Climate change adaptation and disaster risk reduction: Overview of issues and challenges

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CHAPTER 1

CLIMATE CHANGE ADAPTATION AND DISASTER RISK REDUCTION: OVERVIEW OF ISSUES AND CHALLENGES

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INTRODUCTION

Due to rapid industrialization and urbanization in different parts of the world over the past several decades, there have been serious effects on climate. Available observational evidences indicate that regional changes in climate, particularly fluctuations in temperature and rainfall, have already affected a diverse set of physical and biological systems in many parts of the world. International communities have tried to respond to these changing phenomena by establishing high-level Intergovernmental Panel on Climate Change (IPCC). Numerous global treaties and protocols have been formulated on climate change in different countries. However, climate change impacts are found to be most severe in the grassroots-level community, in the form of natural disasters such as droughts, floods, and typhoons/cyclones, which affect the lives and livelihoods of people. Indirect impacts of climate change are observed in the form of increasing poverty and health issues in different ecosystems. Although communities are

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equipped with traditional knowledge and wisdom, new practices and policies are required to enable them to cope with the changing climate, thereby providing them with means to sustain their livelihoods.

Climate change is a reality that few scientists question these days. The evidence of global warming spurred by human activities is overwhelming (Uitto & Shaw, 2006). There are, however, significant uncertainties about its impacts. Possible impacts vary considerably from place to place and go far beyond simply higher average temperatures or rising sea levels that will leave low-lying coastal areas and small islands particularly vulnerable (Pelling & Uitto, 2001). Rainfall patterns are likely to change, causing droughts in certain areas and floods in others. Evidence shows that there is a tendency for heightened extremes, whereby the already wet areas are becoming wetter, while arid areas are becoming increasing dry (Dore, 2005). While the mean annual rainfall may not change substantially, it is possible that rain will be concentrated in shorter periods of time, separated by longer dry spells in between. Such changes may have dramatic effects on agriculture and food production. In coastal areas, there is some evidence that storm intensity may be on the increase because of increases in sea surface temperature, although the evidence is still inconclusive (Webster, Holland, Curry, & Chang, 2005). On the other hand, in mountainous regions the horizontal zonation of vegetation makes biodiversity and agriculture particularly vulnerable to even small changes in climate. While we can now predict climate change with some degree of accuracy on the global scale, the uncertainties increase as we move to regional, national, and local levels. Similarly, the feedback loops in climate are so complex that even powerful computer simulations produce unreliable results over longer time horizons and smaller geographical scales.

Climate change has brought new risks for humanity. It is important to understand the nature of these risks, where natural and human systems are most vulnerable, and what may be achieved by adaptive responses. Adaptation to climate change has the potential to substantially reduce many of the adverse impacts of climate change through enhancing the capacity of governments and communities to withstand the climate change impacts. While climate change adaptation (CCA) has been discussed over several years in past, including organizational response, little attention has been focused on community-level adaptation and integrating community adaptation methods at the policy level.

Since some of the worst sufferers of climate change are rural communities (Shaw, 2006), whose livelihoods are dependent on agriculture, it is important to focus on the impacts of climate change on their livelihoods

and re-establish the links among poverty, defined as stable purchasing power to maintain decent living, livelihood, and environment. However, focusing on communities is not enough; so long as the community initiatives do not become part of the government policies, it is difficult to sustain their efforts, which means that the emphasis should be from both ends. Perhaps, the most important prerequisite for creating sustainable livelihoods and for achieving sustainable development is good and accessible government. Thus, the link between local, state, and national governments to the community is of utmost importance.

CLIMATE CHANGE ADAPTATION

The IPCC defines adaptation as adjustments in ecological, social, and economic systems in response to actual or expected climatic stimuli and their effects (Smit et al., 2001). It includes adjustment to moderate harm from, or to benefit from, current climate variability as well as anticipated climate change. Adaptation to climate change is a broad concept that addresses a wide range of events with different time horizon. Many of slow-onset events, risks, and negative consequences, such as incremental sea-level rise and salinization, loss of water resources, gradual changes in ecosystems and habitat loss, species extinction, loss of agricultural production, and health thread triggered by variations in temperature, are not associated with disasters, while many negative impacts of extreme events, such as intensified hurricanes and floods, are associated with climate-related disasters. Frequent occurrence of climate-related disasters has repeatedly threatened to derail efforts of sustainable development and long-term achievement of the United Nations Millennium Development Goals.

