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Local Disaster Risk Management in a Changing Climate: Perspective from Central America

Tsuneki Hori
Rajib Shaw

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LOCAL DISASTER RISK MANAGEMENT IN A CHANGING CLIMATE: PERSPECTIVE FROM CENTRAL AMERICA

Vulnerable Houses in Illegal Dique Area, Cartago City, Costa Rica.
Source: Authors.

COMMUNITY, ENVIRONMENT AND DISASTER RISK MANAGEMENT VOLUME 17

LOCAL DISASTER RISK MANAGEMENT IN A CHANGING CLIMATE: PERSPECTIVE FROM CENTRAL AMERICA

BY

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ABBREVIATIONS

AyA	Instituto Costarricense de Acueductos y Alcantarillados (Water and Sanitation Institute)
CAC	Consejo Agropecuario Centroamericano (Central America Agriculture Council)
CBDRM	Community-Based Disaster Risk Management
CCA	Climate Change Adaptation
CEPREDENAC	Centro de Coordinación para la Prevención de los Desastres Naturales en América Central (Coordination Center for Prevention of Natural Disasters in Central America)
CGLR	Comité de gestión local del riesgo de desastres (Local Disaster Risk Management Committee)
CNE	Comisión Nacional de Emergencias (National Emergency Commission)
COAMSS	Consejo de Alcaldes del Area Metropolitana de San Salvador (San Salvador Metropolitan Mayor Councils)
COP	Conference of the Parties
CSOs	Civil Society Organizations
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
ECLAC	Economic Commission for Latin America and the Caribbean
ENCC	Estrategia Nacional de Cambio Climático (National Strategy on Climate Change)
EWS	Early Warning System
FTA	Free Trade Agreement
GDP	Gross Domestic Product
GIS	Geographic Information System
GMA	Greater Metropolitan Area
GTZ	Deutsche Gesellschaft fur Technische Zusammenarbeit (German Technical Cooperation)
HFA	Hyogo Framework for Action
ICLEI	The International Council for Local Environmental Initiatives
IDB	Inter-American Development Bank
IDNDR	United Nations International Decade for Natural Disaster Reduction
IMN	Instituto Meteorológico Nacional (National Meteorological Institute)
IPCC	Intergovernmental Panel on Climate Change
JICA	Japan International Cooperation Agency
LSI	Large-Scale Integration
MAG	Ministerio de Agricultura y Ganadería (Ministry of Agriculture and Livestock)
MdeT	Ministerio de Turismo (Ministry of Tourism)

MIDEPLAN	Ministerio de Planificación Nacional y Política Económica (Ministry of National Planning and Economic Policy)
MINAET	Ministerio de Ambiente, Energía y Telecomunicaciones (Ministry of Natural Environmental, Energy and Telecommunication)
MOP	Ministerio de Obras Publicas (Ministry of Public Works)
NGOs	Nongovernmental Organizations
NWP	Nairobi Work Program
PDN	Plan Nacional de Desarrollo (National Development Plan)
PNGIRH	Plan Nacional de Gestión Integrada de los Recursos Hídricos (National Plan for Integrated Water Resources Management)
PNGR	Plan Nacional para la Gestión del Riesgo (National Plan for Disaster Risk Management)
PR	Plan Regulador (Regulatory Plan)
RELSAT	Reforzamientos de Estructuras Locales y Sistemas de Alerta Temprana (Strengthening Local Structures and Early Warning Systems)
RMI	Risk Management Index
SNPRAE	Sistema Nacional de Gestión del Riesgo (National Risk Management System)
SREX	Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation
UCR	University of Costa Rica
UN	United Nations
UNA	National University of Costa Rica
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNISDR	United Nations International Strategy for Disaster Reduction
USA	United States of America

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BRIEF INTRODUCTION OF THE SERIES

COMMUNITY, ENVIRONMENT AND DISASTER RISK MANAGEMENT

This series connects academic research to field practice, strengthening the links between the environment, disaster and community. The series has been developed on field evidences and community practices, and thus provides specific guides to professionals which are grounded in rigorous academic analysis. The series has a specific focus on community-based disaster risk management, urban environmental management, human security, water community, risk communication, climate change adaptation, climate disaster resilience and community-based practices.

BRIEF INTRODUCTION OF THE VOLUME

LOCAL DISASTER RISK MANAGEMENT IN A CHANGING CLIMATE: PERSPECTIVE FROM CENTRAL AMERICA

Disasters cause direct economic as well as human losses. Disaster losses and damages have continued at increasing proportions worldwide since the 1970s. The increasing losses and damages in the world are largely due to an increase in the number of climate disasters (e.g., floods, storms, or landslides). This growing trend of losses and damages is triggered by, among other factors, global climate change. The high frequency of climate disasters intensifies vulnerability in developing countries, especially in the poverty and vulnerable local areas. The aim of this volume is to discuss effective approaches to enhance local disaster risk management (DRM) capacity of developing countries to combat increasing climate disaster impacts. This volume provides ideas and lessons on local DRM with regard to planning and practice in developing countries using a case study in Costa Rica.

PREFACE

Two experiences inspired us to begin writing Volume 17. The first experience was when we met a man in the upper river basin in Cartago, Costa Rica – this man appears in Chapter 5. He and his family owned a small farm that produced potatoes and onions with other neighborhood families. He observed precipitation data three times a day using a simple plastic pluviometer provided by the national disaster risk management authority. He recorded the data daily on a sheet prepared by the authority and submitted it periodically. The data was analyzed by the authority and used for the early warnings to the lower river basin of the city. We were curious because it was a laborious task collecting the data three times daily and in the same place for over a decade. So, when we visited him with a staff of the national authority, we asked him why he did such. His reply was simple and clear "I want to help even the illegal families in the lower river basin to prepare for any future floods." He knew the illegal communities in the lower river basin were a great problem for the city's local socio-economic development. Even though, he wanted to contribute to the people living in the lower river basin.

The second experience was when we met a housewife in a poor community in Chinandega, Honduras – this episode is covered in Chapter 2. She was a temporal local government officer and participated in a small project which elaborated on the community flood evacuation plan. When we visited her – her home looked humble, yet she was proud. She said "I enjoyed participating in the project; even poor women, children, old, educated or not, disabled and migrants, every person can participate in it. I want to help the community when floods occur; even poor people like me want to help and not just receive."

"*I want to help even illegal families*" and "*even poor people like me want to help and not just receive*" made us rethink whether national and local authorities knew these realities existed. This volume discusses effective approaches to enhance local disaster risk management (DRM) capacity of developing countries to combat increasing climate disaster impacts, especially taking advantage of the community's good will as witnessed in Cartago and Comayagua.

This book could not have been accomplished without the support from Professor David Smith, Director of the Disaster Risk Reduction Program at the National University in Costa Rica and his team, Rebeca Lazo, Juan Carlos Zamora, and Nancy Nunes, researchers of the university, who provided helpful technical support for the fieldworks. Additionally, we would like to express thanks to Mr. Douglas Salgado, director of the Department of Information Management of the National Emergency Commission (CNE), who invited us to Cartago to share the aforementioned experiences. We hope this volume will provide ideas and lessons on local disaster risk management with community participation.

Tsuneki Hori
Rajib Shaw

CHAPTER 1

INTRODUCTION

ABSTRACT

The impact of climate disasters (e.g., floods, storms, or landslides), which are generally of low intensity and high frequency, should not be overlooked in developing countries. Global experiences related to the damage due to these disasters indicate that such events can be devastating in communities that are vulnerable to hazardous impacts. Cumulative effects of climate disasters are a sign of a potential catastrophe. Moreover, the recent increase in these events poses additional issues that increase the cost of local public administration, including emergency operation and infrastructure recovery. This chapter explains key problems related to climate disasters that are increasing, particularly in the local area of developing countries, and clarifies the need to incorporate climate disaster risk reduction into public development planning and practice. The chapter also provides descriptions of the research location, approaches of the study, and the structure of this book.

Keywords: Climate disasters; low-intensity and high frequency hazardous events; local disaster risk management; climate change adaptation; 3 × 3 matrix analyzing framework; Costa Rica

CLIMATE DISASTERS

Global Trend

Spending holidays, vacations, and even ordinary days is essential for everyone's well-being and satisfaction with life. Nobody wants to be a victim of road accidents, get involved in incidents, or suffer from disasters that

disrupt life and take people away from their families. However, accidents, incidents, and disasters do occur. Natural disasters, the topic of this book, occur every year all over the world. The Emergency Events Database (EM-DAT) of the Center for Research on the Epidemiology of Disasters (CRED) reports that our planet has experienced 10,540 disasters in the last four decades (between 1971 and 2010) and that these disasters have affected more than six billion people (EM-DAT, 2013), which is nearly equivalent to the current world population. These reported disasters include only the large scale events that cause national and local governments to issue emergency declarations. Additionally, there are a huge number of small-scale disasters that might have occurred, but were reported only at the local level or not reported at all.

Needless to say, disasters cause direct economic as well as human losses. Growing literature illustrates that disaster losses, including both human and economic losses, have continued at increasing proportions worldwide (Benson & Clay, 2000, 2003, 2004; Cavallo & Noy, 2009; Charveriat, 2000; Cutter & Emrich, 2005; ECLAC, 2003; Mechler, 2004; Mechler & Kundzewicz, 2010; Munich Re, 2011; Noy, 2009; Peduzzi, Dao, Herold, & Mouton, 2009; Raddatz, 2009; Swiss Re, 2010; UNISDR, 2009a, 2011). Disaster losses due to single geological events (e.g., earthquakes, consequent tsunamis, or volcanic eruptions) are sometimes much greater in magnitude of losses and damages than attributed to climate hazardous events (e.g., floods, storms, or expense rainfall induced landslides). Despite such huge impacts due to single geological catastrophic events, increasing losses and damages in the world are indeed largely due to an increase in the number of recorded climate disasters (Fig. 1). Economic losses from climate disasters have increased 10-fold over the past 50 years (Stolton, Dudley, & Randall, 2008). Ninety percent of all loss of life associated with natural hazardous impacts between 1970 and 1999 was attributed to climate disaster events (IFRC, 2004). Due to these reasons, this book focuses on subjects related to the increasing climate disasters in recent decades and discusses effective approaches to enhance disaster risk management (DRM) capacity to combat these impacts.

"Climate disaster" in this book is defined, applying as the same of Lavell et al. (2012), as the severe alternations in the normal functioning of a community or a society due to climatic, water or hydro-meteorological hazardous events, interacting with vulnerable social conditions, leading to widespread adverse human, material, economic, or environmental effects that require immediate emergency response, including external support for recovery to satisfy critical human needs. The term climate disaster can

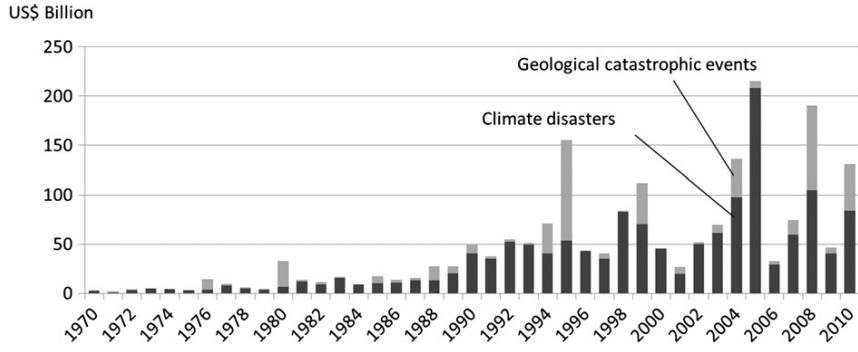

Fig. 1. Economic Losses due to Disasters from 1970 to 2010. *Source*: EM-DAT (2013).

share its meaning with other expressions used in the recent literature, for example, climate-related natural disasters (Bergholt & Lujala, 2012; Brooks & Adger, 2003), climate and water-related disasters (UNDP, 2004; UNISDR, 2008), weather-related disasters (Michaell & Ericksen, 1993), climate-driven hazardous impacts (Acosta-Michlik, Tompkins, Lemos, & Boyd, 2008), and climatic and water extremes (Handmer et al., 2012). At certain instances, this book uses the terms "climate hazardous events" and "climate hazardous risks" to differentiate from climate disasters. Climate hazardous events or climate hazardous risks are situations where there is risk that have not yet materialized as disasters (ex ante), while a climate disaster is a situation that has already happened and has negatively impacted social and economic activities (ex post).

Developing countries already at high risk from climate hazards will experience greater climate disasters and impacts to their economic and social development (Shaw, Pulhin, & Pereira, 2010; UNDP, 2004). Indeed, over 95% of deaths caused by climate disasters during the period from 1970 to 2008 have been occurred in developing countries (Cavallo & Noy, 2009). Poorer developing countries with smaller economies are likely to suffer more from climate disasters than developed countries (Hallegatte, Hourcade, & Dumas, 2007; Heger, Julca, & Paddison, 2008; Loayza, Eduardo, Jamele, & Christiaensen, 2009). The high frequency of climate hazardous events intensifies vulnerability in developing countries, especially in the poverty and vulnerable local areas (UNDP, 2004; UNISDR, 2008).

The majority of the high frequency climate disasters are indeed, small scales. Small-scale disaster is defined in this book as those in which

fewer less than 50 people are killed and fewer than 500 homes destroyed (UNISDR, 2009a). The impact of small-scale disasters in developing countries should not be overlooked (Ahmed, Diffenbaugh, & Hertel, 2009; Hardoy, Mitlin, & Satterthwaite, 2001; Hellmuth, Moorhead, Thomson, & Williams, 2007; McSweeney & Coomes, 2011; Passerini, 2000; Sperling & Szekely, 2005; UNISDR, 2009a, 2011, 2012; Zimmerman & Carter, 2003). Global experiences of damage due to small-scale disasters show that even such events can be devastating to communities that are vulnerable to hazardous impacts (Iwasaki, Razafindrabe, & Shaw, 2009; Rojas Blanco, 2006; Shaw, 2007; Sperling, 2003; Thomalla, Downing, Siegfried, Han, & Rockstrom, 2006). Moreover, cumulative effects of small-scale disasters are sign of a potential large-scale disaster or catastrophe (Birkmann, 2006; Lavell et al., 2012; Quarantelli, 1998; UNISDR, 2009a, 2011).

Are Increasing Climate Disasters due to Climate Change?

"Climate change" refers in this book to the definition of the Intergovernmental Panel on Climate Change, IPCC (2007), a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period, typically decades or longer. Reports of the IPCC have reaffirmed that global climate change exacerbates worldwide climate hazardous events (IPCC, 2007, 2012). The potential hazardous impacts associated with climate change includes: increases the intensity of extreme climate events (Dong, Xing, & Tiexi, 2011; Min, Zhang, Zwiers, & Hegerl, 2011; Shang, Yan, Gebremichael, & Ayalew, 2011; Shongwe, van Oldenborgh, van den Hurk, & van Aalst, 2011; UNISDR, 2009a, 2011); increases the frequency of non-extreme climate events (Hellstrom, 2005); and changes the pattern of tropical storms (Zhai, Zhang, Wan, & Pan, 2005). New threats such as sea-level rise are also expected to occur and will increase flood risk in coastal zones (Allen, 2006).

Fig. 2 illustrates the recent local precipitation data observed in a community of Cartago City, Costa Rica, a study community of this book. This figure illustrates the number of days that have fallen intense rains in each year, and shows an increasing trend from 1999 to 2009. This phenomenon recorded in the community of Cartago, a local data, corresponds with the IPCC's and other literature's implication, a global data. It can be said that climate change is now unequivocally an influence in the increasing frequency and intensity of climate hazardous events even at the local level.

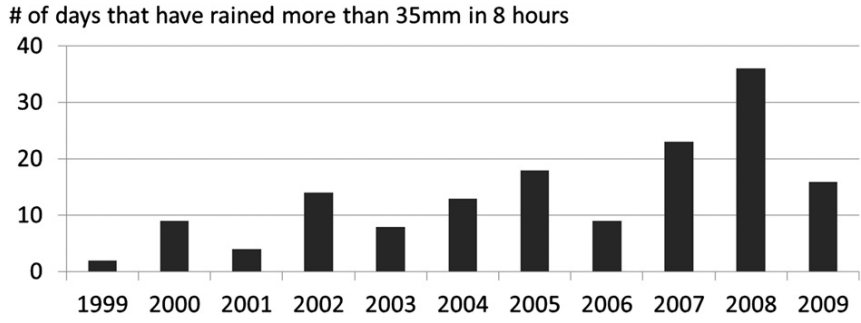

Fig. 2. Number of Days that Cartago Experienced Intense Rains. The Data Is Observed in a Precipitation Monitoring Station in Cartago. The Station Monitors Precipitations Three Times Daily. Data Is Provided by CNE (2012). Intense Rain Means the Precipitation of More than 35 mm during Continuous 8 hours, according to the CNE.

Some readers of this book might assume that climate change may be a key factor in the increase in climate disasters, especially in developing countries. However, this assumption may not always be true; others opine that climate change is not the only unique factor causing the recent increase in climate disasters. Choi and Fisher (2003), Miller, Muir-Wood, and Boissonnade (2008), and Neumayer and Barthel (2011) insist that long-term trends in economic losses have not been attributed to climate change. Economic losses due to hurricanes have not increased since the 1940s when the data is corrected considering the growth of population and wealth in Latin America and the Caribbean (Pielke et al., 2008). Climate change would not lead economic losses seriously even their effects on Gross Domestic Product (GDP) growth (Bergholt & Lujala, 2012). Overall, predictions of future impacts associated directly from climate change are indeed, still uncertain (Cox & Stephenson, 2007; Dessai & Hulme, 2004; Dessai & Wilby, 2011; Hawkins & Sutton, 2009; Knutti, 2010; Stainforth, Allen, Tredger, & Smith, 2007). Cartago City has no explicit local data that evidence a correlation among global climate change, intense local rains, and local climate disaster impacts.

Disaster in general is materialized with a combination of hazards, exposure, and vulnerability and these factors interact among each other in a complex manner (Handmer et al., 2012; IDB, 2007; Lavell et al., 2012; Wisner, Blaike, Cannon, & Davis, 2004). Overall, the majority of the reason for increasing impact due to climate disasters in developing countries is because of their rapid population and exposure growth with few effective

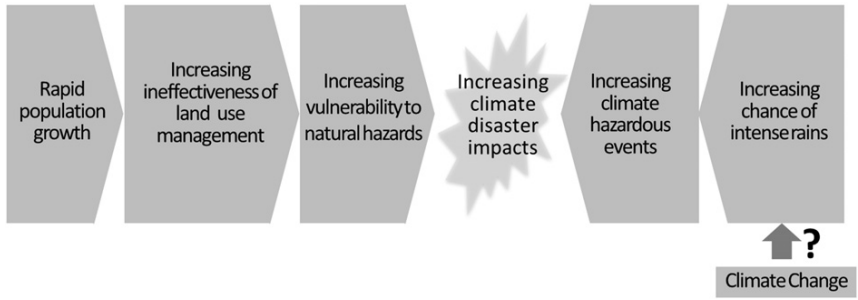

Fig. 3. Concept of Climate Disasters in a Changing Climate, Applying the Access Model Defined by Wisner et al. (2004).

land use management in the urban areas (Cardona et al., 2012; Hallegatte et al., 2011). The most relevant figures to assess disaster risk are indeed, the exposed population. Fig. 3 illustrates this concept of the possible threat of climate change as an additional cause for increasing climate disasters at the local level. This concept provides the context for understanding "Local Disaster Risk Management in a Changing Climate," the title of this book.

DISASTER RISK MANAGEMENT IN A CHANGING CLIMATE

Concept of Disaster Risk Management

The last section reviews the uncertain relationship between climate change and the increase in impacts due to climate disasters, especially in the local areas of developing countries. Efforts should be made to reduce the increasing impacts caused by climate hazardous events, whether they are caused by climate change or other socioeconomic reasons. The next question should be how to reduce potential impacts of climate hazardous events; what should national authorities, local governments, and communities do to reduce the increasing risks? This section reviews the general approach of DRM and clarifies the framework for combating impacts of increasing climate hazardous events.

The basic concept of DRM defined in this book is same as Lavell et al. (2012); as processes for designing, implementing, and evaluating strategies,

policies, and measures to improve the understanding of disaster risk, foster vulnerability reduction and risk transfer, and promote continuous improvement in disaster preparedness, response, and recovery practices, with the explicit purpose of increasing human security, well-being, quality of life, and sustainable development. DRM is a kind of policy aspects that should incorporate seamlessly into development planning and practice (IDEA, 2005). Approaches to realize this policy aspect already exist including, among others, Hyogo Framework for Action (HFA), Renn's framework of Risk Governance (Renn, 2008), and the Inter-American Development Bank's (IDB) disaster risk management indicators (RMI) (Carreño, Cardona, & Barbat, 2007; IDB, 2007; IDEA, 2005).

HFA, endorsed by the member countries of the United Nations in 2005 includes the following five priorities: (i) making disaster risk reduction (DRR) a policy priority, institutional strengthening; (ii) risk assessment and early warning systems (EWS); (iii) education, information, and public awareness; (iv) reducing underlying risk factors; and (v) preparedness for effective response. Renn's Risk Governance framework consists of four phases: (i) pre-assessment; (ii) appraisal; (iii) characterization and evaluation; and (iv) management. IDB's RMI comprises four components including (i) risk identification; (ii) risk reduction (prevention and mitigation of the risk); (iii) disaster management (preparing for eventual disasters); and (iv) governance and financial protection. These policy frameworks commonly emphasize its importance of proactive (or ex ante) measures to reduce vulnerability to natural hazards. Natural hazards, including climate hazardous events, are uncontrollable factor, thus managing disaster risk mainly focuses on reducing socioeconomic vulnerability (Lavell et al., 2012; UNDP, 2004; Wisner et al., 2004). This book agrees on the idea of prioritize proactive measures to reduce the increasing risk.

