors at different spatial scales requires new or modified governance approaches for adaptation and risk reduction.

In order to ensure that strategies for DRR and CCA span different timescales and spatial scales as well as recognise different types of knowledge, it is essential to also modify and re-direct adaptation and DRR funding mechanisms. For example, more flexible DRR-funding, to include the opportunity to utilise the money received for a specific disaster to implement medium- and long-term adaptation strategies, is needed. In addition, funding for adaptation strategies and measures should not be based on the individual strategy alone, but should include a procedural requirement linking different actors at different scales while considering the benefits and costs of the adaptation measures at different temporal scales. Inclusive adaptation strategies and respective funding mechanisms would also need to provide incentives to bring together different types of knowledge, such as expert and indigenous knowledge and to evaluate potential commonalities and conflicts. Various structural adaptation measures in the past and at present focus mainly on the adjustments to physical processes, without the consideration of how these measures might affect the adaptive

capacity of different groups in the long-run. Consequently, the adaptiveness of adaptation strategies and measures should be a part of integrated plans.

Finally, one has to address mismatches between governmental/formal adaptation strategies and norms on the one hand and non-governmental/informal adaptation strategies and norms on the other. It would be naïve to assume that such divergences between different norms could be easily eliminated. Our recommendation would be to first identify and reveal these mismatches between different norm systems in order to create a basis from which to address them. At present many governmental adaptation strategies, such as relocation or the development of hard physical infrastructure often neglect the potential and actual conflicts of these measures with the norms of individual households and other relevant stakeholders. Developing procedures that enable these issues to be addressed in an inclusive manner would allow the coherence and coordination of different adaptation and risk reduction strategies as well as underlying norm systems to be improved.

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