Schipper and Burton (2009) made an excellent review of the evolution of the term adaptation, from its inception by UN Convention of Climate Change Adaptation (UNFCCC) in 1992. They emphasized that adaptation has a long history in the ecosystem and human sciences; however, it is only recently that the scientists and growing number of policy makers have begun to grapple with how humanity can actually adapt in a planned and strategic way as the climate that the life depends on changes. Burton (2009) has argued the political negotiations for deconstructing and reconstructing adaptation by exemplifying the UNFCCC negotiations to take out adaptation from the discussion due to growing sentiment on softer approach of negotiation (by focusing on adaptation) and lack of clarity on how the developing nations might use adaptation as negotiation tool. However, the

adaptation reemerged through the third assessment report of IPCC. In their book, Schipper and Burton (2009) gave a logical flow between theory, definitions of vulnerability, resilience, relation to disaster risks, and development and linkage to climate change policy.

Leary et al. (2008) stated that adaptation can be a specific action (e.g., a farmer switching one crop to another that suits better the changed environment), systematic change (e.g., diversifying rural livelihoods), or an institutional reform (revisiting water reform and land ownership). Adaptation can be product as well as process. Leary et al. (2008) argued adaptation to be a process, which includes learning about risk, evaluating response options, creating the conditions that enhance adaption, mobilizing resources, implementing adaptation, and reviewing choices with new learning.

Adaptation to climate change has the potential to substantially reduce many of the adverse impacts and enhance beneficial impacts, though neither without cost nor without leaving residual damage. While CCA has been discussed over the past several years through organizational and adaptive responses, little has been focused on the community-level adaptation and integrating the adaptation methods in the policy perspective. Needless to say that international interventions are essential for the commitments and negotiations among the governments; however, at the community level, there is an urgent need to disseminate the impacts of climate change and its possible adaptation strategies. Adaptation occurs at different but related levels. Policies shaped by national and international circumstances set objectives to be achieved at local and regional levels. Individual and organizations, however, do not operate in isolation. Interpretation of information and its translation into decisions and behaviors are affected by social context, individual characteristics, and direct experiences. In other words, adaptation is a multiscalar process of multilevel governance, concerned with the interactions of individual and collective behaviors acting from the bottom-up and top-down in response to changing circumstances (Adger, Lorenzoni, & O'Brien, 2009)

DISASTER RISK REDUCTION

Disasters result from complex interactions between human and natural systems. It has been argued convincingly that there is no such thing as a purely natural disaster. Disasters only occur when a natural phenomenon—a hazard such as an earthquake or storm—affects a human population or community that is exposed and vulnerable to it. Risk is therefore a function

of exposure to the hazard, the vulnerability of people (in terms, for example, of their settlement and livelihood), and the degree to which society has been engaged in disaster mitigation activities (Uitto & Shaw, 2006). Furthermore, people's capacity to protect themselves and to cope with hazards is an important factor that needs to be recognized. This can be expressed in a simple equation, where $R =$ risk, $H =$ hazard (an extreme event or process), $V =$ vulnerability, and $C =$ capacity:

$$R = \frac{H \times V}{C}$$

The above can also be explained as $R = f(H, V, C)$, which means that risk is a function of hazard, vulnerability, mitigation, and capacity. This is a general way of expressing risk without showing the empirical relationship. There is also an argument to put mitigation in this equation (Uitto & Shaw, 2006), where risk is the factor of hazard multiplied by vulnerability minus mitigation, divided by capacity.

Disasters always have a social dimension and, whatever their cause, their effects are invariably rooted in societal processes that render certain groups or individuals particularly vulnerable to their impacts (Wisner, Blaikie, Cannon, & Davis, 2003). Disasters also have geographical and time dimensions rendering certain areas particularly vulnerable, while societal dynamics may change the vulnerability of particular areas or groups and individuals over time (Uitto, 1998). While such social interpretations of disaster are not new (e.g., Burton, Kates, & White, 1978), they have become more widely accepted and increasingly sophisticated over time (e.g., Hewitt, 1997; Pelling, 2003; UNDP, 2004). A number of studies have accordingly addressed the issue of vulnerability assessment (e.g., Adger, Kelly, & Huu Ninh, 2001; Briguglio, 1995; Downing & Patwardhan, 2004; Luers, 2005; Shea & Shubbiah, 2004).