There is other term that shares the concept of DRM: DRR. This book refers DRR by the definition of UNISDR (2009b) as the concept and practice of reducing disaster risks through systematic efforts to analyze and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events. The concepts of these two terms, DRM and DRR, are crossing borders (Lavell, 2009), and the determination to use either depends on policy decisions in each region, country, local area, and institutional organization. This book unifies the use of the term DRM in all cases. However, Chapter 6 specifically addresses the concept of DRR at the individual action level.

Local Disaster Risk Management

DRM requires coordination among a variety of different stakeholders, including individuals and entities at the international, national, and local levels, as well as expects cooperation among all of them (Cutter et al., 2012; Renn, 2008). This book focuses on local areas in developing countries, where the impacts of climate disasters have increased in recent decades. "Local" or "local area," in this book, refers to a geographical area where a municipality administers the public law and regulations, guarantees safeguards, and provides public services. Although this book focuses on local or local areas, national and international level cooperation are still required to enhance local DRM capacity.

Moreover, initiatives for social groupings, experiences, managements, institutions, conditions, and sets of knowledge exist at the sub-national scale (Cutter et al., 2012). Local areas should have their own local capacity that accumulates the strengths, attributes, and resources available to an individual, community, society, or organization at the local level. Local capacity, powered by communities and individuals, should be effective in achieving local development goals (Lavell et al., 2012); their actions may provide an opportunity to enhance the local DRM capacity (Shaw, 2006; Subbiah, 2002).

In summary, local DRM capacity should be reviewed from the following three perspectives: (i) the local area perspective, (ii) perspective of the national and international capacities that may complement or support local implementation capacity, and (iii) perspective of the individuals and communities that may enhance local DRM capacity. Applying these criteria, Fig. 4 illustrates the basic concept of this book, that is, the need to enhance local DRM capacity.

Local DRM in developing countries has been initiated in recent years (Birkmann, Tetzlaff, & Zentel, 2009; Few, Osbahr, Bouwer, Viner, & Sperling, 2006; Lavell, 2009). Despite this limited experience, available literature reports empirical opportunities and challenges relative to these climate hazardous events. Overall, the local jurisdictional level is a small but critical scale at which to reduce the impacts of climate hazardous events, in contrast to the scale at which the national government controls DRM for the entire country (Bai, 2007; Hewitt, 1983, 1997; Lavell, 2003; Maskrey, 2011; Osman-Elasha, 2006; van Aalst, Cannon, & Burton, 2008; Wisner et al., 2004). Additional theoretical opportunities to enhance local DRM capacity in developing countries found in available literature can be summarized as follows.

Fig. 4. Basic Concept of This Book – The Need to Enhance Local DRM Capacity.

DRM Affinity with Local Development Agendas

Historically, DRM at the local level has conventionally dealt only with extreme events with the support of national authorities (Cutter et al., 2012). However, recent, frequent small-scale climate hazardous events have forced local decision makers to be concerned additionally with small but urgent local problems (O'Brien et al., 2012; Tang, Brody, Li, Quinn, & Zhao, 2011). This awareness among local decision makers may result in additional local job opportunities, infrastructure investment, and economic development (Lindseth, 2004). Furthermore, it may increase the coordination among different local institutions for incorporating climate hazardous risks into local development planning as a single, local, sustainable development agenda (Sperling & Szekely, 2005).

Active Community Participation

Successful efforts to reduce impacts of climate hazardous events are locally steered by and involve community participation (Satterthwaite, Huq, Pelling, Reid, & Lankao, 2007; Zimmermann & Stössel, 2011). Local residents, proactively involved in taking action, often lead to an increase in local ownership and expect sustainable development outcomes (Cutter et al., 2012). Active community participation is reported in developing countries, including Costa Rica, Honduras, Panama, and El Salvador (Hori & Shaw, 2011). This bottom-up approach is an opportunity to influence local policies and to have more communication between municipalities and local communities (Twigg, 2007; Urwin & Jordan, 2008).

Existing Local DRM Measures

DRM represents approaches and measures that have been developed specifically for local use. These include community EWS (Abon, David, & Tabios, 2012; Ardalan et al., 2009; Basha & Rus, 2007; Yoshimura, Sakimura, Oki, Kanae, & Seto, 2008), community organizations for emergency (Gebbie & Qureshi, 2002; Quarantelli, 1986), and construction of mitigation measures with community participation (Juergen, 2001). These existing measures to enhance local DRM capacity present an opportunity for scaling up to other local areas that have not yet applied these measures.

However, in many developing countries, local DRM faces implementation obstacles (Bedsworth & Hanak, 2010) that can be summarized as follows.

Coordination Difficulties

In many cases, municipalities present obstacles for the successful coordination with the national government and other local institutions (Bedsworth & Hanak, 2010; Devereux & Coll-Black, 2007; DFID, 2006; Mitchell & van Aalst, 2008; Tearfund, 2006; UNDP, 2004). Local DRM entails daily struggles to enhance its capacity to improve livelihoods, social services, and environmental quality (Cutter et al., 2012). Due to the multi-sectorial characteristic of local DRM, diverse stakeholder groups need to coordinate with each other but, generally, fail to do so (Sperling & Szekely, 2005).

Limited Project Implementation Capacity

The lack of project implementation capacity is another challenge for local DRM. As previously discussed, local DRM approaches and measures are already developed; however, climate hazardous events vary from place to place. Thus, these approaches and measures require "fine tuning" for each local place (Djalante, Thomalla, Sinapoy, & Carnegie, 2012). In general, climate DRR is an initiative originally approached from the top-down by international organizations; it requires a certain amount of time to localize these experiences for each local area (Bai, 2007; Vignola, Locatelli, Martinez, & Imbach, 2009; Wilbanks & Kates, 2010).

Limited Community Participation

Notwithstanding the theoretical opportunities previously seen regarding active community participation, in practice, there are obstacles to community participation, especially in poor communities (Cardona et al., 2012).

Many poor communities do not sufficiently manage current risks, although they need to improve their ability to reduce local climate hazardous risk (Pielke, 2007; Smit & Wandel, 2006).

To summarize, local DRM theoretically has some potential and opportunities, especially with respect to the following: (i) DRM affinity with local development agendas; (ii) active community participation; and (iii) existing local DRM measures that have been developed by international and national organizations in recent decades. However, in practice, literature reports some specific challenges for local DRM, which include the following: (i) coordination difficulties; (ii) limited project implementation capacity; and (iii) limited community participation. These key issues are addressed in this book in discussions of effective approaches for enhancing local DRM capacity in developing countries.

Disaster Risk Management and Climate Change Adaptation

Another concept that crosses borders when it comes to DRM is climate change adaptation (CCA). In this book, CCA refers to the initiatives and measures to reduce the vulnerability of natural and human systems to actual or expected climate change effects (IPCC, 2007). DRM and CCA are dynamic approaches to policy making that share key concepts, and complement each other for reducing vulnerability to climate hazardous events. Reduction of the increasing impact of climate disasters requires a complementary approach between DRM and CCA. Nonetheless, it is not always a simple process to maximize the synergy between these two. Multiple international organizations, in coordination with national and local institutions, are leading the way to concretize the framework for policy integration between DRM and CCA. This section reviews the current efforts of international organizations, multilateral banks, and bilateral cooperation agencies for developing a conceptual policy framework for integrating DRM and CCA.

International efforts on implementing DRM in developing countries are not new. An international group for DRM has been formed under the United Nations International Strategy for Disaster Reduction (UNISDR) and former United Nations International Decade for Natural Disaster Reduction (IDNDR) in the decade of 1990s. The mission of UNISDR includes reducing losses and damages of life and property by intervening through corrective (mitigation to reduce existing risk) and prospective (anticipation and prevention of possible future conditions of risk) DRM.

National authorities related to DRM, civil protections, emergency response organizations, international and national nongovernmental organizations (NGOs), academics entities and private companies are principal members under UNISDR umbrella.

In addition to such efforts made under UNISDR umbrella, a complementary international initiative on DRM was also formed under the United Nations Framework Convention on Climate Change (UNFCCC). UNFCCC leads global policy initiatives related to climate change, both on climate change mitigation (initiative related to the reductions in emissions of greenhouse gases generated by human activities) and CCA. Its Conference of the Parties (COP) has been convening annually since 1995, which deals with broader subjects including DRM in terms of reducing the vulnerability of natural and human systems to climate change effects (Table 1). National environmental management authorities, meteorological service institutions, academic entities, and private companies mainly form an international group under UNFCCC umbrella.

The two international groups have recognized the need for confronting both DRM and CCA in a more coherent manner (Birkmann & von Teichman, 2010), and some of these have made efforts in improving effectiveness of the DRM in the context of changing climate especially in developing countries. For example, the World Bank supports to the national government of the Latin American countries for training on the incorporation of the increasing climate hazards into DRM measures (World Bank, 2012). The IDB supports the Central American countries for developing a longer-term hurricane generating scenario and estimates probabilistic maximum future hurricane losses (IDB, 2012). The Japan International Cooperation Agency (JICA) provides technical trainings to the developing countries to learn the estimation of the hazardous impacts due to changing climate in long-term scenarios (JICA, 2012).

International organizations, multilateral banks, and bilateral cooperation agencies have developed conceptual analysis of integrating CCA and DRM (Birkmann et al., 2009; Mercer, 2010; Mitchell, van Aalst, & Villanueva, 2010; O'Brien, O'Keefe, Rose, & Wisner, 2006; Schipper & Pelling, 2006; Sperling & Szekely, 2005; Subbiah, 2002; Thomalla et al., 2006). As a result, progress has been made in analyzing differences and similarities between DRM and CCA and in clarifying effective approach of the DRM in a changing climate, particularly from the perspective of policy integration (Bettencourt et al., 2006; Hori & Shaw, 2011; Mercer, 2010; Thomalla et al., 2006; van Aalst et al., 2008; Venton & La Trobe, 2008). Table 2 provides a systematic overview of the sources of similarities

Table 1. Examples of UNFCCC COP's Discussions Related to the Climate Hazardous Risk Reduction.

Year	COPs' Discussion Related to Reducing Climate Disaster Risk
1996	• Recognize the need for continuing work by the IPCC to further reduce scientific uncertainties, in particular regarding socioeconomic and environmental impacts on developing countries, including those vulnerable to drought, desertification or sea-level rise. • Parties are encouraged to use the IPCC Technical Guidelines for Assessing Climate Change Impacts and Adaptations.
1998	• Implement adaptation response measures […] especially in countries vulnerable to climate natural disasters, taking into account their preparatory adaptation planning frameworks in priority sectors.
2000	• Disaster relief, avoidance of deforestation and prevention of land degradation may be included […] in national adaptation programs of action. • A separate work program will be established for the least developed countries (LDCs) to be financed by the GEF, focusing on […] implementation of concrete adaptation projects.
2001	• Conference […] called upon to fashion solutions to the problems of global warming, drought, the ozone layer, and greenhouse gas emissions, in order to avert a worldwide disaster.
2003	• Special Climate Change Fund supports capacity-building, including institutional capacity, for preventive measures, planning, preparedness and management of disasters relating to climate change, including contingency planning, in particular, for droughts and floods in areas prone to extreme weather events.
2004	• Building capacity required, including institutional capacity for preventive measures, planning, preparedness and management of disasters relating to climate change, including contingency planning, in particular for droughts and floods and extreme weather events.
2007	• Disaster reduction strategies and means to address loss and damage associated with climate change impacts in developing countries that are particularly vulnerable to the adverse effects of climate change.
2008	• Noting the importance of the national adaptation program of action process as a first step towards the scaling up of adaptation and integration of climate disaster risks into national development plans.

Source: UNFCCC (1996, 1998, 2000, 2001, 2003, 2004, 2007, 2008).

and differences between DRM and CCA extracted from available literatures. In general, available literatures emphasize the value of a more holistic, integrated, trans-disciplinary approach of these two integrations for effective risk management (ICSU-LAC, 2009).

Overall, both DRM and CCA are as a part of sustainable development process for economies, societies, and environmental sustainability (Bedsworth & Hanak, 2010; Gero, Méheux, & Dominey-Howes, 2011;

Table 2. Summary of Similarities and Differences between DRM and CCA.

	CCA	DRM
Similarities	• Linked to long-term sustainable development; • Multi-territorial principle (international, national, and local); • Wide range of stakeholder groups required to be involved; • Bottom-up or community-based approach to be encouraged.	
Differences	• Covers climate hazards only; • Covers both rapid-onset and slow-onset hazardous events; • Includes its focus more on long-term future risks; • International organizations structure, experiences and funding mechanisms (UNFCCC umbrella).	• Covers climate and geophysical hazards; • Focuses mainly on rapid-onset hazardous events; • Focuses more on current disaster risks; • International organizations structure, experiences and funding mechanisms (UNISDR umbrella).

Source: Edited by author.

Lavell et al., 2012; O'Brien et al., 2006, 2012; Schipper, 2009; Schipper & Pelling, 2006; Sperling & Szekely, 2005; Thomalla et al., 2006; UNISDR, 2009c; Wilbanks & Kates, 2010). Successful sustainable development agenda depends on reducing vulnerability to both current and future natural hazards (Gero et al., 2011). Both DRM and CCA will only be successful where understanding and interventions is activated based on multi-territorial principle, including all international, national, and local levels (Cutter et al., 2012; UNISDR, 2009a, 2011). Furthermore, CCA and DRM should involve in a wide range of decision-making by scientists, policymakers, private firms, NGOs, media, educators, and public entities especially in a process of exchanging, integrating, and sharing knowledge and information (Kates, 2001). Both CCA and DRM should be encouraged to bottom-up and community-based approach (Lavell et al., 2012), which foster active participation in collecting information that is rooted in the communities and enables people to participate in their own assessment of risk (Allen, 2006; Lavell et al., 2012; Patiño & Gauthier, 2009).

There are some differences between DRM and CCA, though. DRM covers a broad range of hazardous events including climate and geophysical hazards (e.g., earthquake, volcanic eruptions as well as tsunamis), while CCA focuses on only climate disaster risk. DRM in general tends to reduce the risk associated with rapid-onset or extreme hazardous events, while CCA includes dealing with slow-onset events such as drought and sea-level

rise. Time scales play an important role when considering the linkages between DRM and CCA (O'Brien et al., 2012); DRM focuses more on current disaster risks to be reduced, while CCA includes its focus more on long-term future risks (Bedsworth & Hanak, 2010; Thomalla et al., 2006).

International organization structure of each CCA and DRM is different. As discussed earlier, UNISDR is an organization that leads the international policy decision and promotion related to DRM, while UNFCCC leads and promotes the subject related to CCA. Subsequently, each CCA and DRM practice has tended to follow independent paths of advance and development of concepts, methods of processes for social knowledge construction and the ensuring scientific compartmentalization of subject areas, organizational funding and instrumental backgrounds, strategies and individual frameworks to achieve their ends (Lavell, 2010; Lavell et al., 2012; Mitchell & van Aalst, 2008; Schipper & Burton, 2009; Schipper & Pelling, 2006; Sperling & Szekely, 2005; Thomalla et al., 2006; Venton & La Trobe, 2008).

Both DRM and CCA are individually applicable for reducing the high-frequency impacts of climate hazardous events, increasingly found in developing countries. However, the integration of policy aspects of these two programs should increase their efficacy in reducing the risks. Therefore, it is important to understand the similarities and differences between DRM and CCA as the background for integrating their policy aspects. The next section reviews the strategy for framing DRM in a changing climate to combine it with CCA.

Framing Disaster Risk Management in a Changing Climate

Among many strategies for integrating DRM and CCA in policy making, Birkmann and von Teichman (2010) have identified two simple strategies for its integration. These include (i) incorporating CCA into DRM by considering the increasing climate disasters as a new threat in DRM planning (CCD, 2008a, 2008b, 2008c; Prabhakar & Srinivasan, 2009) and (ii) incorporating DRM into CCA context by treating CCA as a transversal topic that should be mainstreamed in every sector's sustainable development practice (Birkmann, 2011; German Government, 2008). This book applies the simple idea of Birkmann and von Teichman, specifically its former strategy of incorporating CCA into DRM for framing the DRM in a changing climate. This book calls this "an incorporation of increasing climate disaster impacts as a new or additional threat into DRM in planning and

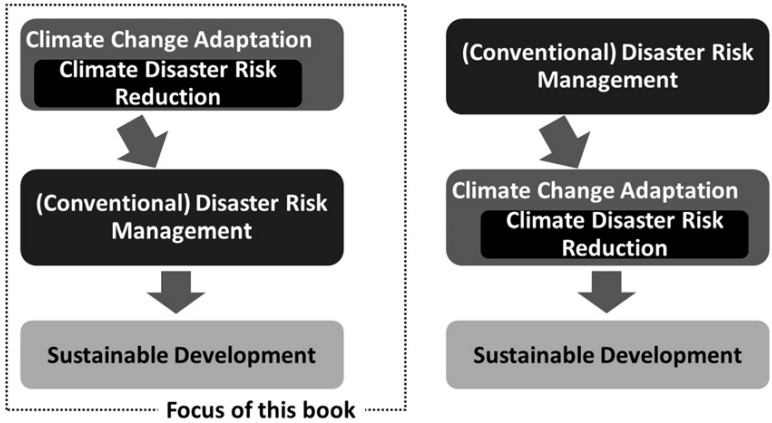

Fig. 5. Two Strategies for Integration Identified by Birkmann and von Teichman (2010) and the Focus of This Book.

practice" (Fig. 5); or simply "the incorporation of climate hazards into DRM."

Lavell (2009) indicates the aspect of incorporating CCA into DRM, or in case of this book, the incorporation of climate hazardous in DRM or in sustainable development planning and practice, should involve the following three aspects (i) risk identification and awareness; (ii) policy, strategy, planning, and institutional framework; and (iii) development practice. Each of these three aspects should interact among each other for effective DRM performance. The general idea of this framework coincides with the three DRM policy frameworks presented in the previous section. Fig. 6 illustrates the framework of this book to discuss effective approaches for enhancing local DRM capacity to combat the increasing impact form climate disasters, a principal subject of this book.

APPROACH AND STRUCTURE

Case Study

This book reviews the progress and challenges made in terms of enhancing local DRM capacity to combat increasing climate hazardous impacts in

Fig. 6. Framework of This Book.

Costa Rica. The country is ranked the second in the world for most exposure to multiple natural hazards (World Bank, 2005). According to the DesInventar Disaster Database (2013), there have been registered 4,291 floods and landslides between 2006 and 2010 in Costa Rica, of which are significantly more than the 2,293 events recorded between 1971 and 2000 (Fig. 7). The country is required a challenge in enhancing DRM capacity for reducing recent increasing the impact due to climate hazardous events both at the national and local levels (IDB, 2009a; IPCC, 2007; Krishnamurthy, Fisher, & Johnson, 2010).

Cartago city, a local study field of this book, is located in the central valley of Costa Rica, to the east of San Jose, the nation's capital (Fig. 8). The city covers an area of 287.8 km^2 of both urban and rural areas and has a population of 132,057 (INEC, 2000). There has been no major change of its population during recent decades. City's population includes 45% of total workers living in the city but commute to San Jose for the daily work in the capital city (INEC, 2000). This situation characterizes Cartago as a

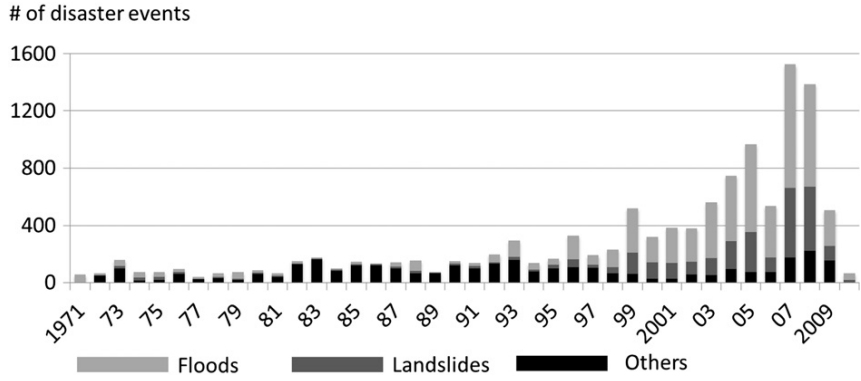

Fig. 7. Number of Disasters in Costa Rica from 1971 to 2010. *Source*: DesInventar (2013). DesInventar is a database developed Mainly by La Red (Network for Social Studies on Disaster Prevention in Latin America), United Nations Development Programme (UNDP), and United Nations International Strategy for Disaster Reduction (UNISDR). The Database registers the occurrence of small- and medium-scale disasters during the last 40 years. It covers 29 countries to date, including Costa Rica.

"bed town" of the metropolitan area of Costa Rica. Additionally, the city has competitive industries including agriculture, dairy farming, and tourism. In particular, the city produces 90% of potatoes and 80% of milk that are consumed domestically (Ramirez, Alvarado, Pujol, & Brenes, 2008). High quality of Cartago's agricultural productions depends on the soil that is enriched by the periodic eruptions of the Irazu volcano, a major hazard to which the city is exposed (Montoya & Masser, 2005). Development and natural disaster of Cartago are thus in close relation.

The reason for selected Cartago as case study in this book lies in its increasing losses and damages due to climate disasters in recent decades. Historically, Cartago faces natural hazardous risks including volcanic eruptions and earthquakes; the city experienced severe volcanic eruptions and earthquakes in 1724, 1861, 1891, 1922, 1928, 1951, 1963, and 1964. Cartago was an ancient capital of Costa Rica until the city has devastated by the severe earthquake in 1922 and then, central government functions have decided to move to San Jose. The most recent severe disaster event was a combination of volcanic eruption and floods in 1963–1964, caused US$3.5 million of local infrastructure loss and additionally, damaged 90% of domestic milk production and resulted in the loss of 20 lives (ICE, 1965).

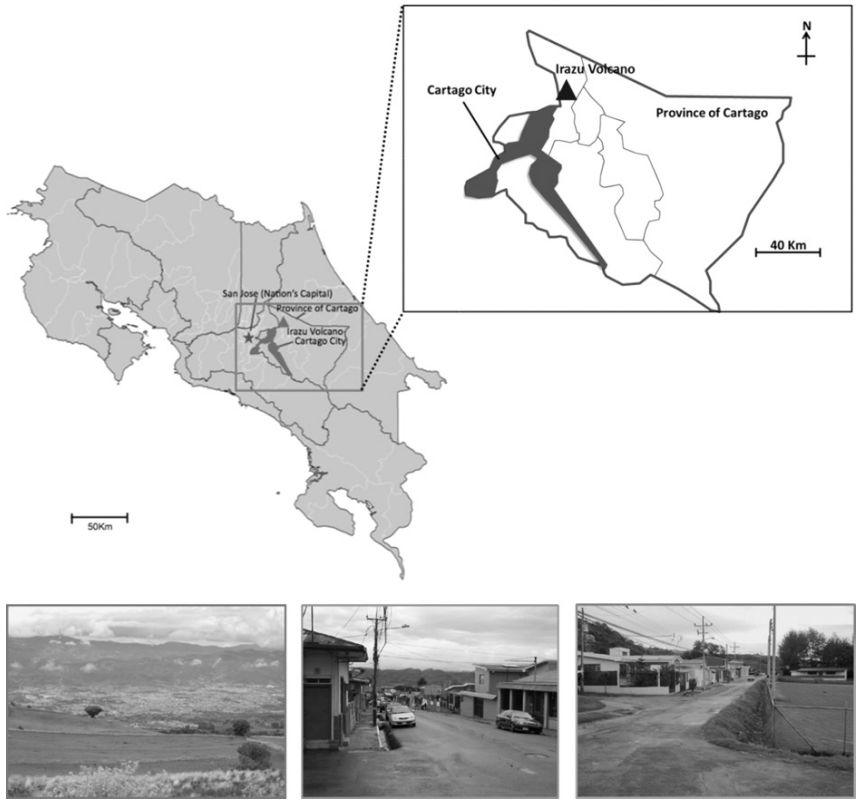

Fig. 8. Geographical Location of Cartago and Some Images of the City. Left: Whole City, Center: Urban Area, and Right: Rural Area. *Source*: Photos by author.

Cartago's recent problem, in addition to these conventional geological hazards, is related to the increasing losses and damages associated with climate disasters including floods and landslides. According to the DesInventar database (2013), the city has experienced 133 of these events between 2006 and 2010, which are significantly more than the 51 events recorded between 1971 and 2000 (Fig. 9). In the same period, 2,473 people in the city have affected and 520 houses have collapsed by floods and landslides, which have been greater than the 2,098 people affected, and 402 houses collapsed between 1971 and 2000 (Fig. 10).

As discussed earlier, it is difficult to determine the specific reasons for the increase in climate disasters in Cartago City. The reason for an increase

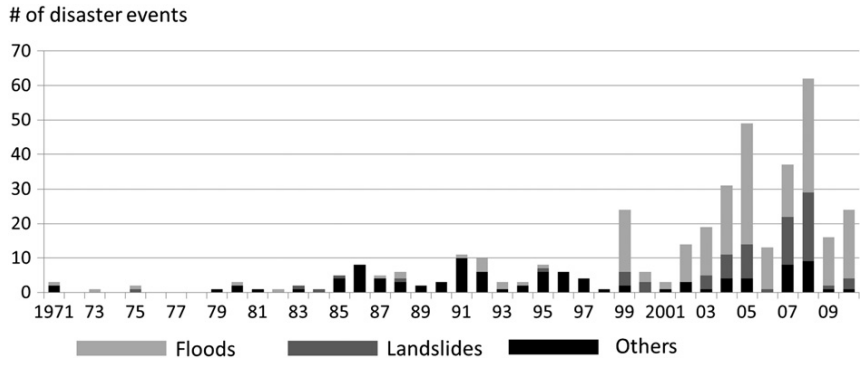

Fig. 9. Number of Disasters in Cartago from 1971 to 2010. *Source*: DesInventar (2013).

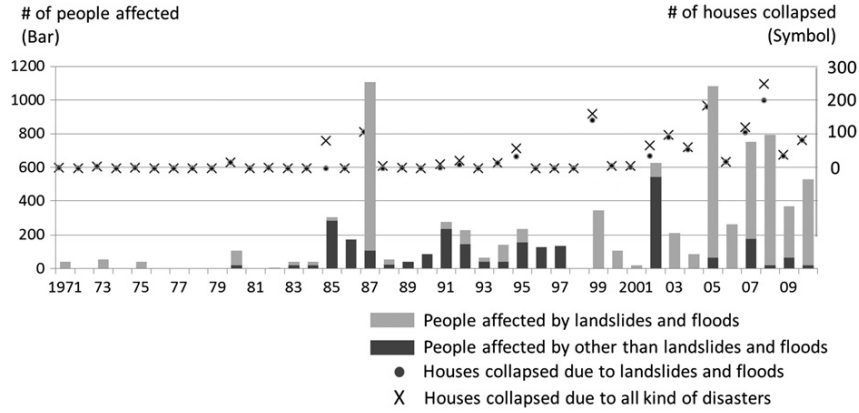

Fig. 10. Number of Affected People and Houses Collapsed. Bar Graph Shows the Number of Affected People and Point Plots Show the Number of Houses Collapsed in Cartago due to Disasters. The Number of Houses Collapsed Includes Both Complete and Partial Collapses.

in the number of climate disasters in Cartago City is rooted in its rapid economic growth and ineffective development, which increase vulnerability and exposure. Moreover, it may be possible to argue that data from National Emergency Commission (Comisión Nacional de Emergencia, or CNE) (Fig. 2) and DesInventar (Fig. 9) show serious consequences of frequent intense rains as well as local damages and losses caused by these

events. Thus, frequent intense rains may be associated with the increase in climate hazardous risk of the city.

Most climate disasters observed in Cartago are low intensity, or small-scale disasters. For example, between 2000 and 2009, Cartago has experienced 252 climate disasters, of which all of these are classified as small-scale disasters. According to the Cartago local Red Cross, almost 30% of emergency assistance in recent years has been related to the assistance of post climate disaster emergency operations, while other 70% are mostly related to the medical emergencies. Compared to the decade of the 1990s, this percentage of post climate disaster emergency operations has been doubled. In summary, the city's conventional disaster risk has been high magnitude but low frequent geophysical hazards, thus the recent increase in climate hazardous events, which are low intensity but high frequency, poses additional issue that increase the cost of public administration
(e.g., emergency operation and infrastructure recovery), as well as the threat of communities lives.

Under these circumstances of increasing the climate disaster risk, the municipality of Cartago has taken two local policy initiatives since the beginning of 2012. First is an initiative to incorporate the aspect of DRM into the municipality's Regulatory Plan (Plan Regulador, or PR). This policy instrument is considered in Costa Rica as a municipality's central planning instrument for attending local development issues, according to the country's Urban Planning Law (Ley de Planificación Urbana, Ley No. 4240 of 1968). With regard to the increasing climate hazardous risk and its local impacts, the PR for Cartago City, incorporating DRM, was finally approved in early 2012. This PR is explained in Chapter 4.

Second is the establishment of municipality's new local DRM committee (Comité de Gestión Local del Riesgo de Desastres, CGLR) that has been established in the mid-2012 subsequent to the approval of PR. The mission of the CGLR is to promote incorporating the aspect of DRM in local development agenda. The CGLR has developed the Local DRM Action Plan in the mid-2013. The municipality has established the coordination office of CGLR. Thirty-five members from local public and private institutions including local NGOs, civil society organizations (CSOs), public entities, local offices of the international organizations, and universities have assigned as the committee members. Indeed, the city had a local disaster emergency plan since 1998. However, this emergency plan was only for emergency preparedness and assistance. The establishment of CGLR and Local DRM Action Plan thus are the first experience for

municipality to incorporate DRM as a part of local development agenda. On these bases, the book discusses approaches for enhancing local DRM capacity to combat the impact due to the increasing climate disasters in recent decades.

Approach

This book assumes that the Cartago municipality's recent local policy efforts would be an opportunity to enhance the local DRM capacity. Additionally, the book assumes that communities' ability to perceive climate change and their consequent action for reducing local disaster risk would complement the municipality's local DRM capacity (Bone, Alessa, Altaweel, Kliskey, & Lammers, 2011; Mercer, Kelman, Suchet-Pearson, & Lloyd, 2009; van Aalst et al., 2008). Fig. 11 illustrates these assumptions; a comparison between periods before and after the increase in climate hazardous events (decades before 1990 in the case of Cartago) indicates that local DRM performance would deteriorate if no additional measures were implemented. However, optimum utilization of the aforementioned opportunities (including the two local policy efforts in Cartago; the Regulatory Plan and CGLR in case of Cartago, and community ability for reducing the risk) would enhance local DRM capacity and make it possible to reduce local climate hazardous impacts. Therefore, the key questions of this book are defined as follows: (i) What are the roles of national and local governments for effective local DRM performance in a changing climate and (ii) what are the factors in complementing local DRM capacity by the communities' initiatives?

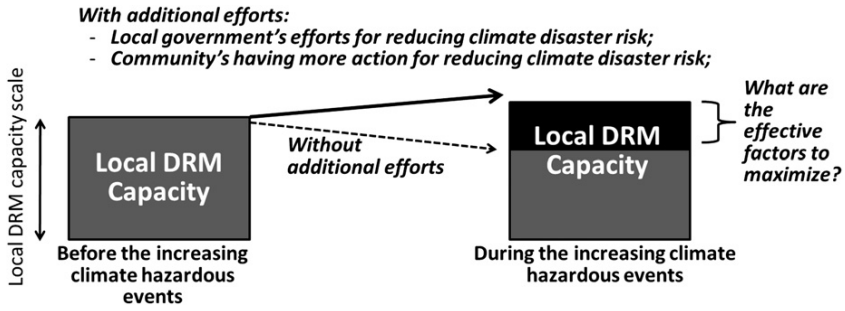

Fig. 11. Assumption of This Book.

Book Structure

Being based on the two key questions discussed in the previous section, this book performs three angles of studies that are necessary for approaching effective local DRM capacity to combat the impact due to the increasing climate disasters in recent decades. The three approaches include: (i) a baseline analysis, to identify current progress on local DRM; (ii) an analysis to respond the first key question; and (iii) an analysis to respond the second key question. The three angles of approaches are explained in a following way.

Angle 1 – Baseline Analysis
Chapter 2 corresponds to this part to review the current progress made in terms of local DRM. Costa Rica began certain attention on the local DRM initiative recently, after Tropical Storm and Hurricane Mitch in 1998 (Mitch), the Central American region's worst catastrophe of the past century, hit the country. After the devastation by the Mitch, some projects related to local DRM capacity development have been implemented in Costa Rica. Because the number of the relevant project in Costa Rica has been limited to analyze, this chapter collected project data from all six countries in Central America including Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, and Panama. The data has been collected in earlier 2011 and based on the analysis of these data, the chapter identifies outcomes, lessons, and challenges related to local DRM from Mitch to date in the Central America, being as a baseline for further discussion of this book.

Angle 2 – National and Local Governments' Current Efforts on DRM in a Changing Climate
Chapters 3 and 4 correspond to this part. These two chapters explore whether the national and local governments' efforts on incorporating the increasing climate hazardous concerns into national and local development provides any answer to respond the recent problem identified in the baseline analysis. A checklist, originally developed in a policy meeting organized by the IDB in 2009, has been applied in these two chapters; Chapter 3 applied the checklist to the national government of Costa Rica, and Chapter 4 applied it to the municipalities in Costa Rica.

Angle 3 – Communities' Ability to Complement Local Government's DRM Capacity
Chapters 5 and 6 assess whether communities' climate change perceptions, awareness of climate hazardous risk, and subsequent DRR actions

complement local DRM capacity. Chapter 5 presents information from qualitative field interviews conducted in the communities of Cartago City to identify key factors necessary to motivate communities to commit to DRR actions. These field interviews were conducted in the middle of 2010 and early 2011. Subsequently, Chapter 6 discusses household surveys that were conducted to quantitatively evaluate whether climate change perceptions and disaster risk awareness support community initiatives for having DRR actions. The household surveys were conducted in mid-2012 in four communities that had been affected by floods or landslides in 2010.

Drawing on key findings from angle 1 to 3 (Chapters 2–6), Chapter 7 discusses potential factors for enhancing local DRM capacity in a changing climate and finally, Chapter 8 concludes the discussion of this book, with a brief implication based on the key findings.

CHAPTER 2

LOCAL DISASTER RISK MANAGEMENT IN CENTRAL AMERICA

ABSTRACT

Central America is exposed to a variety of natural hazards such as earthquakes, volcanic eruptions, landslides, and floods. The region, located on four connected tectonic plates with 24 active volcanoes and in the path of hurricanes, has experienced 348 major disasters from 1981 to 2010, resulting in 29,007 deaths and US$16.5 billion in direct economic losses. Therefore, all six Central American countries rank among the top 35 countries in the world at high mortality risk from multiple hazards. The countries in this region, including Costa Rica, began paying attention to the disaster risk management (DRM) initiative recently, after Tropical Storm and Hurricane Mitch in 1998, which was the region's worst catastrophe of the century. After the devastation by Mitch, several local DRM capacity development projects were implemented in the region. By reviewing these project profiles of local DRM implemented in the region, this chapter identifies outcomes, lessons, and challenges of DRM at the local scale, from Mitch to the present, as a baseline for incorporating climate disaster risk reduction into local development planning.

Keywords: Disaster risk management; community empowerment; Central America; tropical storm and hurricane Mitch; project sustainability

CHARACTERISTIC OF LOCAL DRM

Background

The region began local DRM initiative nearly 35 years before this book. This includes especially a community-based DRM (CBDRM) initiative, originally proposed during 1980s (Maskrey, 1988; Wilches-Chaux, 1988). There have been numerous attempts to develop its methodologies and measures between 1997 and 1998 (Zilberth, 1998), including community EWS, evacuation plan, and construction of small dikes. However, what focused certain attention on the region's local DRM needs were after Tropical Storm and Hurricane Mitch (hereafter, Mitch) in 1998, the region's worst catastrophe of the 20th century. According to Duran Vargas (1999), the region has been affected 10% of the population, causing 10,000 deaths, and costing US$5 billion in economic losses due to this catastrophe in 1998.

The occurrence of disasters is even positively assumed to be a window of opportunity for having more attention to DRM (Archer & Boonyabancha, 2010; Christoplos et al., 2010). Mitch provided this opportunity for Central America to open the window to start reducing the risk. The Guatemala Declaration II ratified in 1999 by six Central American presidents has recognized the region's new development priority: reducing the vulnerability to natural hazard impacts.

Regional Policy Framework

The mission of the Coordination Center for Prevention of Natural Disasters in Central America (Centro de Coordinación para la Prevención de los Desastres Naturales en América Central, or CEPREDENAC), a regional DRM institution, is to promote DRM policy toward the member countries. Among the efforts made, CEPREDENAC has promoted, including above-mentioned Guatemala Declaration II, six DRM policy instruments since Mitch (Table 1). The Presidents or DRM authorities of the six member countries have ratified these policy instruments. All of these instruments have incorporated the consideration of local DRM, or specifically CBDRM as one of the key aspect for DRR. The HFA, a result of the World Conference on Disaster Reduction in 2005 seems to have influenced to the region's local DRM accelerations, because the region has approved three subsequent policy instruments after that.

Table 1. List of DRM Policy Instruments in Central America since Mitch.

Year	Title	Context Related to Local DRM
1999	Guatemala Declaration II	The region needs to reduce vulnerabilities and mitigate future damage caused by disasters.
1999	Strategic Framework for Vulnerability Reduction	Strategies and plans should be developed for **strengthening the capacity of municipal and local governments** in the prevention and mitigation of disaster risk.
2003	Tegucigalpa Declaration	**Progress made**, especially as regards policies, programs and projects directed at […] **increasing capacities for local level risk management**.
2006	Regional Disaster Risk Reduction Plan 2006–2015	**Municipal and local governments should assume a role** for implementation, monitoring and evaluation of strategic and operational objectives of the Plan.
2009	Mitch + 10 Declaration	Local capacity building for risk reduction and disaster response must be intensified to consolidate the autonomy and resilience of communities and territories.
2010	Central American Policy for Integrated Disaster Risk Management	Vulnerable people and communities […] have the right to have processes, plans, and development programs, considering current conditions of risk and avoiding creation of new risks and vulnerabilities.

Source: CEPREDENAC (1999a, 1999b, 2003, 2006, 2009, 2010).
Bold: Local DRM context, Underline: CBDRM context.

Recent Activities

Table 2 shows samples of the relevant local DRM projects implemented after Mitch in Central America. These samples are collected from archives of the Executive Secretary of CEPREDENAC (SE-CEPREDENAC). Indeed, the sample lists in Table 2 have several limitations. First, the projects in the list are donor-driven or donor-financed activities. The funds for these projects are administrated by the SE-CEPREDENAC or national authorities. Therefore, most of the projects in the list are apparently executed by SE-CEPREDENAC or national authorities. In other words, projects that were financed by local governments or local NGOs and by-passed coordination with the SE-CEPREDENAC or national DRM authorities have not included in the list. Second, the data resources collected from the

SE-CEPREDENAC do not clearly show the budget size. This implies that some items in the list might have spent millions of US dollars and others only hundreds of US dollars. Third, the data resources collected here include a variety of territorial intervention sizes for project execution; one includes 333 municipalities as its intervention area, others include only one community.

Despite such limitations, the SE-CEPREDENAC and national DRM authorities manage numerous projects with donor agencies or international organizations, so that listed projects do still represent the characteristics of local DRM projects in the region. The list does not include the project executed under CCA initiative, because the objective of this chapter is to review actual progress of local DRM in Central America, independent from CCA initiatives.

This book uses the Bollin's criteria (2003) to characterize the sampled local DRM projects. The same criteria are used by the CEPREDENAC for their project administration. The criteria include primarily the following three aspects:

- Type of activity – which types of project activities were implemented?
- Beneficiaries – who are beneficiaries of project activities?
- Execution year and project duration – which year did the projects executed and during how many years did it executed?

The following are the results of these characterizations.

Types of Activities

This book applies the IDB's definition to characterize type of local DRM activities because of its simplification. The type includes: (i) risk identification (RI), signifies identification of hazard type and magnitude, vulnerability, and risk factors; (ii) risk reduction (RR), implies the plan and implementation for disaster risk mitigation and prevention measures; (iii) disaster management (DM), implies EWS and other disaster preparedness plan and measures; and (iv) governance and financial protection (FP), signifies adequate allocation and use of financial resources to manage disaster risk (IDB, 2008).

Indeed, certain projects implemented in Central America listed in Table 2 address more than one type. For example, the "Building partnerships across sectors, hazardous assessments and identification of vulnerabilities" project in three municipalities in El Salvador addresses both RI and RR. In such cases, analysis allows a double count for both RI and RR. In contrast, several items lack sufficient data to be categorized. For example,

Table 2. List of Local DRM Projects Implemented in Central America.