The UN World Conference on Disaster Reduction (WCDR, 2005) has reviewed the current trend in disaster risk management and recognized the need for community-based approaches. Communities worldwide have coexisted with disasters from the earliest of times. Their mechanisms for coping with natural disasters have protected and nurtured the very existence of their civilizations. Therefore, their indigenous knowledge and methodologies should be considered and, where appropriate, adopted and imparted to reduce disaster risks at the global level.

Decentralization in disaster management is considered to be another important aspect that emphasizes the capacity enhancement in the local governments. Multisectoral and multistakeholder partnership in disaster

management is a crucial concept in the course of promoting integrated disaster management at all levels. Partnerships have facilitated holistic approaches to disaster management involving all constituents. Such partnerships have also helped to reduce redundancy and duplication of disaster management efforts, whereby cooperation and collaboration have been achieved.

As more researches on development are conducted in various fields, the approach to disaster mitigation is becoming increasingly community based (Blaikie, Cannon, Davis, & Wisner, 1994; Mileti, 2001), and much more effort is being put into incorporating disaster management aspects into the holistic development of communities (Twigg & Bhatt, 1998; Shaw & Okazaki, 2003). Maskrey (1989) has rightly pointed out that disaster management should not be treated as one single issue but should be incorporated into the socioeconomic activities of local people. The rationale for community involvement or community-based activities is now well rehearsed (Twigg, 1999). Because community-based activities and organizations are rooted deeply in the society and culture of an area, they enable people to express their real needs and priorities. This allows problems to be defined correctly and responsive measures to be designed and implemented. Twigg also argues that since the existence of community-based organizations allows people to respond to emergencies rapidly, efficiently, and fairly, available community resources (even where these are limited) will be used economically. Maskrey (1989) pointed out that "top-down" programs in which communities are not involved tend not to reach those worst affected by disaster and may even make them more vulnerable. This is found to be similar in developing and developed countries, as argued by Shaw and Goda (2004).

It has been observed that effective and successful disaster reduction initiatives and responses are often attributed to the spontaneous participation of communities and the people affected (Shaw & Okazaki, 2003). There are two key challenges to community-based disaster management: first, to ensure the sustainability of its initiatives, and second, to integrate them into local development policies. These challenges are obviously two sides of the same coin, in which both aims to ensure a continued and systematic approach that sees disaster risk reduction (DRR) as a central dimension of local development. Tools are currently being developed that seek to facilitate this integrated level of community-based disaster management (e.g., Shaw & Okazaki, 2004), but more needs to be done. In particular, the risk from climate change and the need to assist communities to adapt to its impacts pose new and additional challenges. We argue that the practical field-level experiences gained in grassroots disaster management can provide valuable lessons for incorporating climate risk into development plans.

CLIMATE CHANGE ADAPTATION AND DISASTER RISK REDUCTION

There are increasing trends of disaster risks over time. Fig. 1 shows an increasing trend in hydrometeorological disaster. Due to increase in hydrometeorological events over time, climate change is often related to the disasters. However, climate change is not the only reason for it. The disaster impacts are results and manifestation of complex issues of larger environmental changes, social changes, economic changes, to name a few among many. Disasters show the vulnerability or weak part of the society and system. Since disasters are visible, it is argued that disasters played important roles in bringing climate change to general public. From a practitioner's and policy perspective, it has been argued that adaptation to climate change should include adaptation to climate variability and extremes (Schipper & Burton, 2009).

CCA and DRR, though broadly understood to be linked in some ways, have not yet been taken as a holistically linked complementary set of actions that require collaborative and coordinated action by all concerned stakeholders. The significance of CCA–DRR synergy cannot be felt more by vulnerable communities who do not feel the impact of climate change or natural disaster sectorally, but it hits them as a combined whole