Year	Project Title	Project Area	Executing Agency
Costa Rica			
1997–1999	Strengthening Local Structure in Disaster Mitigation	Province of Cartago	SE-CEPREDENAC
1997–1999	Comprehensive Strategy for Risk Management in Multi-Hazard Area	Costa Rica	SE-CEPREDENAC
1999–2001	National System against Disasters	Costa Rica	National Government
2000	Vulnerability Reduction, Mitigation and Community Risk Management	Municipality of Tapezco	SE-CEPREDENAC
2001	Strengthening Emergency Communications Network in the Central Chorotega	Municipality of Chorotega	SE-CEPREDENAC
2001	Landslide Early Warning System (EWS)	Costa Rica	SE-CEPREDENAC
2002–2003	Physical Vulnerability Reduction against Seismic Hazards	Municipality of Canas	SE-CEPREDENAC
2004	Local Disaster Risk Management in Vulnerable Communities	Municipality of San Jose	National Government
2006	Local Educational Committee of Disaster Risk Management	Province of Limon	National Government
2004–2007	Institutional Risk Management Plan in Lloente School	Province of Heredia	National Government
2010	Urban Risk Evaluation	Minucipality of San Jose	National Government
El Salvador			
2000–2001	Vulnerability Reduction in San Salvador	Municipality of San Salvador, Berlin, Alegria and Usulután	National Government
2000	MARLAH Project	Department of Ahuachapan	National Government
2002	Preparation of Local Emergency	El Salvador	National Government
2002	Local Disaster Risk Management Initiative	Municipality of San Salvador	National Government
2002	Disaster Mitigation at Municipal Level	San Vicente, Verapaz, Teoetilan and other 22 municipalities	National NGO
2002–2003	Organization for Local Emergencies	El Salvador	National Government

Table 2. (*Continued*)

Year	Project Title	Project Area	Executing Agency
2001–2003	Development of Methodology and Criteria for Relocation	In the Juayua region	National Government
2002–2003	Flood and Landslide Risk Analysis	Municipality of San Salvador	SE-CEPREDENAC
2005–2008	Disaster Risk Management at Municipal Level	Dept. of Sonsonate	National NGO
2007–2008	Capacity Development for Disaster Risk Management	River basin area in San Salvador	National Government
2007–2008	Improved Local Capacity for Risk Management in Metropolitan Area	Municipality of San Salvador and Mejicanos	National NGO
2008	Vulnerability Reduction at Community Level	Department of Sonsonate	National NGO
2007–2008	Local Management of Risk due to Landslides	Department of Ahuachapan	National Government
2008–2009	Community and Municipal Capacity for Disaster Preparedness	Department of Usulután, Ahuachapán, etc.	National NGO
2010	More Safe Community	Municipality of Cojutepeque and San Pedro	National NGO
Guatemala			
2001	Disaster Risk Assessment in Metropolitan Area	Municipalities in Metropolitan area in Guatemala	SE-CEPREDENAC
2001	Disaster Risk Reduction in the Metropolitan Area of Guatemala	Municipality of Guatemala, Chinautla and Villa Nueva.	SE-CEPREDENAC
2000–2002	Local Early Warning System	Guatemala	SE-CEPREDENAC
2000–2002	Training and Knowledge Dissemination	Guatemala	SE-CEPREDENAC
2002	Institutional Strengthening for Inter-Institutional Coordination	Guatemala	SE-CEPREDENAC
2002–2003	Natural Hazard Zoning and Vulnerability Analysis	Samala River basin and Reththuleu Community	SE-CEPREDENAC
2008–2009	Community Capacity Development on Disaster Risk Management	Rio Coyolate, Rio Polochic and other 5 municipalities	Local NGO
2007	Disaster Risk Reduction in the Escolarizado Region	333 municipalities of Guatemala	National NGO

Honduras			
2001	Local Disaster Risk Management Development	N/A	SE-CEPREDENAC
2001	Community Strengthening for Radio Communication	Municipally of Colón, Atantida, Cortés, and other 6 municipalities	SE-CEPREDENAC
2002–2003	GIS Application for Hazard and Risk Identifying	Tegucigalpa municipality	SE-CEPREDENAC
2006–2008	Local Strengthening for Integrated Risk Management	10 municipalities in the Province of Colon	National Government
2006–2008	Community Education on Disaster Prevention	Municipality of Aramecina, San Jose and Prespire.	SE-CEPREDENAC
2006–2010	Community Living with Risk	Cholteca, SanRafael Sentro and other five communities	Local NGO
2007	Local Disaster Risk Management	Municipality of San Esteban	National NGO
2007–2008	Organization of Municipal Committees	Honduras	Local NGO
2008–2009	Community Capacity Development on Disaster Risk Management	Municipalities of Francisco Marazan, and other 4.	SE-CEPREDENAC
Nicaragua			
2001	Disaster Prevention Culture	Muy Muy, El Tuma and other 8 municipalities	SE-CEPREDENAC
2001	Comprehensive Risk Management for Local Disaster Reduction	Ometepe Island	SE-CEPREDENAC
2001–2002	Local Support for Analysis of Risk and Natural Hazards	Santo Domingo, La Trinidad and other 8 municipalities	SE-CEPREDENAC
2003–2006	Community Development and Disaster Risk Management	Province of Villa Nueva	National Government
2003–2005	Disaster Management and Attention	Municipalities of Raspan, Rio Coco and Puerto Cabezas	International NGO
1998–2008	Local Capacity Strengthening in Disaster Risk Reduction	Department of Chinandega, Leon, Masaya etc	SE-CEPREDENAC
2002–2004	Establishment of Educational Center for Climate Change and Disaster Preparedness	Municipality of Puerto Cabezas	National NGO
2006	Community Sensitization and Organization for Early Warning System	Dept. of Managua	National NGO
2004–2009	Enhancing Capacities on Disaster Response at Community Level	Rama, Bluefields and Kukrahill	National NGO

Table 2. (*Continued*)

Year	Project Title	Project Area	Executing Agency
Panama			
1997–1998	Early Warning System for Floods	Eastern Region of the country	SE-CEPREDENAC
2004–2007	Local Disaster Risk Management	Province of Bocas del Toro	National Government
2004–2005	Local Disaster Risk Management	Province of Darien	National Government
2006	Community Emergency Response	Province of Chiliqui	National Government
2006	Local Capacity Development on Disaster Risk Management	Province of Panama	National Government
2007	Scholl Protection	Municipality of Panama	National NGO
2007	Flood Risk Reduction	Municipality of Panama	SE-CEPREDENAC
2009	Mainstreaming Climate Change Adaptation and Disaster Risk Reduction	Communities in Chucanaque and Tabasara	National Government

Panama's project "community development on disaster risk management" has no description in the SE-CEPREDENAC's records beyond its title. Such projects count in none of the types.

Results indicate that 81% of the listed projects (49 out of 60) addressed DM, 17% RI (10 projects), 13% RR (8 projects), and 0 PF. The majority (81%) of the local DRM projects in the region have been identified addressing disaster preparedness, or DM. (Fig. 1).

Reviewing more detail of the category DM, results revealed that 44 out of 49 projects (90%) address especially the installation or strengthening EWS (Fig. 2). These include the project "Landslide Early Warning System (EWS)" in Costa Rica in 2001, which installed pluviometers and radio communication systems in communities. 24 out of 49 projects (49%) addressed other disaster preparedness, including the project "Training and knowledge dissemination" in Guatemala (2000–2002), which has disseminated a series of workshops to sensitize residents to flood disaster preparation.

Beneficiaries

This book categorizes two levels of beneficiaries: local governments (e.g., municipalities) and communities. Results show that 48% of the listed projects were implemented directly toward communities. For example, the project "Development and installation of early warning and radio communication system" in El Salvador in 2008 has installed the system in 24 communities in the Department of Sonsonate. Another 22% were designed for both communities and local governments, including the project "Local development and flood risk reduction through school education and community sensitization" in Panama in 2007, which developed DRM

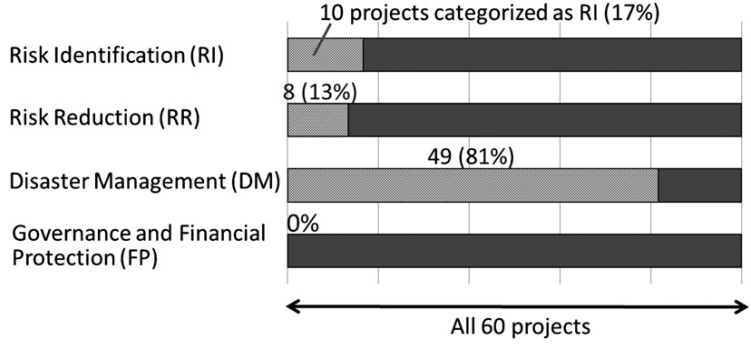

Fig. 1. Local DRM in Central America: Type of Activities.

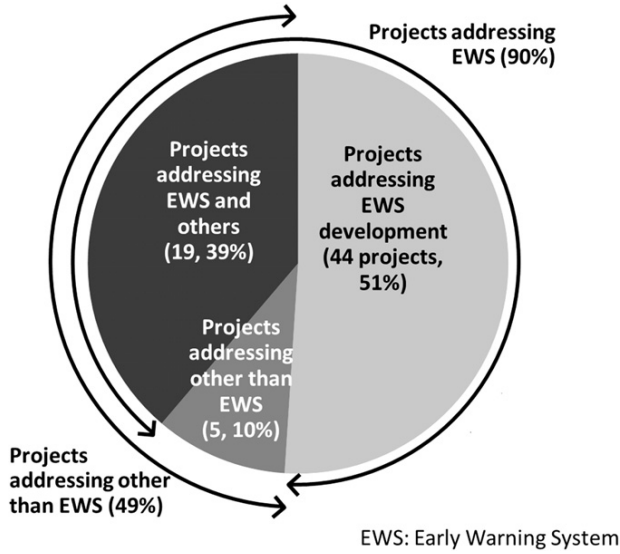

Fig. 2. Local DRM in Central America: Types of Contents of 49 Projects Categorized as DM.

non-formal education materials for local governments as well as pilot dissemination targeting four communities. The remaining 30% were only toward local governments. For example, the project "Support Education with a focus on disaster risk reduction and development of curriculum" in Guatemala in 2007 developed a formal DRM education material and disseminated it in 333 municipalities, but the project did not support implementation in communities (Fig. 3).

Results indicate that 70% of the projects in the region have been implemented directly toward community level with or without the participation of local governments, suggesting that the local DRM's primarily actors in the region were communities and secondarily local governments.

Execution Year

It was previously assumed that the number of local DRM project implementations was higher immediately after Mitch, when the lessons were still fresh. In order to validate that hypothesis, analysis here divides the duration since Mitch into five periods (1998–2000, 2001–2003, 2004–2006, 2007–2009, and 2010) and counts the number of executed projects in a

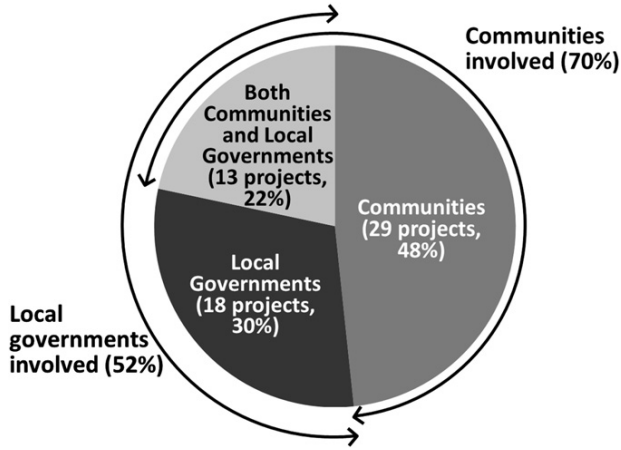

Fig. 3. Local DRM in Central America: Target Beneficiaries.

period. Results indicate that the local DRM project was executed nearly continuously across all periods so that the hypothesis is not supported (Fig. 4).

This finding indicates that the SE-CEPREDENAC and national DRM authorities continued implementing for strengthening local DRM in the region, probably with donor agencies' support.

Project Duration

The 60 projects are categorized by project duration periods: (i) within one year; (ii) in one or two years; and (iii) in three years or more. The results indicate that 45% of the listed projects were executed within one year, 43% within two years, and only 12% in three or more years (Fig. 5). This finding suggests that the majority of the local DRM project initiatives in the region (88% of the listed projects) were implemented in a relatively short period (within two years).

Summary — Characteristics of Local DRM in the Region

On the basis of the above analysis, the profile of local DRM project activities in the region is summarized as follows: First, the majority (81%) of the listed projects implemented in the region addressed disaster preparedness, preponderantly addressing EWS development (install of the

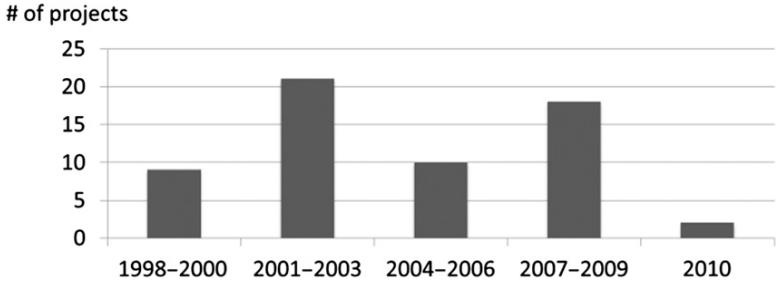

Fig. 4. Local DRM in Central America: Execution Year.

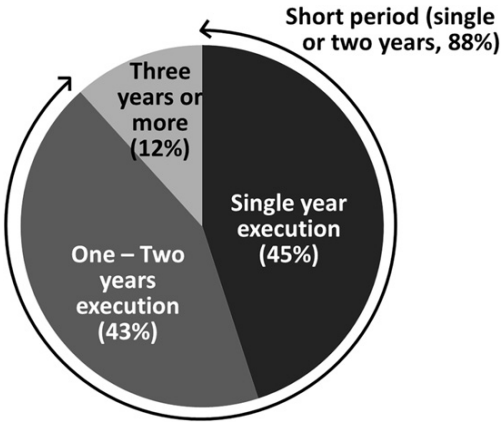

Fig. 5. Local DRM in Central America: Project Duration.

equipment such as pluviometers) or related activity improvement (formulation of community disaster committees or emergency drills). Second, the majority (70%) of the listed project activities in the region executed for community as beneficiaries compared to 30% for local governments. Third, local DRM initiatives have been implemented continuously from Mitch to date. Last, the majority (88%) of the listed project were executed less than two years, in other words, in a short period.

RESULTS, OUTCOMES AND LESSONS

This section identifies specific results, impacts, and lessons drawn from the interviews conducted during January to March 2011 covering all six

Central American countries. The methodology to select interviewees was as follows: first, a random sample of 20 projects was selected from entire 60 projects listed in Table 2. Second, each project's manager in the national government or local government, community leaders, or NGOs counterparts were contacted in order to perform interviews (face-to-face or via telephone). And third, of which 10 interviewees of the 20 chosen samples were responded and the interviews have been completed (Table 3). The interview included three questions in a qualitative manner: (i) the results of the project (products obtained directly from the projects); (ii) the outcomes of the project (broad positive impacts that have obtained after years from the project implementation); and (iii) the lessons learnt from the project implementation. Finally, the results of the interviews are analyzed and summarized as following way.

Results of the Local Disaster Risk Management Projects

The interviewees responded with a variety of results from local DRM projects implemented in the Central American region, and these can be categorized as four types shown in Table 4.

The first category is a local capacity building for disaster preparedness which includes (i) execution of community capacity building and sensitization workshops or seminars for disaster preparedness, (ii) establishment or strengthening of the local (or community) committee for disaster preparedness, and (iii) facilitate training activity for community first aid drills or evacuation simulations during the period of project execution. These results

Table 3. List of Interviewees.

Country	Title	Face-to-Face/Telephone Interview
Costa Rica	National government officer	Face-to-face
Costa Rica	National university researcher	Face-to-face
Costa Rica	International organization officer	Face-to-face
Costa Rica	Cartago Red Cross officer	Telephone
Panama	National government officer	Face-to-face
Panama	Panama City Municipality officer	Face-to-face
Panama	National government officer	Face-to-face
Nicaragua	National NGO officer	Telephone
El Salvador	Santa Tecla Municipality officer	Face-to-face
Honduras	National government officer	Telephone
Honduras	Comayagua municipality officer	Telephone

Table 4. Result Obtained from the Local DRM Projects.

Category	No. of Responses	Details
Capacity building	9	• **Workshops or seminars** for community disaster preparedness provided *(9 people responded)*. • **Establishment of local organizations** for disaster preparedness established or strengthened *(6 people)*. • **Evacuation simulations** or first aid drills executed *(4 people)*.
Equipment provisions	3	• **Monitoring equipment** (pluviometers etc) for community use provided *(2 people)*. • **Radio communication equipment** for community emergency use provided *(2 people)*. • Materials necessary for first aid (**boats and tents**) supplied *(1 person)* • Provisions for emergency shelters (**food, water and medicine**) supplied *(1 person)*.
Knowledge products	4	• Formal and non-formal **education material** developed *(2 people)*. • Community **hazard (or risk) maps** developed through community participation *(3 people)*.
Infrastructures	1	• Small-scale **embankments** for flood mitigation (300m longitude along the river) developed *(1 person)*.

Bold: Keyword of the answers.

also coincide with the European Commission (2008) findings on local DRM initiative in the region: "there has been a demonstrated increase in the capacity of local institutions in Central America, mandated with protecting vulnerable population against disasters."

Second, the interviewees other than Honduras and Nicaragua identified the project's improvement in the provision of equipment and materials needed for disaster preparedness. These include (i) monitoring equipment (e.g., rain gauges for floods) for community use, (ii) radio communication equipment for emergency situations within community, among communities, and between community and local or national institutions, (iii) materials necessary for first aid (e.g., small boats and tents) and provisions for emergency shelters (e.g., water bottles, food for emergency use, and medicine).

Third, the interviewees from Honduras, Panama, and Costa Rica identified the project's improvement in the provision of knowledge products needed for disaster preparedness. These include (i) formal and non-formal education material used in schools and community workshops and (ii) community hazard (or risk) maps developed through community participation workshops.

Forth, the interviewee from Costa Rica responded the construction of small-scale embankments (300 m longitude along the river at project site) provided as one of the components of the project. This small-scaled embankment was created from used tires and constructed through community participation. The interviewee stated that community participation in the construction process included woman and children volunteers.

Outcomes

The interviewees responded with a variety of outcomes, or positive long-term impacts of the local DRM projects, which fall into three categories (Table 5).

Table 5. Outcomes Obtained from the Local DRM Projects.

Category	No. of Responses	Details
Life saving	2	• The municipality of La Masica, Honduras: Floods and landslides during the Mitch in 1998. Collapsed 30% of houses. Community organized evacuations after received EW alert and **no loss of lives**. • The Province of Darien, Panama: Floods in November 2010. 96 houses collapsed. Community made self-evacuation, and **no major human damage reported**.
Collaboration for community solidarity	3	• Province of Darien (Panama-Colombia border): migrants establish new communities, conflicts with the traditional ones. Community DRM Workshops **relieves the conflict** and knowing each other. • Municipality of Canas, Costa Rica: community hazard map in school curriculum. Students **disseminated their knowledge to their families**, letting them participate to the local committee. • Comayagua City in Honduras: Women and children are willing to participate in the local DRM committee, learning, eager to **disseminate their experience among neighbors**.
Influence to local government's legal reform	1	• Santa Tecla City, El Salvador: Manager of the municipality's department of planning participated to the Community DRM project. After that, he **requested local Mayor Councils to incorporate DRM in the local policy and approved it** (incorporating DRM as a permanent action for local development agenda).

Bold: Keyword of the answers.

The first category is saving lives, particularly mentioned by the interviewees in Costa Rica and Panama. The interviewee in Costa Rica explained the experience in the municipality of La Masica, northern Honduras (the Costa Rican interviewee had worked for the Honduras project). The project had provided equipment for the community EWS in earlier 1998 (the rain gauge for the river and radio communication equipment for flood alerts). The involved communities were affected by a flood during Mitch in November 1998. The system worked effectively and community residents evacuated prior to the flood, with no deaths reported in the community. This successful experience reflects the opinion of Lavell (2001), who called it "a regional and international example of good practice," as well as Duran Vargas (1999) who also comments that this successful experience is noteworthy because other communities in the municipality lost 150–200 lives each during Mitch, whereas La Masica lost none.

Similar life-saving outcomes were reported by the interviewee from Panama. The project on non-formal education for disaster preparedness, organization of community emergency committees, and developing a flood evacuation route map was provided in the province of Darien, in the eastern Panama in 2007. Each project involved communities training through five workshops on self-evacuation in flood emergencies. Proof of its effectiveness was thus reported by the interviewee: when one of the project involved communities, El Salto, was flooded in November 2010, community residents self-evacuated and were in a public primary school, an assigned shelter. According to the report from the national civil protection of Panama, 96 houses and 261 people in the community were affected by the floods (SINAPROC, 2010). However, no major damage was reported.

The second category of outcome is collaboration for community solidarity. The Panamanian interviewee discussed the following experience in the province of Darien, located on the border with Colombia. In recent years, Colombia immigrants in this area have formed their own communities. However, these new-formed immigrant communities are isolated, and do not engage in social exchanges with traditional communities. One of the reasons is that other projects implemented in the region such as rural community agriculture development and community folk-craft development, sometimes cause conflicts between project beneficiary (traditional communities, in most cases) and non-beneficiary communities (the majority of new-formed immigrant communities). In contrast, the CBDRM project directly related to "natural phenomena" and did not stimulate economic activity for community residents, which ensured that people from

traditional and newer communities participate equally in the project, and eventually relieved some of the conflicts among these communities.

The Costa Rican interviewees described the effectiveness of community hazard map development in the primary school curriculum (at the second grade level), an activity engaging students in town observation, sketching community hazardous risks and vulnerabilities, developing neighborhood risk maps, scale modeling, and presentations to the communities. The interviewee stated that the youngsters enjoyed these activities and disseminated their knowledge to their families, so that such activity also strengthens community solidarity led by school children – a habit that may continue into the next generation. This example coincides with the UNISDR (2007) stating that young people can act as informants through unofficial communication networks which evolve within a community.

The Honduran interviewee believed that it is fundamental human nature for every human being (poor, rich, women, men, young, old, highly educated or not, disabled, migrants, or visitors) to want to support their neighbors. The local DRM project implemented in the City of Comayagua (a northern-west city) made it relatively easy for women and children to participate in the disaster risk committee, community sensitization workshops, and the elaboration of evacuation planning and evacuation drill exercises. Women who participated in these activities seemed satisfied with having participated in community development and were eager to disseminate their experience among their neighbors who did not participate.

The third category is the influence of the local DRM project initiative on reforming the local government's legislative framework. One example comes from the El Salvadoran interviewee. The project on community sensitization workshops was conducted in the City of Santa Tecla in 2004 and 2005. The manager of the department of planning in the municipality participated in the project as a local counterpart and realized that activities for disaster preparedness are significant for community residents. After the project implementation, he requested the San Salvador Metropolitan Mayor Councils (Consejo de Alcaldes del Area Metropolitana de San Salvador (COAMSS), of which the City of Santa Tecla is a member) to incorporate DRM context into the Municipality's development planning policy instrument (Strategic Plan for Municipalities of Metropolitan Area). The Council approved the Strategic Plan in December 2008, incorporating DRM as a permanent aspect for local development in the San Salvador Metropolitan area.

Lessons

The interviewees responded with a variety of lessons of the local DRM projects, which fall into three categories (Table 6).

First, interviewees in Honduras, Nicaragua, Panama, and Costa Rica stressed that the lessons they learned were related to the difficulty of continuing activities after the project execution period due to Donor-Driven project design. The Honduran interviewee stated that the donor agency had visited the municipality at the beginning of the project and discussed the project design, including project result indicators for post-project impact measurements (e.g., the number of community emergency committees to be established, emergency plan to be prepared, and emergency drills to be executed). The project's execution period was only one year, and the local project promoter (a contracted local NGO) seemed to be obliged to accomplish only the targeted indicators. Therefore, they urged community residents to volunteer as emergency committee members, copied donor agency's local emergency plan example and submitted it to the municipality as the proposed municipal emergency plan, and conducted community workshops regardless of the number of community residents who participated. As a result, each target indicator designed at the beginning of the project had been accomplished, but only in theory. In reality, the project's purpose was understood by very few community residents (although many people in the community did participate in the project activities). Therefore, the project didn't achieve its self-continuity by the community residents after the project implementation ended.

Second lesson is related to the subject of ineffectiveness of the "high-technology." The Honduran interviewee described it, for example, a digital geographic information system (GIS) provided by the project and installed in the Comayagua municipality. The objective of this system in the municipality was to develop and provide hazard maps to the community residents. Although the quality of the exampled maps were attractive (high-resolution colored hazard maps), few staff members in the municipality had used the GIS system because it was not easy to operate, understand, and maintain, and no data updates had been performed since the initial installation. Finally, the information of the GIS system was outdated, maps in the digital GIS system were different from the city's actual figure and profile. Eventually, the municipality never disseminated hazard maps to the communities.

This second lesson includes the subject regarding maintenance of equipment provided by the projects, as El Salvador interviewee stated. The city

Table 6. Lessons Obtained from the Local DRM Projects.

Category	No. of Responses	Details
Donor-Driven project design	1	• Donor agency (Headquarter-based project team) developed the project design without local participation. • Local project promoter (hired consultant) obliged to accomplish only his duty, without community participation: – **Forced community residents to participate** as local DRM committee; – Submitted local emergency plan that was the same as the donor's example; – Conducted community WSs **regardless of the number participation**. • Each activity had been accomplished, with only in theory and the communities have not understood its importance.
Too much high-technology	2	• GIS system provided from the donor agency to the municipality for creating hazard map. – Quality of the exampled maps was attractive. However it was **difficult for municipality to operate**. – The municipality **did not update the hazard/exposure data**, thus the information was outdated after a couple of years. • Automatic landslide early warning system equipment provided. – Equipment became **faulty and ceased to operate** after 5 years. – Local government officer tried to repair it, but could not **due to complex electronic parts**.
Discontinuity of the local disaster committee	2	• Frequent member change of City and **local DRM committee did not work** as originally designed. – The leader of the local disaster committee **had left from the City** with no prior notification due to economic reason. – People from other areas come and settle in the city, new comers **spread toward suburbs** including river basin and vulnerable area.
Local government's weak follow up capability	1	• Project design including **local government capacity development** to undertake community support after the project execution. However, – In reality, insufficient activity for local governments' capacity development, with **executed only a few seminars**. – Early warning equipment installed, but **insufficient maintenance training**.

Bold: Keyword of the answer.

of Santa Tecla (a city in the metropolitan area) has experienced landslides after a strong earthquake in January and February 2001 resulting in more than 500 deaths. After this catastrophe, a donor organization supported the local government and installed landslide early warning monitoring equipment. The equipment was sophisticated, with a siren that automatically alerts the communities when rain exceeds 35 mm per hour, according to the local risk management regulations. The system was installed in a local police office and functioned effectively for five years since its installation. However, after this period, the equipment became faulty and ceased to operate. The city government officer tried to repair it. However, that could not be possible because equipment documentation was lost and the equipment contained many complex large-scale integration (LSI) electronic parts for which there were no experts to repair in the city or even in the entire country. Since then, the system has never been used. The interviewee suggested that the lesson is that any equipment installed in the local area should be simple to maintain so that local people could use it permanently.

Third lesson is regarding continuity of the local disaster committee as the Nicaraguan interviewee responded. Many people migrate from Chinandega city (a northern-pacific city) to find better jobs in Managua, the capital, or major cities in Costa Rica, a neighboring and macroeconomically stable country. Members of the local disaster committee had left with no prior notification, and so the committee did not work as originally designed. Ironically, people from other areas or countries come and settle in the city, and the population is growing, causing denser population in the city center. New comers also spread toward suburbs, including the river basin area, increasing the magnitude of their vulnerability to flood events.

Forth lesson is regarding the local government's weak follow-up capability to a "seeded" local DRM activity financed and administrated by the donor agency. The Panamanian interviewee described that project in Darien was designed including local government capacity development activities (such as technical seminars for local government workers and installation of emergency aid equipment) so that they would undertake community activities after the project execution. However, these activities were insufficient for local governments; the project executed only a few seminars and installed equipment with insufficient explanation regarding their use for a "real" emergency situation. Another problem was that the local government lacked human resources and budget to follow up, update, and upgrade the local DRM activities. The lesson according to the interviewee includes the need for much more technical support from national

Table 7. Summary of the Interviews Regarding Local DRM Progress.

Category	Details
Project results	• Community capacity building. • Provision of the equipment. • Knowledge products (Educational material/hazard map). • Infrastructures for risk mitigation.
Outcomes	• Lifesaving experience from floods. • Community solidarity. • Local government's legal reform.
Lessons	• Donor-Driven project design (and no continuity by local actors). • Too much high-technology (and no follow-up to use). • Discontinuity of the local disaster committee. • Local government's weak follow up capability.

authority to local governments. Although as discussed earlier one of the communities in Darien has successfully operated a self-managed flood evacuation plan, the interviewee commented that if the community was aware that there was no support from the local government, the residents would no longer prepare for emergency self-management, instead just stay home and blame no support from the local and national governments.

The results, outcomes, and lessons from the local DRM project activities in the region are summarized in Table 7.

DISCUSSION: FOR EFFECTIVE AND SUSTAINABLE LOCAL DRM

On the basis of the lessons demonstrated in the previous section, a challenge for more effective local DRM project initiatives in the region seems to be project sustainability. It is true that 88% of the projects listed in Table 2 were implemented within two years. However, thereafter communities received few support from the projects, the evidences based on the lessons: "Discontinuity of the local disaster committee" and "Local government's weak follow up capability." From the community perspective in practice, disaster risk is one of the many risks that communities face in daily life particularly for poor communities, including family or social violence, unemployment, lack of income, malnutrition, or health problems discussed in earlier sections. Disasters due to natural hazards may occur less frequently than other kind of risks of incidents faced by the community.

Eventually, the priority of DRM in these communities may have decreased soon after the withdrawal of direct support from the projects.

The following event occurred in Costa Rica, as recounted by the interviewee from Costa Rica. In November 2010, the country suffered Tropical Storm Thomas, which spread intense rainfall in a broad area of the country. Among many areas, the community of Escazu in the city of San Jose was the most affected area by rain-triggered landslides. The community is covered by the nation's EWS and the community has been educated for self-evacuation in case of hazardous events (mostly for floods and intense rains). Indeed, the local emergency committee issued the alert and recommended that the community immediately evacuate to the assigned shelters. However, not many residents reacted to the alert. Hours later, a landslide occurred in this area, destroying several homes and causing 23 deaths. This tragic experience in Costa Rica fundamentally shares the lesson learned in Nakagawa (2010) that even with a sophisticated EWS in place, a successful evacuation and disaster loss reduction occurs only when people respond appropriately to the early warning information and instructions. Therefore, local DRM should be permanently enacted, even after the project implementation period.

Bollin (2003) suggests that local DRM capabilities are organized most effectively when responsibility is borne jointly by the municipal authorities and communities. Municipal or local authorities' support for the communities may be the key to the permanent function of local DRM. This also enables local authorities to develop a better understanding of communities' daily problems, risks, and needs, as well as to bridge good relationships between national authorities and communities. Risk identification and risk reduction are element that should be incorporated in the local development process and development planning (Lavell, Elizabeth, & David, 2002). Nevertheless, it seems that not all local governments in the region have sufficient capacity to provide permanent support for that. The region already recognizes this challenge, because 52% of the listed projects in Table 2 have included any components for local governments' capacity development. However, that effort may still not provide sufficient community support initiatives, as indicated by the interview in Honduras and Panama.

In the end, when the project execution period is short (less than two years for 88%) and direct support from the project terminates, given that local authorities' support cannot be much expected, one alternative for a sustainable local DRM may be self-continuation through community ownership. Fortunately, several interviews demonstrated that certain activities in the region stimulated community ownership of DRM. For example, in

Costa Rica, youth develop hazard maps in school and their learning is disseminated among their families. This positive experience implies that the primary school curriculum is one of the key elements of self-continuation for community-owned local DRM. The case of the City of Comayagua suggests that it is fundamental human nature to help neighbors, and thus, local DRM activity may involve all residents (including socially vulnerable people such as the poor, the women, the elderly, and the children) in collaborating with their neighbors to improve awareness of hazardous risks. The case of the province of Darien suggests that local DRM activity is a kind of "natural phenomenon based initiative" and non-economical incentives so that every status of people, including traditional communities and new-formed immigrant communities can participate freely, and this relieves conflict between traditional communities and newer migrant communities.

SUMMARY

The goal of DRM – including local DRM – is quite simple in theory: to reduce, minimize, or eliminate damage and loss resulting from hazardous events. Certainly, such a "super goal" is not easy to achieve in practice, because disaster risk is unpredictable and under latent condition depending on the vulnerability of structures and human beings that vary day-to-day and from land-to-land. The present chapter found that one of the outcomes of the local DRM in the region is related to saving lives. Moreover, this present chapter found the local DRM brings opportunity to collaborate community solidarity and influences on reforming local government's legislative framework.

Project sustainability seems to be a major challenge for effective local DRM in the region, and the result of the interviews includes some lessons in this regard. These include (i) technology used in the local DRM should be adapted for local use thus its maintenance should be as easy as possible; (ii) project design should focus more on the process of community participation, or community capacity development process rather than on just a tangible, or materialized project results; and (iii) a member of community emergency committee and hazard maps should be regularly updated after project initiation to cover a current and accurate profile of the local area.

This chapter concludes that self-continuation through community ownership is an important element for practical and effective local DRM implementation continuously and some implications is also found for that. These

include (i) youth develop hazard maps in school is effective way for a dissemination of their learning among their families and rise communities' disaster risk awareness; (ii) local DRM activity allows all kind of participants (including socially vulnerable people such as the poor, the women, the elderly, and the children) and collaborates to improve community solidarity; and (iii) local DRM as non-economical incentives activity relieves conflict between traditional communities and newer migrant communities.

This chapter meets several limitations. The projects analyzed in this chapter were only donor-driven or donor-financed activities and most of these are executed by SE-CEPREDENAC, national government or national NGOs and thus, projects that were financed by local governments, communities, or local NGOs have not included in it. Additionally, it did not interview the people in the beneficiary and non-beneficiary communities. It has been only less than twenty years from Mitch to date, therefore, it is obvious to be followed up to monitor and provide further analysis for more effective local DRM in the region.

CHAPTER 3

INCORPORATING CLIMATE HAZARDS INTO NATIONAL DISASTER RISK MANAGEMENT

ABSTRACT

In recent years, Costa Rica has experienced increasing economic loss from numerous climate disasters. To meet the challenge of reducing local vulnerabilities, it is necessary to incorporate the potential impacts of current and future climate disaster events into DRM policy, planning, and practice, both at the national and local levels. This chapter evaluates the current status of policy initiative on incorporating the climate disaster risk aspect in DRM planning at the national level in Costa Rica and discusses whether this initiative provides any answers to reduce climate disaster risk. The study applies a "checklist" as a means of evaluation.

Keywords: Climate change threat; disaster risk management; public policy and development planning; checklist; Costa Rica

COSTA RICA'S NATIONAL DRM FRAMEWORK

Background

Comparing to the neighboring countries, Costa Rica better established its legal and institutional framework for reducing the disaster risk. The IDB (2008) indicates that Costa Rica ranks as the second best country among the Latin American and Caribbean countries in terms of performance

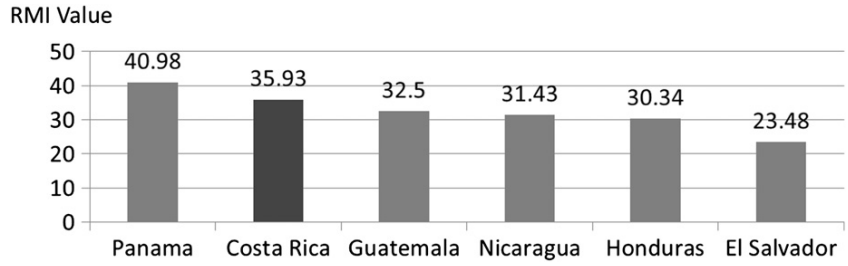

Fig. 1. Disaster Risk Management Performance of Costa Rica in 2005 and Other Countries in Central America. Risk Management Index (RMI) Measures a Country's DRM Performance, from 0 (Minimum) to 100 (Maximum). *Source*: IDB (2008).

related to the national DRM system (Fig. 1). Recent national report of the HFA, an evaluation instrument developed with, and approved by the participants of the World Conference on Disaster Reduction held in Kobe, Japan in January 2005, additionally illustrates the country's relevant progress in terms of national and local DRM frameworks (Fig. 2).

Legal and Institutional Framework

According to the IDB (2008), one of the reasons for favorable DRM performance of Costa Rica is because the country has reformed the national legal framework related to DRM and additionally has realigned the national DRM institutional frameworks. The government approved an amendment of the national emergency and risk prevention law (Ley nacional de emergencias y prevención del riesgo: Act 8488) in 2006. The principal objective of Act 8488 is to reduce the cause of loss of life and social, economic, and environmental resources induced by natural and anthropogenic risk. Act 8488 defines DRM as aspect necessary for sustainable development that includes effective prevention and mitigation measures in spatial and sectorial planning. Article 5 of Act 8488 states the responsibility of the national government: "Any country's public development policy must incorporate elements necessary for a proper diagnosis of risk management and susceptibility to the impact of disasters, and to manage it." Article 6 of Act 8488 creates the National Risk Management System (Sistema Nacional de Gestión del Riesgo, or SNPRAE), which includes national institutions, private sectors, and civil society for the country's

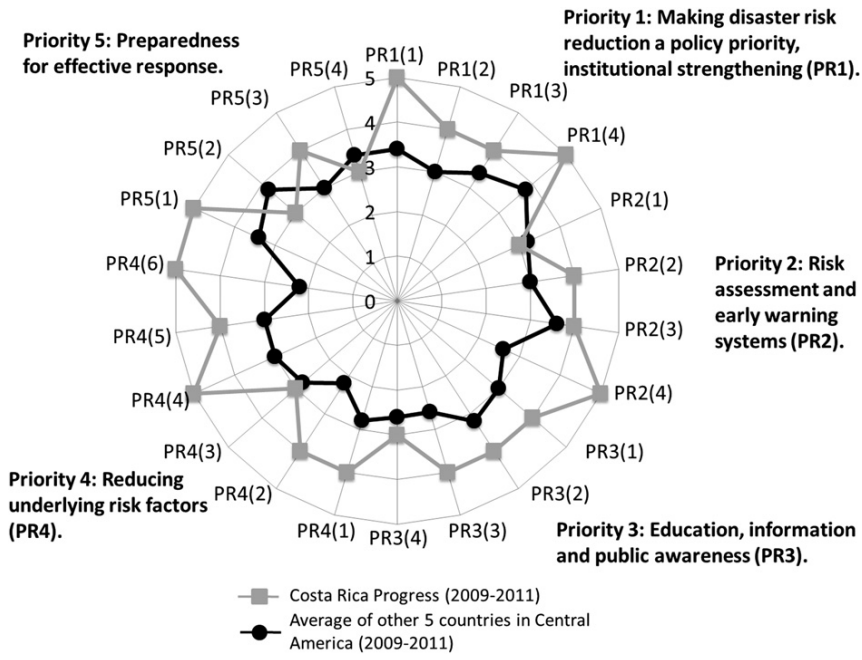

Fig. 2. HFA National Progress of Costa Rica in 2009–2011. Compared to the Average of Other Five Central American Countries in the Same Period. *Source*: UNISDR (2009e, 2009f, 2009g, 2009h, 2009i, 2009j).

DRM. The National Emergency Commission (CNE) is assigned by Act 8488 as the nation's DRM authority and coordinator of the SNPRAE.

National Development Planning

Country's principal public development planning instrument is National Development Plan (Plan Nacional de Desarrollo: PDN), of which the Ministry of National Planning and Economic Policy (Ministerio de planificación nacional y política económica: MIDEPLAN) takes initiative for its preparation and implementation. Recent plan is titled PDN 2011–2015, meaning that the Plan has been issued in 2011 and is valid through 2015. PDN 2011–2015 aims to provide strategic methodology for sectorial and multi-sectorial development options of the country. Each sector ministry and institutions have to respond for its implementation. There are four priority subjects included in the PDN 2011–2015: social welfare, public

safety and peace, environment and land use sustainability, and competitiveness and innovation. DRM is included under the priority of environment and land use sustainability, concerning the country's increasing climate disaster impacts thus its reduction should be necessary for the country's sustainable and long-term development. CNE is assigned as a responsibility of national DRM planning and implementation.

National DRM Plan

Under the mandate of Act 8488 and PDN 2011–2015, CNE has prepared the National Plan for Disaster Risk Management 2010–2015 (Plan Nacional para la Gestión del Riesgo, or PNGR 2010–2015) in January 2010. The objective of PNGR 2010–2015 is to reduce the causes responsible for loss of lives, social, economic, and environmental resources induced by natural and anthropogenic hazards that affect the nation's territory. The CNE began to develop this plan in June 2009, with the participation of 91 institutions (the majority of them were national level institutions). The general director of the CNE approved the plan in December 2009.

PNGR 2010–2015 includes seven priority activities shown in Fig. 3, including the concerns related to the increasing climate disaster damages and losses. Its priority activity "mechanisms and legal instruments for DRM" includes two goals specifically for reducing recent increasing climate disaster impacts. One is a short-term aspect – a national adaptation strategy to be approved by 2011. The other is a medium-term – the entire country will have an EWS by 2015 for monitoring climate hazardous risk.

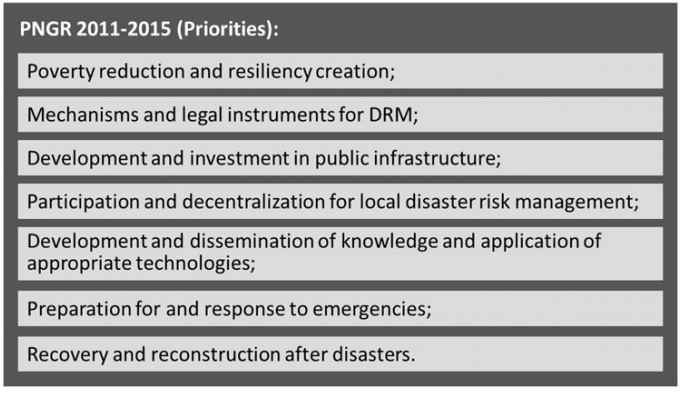

Fig. 3. Priorities of PNGR 2010–2015. *Source*: CNE (2010).

Ministry of Environment, Energy, and Telecommunications (Ministerio de Ambiente, Energía y Telecomunicaciones, or MINAET) and CNE are responsible for both goals.

National Strategy on Climate Change

In addition to the PNGR 2010–2015, the national government of Costa Rica has issued the National Strategy on Climate Change (Estrategia Nacional de Cambio Climático, or ENCC) in 2009, other national policy instrument related to DRM. MINAET, the nation's climate change authority and representative to the UNFCCC led initiative for its preparation, with participation of 93 national institutions.

The objective of the ENCC is to reduce the social, environmental, and economic impacts of climate change through mitigation and adaptation options (see Chapter 1 for the definition of "mitigation" and "adaptation" in this book). In general manner, ENCC promotes sustainable development thus environmental protection actions are necessary to improve the quality of lives for all nation's inhabitants and ecosystems and to move forward with carbon-neutral competitive economy by 2021.

The ENCC includes two main agendas. The first is the national agenda – to reduce impact from climate change. The other is the international agenda – to increase international presence of Costa Rica to share the experience of mitigation and adaptation options. The national agenda includes five principal subjects, and the international agenda includes another five, both shown in Fig. 4.

The objective of the subject "adaptation" under the national agenda is to reduce the vulnerability to impacts from climate change. This subject defines eight priority sectors shown in Fig. 5. Concerning about negative impact of climate change in a long term, ENCC recommends each sector should prepare an adaptation strategy. ENCC additionally recommends each sector to conduct study for identifying areas vulnerable to the impacts from climate change.

One of the priority sectors, coastal zone management includes the following statement specifically related to the context of the increasing climate hazardous risk:

> The coastal zone of the nation is vulnerable to climatic extreme events such as tropical storms. In these areas, 1.2 million people in the country (20% of the nation's population) as well as more than one million tourists visiting the same area every year, are exposed to climate hazards. Therefore, ENCC recommends all public and private actors to take measures for reducing the risk.

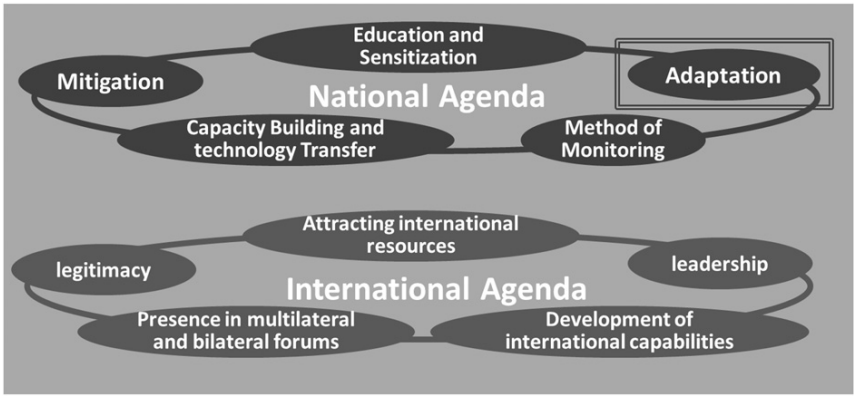

Fig. 4. Subjects of the National Strategy on Climate Change (ENCC). *Source*: MINAET (2009).

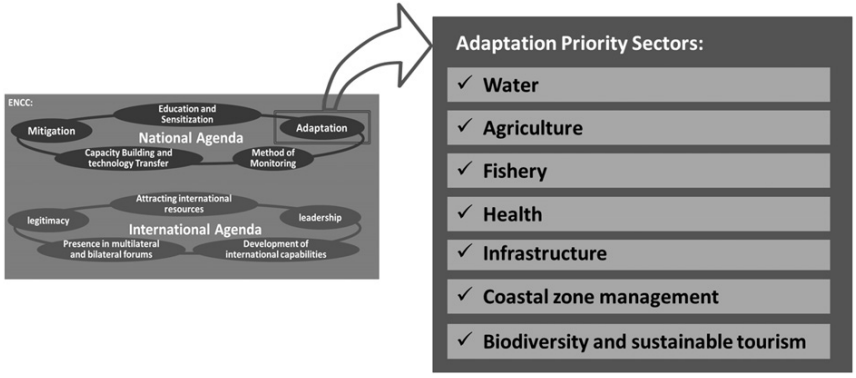

Fig. 5. Seven Priorities of Adaptation in the ENCC. *Source*: MINAET (2009).