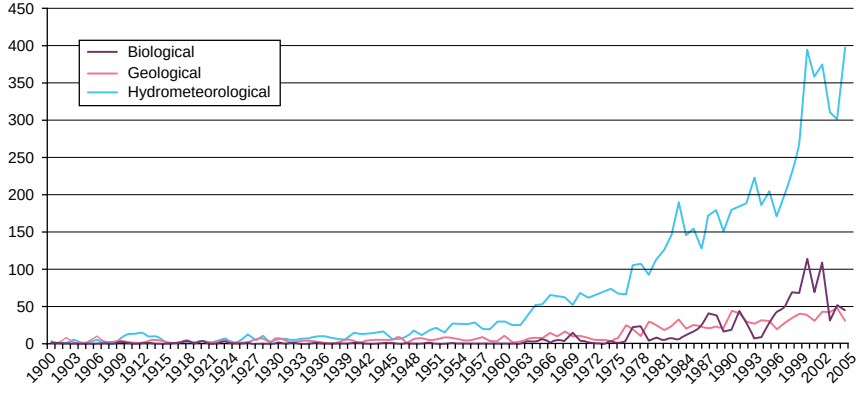

Fig. 1. Trends of Natural Disasters. *Source:* UN ISDR Prevention Website: http://www.unisdr.org/disaster-statistics/occurrence-trends-century.htm; EM-DAT: The OFDA/CRED International Disaster Database – www.emdat.net – Université catholique de Louvain – Brussels – Belgium.

with devastating effects. It needs to be appreciated that a piece-meal, sectorally split approach to this complex set of problems will not bear fruit. Recent work by researchers and policy makers has thrown light on the intricate linkages between cross sectoral development activities, their impact on the environment, subsequent detrimental impacts of a deteriorating environment on human life, and the integrated approach needed to address this combined threat of climate change and disasters (AUEDM, 2010). Such an understanding can be very meaningfully deployed at various levels: from governance to voluntary action to education and can go a long way in developing community-based and environment-based resilience to climate change as well as disasters. Fig. 2 shows the evolution of the concept of CCA and DRR. CCA has got the significance and attention in 2005 in COP 11 in Nairobi, which prepared the Nairobi Action Plan. Significant attention and commitments were gained in 2007 in Bali Road Map and Action Plan, followed by 2009 Copenhagen COP 15. A consensus exists that the CCA has too much of talk, less actions. Local-level implementation of adaptation policy and action is considered to be the core of success of adaptation.

DRR evolution also shows similar trends. While in 1960s and 1970s, disasters were more thought to be extreme events and the focus was more on relief and rescue, dominated by civil defense and Red Cross. Due to strong lobbying of the professional society such as International Association of Earthquake Engineering (IAEE), United Nations designated 1990–1999 as the International Decade of Natural Disaster Reduction (IDNDR). Two major events changed the scenario of disaster field: 1994 Yokohama World Conference on Disaster Reduction and 1995 Hanshin Awaji earthquake of Kobe, Japan. A strong need of multidisciplinary approach was felt, which emphasized the focus on local governments from nation-based approaches. In 2000, UN International Strategy for Disaster Reduction (ISDR) took the charge of international advocacy and negotiations in disaster field. In 2004, Indian Ocean tsunami brought the disaster field into high political profile, and in 2005, the UN member states signed the Hyogo Framework for Action (HFA: 2005–2015) as the action program for 10 years. Development agencies also expressed their commitments by establishing the Global Facility for Disaster Reduction and Recovery (GFDRR) with its secretariat at the World Bank and incorporating the disaster-related issues in development activities.

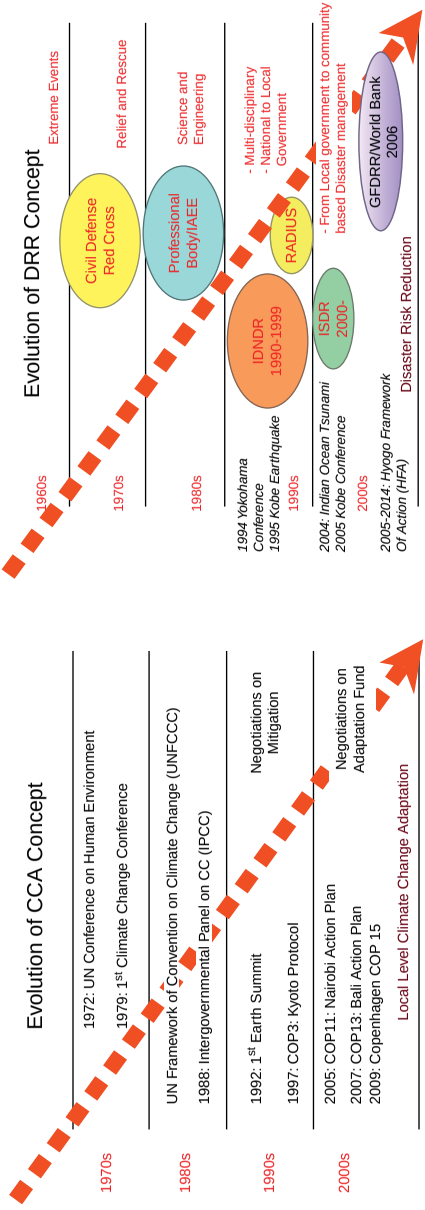

Fig. 2. Evolution of CCA and DRR Concept. *Source:* (Shaw, 2008).