Measures to reduce the risk proposed by the ENCC include mangrove replanting, protection for coastal reefs, flood protection works, promotion of integrated management of the coastal zone, establishment of storm monitoring system, and study on the recovery of degraded coastal areas.

In summary, Costa Rica's two recent national development plans, both PNGR 2010–2015 and ENCC include the aspect of increasing climate hazardous risk incorporation into development policy and planning. However, it is still unclear that this exercise at the national planning level is sufficient for reducing disaster risk. The next sections evaluate this point

and identify opportunities and challenges for successful incorporation practice at the national level.

CASE STUDY

Methodology

This book applies a checklist to assess current progress made in terms of the incorporation of climate hazardous concerns in national development planning of Costa Rica. Indeed, no relevant tool has been existed for this purpose in Costa Rica or Latin America. Therefore, national authorities in Latin American countries including Costa Rica, as well as authorities in and Caribbean region developed a checklist during the "Regional Policy Dialogue on Integrating Climate Change Adaptation and DRM into Development Planning," held on June to July 2009 in Panama City, Panama. The checklist aims to evaluate the status of the incorporation of climate disasters as a new or additional threat into development planning and implementation process. Target user of the checklist is considered to be sector authorities responsible for development planning both at the national and local level. Seventeen high-level government officers (e.g., managers or directors) of both DRM and the climate change national authorities from 11 countries in Latin America and Caribbean participated in its development process. The checklist methodology was finally approved by authorities participated to the meeting, and then administrated by the IDB (IDB, 2009b).

Prior to the Panama Dialogue, the checklist was intended to be a single list of questions. However, during the Panama Dialogue, participants were requested to develop sector-specific checklists for priority sectors in the region. These included the tourism, water, and agriculture. In other words, authorities in Latin America and Caribbean were concerned about new or additional climate disaster risk in these sectors. The high-level authorities' concern about climate hazardous risk, specifically in these three sectors is explained as follows.

Tourism Sector

Specifically, the Caribbean region is the most significant region related to tourism as economic activities, accounting 15% GDP. Indeed, the Caribbean region has lost US$8 billion in direct loss of tourism services

during 1983 to 2009 due to disasters, especially due to recent increasing hurricane events and floods (IDB, 2010).

Water Sector
Latin American region's 70% disaster losses have been due to climate disasters and these affect water-related infrastructures. Appropriate hydrometeorological and water management is one of the region's high priority for the relevant infrastructure development and management process (IDB, 2011).

Agricultural Sector
Latin America is one of the most agricultural-based productive area in the world (OAS, 1990), and economic loss in agriculture sector due to disaster is relatively a huge in terms of its impact of each country's economy. For example, countries in Central America region (including Costa Rica) have lost in average US$318 million of agriculture production every year in each country during 1970–2002 due to disasters (ECLAC, 2011).

Target Sectors and Evaluation Criteria

Specific needs for the incorporation of climate hazardous concerns into development planning in these sectors of Costa Rica are explained as follows.

Tourism Sector
Costa Rica encouraged tourism sector development in the 1980s, and in 1993, this sector became the most productive and largest foreign exchange source in the nation's economy (Raventos, 2006). However, the seashores and vegetation attractive to tourists is vulnerable to climate change (ECLAC, 2010). Probable sea-level rise will cause coastal erosion and the flood hazard area will broaden in several coastal zones (IMN, 2009). The government concerned about climate change's potential impact and incorporated it into the National Tourism Development Plan 2010–2016, in its "Sustainable Tourism Program" section, developing a specific action plan to reduce the risk (ICT, 2010).

Water Sector
The country issued the National Plan for Integrated Water Resources Management (Plan Nacional de Gestión Integrada de los Recursos

Hídricos, or PNGIRH) in 2008, outlining critical actions for sustainable water resource management (MINAET, 2008). The PNGIRH estimates potential change in rainfall patterns, floods, and in average annual temperatures probably associated with climate change. However, these estimations were in a qualitative manner due to lack of information to estimate the potential changes in a quantitative manner.

Agricultural Sector

Approximately 53% of the nation's land is used for agriculture, with its main products being coffee, bananas, beans, sugar, and pineapples (World Bank, 2009). In recent years, agricultural production has represented over 7.5% of Costa Rica's GDP and employed 15% of the available labor force. In general, agriculture sector is known as one of the sectors most vulnerable to climate hazardous impacts. Ordaz, Ramírez, and Mora (2010) explain that the country has already been affected by recent increasing climate disasters with a reduction of certain crop production specifically due to excessive rainfall and floods. The ENCC includes recommendations to reduce the potential climate hazardous impacts of this sector.

Checklist Contents

Prior to embarking on the development of a checklist, the authorities in the Panama Dialogue discussed a number of fundamental contexts for which the definition of concepts was required. These efforts focused on the following: (i) which and how many transversal topics for the selected sectors should be included in this checklist; (ii) how to incorporate the common concerns for all participant countries in the Panama Dialogue to include in the checklist; and (iii) which and how many sector-specific questions would be needed to address the checklist objective. Taking into account these fundamental discussions, an explicit decision was made to develop the checklist as a functional tool, specifically one that includes the incorporation practice in terms of practical actions as well as policy integration. On these bases, the checklist developed in the Panama Dialogue includes the following three categories, in order to assess in different sectors but with the same criteria: (a) risk identification, monitoring, and evaluation; (b) policy and institutional frameworks; and (c) development practice. These three categories consist with this book's analyzing framework (see Chapter 1).

Risk Identification, Monitoring, and Evaluation (Hereafter "Risk Identification")
Focusing on the observation activities of changing climate projection, using appropriate monitoring tools, information, and references to diagnose potential climate disaster risk in a long term.

Policy and Institutional Frameworks
Focusing on the coordination mechanism, its legislation, normative and development planning framework, and budget evidence to support climate hazardous risk incorporation in development planning among various institutions involved in the process.

Development Practice
Focusing on implementation experiences or pilot experiences to find alternatives for reducing climate hazardous impacts and future disaster losses and damages, as indicative of effective DRM planning.

All of the categories in each sector hold 4–19 specific questions. The complete checklists are presented in Tables 1–3.

Application Methodology

The application methodology of the checklist at the national government of Costa Rica was the following way: first, a conference call was held with the national DRM national authority (CNE) on April 2011 to share the background, objective, and detailed methodology of how to apply the checklist. Indeed, a staff of CNE has participated to the Panama Dialogue to collaborate the checklist development process. Second, CNE called under the SNPRAE framework, the specific national institutions necessary to apply checklist, including the Ministry of Agriculture and Livestock (El Ministerio de Agricultura y Ganadería, or MAG), the Water and Sanitation Institute (Instituto Costarricense de Acueductos y Alcantarillados, or AyA), and the Ministry of Tourism (Ministerio de Turismo, or MdeT). These institutions completed the relevant sectorial checklist and reported to the CNE. Finally, CNE systematized and summarized the responses. According to the IDB at the moment of writing this book, no country has reported any results from the application of the checklist, nor have third parties published. In this sense, the application of the checklist for this book was the first such experience since the development of its methodology.

Table 1. Items in the Checklist (Tourism Sector).

Risk Identification, Monitoring, and Evaluation	Policy and Institutional Frameworks	Development Practice
• Are there projections of changing climate and impacts on the recurrence and intensity of hurricanes, storm surges, flooding, and landslides? • Are any such projections and analyses transformed into, or used for: – GIS systems and data platforms, – Hazard maps, – Land use plans, – Integrated coastal zone management plans, – Carrying capacity assessments, – Mitigation plans, – Development control processes and orders, – Integrated watershed management plans, and – Individual and accumulative assessment of public sector investment projects? • With reference to impacts, do systems exist for evaluating risk associated with changing climate leading to effects on zone development such as: – Water for human consumption, – Water for production, – Natural resources including biodiversity of marine and terrestrial systems, – Coastal assets, – Energy provision, and – Foreign exchange resources?	• Do inter-sectorial and inter-area commissions or committees exist for promoting CCA and DRM concerns in an integrated and coordinated fashion? • Does local level legislation and normative practice exist that demands consideration of DRM and CCA concerns? • Do local level development plans consider CCA and DRM, and are these updated regularly? • Do plans exist that go beyond the short term and consider scenarios of up to 30 years or more? • Do facilities exist for the guaranteed participation of a wide range of social actors in scenario building and decision making as regards CCA, DRM, and development planning concerns? • Do participatory budgeting procedures exist in the area? • Do ongoing procedures for public and private education on climate change (CC) and disaster risk (DR) exist? • Do early warning systems exist for taking charge of slow incremental and rapid onset risk conditions?	• Do projections exist of the potential impacts of climate change and disaster risk on the potential for development in the zone? • Are alternative development scenarios discussed in participatory fashion, given projected climate change and sea-level scenarios? • Are there signs or evidence of changing attitudes to local development and investment on the part of entrepreneurs, and what directions do these take? • Are there efforts to streamline local and sectorial development plans with CCA and DRM concerns? • Do local and national budgeting and financial allocation schemes demand analysis of CC and DR impacts in the zone? • Do systems of indicators exist that link project objectives to CCA and DRM policy goals?

Table 1. (*Continued*)

Risk Identification, Monitoring, and Evaluation	Policy and Institutional Frameworks	Development Practice
• Are there efforts to incorporate the results of analysis and monitoring in the projections and projects for: – Business expansion and continuity, – Food security, and – Health security?		

The checklist has already defined a framework and series of questions as seen in Tables 1–3. However, the checklist is not regulated in terms of how to apply and use it. Hence, the methodology of how to regulate the use of the checklist in this study was discussed with the CNE and applied in the following way:

- To each question, the interviewee should answer either yes or no;
- Each question or sub-question is assigned one point when the interviewee responds with yes (or positively) from his or her institutional perspective; and
- If the interviewee judges yes, it should then be verified with available materialized evidence, for example laws, norms, plans, or official documents.

The checklist was applied in the two time periods: retroactively in March 2008 (baseline, or before the approval of two relevant policy instruments: PNGR 2010–2015 and ENCC) and in March 2011 (three years after the baseline data were collected). In this sense, this case study intends to compare between the two time periods.

Each category of each sector expresses its results of completion from 0% to 100%, being unsatisfactory to excellent performance in terms of the climate hazardous risk incorporation into national development planning. The results of this study are evaluated as mature (excellent) when more than 76% of the items were completed; 75–51% as maturing (satisfactory); 26–50% as early stage (weak); and below 25% as very early stage (unsatisfactory) regarding the progress of the incorporation practice.

Table 2. Items in the Checklist (Water Sector).

Risk Identification, Monitoring, and Evaluation	Policy and Institutional Frameworks	Development Practice
• Do projections exist of changes in water availability from different sources for domestic and productive uses based on climate change projections? • Are adequate monitoring and measurement systems in place to register information with which to understand and project changes in the future? • Do projections and monitoring exist as regards the changes in drought and flooding conditions to be expected in different areas? • Does subterranean monitoring of water sources take place to control for processes of contamination?	• Do policy guidelines exist with regard to changing demand and supply of water and changing patterns of climate variability? • Is water supply and demand the object of planning procedures and integrated plans? If so, do these cover: – River basin planning and – Demand and supply planning in the domestic and production sectors? • Do the same or different institutions deal with the treatment of changing climate averages and climate variability and their impacts on water supply and demand? • Are the joint problems of changing averages and extremes dealt with from a planning perspective? • Do instruments of control exist for: – Regulating negative impacts of water shortage or abundance, – Creating incentives and disincentives for changing consumption and use practices, – Standardizing practices of water use, and – Developing a common agenda for the protection of sources, efficiency in usage and reduction of impacts in sectors?	• Are modifications introduced that improve: – Protection of sources, – Water re-usage practices, – Efficiency in irrigation systems, – Controls over deforestation in river basins, over flooding, and landslides, – Alternative methods of collecting water, including rainfall, – Promotion of community control and participation, and – Multi-hazard planning procedures?

Table 3. Items in the Checklist (Agricultural Sector).

Risk Identification, Monitoring, and Evaluation	Policy and Institutional Frameworks	Development Practice
• Has climate change manifested itself in the zone to date? • Have the impacts of such changes on productivity and employment been measured and socialized? • Are mechanisms in place for measuring and monitoring changes in climate averages and variability, including the incidence of climate extremes and their projection into the near and medium range future? • Do mechanisms and methodologies exist for evaluating the vulnerability of the different components of the process of agricultural production, commercialization and service provision when faced with possible climate change and new extreme events? • Is climate information regularly produced and distributed among farmers at appropriate scales of resolution? • Are there mechanisms in place such that participatory schemes of information generation and discussion can take place, future risk scenarios be worked out and decisions taken collectively as to reduction options? • Are early warning systems in place for drought, flooding, landslides etc.?	• Have existing institutions for agricultural planning, weather monitoring and disaster risk reduction been brought together under inter-sector or inter-ministerial schemes, guaranteeing coherence and coordination in terms of intervention? • Do coordination schemes exist such that early warning systems are immediately aware of climate information and user demands? • Do agricultural insurance mechanisms exist for small, medium, and large-scale farmers and to what extent do they factor in climate change risk and promote ongoing risk reduction and adaptation measures? • Do funding mechanisms for CCA and DRM exist and are they duly coordinated and integrated into development planning mechanisms?	• Do local and sub-regional land use and territorial organization plans exist that take into account climate change and climate variability variables**?** • Is there a research capability to develop crops and animal strains that are resistant to climate change conditions in the area? • Do mechanisms exist for guaranteeing the importation of good practices from other areas when dealing with climate risk factors? • Do plans exist that link production opportunities and needs to such factors as livelihood security, food security, and poverty reduction? • Have traditional mechanisms for understanding local climate and adjusting production to this been systematized and utilized in agricultural planning? • Have mechanisms been introduced to promote actualization of traditional knowledge when faced with changes in environmental variables and bio-indicators?

Specific Definition and Limitation of Application

As indicated earlier, this study seems to be the first experience the checklist has been applied since its development. Thus, some challenges and limitations were experienced. First, some of the questions are indeed, not stated clearly enough. For example, the question "Do facilities exist for the guaranteed participation of a wide range of social actors in scenario building and decision making as regards climate change, disaster risk, and development planning concerns?" (see Table 1) includes an unclear definition of "wide range of social actors." The same challenge is evident in other questions that contain the phrase "adequate monitoring and measurement systems." The term "adequate" is not clearly defined. In such cases, the CNE held internal discussions and made its own definition. For example, "wide range" has been defined as more than five types of actors.

Second, some of the questions are not defined at the geographic level of intervention. For example, the question "Do projections exist of the potential impact of climate change and disaster risk on the potential for development in the zone?" (Table 1) includes the undefined term "zone." In such a case, it was determined that question items refer to the national level, given that the interviewees are national authorities.

Indeed, the checklist is an evaluation tool with binary answers (yes or no) thus does not have a "performance target" to evaluate results in a qualitative manner. In other words, each question of the checklist does not evaluate level of the incorporation of climate disaster risk into development planning (e.g., highly or moderately incorporated).

Another limitation is seen from the perspective of the multi-sectorial development approach. The country's DRM legal framework, Act 8488, includes statements on "poverty reduction and creation of resiliency" and "participation and decentralization for local disaster risk management," which require a multi-sectorial development approach. The checklist does not evaluate from the multi-sectorial development perspective, but it only does so from the sectorial approach.

Study Results (1) — Tourism Sector

The result of the application of the checklist in tourism sector is described below and summarized in Table 4.

Table 4. Application Results of the Checklist (Tourism Sector).

Accomplished Items	Accomplished When?	Verification
Risk identification, monitoring, and evaluation		
Are there projections of changing climate and their impact on the recurrence and intensity of hurricanes, storm surges, flooding, and landslides?	May 2008–May 2011	Description related to this topic is included in the ENCC in its section of "Situation in Costa Rica"
Any projections and analysis transformed into or used for integrated coastal zone management plans?	May 2008–May 2011	Description related to this topic is included in the ENCC in its section of "Adaptation"
Evaluating risk for natural resources including biodiversity of marine and terrestrial systems.	May 2008–May 2011	Report: Assessment of climate change impacts in the ecotourism sector
Result accomplished	3 out of 19 points (16% of the items)	
Policy and institutional frameworks		
Do inter-sectorial and inter-area commissions or committees exist for promoting CCA and DRM concerns in an integrated and coordinated fashion?	–May 2008	SNPRAE with the participation of MdeT and had dealt with climate change impact assessments.
Do early warning systems exist for taking charge of slow incremental and rapid onset risk conditions?	–May 2008	CNE's national early warning system
Result accomplished	2 out of 8 points (25% of the items)	
Development practice		
Result accomplished	0 out of 6 points (0%)	

Risk Identification, Monitoring, and Evaluation
In May 2008, MdeT had not made any progress with the items on the incorporation. However, by 2011, it has made progress on assessments and projections of the impacts of climate hazardous impacts on the tourism sector, the coastal zone management plan in the Caribbean region (eastern part of the country), and the assessment of the relevant impacts in the ecotourism sector.

Policy and Institutional Frameworks
In May 2008, the CNE had already managed SNPRAE with the participation of MdeT and had dealt with climate disaster impact assessments. Furthermore, CNE had begun to administer a national EWS to share information among participants of the SNPRAE. No additional progress has been made from May 2008 to May 2011.

Development Practice
No progress was made before May 2008 or in the next three years.

Study Results (2) – Water Sector

The result of the application of the checklist in water sector is described below and summarized in Table 5.

Risk Identification, Monitoring, and Evaluation
No progress was made until May 2008. PNGIRH has not been qualified because of its qualitative manner and insufficient information from the aspect necessary for the incorporation practice. From May 2008 to the next three years, AyA, with support from the National Meteorological Institute (Instituto Meteorológico Nacional, or IMN) and CNE, made an effort to advance a system monitoring long-term changes in drought and flooding conditions.

Policy and Institutional Frameworks
By March 2008, AyA had made progress on water supply and demand planning at the national level and on regulation of negative impacts of water shortages. From May 2008 to the next three years, AyA, with support from MINAET has included policy guidelines with regard to changing supply and demand of water due to changing climate.

Table 5. Application Results of the Checklist (Water Sector).

Accomplished Items	Accomplished When?	Verification
Risk identification, monitoring, and evaluation		
Do projections and monitoring exist as regards the changes in drought and flooding conditions to be expected in different areas?	May 2008–May 2011	System progressing with support from the National Meteorological Institute (IMN) and CNE. This topic is being included in one of the priority activities of PNGR 2010–2015.
Result accomplished	1 out of 4 points (25% of the items)	
Policy and institutional frameworks		
Do policy guidelines exist with regard to changing demand and supply of water and changing patterns of climate variability?	May 2008–May 2011	Study on demand and supply planning at the national level.
Are water supply and demand the object of planning procedures and integrated plans in the domestic and production sectors?	–May 2008	Climate change adaptation strategy on water management in 2007.
Result accomplished	2 out of 8 points (25% of the items)	
Development practice		
Are modifications introduced that improve water re-usage practices?	–May 2008	AyA's water re-usage assessments and implementation of water supply projects.
Are modifications introduced that improve multi-hazard planning procedures?	May 2008–May 2011	PNGR 2010–2015 introduces multi-hazard risk reduction procedures and measures.
Result accomplished	2 out of 7 points (29% of the items)	

Development Practice
By March 2008, AyA had already outlined water re-usage practices. From May 2008 to May 2011, AyA, with contribution from the CNE, made progress with PNGR 2010–2015, including multi-hazard risk reduction action plan at the national level.

Study Results (3) – Agricultural Sector

The result of the application of the checklist in agricultural sector is described below and summarized in Table 6.

Risk Identification, Monitoring, and Evaluation
Prior to March 2008, no progress was made regarding the category of risk identification. After that, however, in the ENCC, the MINAET included assessments of climate disaster impacts on the agriculture sector. The MAG, in collaboration with the Economic Commission for Latin America and the Caribbean (ECLAC), developed a study regarding economic impacts from climate disasters on the agricultural sector. The CNE began a partial EWS operation to share the information among the SNPRAE members including MAG. MAG additionally responded there is no communication mechanism between MAG and municipalities, thus it is difficult to take place participatory schemes of information generation. MAG only disseminates national level information to municipalities by published documents.

Policy and Institutional Frameworks
MAG responses assume that SNPRAE works for the inter-institutional coordination mechanism for agriculture planning in the context of increasing climate disaster risk, as well as the mechanism to share an EWS. SNPRAE already existed in March 2008. No further progress has been made after that.

Development Practice
For many years before 2008, MAG worked closely with national universities to implement studies on the development of crops and animal strains in the context of increasing climate hazardous events. MAG is also a member of the Central America Agriculture Council (Consejo Agropecuario Centroamericano, CAC) since 2007, which allows for sharing good practices among other Central American countries. No progress was made after that.

Table 6. Application Results of the Checklist (Agricultural Sector).