COMMON ISSUES AND CHALLENGES OF CCA AND DRR

Three common issues of CCA and DRR development are increasing focus on local governments, emphasis on multidisciplinary approaches, and emphasis on theory to practice. The key challenge is how to incorporate the CCA and DRR in the local practices. Fig. 3 shows the classic example of the need of actions at local level (Takahashi, 2008). A comparative analysis of rainfall data analysis and people's perception shows the gap in understanding. While in the area called Kurigram, almost 80% of the farmers think that rainfall is decreasing, the fact is that the average annual rainfall is increasing. The reason of this gap can be explained with the local variations. To a farmer, the rainfall is the one that is required for the agriculture purposes. Monthly variation shows that there has been strong change in the monthly rainfall and the effect is that agriculture is affected. To cope with this type of changes, local adjustment in farming practices are essential. The similar approach is required for reducing the impacts of disasters at the local level.

CCA and DRR have their own positive sides, issues, and challenges. CCA and DRR do not overlap exactly. However, there are significant scopes to bring these two sectors together. One of the key differences is that the DRR approaches are mainly based on past experiences, while CCA is more on the future projections. For example, when a river dyke is made as a risk reduction measure, the deciding factors for the height of the dyke are past flood levels or rainfall data, and importance of the area (commercial, residential, industrial, or agriculture). This has been a traditional approach of DRR. However, the current DRR approach incorporates future possible rainfall in the area (with different levels of uncertainty), in addition to the above factors. This is an example where CCA and DRR overlap and come together. Adaptation can be planned (with information on future uncertainty) or autonomous (without focusing on long-term future and planning). Understanding adaptation depends on two key parameters: clarity or uncertainty of existing climate predictions and the vulnerability of a community or household to a given climate-related hazard. After examining uncertainty and vulnerability in more detail, the elements of adaptation are considered, with particular emphasis given to the role played by social networks in enabling knowledge sharing, access to resources, and influence over policy. The principal adaptation activities are identified as vulnerability reduction, building adaptive capacity, and strengthening resilience (Ensor & Berger, 2009).

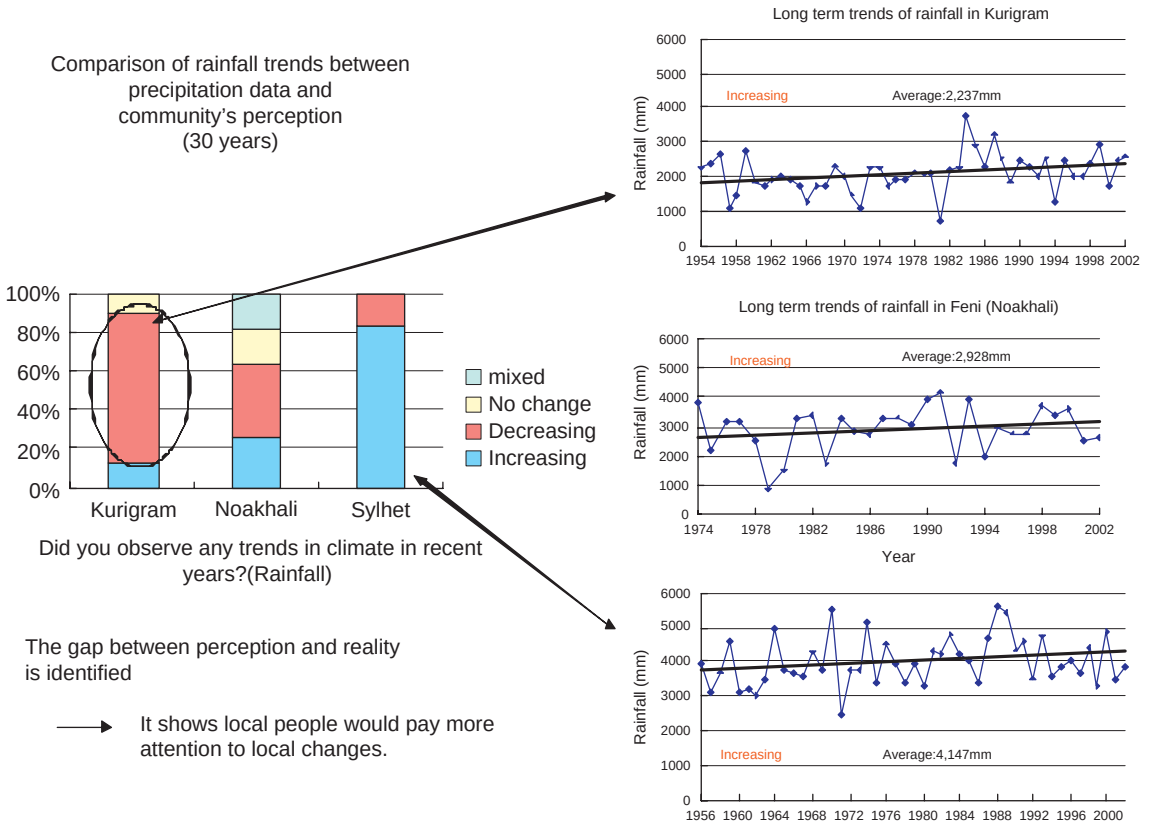

Fig. 3. Gap between Farmer's Perception and Reality in Rainfall Changes in Bangladesh.

UNDP (2002) suggested a systematic process to logically identifiable and justifiable courses of actions in specific areas, which has four core steps: scoping, building common understanding, structured reviewing of potential strategies, and financial evaluation of the costs and anticipated benefits of interventions. Following specific activities are considered useful to contribute to resilience and adaptive capacity of communities: diversification of livelihood activities, assets and financial resources, mobility and communication (ability of goods, people, information, and services), ecosystem maintenance (with basic services such as water), organization (social networks, organizations, and institutional systems), adapted infrastructures (physical structures for basic services), skills and knowledge (ability to learn and basic educational skills), asset convertibility (development of assets or markets), and hazard-specific risk reduction (early warning, spatial planning, building codes, etc.). UNDP (2002) also argued that governance plays an important role in bringing CCA and DRR closer. Social, political, and economic systems that deny groups access to key decision making are also considered important. This argument is also posed by Adger et al. (2009), where they emphasized three challenges of adaptation: ecosystem and sociological systems absorbing the perturbation as adaptation, values of adaptation (from different perspective) to be included properly in decision making, and the governance dimension of adaptation.

Leary et al. (2008) listed nine adaptation lessons: incorporate adaptation action now, create conditions to enable adaptation, integrate adaptation with development, increase awareness and knowledge, strengthen institutions, protect natural resources, provide financial assistance, involve those at risk, and use place-specific strategies. The same lessons are equally applicable to the DRR field, when it is seen though the lens of Hyogo Framework for Action (HFA, 2005): ensure that DRR is a national and a local priority with a strong institutional basis for implementation (institutional issue); identify, assess, and monitor disaster risks and enhance early warning (risk assessment); use knowledge, innovation, and education to build a culture of safety and resilience at all levels (education); reduce the underlying risk factors (links to development); and strengthen disaster preparedness for effective response at all levels (emergency response).

STRUCTURE OF THE BOOK

With the above context of adaptation, this book very specifically focuses on CCA and DRR issues through different examples. The book is divided into

four parts: *Part 1* focuses on the theory of CCA and DRR and its enabling environment, with four chapters (Chapters 2–5); *Part 2* focuses on governance, education, and technology as the framework of CCA–DRR linkage with three chapters (Chapters 6–8); *Part 3* focuses on different entry points with five chapters (Chapters 9–13); and finally, *Part 4* focuses on regional perspective of CCA and DRR with four chapters (Chapters 14–17) (Fig. 4).

In *Part 1*, four chapters have a unique focus on: CCA–DRR linkages, UNFCCC framework, post-Kyoto climate regime, and enabling environment. In *Chapter 2*, Kelman and Gaillard have argued that global changes to the climate have dominated much policy and practice regarding how to deal with large-scale environmental changes. Under the name of CCA, the domination has led to the reinvention of many approaches that were known already. Through a discussion of vocabularies used by CCA and DRR along with the research and policy role of each, practical implications for work on the ground are discussed, focusing on flood risk reduction. The chapter concludes that the appropriate framework to implement is DRR embedded within wider sustainability, development, and environmental management processes, a framework that includes CCA embedded within DRR.