Accomplished Items	Accomplished When?	Verification
Risk identification, monitoring, and evaluation		
Has climate change manifested itself in the zone to date?	May 2008−May 2011	ENCC includes a description in the section "Situation in Costa Rica."
Have the impacts of such changes on productivity and employment been measured and socialized?	May 2008−May 2011	ECLAC reports on economic impacts from climate change on the agricultural sector.
Are early warning systems in place for drought, flooding, landslides, etc.?	May 2008−May 2011	CNE's early warning system. Target objective of PNGR 2010−2015.
Result accomplished	3 out of 7 points (42% of the items)	
Policy and institutional frameworks		
Have existing institutions for agricultural planning, weather monitoring, and disaster risk reduction been brought together under inter-sector or inter-ministerial schemes?	−May 2008	SNPRAE mechanism
Result accomplished	1 out of 4 points (25% of the items)	
Development practice		
Is there a research capability to develop crops and animal strains that are resistant to climate change conditions in the area?	May 2008−May 2011	MAG works closely with national universities to implement studies.
Do mechanisms exist for guaranteeing the importation of good practices from other areas when dealing with climate risk factors?	−May 2008	MAG is a member of CAC since 2007.
Result accomplished	2 out of 6 points (33% of the items)	

Summary of the Study Results

All result of the application of the checklist at the national level of Costa Rica is shown in Fig. 6. Some generalizations can be made from the results of this checklist. First, as illustrated earlier, Costa Rica has a relatively high performance regarding a national DRM system when compared with other Latin American and Caribbean countries. In addition, relevant policy instruments (Act 8488, PNGR 2010–2015 and ENCC) have already been published and provide the framework for incorporating climate hazardous risk into development planning. However, the checklist results indicate that the national government of Costa Rica is still in early stage of the incorporation of climate hazardous risk as additional threats in development planning and practice. The accomplishment percentages of the items in each category of the checklist as of March 2011 vary from 0% (development practice in the tourism sector) to 42% (risk identification, monitoring, and evaluation in the agriculture sector), with an overall average of 26%. Thus some form of general hypothesis can be assumed for this result of this low average of the result of checklist. For example, because of structural and financial barriers (German Government, 2008), institutional barriers (Schipper & Pelling, 2006), communication and cooperation issues between administrative entities (Birkmann et al., 2009), or for other reasons, for example, the incorporation process may take a certain amount of time.

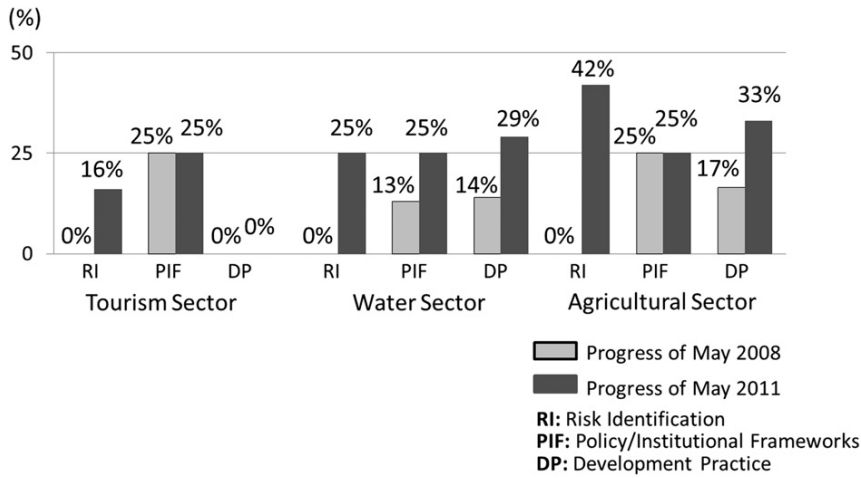

Fig. 6. All Result of the Checklist at the National Level of Costa Rica.

Second, the average accomplishment percentages in March 2011 in tourism, water, and agriculture are 14%, 31%, and 33%, respectively, indicating that the water and agriculture sectors are progressing the incorporation practice relatively better than tourism. For example, in the agriculture sector, the item "climate change has manifested itself to date" has been accomplished because ENCC included the same recognition in its section "Situation in Costa Rica." The other item of the checklist, "impacts have been measured and socialized," is also accomplished because the same impacts have been described in the ENCC in its section "adaptation." The item "warning systems in place" was also accomplished because this is one of the target objectives of PNGR 2010–2015. Regarding the water sector, AyA developed its own CCA strategy on water management in 2007. The strategy was developed as an input for the elaboration of ENCC (Brenes, 2009). Therefore, it can be said that one reason for the progress on the incorporation of climate hazardous in the agriculture and water sectors in Costa Rica is directly related to the distribution of PNGR 2010–2015 and ENCC, or the relevant national policy instruments.

Third, among three transversal topics, the "risk identification, monitoring, and evaluation" has progressed relatively well in the last three years when compared to the other two topics. Furthermore, it is found that six out of all seven accomplished items in this topic are related to the recent publication of the ENCC and PNGR 2010–2015. For example, the item "integrated coastal zone management plans" in the tourism sector was accomplished because the description related to these topics is included in the ENCC in the subject "Adaptation." The other item "projections and monitoring exist as regards the changes in drought and flooding conditions" in the water sector is additionally accomplished because PNGR 2010–2015 included it in its priority activity "development and dissemination of knowledge and application."

DISCUSSION

Opportunities

The checklist results indicate that the topic of "risk identification, monitoring, and evaluation" has progressed further during the last three years than the other two topics. Progress appears to be directly related to the publication of recent policy instruments ENCC and PNGR 2010–2015. Therefore, it can be said that relevant policy instruments in Costa Rica did

stimulate and provide the opportunity for incorporating climate disaster risk into sector development planning, especially related to the topic of risk identification, monitoring, and evaluation.

Since the initiation of the IDNDR and the UNISDR, DRM has moved from a paradigm dominated by emergency response and post-impact recovery toward a framework that considers more closely ex ante activities, and is informed by sustainable development goals (Lavell, 2004). Whereas traditionally, a good part of what was known as disaster prevention and mitigation related to contexts where disaster risk existed (communities located in flood-prone areas, hill slopes subject to landslide), the context of climate disaster risk has brought new ideas forward, toward proactive DRM oriented to a longer term. This requires anticipating risk and risk factors and attempting to guarantee that additional risk associated from climate hazardous impacts are concerned about and is incorporated into policy and planning instruments. In addition, this paradigm shift requires information of risk identification, monitoring, and evaluation as an input for policy and planning decisions. The checklist results seem to reveal an effort by the national government to first promote the development of information related to risk identification, monitoring, and evaluation for decision making in order to incorporate the new or increasing risk into development planning, prior to proceeding with development action.

One question is raised here: is it an easy process to incorporate information related to climate hazardous risk into national development planning? Climate hazardous events are just an element to be included in analysis and do not require doing much that is different (van Aalst, 2006). However, it is not always simple because of its methodological difficulties and insufficient quantitative data (Burton, Huq, Lim, Pilifosova, & Schipper, 2002). Incorporation of climate disaster risk information into already existing risk identification, monitoring, and evaluation processes would additionally increase the levels of uncertainty associated with the number, intensity, temporal distribution, and recurrence patterns of climate events. Stakeholders should focus attention on processes that address the uncertainty of future climate hazardous events in order to identify appropriate measures (Pittock & Jones, 2000).

Gaps and Challenges

Results of this case study have identified that the national policy instruments do provide an opportunity to influence the incorporation of climate

hazardous risk into development planning and practice, especially when related to the context of risk identification in planning. However, it may additionally be true that several gaps exist when doing so in practice. These are observed mostly in the deference in terms of parameters and scopes between the two national policy instruments: PNGR 2010–2015 and ENCC.

The first gap is related to the parameter of information necessary for the incorporation of climate hazardous into development planning and practice. PNGR 2010–2015 explains two parameters of hazardous events required for the incorporation practice. The two parameters include intensity and frequency, required according to PNGR 2010–2015, "constant occurrence of climate hazardous events in the nation is due to the increase of the number and intensity of relevant events, so that it is required to identify future hazardous scenarios taking into account the two parameters." On the other hand, climate disaster risk is explained in ENCC only from the context of the annual or decadal change in average temperature and precipitation at the national and sub-national level. Indeed, the context of adaptation to climate change is focused on changes in average climatic conditions (Sperling & Szekely, 2005). This gap may encourage the notion that climate hazardous risk information to be incorporated into development planning should include information on intensity and frequency of probable hazard events, and not information on average changes of temperature and precipitation.

The second gap regards the scope of measures and how to use the climate disaster risk information for that purpose. For example, ENCC recommends that adaptation actions should primarily use corrective measures. This is found in the description of the ENCC in its section "adaptation" with the wording "probable measures to reduce vulnerability including mangrove replanting, protection works of coastal reefs, and mitigation works." On the other hand, PNGR 2010–2015, apart from the corrective measures, includes prospective measures to be implemented for DRM with the following wording "control of risk generating process over the regulatory function performed in the development process." The question is whether these two measures require the same type of risk information. In a general sense, corrective measures require information on the effects of natural hazards, as well as information on physical vulnerability to natural hazards. On the other hand, prospective measures require broader information on social, environmental, and institutional conditions or vulnerabilities to natural hazards. This gap may generate a challenge in selecting appropriate information for risk identification related to either

corrective or prospective measures, one of which is included in both ENCC and Act 8488, while the other is included only in PNGR 2010–2015.

The last gap is related to actors, or those who are involved in the process of information development needed for development planning in the context of increasing climate disaster risk. For example, in the "adaptation" section of ENCC, this does not indicate who should provide information to estimate climate disaster risk. In general, most climate hazardous impact assessments are based on the output of global climate models (Mastrandrea, Heller, Root, & Schneider, 2010). The assessment should include specifically scientific entities, including international and national actors. Nonetheless, ENCC does not clearly indicate whether civil society and private sectors would additionally participate in its process. On the other hand, PNGR 2010–2015 indicates actors to be involved for DRM planning by stating, "the need for participation and input from civil society and private sector is unquestionable." This may be a gap; information on climate disaster risk is developed by unidentified actors, or only by scientific entities, according to the ENCC, whereas the information for DRM planning, according to PNGR 2010–2015, is developed by named actors that include civil society including communities and private sectors. This gap would present a challenge to the nation's scientific entities and/or DRM authority, the final actors responsible for collecting and compiling relevant information.

The three identified gaps and challenges of incorporating climate disaster risk into different national development planning and practice are summarized in Table 7.

SUMMARY

This chapter concludes that the national policy instruments do provide an opportunity to influence the incorporation of climate hazardous into development planning and practice, especially in the context of risk identification. Furthermore, it identifies three gaps and challenges to more efficient the incorporation practice, being coinciding with two national policy instruments: PNGR 2010–2015 and ENCC. These include the parameters of information, approach to measures, and identification of actors.

All three identified gaps emphasize that the involvement of social actors, especially through local and community participation, in the identification of climate disaster risk is a key factor to moving forward for effective

Table 7. Summary of Gaps and Challenges Regarding the Incorporation Practice at National Level.

	Gaps	Challenges
Parameter of information: whether it includes intensity and frequency of the climate disaster risk.	*ENCC*: explains only from the context of average change of temperature and precipitation as an input for planning. *PNGR 2010–2015*: requires parameters including intensity and frequency of hazardous events for DRM planning.	Nation's technical and scientific authorities (especially climate change information providers) should develop two additional parameters of information (intensity and frequency of natural hazard events) to allow incorporation of climate disaster risk estimation into DRM planning.
Scope of measures: how to use the climate disaster risk information for purpose of risk identification and management.	*ENCC*: recommends adaptation actions should use primarily corrective measures. Corrective measures require information on the impacts of natural hazards to be reduced, and information on physical vulnerability to natural hazard impacts. *PNGR 2010–2015*: includes prospective measures to implement DRM. Prospective measures require broader information including social, environmental, and institutional vulnerabilities to natural hazards.	Nation's development planning authorities have a challenge in selecting appropriate information on risk identification for each case of corrective or prospective measures.
Actors involved: who is involved in the process of information development needed for DRM planning?	*ENCC*: ENCC does not indicate who should develop information to estimate climate change threats. *PNGR 2010–2015*: indicates actors to be involved in DRM planning, including civil society and the private sector.	Nation's scientific entities and/or DRM authority, to collect and compile additional climate disaster risk information and already existing disaster risk information.

DRM planning and implementation. Indeed, communities have the opportunity to build a strong perception about the hazard types and dealing with these hazards as an everyday occurrence (Guevara, Rivera, Umana, & Vega, 2008; Parvin, Takahashi, & Shaw, 2008). Local people have much experience to draw on in identifying current climate disaster risk such as changes in precipitation patterns. Such experiences would be a great help in identifying probable future climate disaster risk. National stakeholders should take account of this to downscale the incorporation practice and empower communities to achieve that. Stakeholder inclusion can play a major role in overcoming the identified challenges.

CHAPTER 4

INCORPORATING CLIMATE HAZARDS INTO LOCAL DEVELOPMENT PLANNING

ABSTRACT

Using the same checklist as that in the previous chapter, this chapter evaluates the current status of policy initiative on incorporating climate disaster risk aspects in local development planning in Costa Rica. The chapter identifies opportunities and challenges of this local initiative for reducing climate disaster risk. In addition, the study discusses the influence of national policy on local development planning.

Keywords: Disaster risk management; climate change's hazardous impacts; local development; policy decentralization; checklist; Costa Rica

LOCAL PLANNINGS IN COSTA RICA

Legal Framework of Local Development Planning

Despite the fact that Costa Rica has been traditionally classified as one of the most centralized countries in Latin America (IDD, 2011; Segura, 2008; USAID, 2004), several laws are being approved in recent decades to promote policy decentralization. These include the 1998 Act 7794 (Municipal Code), which declares municipalities to be legal entities with their own assets and staffs, having full legal capacity to execute all actions necessary

to accomplish local public development objectives. Act 7554 allows transferring the administration of local taxes to the local governments. The Urban Planning Law (Ley de Planificación Urbana, Ley No. 4240 of 1968) was additionally reformed by Act 7495 in 1995, stimulating each municipality to prepare a Regulatory Plan (PR) in each four to five years. This PR regulates local land use planning particularly in urban areas. The regulation must be developed, approved, and issued by the municipalities. The PR is considered as municipalities' central development planning instruments for incorporating national and local policy priorities.

Local Disaster Risk Management Planning

The PRs are materialized with several technical inputs as references prior to develop this plan. For example, the municipality of Cartago issued the Action Plan titled "Preparation, Updating and Approval of the Regulatory Plan of Cartago City," (Elaboración, Actualización y Homologación de los Planes Reguladores del Cantón Cartago) in 2010 prior to developing the PR. This technical document includes several sector-based development diagnoses and its proposal plan such as water resource management plan, tourism sector development plan (particularly for Irazu volcano national park area), and agriculture development plan. Indeed, these sector plans incorporate explicitly and implicitly the context of DRM, and this indicates the municipalities do not have to develop individual DRM plan, rather, they merely need to incorporate DRM into the PR as a sector. That is, opportunities and challenges for incorporating climate hazards into development planning at the local scale may be seen in the development process of the PR.

Local Challenges

Despite the fact that the PR is a systematic local planning instrument that allows incorporating DRM in each sector development, this doesn't always generate appropriate coordination or communication among sectors for greater multi-sectorial development synergies. For example, risk assessment information developed for water sector management in Cartago has not been referenced to the infrastructure development plan. Indeed, one of the reasons of the recent establishment of local DRM Committee (CGLR) was to resolve this issue and to generate greater coordination among sectors (see Chapter 1).

Other local challenge is relating to the limits of local knowledge. This point is additionally implied by recent literature (Bedsworth & Hanak, 2010; Hardoy, Pandiella, & Velasquez, 2011). In case of Costa Rica, national authorities and academic entities intend to complement this gap. For example, the National Emergency Commission (CNE) has started to encourage two target municipalities (Guanacaste and Canas, northern cities of the country, preliminarily identified as seismic activity prone areas) to incorporate the DRM into the PR since the later-1990s. CNE activity includes development of seismic hazard maps, dissemination of the maps to the municipalities, and technical dialog with local authorities. At first, the local authorities did not understand why DRM was a priority for the municipality's development agenda, dispute the fact that the municipality faces daily issues including development of the local public infrastructure, a united citizenry, and increased human security, among others. Fortunately, the two municipalities have prioritized natural resources and environmental management, since tourism (i.e., eco-tourism) was an important economic activity for them. Finally, the two municipalities did incorporate DRM regulation into their PRs in the early 2000s. However, the CNE did not have additional room to follow up their implementation of the plan for these two municipalities, because they had to attend eight additional municipalities to promote DRM incorporation into the PRs since earlier 2000s, some of which have incorporated it into their PRs, and others remain in progress.

In case of Cartago, CNE has started their coordination with the Municipality to support developing technical inputs to incorporate the DRM aspects in each sector planning in 2006. The facility of Geology in the University of Costa Rica (UCR) and the facility of Psychology of the National University (UNA) have additionally participated in this technical advisory process. This process has been continued but a sporadic manner for five years until 2011. The reason of this limited support was mainly due to the coordination failures between national institution and local authority, according to the municipality official. The same local official told that the coordination failures were additionally due to the no existence of permanent counterpart organization in the Municipality to receive the supports. This experience in Cartago demonstrates that supporting from the national authority, or national-based university requires considerable hands-on effort, a great deal of energy, knowledge and budget, and that convincing local stakeholders is a long-term project. Based on these backgrounds, the next sections review the current progress made in terms of the incorporation of climate hazardous risk into local development planning.

CASE STUDY AT LOCAL LEVEL

Selection of Study Municipalities

This case study applies the checklist only to municipalities where the PR is already approved or about to be approved, because as discussed earlier, the PR only provides a systematic method of incorporating DRM seamlessly into local development planning. According to Costa Rica's Institute of Municipal Promotion and Advice (El Instituto de Fomento y Asesoría Municipal, or IFAM), 31 of the 81 municipalities in Costa Rica have already issued the PR as of 2003, and in 16 municipalities, the PR is pending for approval (IFAM, 2003). This 2003 IFAM data is the latest official information from the government that reports the status of the PR development.

Based on this IFAM's baseline, a preliminary research has been conducted to identify how many municipalities of these 31 plus 16 municipalities have incorporated DRM into the PRs to date (yet obviously still unknown whether the increasing climate hazardous risk has been incorporated in the PR). Results show that 17 municipalities have already incorporated DRM in the PR as of May 2012. Other four are in the process of approval and waiting to be approved, and nine are in the finalization process of PR development. Thus the target municipalities in this case study are these 30 municipalities (17 municipalities with approved PR and incorporated DRM, four in the process of approval, and nine in the finalization of its development for approval), where the DRM was incorporated, or are in the process of incorporation in the PR.

Data Collection

The application of the checklist in this chapter was implemented via face-to-face interviews to the target municipalities, in collaboration with the National University of Costa Rica. The University's team included four members, with one supervisor and three implementers. First of all, the University's team made a call by telephone to the target municipalities, explained to them the objective of the interview, and asking each municipality to assign an appropriate person responsible for the DRM. The checklist interviews were conducted with the person assigned in the municipalities from August to September, 2011. In Cartago's specific case, the

interview waited for its approval of the PR and interview was conducted in April 2012, or after the PR's approval. The interview follows the method of the previous chapter to apply questions in checklist (see Chapter 3 for all lists of check items). The methodology includes: (a) the interviewee answering yes or no to all the items of checklist; (b) each question being assigned one point with no weight when the interviewee responds with yes (or positive) from his or her institutional perspective; (c) the interviewee's positive response must be verified by materialized evidence such as laws, norms, plans, or other relevant official documents.

Each interview took an average of two hours, including explanation of the interview objective, the context of each question, and presentation of the required evidence. The checklist was developed originally in English, and was translated into Spanish prior to the interviews.

Checklist Interviews

Indeed, 12 out of all 30 target municipalities have been finally failed to complete the checklist. In most cases, no one in the municipality was responsible for DRM, rendering it impossible to complete three target checklist sectors (tourism, water, and agriculture sector, see Chapter 3) with single interviewee. In such cases, the checklist had to be implemented by asking second or third persons of the municipalities, especially when a different department was responsible for each target sector. When these alternative interviewees were not available to meet on the same day, the interview had to be conducted over multiple days, returning to the municipality two or three times for them to complete the checklist. Finally, only 18 municipalities completed the checklist interviews (22% coverage of all 81 municipalities in the country), which are listed in Table 1. Most of the 18 municipalities are located west and central region of the country (Fig. 1). This chapter uses the definition of urban and rural areas in Urban Planning Law No. 4240 of 1968 (Ley de Planificación Urbana No. 4240 de 1968), which specifies the Greater Metropolitan Area (GMA) as urban area and outside this area as rural area.

Criteria of Data Analyses

Same as Chapter 3, each category in each sector expresses its results of completion from 0% to 100%, being unsatisfactory to excellent

Table 1. Basic Information of the 18 Municipalities Where Checklist Was Applied. Shadow Means the Municipalities in the Greater Metropolitan Area (GMA), while Others Outside of the GMA.

Municipality	Population[a]	Population Density (/km^2)	Area (km^2)[a]	Status of PR Approval
Aguirre	20,188	37.1	543.77	Approved the current version in 2008
Alfaro Ruiz	10,845	69.9	155.13	In preparation
Aserri	49,319	171.4	287.77	Approved the current version in 2007
Belen	19,834	1,632.4	12.15	Approved in 1997
Cartago	132,057	458.9	287.8	Approved the current version in 2012
Desamparados	193,478	1,636	118.26	Approved the current version in 2007
Escazu	52,372	1,047.4	34.49	Approved the current version in 2005
Esparza	23,963	110.5	216.80	In preparation
Flores	12,329	1,771.4	6.96	Approved the current version in 2008
Garabito	8,043	25.4	316.31	Approved in 1990
Grecia	65,119	164.6	395.72	Approved the current version in 2006
Guarco	33,788	201.5	167.69	In preparation
Heredia	103,894	367.6	282.60	In preparation
Naranjo	37,602	296.8	126,62	In preparation
Parrita	12,112	26.9	448.79	Approved in 1996
Poas	24,764	335.4	73.84	In preparation
Santa Ana	34,507	561.8	61.42	Approved in 1991
Tibas	72,074	8,843.4	8.15	In preparation

[a]INEC (2000).

performance of the increasing climate hazardous risk incorporation into local development planning. This means the results of this case study are evaluated as the same criteria used in the previous chapter, as mature (excellent) when more than 76% of the items were completed; 51–75% as maturing (satisfactory); 26–50% as early stage (weak) and below 25% as very early stage (unsatisfactory) regarding the progress of the incorporation practice.