Chapter 3 by Kato explores how issues related to DRR have been addressed under UNFCCC since its adoption up to deliberations on the post-2012 climate change regime. The first section provides an overview of the Convention provisions for DRR within the context of adaptation, as well as the evolutionary profile of negotiations on adaptation over time. The second section describes ongoing processes and programs on

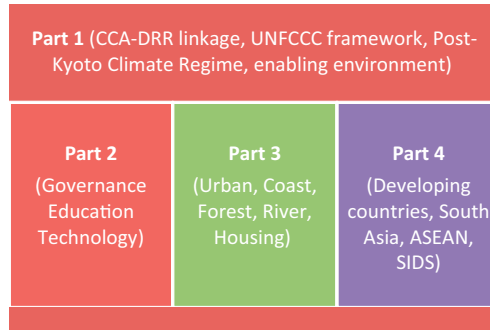

Fig. 4. Structure of the CCA–DRR Book.

adaptation under the Convention with particular focus on the Nairobi work program on impacts, vulnerability, and adaptation to climate change (Nairobi work program). The third section highlights the gaps, needs, and challenges in enhancing climate-related risk management in the context of adaptation. Finally, the chapter concludes by summarizing some of the opportunities for further work proposed by Parties to the Convention to overcome challenges in enhancing adaptation efforts to ensure integrated approaches for adapting to climate change.

Chapter 4 by Prabhakar assesses the role of future climate regime under UNFCCC in promoting adaptation to climate change through supporting DRR initiatives. The chapter concludes that there are synergies between CCA and DRR through promoting risk insurance, enhancing adaptation governance, and providing additional finances.

Chapter 5 by Phong and Tinh emphasizes the importance of enabling environment for changes in institutions, markets, political relationship, and public services. It argues that it is essential to understand the nature of local governance and market relationships before undertaking grand efforts to change them. A balance between local actors in development planning and need-based decision making is important for undertaking decisive actions.

Part 2 focuses on the framework of CCA–DRR through emphasizing the governance, education, and technology in three chapters. *Chapter 6* by Lebel et al. focuses on adaptive governance with specific focus on water and disasters. Through analyzing DRR and water resource management systems, the chapter focuses on elements of adaptive governance and persistent barriers. The chapter argues that in the changing climatic condition, it will be important to focus on risks related to water and disaster management, which provides scopes of adaptation. Climate-related disaster provides an entry point for CCA policies.

Chapter 7 by Bonifacio et al. illustrates an important dimension of CCA education and its linkages to DRR education. Providing illustrative examples of school education, the chapter shows that the curriculum changes and updates, focusing on community-based education outside the school boundaries and training and capacity development of teachers and education boards, are important elements of sustainable education in CCA–DRR. The chapter also argues that the education should be linked to other ongoing educational frameworks like Education for Sustainable Development (ESD), Education for All (EFA), and Millennium Development Goals (MDG).

Chapter 8 by Joshi et al. focuses on other dimension of the framework, technology for CCA–DRR. The chapter argues that teleprocessing with

better spatial and temporal coverage of climate data and efficiency of extraction of information, processing, and dissemination to the community and mitigation agencies should be developed for risk and vulnerability assessment studies. The chapter also emphasizes that continuous monitoring, evaluation, and enhancement of climate change modeling techniques can be used for preparing disaster inventories and enhancing early warning systems.

Part 3 consists of five chapters as the entry points of CCA and DRR: urban, coast, forest, river, and housing. *Chapter 9* by Joerin and Shaw shows that urban risk management can be a possible entry point for CCA and DRR. Providing an example of climate and disaster resilience indexing of cities, the chapter provides a framework of adaptive capacity at individual, collective, and institutional levels. Policies, management, plans, good governance, decision making, and mainstreaming urban risk are the key issues of CCA–DRR synergy in urban areas at institutional level. In contrast, relocation, slum upgrading, local knowledge, social capital, and community-based adaptation facilitate collective capacities, where there are different issues of implementation at individual levels.

Chapter 10 by Chandrasekar and Krishnamurthy addresses the need for implementation of adaptation practices in the coastal region. The chapter discussed the important biophysical and social drivers of the climate change and the direct effect of each driver on the human habitat, health, and food security. Integrated coastal zone management influenced by the social and biophysical drivers such as population pressure, coastal developmental activities (industrialization, urbanization), and climate extremes are one of the major drivers of climate change in coastal zone; some of the adaptation to be followed in the coastal zone are discussed.

Chapter 11 by Pulhin et al. shows that effective forest management can be an entry point of CCA–DRR through community-based activities. The tropical forest ecosystems including the local communities dependent on them for livelihood and survival are under great threat from various anthropogenic-related forces, including climate change. Climate change is likely to further exacerbate the already vulnerable situation of tropical forests and people in the absence of effective adaptation interventions. The chapter concludes that priority should be given toward the enhancement of climate change resilience by building the adaptive capacity of local communities and the institutions that support them (i.e., forestry agencies, local government units, and nongovernment organization) by combining technical and nontechnical adaptation measures to ''climate-proof'' community forest management.

Chapter 12 by Phong and Shaw focuses on river basin management as the entry point of CCA–DRR. Through exemplifying integrated river basin practices, the chapter argues that the objective is to optimize the use of resources in a sustainable way, protect and improve the environmental quality, minimize and mitigate negative impacts of natural disasters, impulse socioeconomic development in order to improve, and enhance living conditions of local communities. Therefore, the Integrated River Basin Management (IRBM) strategy needs to provide a framework for coordination of a wide array of interests and a direction to relevant stakeholders in order to tackle complex issues caused by conflicts in multiple uses of natural resources. The strategy directs stakeholders to rationally use the natural resources and has a clear relation with existing departmental annual development plans. The strategy aims to contribute to the economic growth rate targets proposed through the socioeconomic development plans, but also to fulfill that growth with full consideration of the limitations and challenges imposed by the provinces' vulnerable areas with respect to natural disasters and the sustainable use of the natural resources for the maintenance of a healthy environment.

Chapter 13 by Phong and Tinh focuses on the housing sector as the other entry point of CCA–DRR. The chapter argues that the CCA–DRR mainstreaming in the housing sector can be done through risk reduction through training in safer construction; incorporating design checks, enforcement, and quality control; consulting hazards and construction experts; planning land use and improving building codes for hazard resistance; improving practices; encouraging local uptake and community participation; developing guidelines for performance-based design of structures subject to natural hazards with difference recurrence, adequate operation, and maintenance expenditures; and promoting research into nonengineered structures and the effects of natural hazards, small-scale structures, structural/physical protection, and small-scale participatory planning.

Finally, *Part 4* describes the regional characters of developing countries and certain regional perspectives of South Asia, ASEAN, and Small Island Developing States (SIDS). *Chapter 14* by Ishiwatari focuses on the developing nation perspective for urban flood and CCA. Providing examples of flood risk management, the chapter points out that a combination of structural measures, collaboration with local community development, crisis management, and early warning and evacuation is required for effective flood risk management. The chapter also argues that the limited capacities of governmental institutions and staffs in developing nations are crucial issue in CCA. The chapter emphasized the need for a

no-regret policy for CCA in flood risk management, which has an implication to the cost issues for undertaking CCA measures with DRR.

Chapter 15 by Dhar Chakrabarti points out the need of CCA to be incorporated in DRR in South Asia, since the region is highly vulnerable and exposed to natural disasters. The regional efforts to mitigate the risks of disasters and adapt to the climate changes are being taken in ad hoc manners, in two parallel tracks, without much synergy between the two. In the recent months, there have been some serious efforts to integrate these initiatives. One such initiative was the South Asian Association for Regional Cooperation (SAARC) Action Plan on Climate Change and more recently a Road Map on Regional Cooperation on Climate Change Adaptation and Disaster Risk Reduction in South Asia. The chapter examines the contexts, constraints, challenges, and opportunities for these initiatives.

Chapter 16 by Uy and Shaw provides a similar analysis for the ASEAN region. The chapter describes different regional framework in the region related to the climate change and DRR. Some of them are ASEAN agreement on disaster management and emergency response, regional framework for action to protect human health from the effects of climate change in SE Asia and Pacific regions, regional CCA network, ASEAN climate change initiative, and ASEAN multisectoral framework on climate change and food security. The chapter argues that high-level government action is required for CCA, supplemented by strengthening adaptive capacity and research and information sharing on CCA.

Chapter 17 by Veitayaki addresses specific problems of CCA and DRR in SIDS. Development policies and adaptation approaches must emphasize proactive, anticipatory plans, projects, and programs. On the implementation front, the viability of long-term investments in infrastructure and development activities must focus on the sensitivity of projects to the effects of climate change and sea-level rise. Development of national expertise in specific areas should support ongoing research and experimental work. Capacity building and institutional development should be ongoing with follow-up programs. Finally, the chapter argues that SIDS needs to promote the marine scientific research in their waters, improve their own scientific capabilities, and take advantage of the assistance of regional organizations.

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