This chapter additionally analyses the result of the checklist for identifying opportunities and challenges in the incorporation of climate hazardous risk into local development planning, by using comparative measures

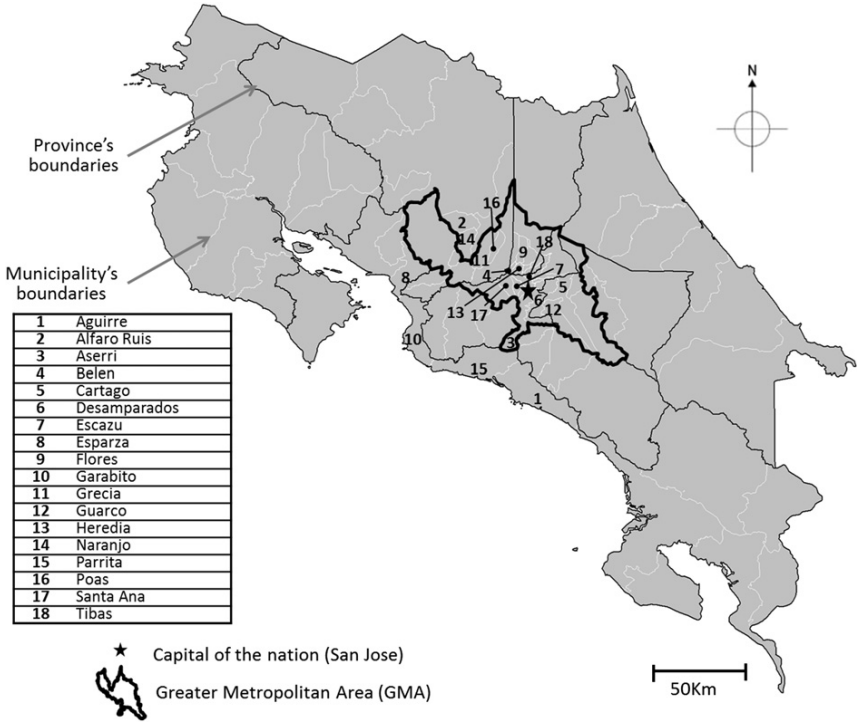

Fig. 1. Location of the 18 Municipalities Where the Application of the Checklist Was Completed. *Source*: Wikimedia Commons.

including by sectors, by categories, and at urban and rural areas. Additionally, the results of this case study will compare with the results of the previous chapter, the results at the national level, to identify opportunity and challenges of the local incorporation practice.

Checklist Results

All the results of the checklist in 18 municipalities are listed in Table 2. This table shows accomplished number of items and percentage according to the interviews in each municipality. The result indicates the overall unsatisfactory progress of the incorporation of climate hazardous risk into local

Table 2. Results of the Application of the Checklist at the Local Level. Shadow Means Municipalities in the Greater Metropolitan Area (GMA), while Others Outside of the GMA. RI is Risk Identification, PIF is Policy and Institutional Framework, and DP is Development Practice.

Sector	No. of Items Accomplished by Municipality (% Accomplished)								
	Tourism Sector			Water Sector			Agriculture Sector		
Category	RI	PIF	DP	RI	PIF	DP	RI	PIF	DP
No. of all check items	19	8	6	4	9	7	7	4	6
Aguirre	0 (0%)	0 (0%)	0 (0%)	1 (25%)	2 (22%)	3 (43%)	0 (0%)	0 (0%)	0 (0%)
Alfaro Ruiz	0 (0%)	0 (0%)	0 (0%)	1 (25%)	1 (11%)	2 (29%)	0 (0%)	1 (25%)	2 (33%)
Aserri	1 (5%)	0 (0%)	0 (0%)	2 (50%)	1 (11%)	0 (0%)	0 (0%)	0 (0%)	1 (17%)
Belen	1 (5%)	1 (13%)	1 (17%)	2 (50%)	0 (0%)	3 (43%)	0 (0%)	0 (0%)	0 (0%)
Cartago	1 (5%)	1 (13%)	1 (17%)	2 (50%)	1 (11%)	3 (43%)	2 (29%)	0 (0%)	2 (33%)
Desamparados	1 (5%)	0 (0%)	0 (0%)	2 (50%)	2 (22%)	3 (43%)	0 (0%)	0 (0%)	0 (0%)
Escazu	4 (21%)	1 (13%)	2 (33%)	3 (75%)	3 (33%)	4 (57%)	1 (14%)	0 (0%)	1 (17%)
Esparza	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Flores	1 (5%)	0 (0%)	0 (0%)	3 (75%)	1 (11%)	3 (43%)	0 (0%)	0 (0%)	1 (17%)
Garabito	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Grecia	0 (0%)	1 (13%)	0 (0%)	0 (0%)	2 (22%)	4 (57%)	0 (0%)	0 (0%)	0 (0%)
Guarco	0 (0%)	0 (0%)	1 (17%)	0 (0%)	0 (0%)	0 (0%)	1 (14%)	0 (0%)	2 (33%)
Heredia	1 (5%)	1 (13%)	0 (0%)	0 (0%)	2 (22%)	3 (43%)	0 (0%)	0 (0%)	0 (0%)
Naranjo	0 (0%)	0 (0%)	0 (0%)	1 (25%)	1 (11%)	1 (14%)	0 (0%)	0 (0%)	3 (50%)
Parrita	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Poas	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (14%)	0 (0%)	0 (0%)	0 (0%)
Santa Ana	3 (16%)	1 (13%)	1 (17%)	2 (50%)	1 (11%)	2 (29%)	3 (43%)	2 (50%)	3 (50%)
Tibas	1 (5%)	1 (13%)	1 (17%)	1 (25%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)

development planning in Costa Rica; seven out of all nine elements (three categories in all three sectors) are evaluated as very early stages on average, two as early stages, and none is maturing or mature (Fig. 2). Details of the results in each sector and category are described as follows.

Results (1) – Tourism Sector

Risk Identification

All the interviewees in the 18 municipalities responded to the number of items accomplished as none (0%) or one (5% accomplished) of the 19 items in this category, except for Santa Ana (three items accomplished: 16%) and Escazu (four items accomplished: 21%). The average items accomplished for the 18 municipalities was 4% (0.78 check of the 19 items), with each municipality scoring in the very early stages.

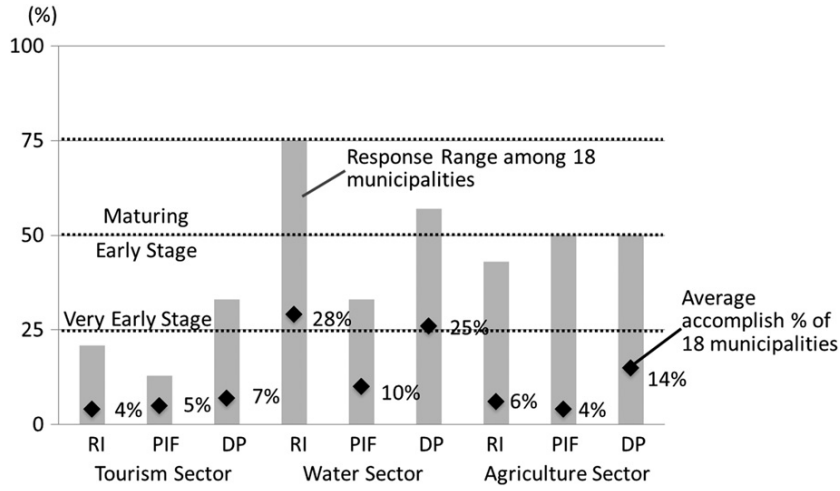

Fig. 2. Overall Results of the Application of Checklist. RI is Risk Identification, PIF is Policy and Institutional Frameworks, and DP is Development Practice.

Policy and Institutional Framework

All the interviewees in the 18 municipalities responded to the number of items accomplished as none (0%) or one (13% accomplished) of the eight items in this category. The average items accomplished for the target municipalities was 4% (0.39 check, of the eight items), with each municipality scoring in the very early stages.

Development Practice

Twelve of the 18 municipalities' interviewees responded to the number of items accomplished as none (0%) of the six in this category, four municipalities responded one (17% accomplished), and one municipality responded two (33%), with the municipality responses ranging from very early stages to early stages. The average accomplished of the 18 municipalities was 7% (0.39 check, of the six items); thus, the tourism sector's development practice is very early stages on average.

Results (2) — Water Sector

Risk Identification

Seven of the 18 municipalities' interviewees responded to the number of items accomplished as none (0%) of the four in this category, four

municipalities one (25% accomplished), five municipalities two (50%), and other two municipalities three (75%), with the municipality responses ranging widely from very early stages to mature. The average accomplished of the 18 municipalities was 28% (1.11 items accomplished, of the four items); thus, the water sector's risk identification is early stage on average.

Policy and Institutional Framework
Seven of the 18 municipalities' interviewees responded to the number of items accomplished as none (0%) of the nine items in this category, six municipalities one (11% accomplished), another four municipalities two (22%), and one municipality three (33%), with the municipality responses ranging from very early stages to early stage. The average accomplished of the 18 municipalities was 10% (0.94 items accomplished, of the nine items); thus, the water sector's policy and institutional framework is very early stages on average.

Development Practice
Six of the 18 municipalities' interviewees responded to the number of items accomplished as none (0%) of the seven in this category, two municipalities one (14% accomplished), other two municipalities two (29%), six municipalities three (43%), and two municipalities four (57%), with the municipality responses raging relatively widely from very early stages to maturing. The average accomplished of the 17 municipalities was 25% (1.78 items accomplished, of the seven items); thus, the water sector's development practice is early stage on average.

Results (3) – Agricultural Sector

Risk Identification
All the interviewees in the 18 municipalities responded to the number of items accomplished as none (0%) of the seven items in this category, except for Cartago two (29%), Santa Ana three (43%), Guarco and Escazu one (14%), with the municipality responses raging from very early stages to early stages. The average accomplished item of the 18 municipalities was 6% (0.39 items accomplished, of the seven items); thus, the agricultural sector's risk identification is very early stage on average.

Policy and Institutional Framework

All the interviewees in the 18 municipalities responded to the number of items accomplished as none (0%) of the four items in this category, except for Santa Ana two (50%) and Alfaro Ruiz one (25%), with the municipality responses raging relatively widely from very early stages to maturing. The average accomplished item of the 18 municipalities was 4% (0.18 items accomplished, of the four items); thus, the agricultural sector's policy and institutional framework is very early stage on average.

Development Practice

Ten of the 18 municipalities' interviewees responded to the number of items accomplished as none (0%) of the six items in this category, three municipalities one (17% accomplished), three municipalities two (37%), and other two municipalities three (50%), with the municipality responses ranging from very early stages to maturing. The average accomplished item of the 18 municipalities was 14% (0.83 items accomplished, of the six items); thus, the agricultural sector's development practice is very early stages on average, although it demonstrates a slight improvement over the other two categories.

Results of the Checklist Interviews in Cartago

The checklist results of Cartago shows slightly more progress made than other GMA municipalities (Fig. 3). For example, all three categories of the

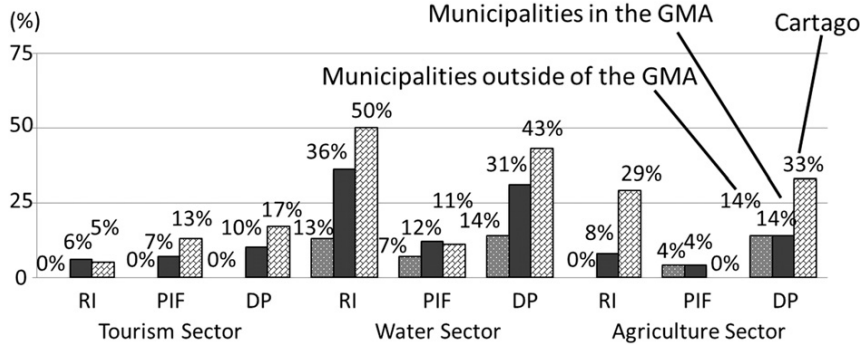

Fig. 3. Comparison of the Checklist Results among Rural Municipalities' Average, Urban Municipalities' Average and Cartago.

tourism sector of Cartago are in very early stage (same as the result of other GMA municipalities). In water sector, two categories were in early stage and one in very early stage that is same as GMA's result. Cartago's agriculture sector has made more progress in terms of the climate hazardous incorporation in local development planning than other GMA municipalities: two were in early stage and one in very early stage, while all three categories of GMA were in very early stage (Table 3).

Progress made in terms of Cartago's climate hazardous incorporation in development planning in agriculture sector is because the city has issued the Action Plan in 2010 as an input for PR as reviewed in earlier section. The Action Plan has included 53 pages annexes regarding City's diagnoses of the agriculture development effectiveness, including probable influence due to changing climate in recent decades. Additionally, the municipality has implemented with some donor agencies a pilot project for agriculture's CCA practice, including onion and potato species that are adaptable for the recent climatic variability.

Cartago's higher score of RI (Fig. 3), especially water and agriculture sector is additionally evidenced during the checklist interview. According to the interviewee, the municipality has established the Reventazon Model Forest Committee in 1996 for monitoring the forest conservation in Reventazon River basin. Municipality of Cartago, universities located in the city, international organizations placed in the city, and communities participate to the Committee. The committee meeting holds each two or three months, discussing mainly regarding the subject related to the forest and natural resources conservation, and recently includes the discussion related to the increasing intense rains and forest fires that make difficult to accomplish their forest conservations. This committee provides better understanding of municipality's climate hazardous impacts in practice. In sum, the existence of this Committee seems to be a reason of why the checklist's RI score in Cartago was higher than the other GMA municipalities.

The category DP in all three sectors (tourism, water, and agriculture) of Cartago was higher than the average of other GMA municipalities. This is because the city has already executing some pilot projects in the context of CCA. For example, local tourism industry, in coordination with the municipality, is developing a new trekking tour plan for sightseeing rainforest environment to observe rare plant species due to the recent extreme rains, and this new plan incorporates tourist's emergency evacuation plan in case of floods. Other example is that water management authority is developing a local water re-use infrastructure development plan and starting its pilot implementation including flood resisting construction design.

Table 3. Comparison between GMA and Cartago's Checklist Results in Terms of the Number of Very Early Stage, Early Stage and Maturing.

Sector	Tourism Sector			Water Sector			Agriculture Sector		
Stage of Progress	Very Early Stage	Early Stage	Maturing	Very Early Stage	Early Stage	Maturing	Very Early Stage	Early Stage	Maturing
GMA average	3	0	0	1	2	0	3	0	0
Cartago	3	0	0	1	2	0	1	2	0

Despite the fact that Cartago scored a better results of the checklist, when comparing to other GMA municipalities, interviewees of the municipality of Cartago have additionally insisted their opinion related to their low priority of climate hazardous impact reduction. On the contrary, they concern about short-term local economic development as a high priority. One of the interviewees in Cartago has manifested that the municipality economy underlies the recent global economic crisis since 2008, more recent European financial crisis in 2012, and affected the cheaper agriculture products to be imported from the United States of America (USA) under Free Trade Agreement (FTA) between Central America (including Costa Rica) and USA. These factors will have negative influence to the local agriculture and other industries, which is much important for the municipality rather than the climate hazardous risk reduction according to the interviewee.

ANALYSIS AND DISCUSSION

Comparisons

Municipalities and National Level Comparison

The result of this case study identifies two categories in more advanced status in terms of the municipality level's climate hazardous incorporation into development planning, compared with its status of the national government of Costa Rica resulted in the previous chapter (Fig. 4). These two categories are the tourism sector's development practice (DP) and water sector's risk identification (RI). The reason for these advances will be supposed and discussed in the next section: *Local Advantages*.

Sector Comparison

The study found the water sector's relatively advanced progress (28%, 10%, and 25% average of RI, PIF, and DP, respectively) compared with that of tourism (4%, 5%, 7%) and agriculture (6%, 4%, 14%). The reason suggested is the effect of long-standing local water management. In some municipalities of Costa Rica, drinking water and sewage to be distributed and managed by the local public service company independent from the national authority, which allows municipalities the flexibility to take action independent from national priorities, a model not pre-existing in the other sectors.

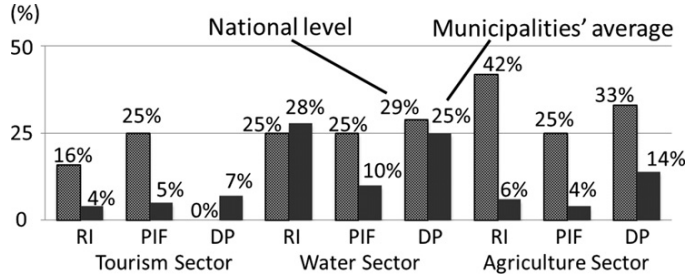

Fig. 4. Results of the Application of the Checklist at the Local Level, Comparing with the Result at the National Government Level of Costa Rica. RI Is Risk Identification, PIF Is Policy and Institutional Frameworks, and DP Is Development Practice.

Category Comparison

The category development practice (7%, 25%, and 14% on average in tourism, water, and agriculture, respectively) is the relatively advanced progress compared with risk identification (4%, 28%, and 6%, respectively) and policy and institutional frameworks (5%, 10%, and 4%, respectively). The reason suggested is that this category requires only actions based on local needs, whereas the other two categories require inputs prior to taking actions including climatic variability and change or precipitation scenarios to identify the potential risk, and dialogs to convince stakeholders to reform local policy and institutional frameworks, which require much effort and time to accomplish.

Urban and Rural Comparison

The results of the study indicate that the municipalities in GMA exhibit more progress than do municipalities outside of GMA all nine categories (Fig. 5). The reason suggested is GMAs' physical accessibility to central government information, knowledge, and human resources related to the incorporation of potential climate hazardous impact into local development planning.

Local Advantages

This section discusses the probable reasons identified in the previous section for the two advantages on the local DRM's climate hazardous

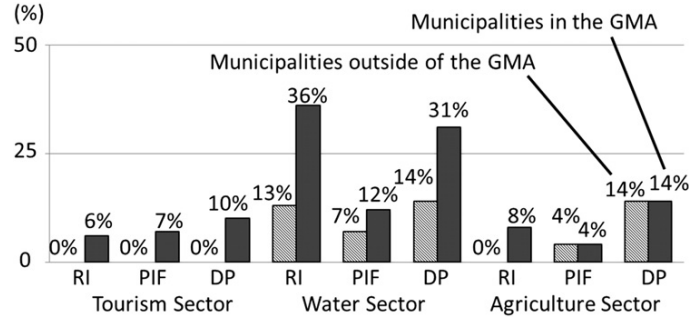

Fig. 5. Results of the Application of the Checklist on Average, Comparing Municipalities Inside of the GMA and Outside. RI is Risk Identification, PIF is Policy and Institutional Frameworks, and DP is Development Practice.

incorporation process (the tourism sector's development practice (DP) and water sector's risk identification (RI)), compared to the national level (Fig. 4), although the increasing climate hazardous risk was originally raised by international and national political organizations.

Tourism Sector's Development Practice

The study found that certain municipalities in Costa Rica, especially those in GMA are engaged in concrete tourism sector planning actions within the context of the increasing climate hazards incorporation into local development planning. For example, the municipality of Tibas's representative commented that local travel agencies and the local emergency committee have recently formed a coordination mechanism to prepare a diagnosis for an increasing number of floods to protect tourists from eventual climate hazardous events, and the result of these diagnoses will be included in the municipality's next PR. The municipality of Santa Ana's representative commented that the municipality is in the process of PR updates that will allow validation of land use licenses for local tourism, including restaurants and hotels. The process of licensing incorporates a variable for reducing potential disaster risk, concerning recent flood impacts.

According to the interview, these municipalities do not sufficiently recognize the national policy instruments including National Tourism Development Plan 2010–2016 and ENCC. Nonetheless, local governments do small but necessary planning actions concerning climate hazardous risk independent from national policies or priorities. In addition, tourism sector is an important sector for local economies in Costa Rica, and municipalities in general hold concerns about the increasing climate hazardous

impacts. This arena of local initiatives constitutes an opportunity for improving the incorporation of the increasing climate hazardous impacts into local development planning, independent from the national policy priorities.

Water Sector's Risk Identification

The interviews identified that certain municipalities engage in developing information for disaster risk in water sector. For example, the municipality of Santa Ana analyzes its future water demand, taking into account future real estate development for commercial infrastructure and residences. The required information incorporates future flood estimation as one of the variables for risk analysis in the sector. The municipality does not have an in-depth capacity for this analysis. However, national universities provide technical and analytical support. For sustainable groundwater use, the municipality of Belen has developed a regulation that required relevant information on potential climate hazardous impacts. This study was conducted in collaboration with the National Meteorological Institute (Instituto Meteorológico Nacional, or IMN).

These activities represent the characteristics of efficient local approaches to developing relevant information on this sector. First, municipalities research only for their local needs, independent from national priorities or policies. Second, the municipalities do not always use high technology for potential risk scenario information that is generally used by the international science community; instead, they conduct research with the tools that they have. Third, when municipalities need any additional technical support, they request minimum support from national technical institutions or universities.

The essence of this approach may be applicable for every sector and every country. The reason for only the water sector's advanced status at the local level is believed, as discussed earlier, that the existing local public service company already manages water distribution, and hence municipalities respond rather promptly based upon their habit of local decisions on preparing information needed for the sector analysis. This element may be opportunity to incorporating the aspect of increasing climate hazardous concerns into local development planning.

Local Challenges

Although the study has identified two categories in which local governments are seen more progress made in terms of climate hazardous risk

incorporation into their development planning than the national level, it also found that the local level of current progress in most of the categories is far below the national level (Fig. 4). The following discusses the probable reasons for that phenomenon as challenges and how can address for having greater capacity of local development planning in the context of increasing climate hazardous impacts.

The first reason is related to the shortage of local municipality experience in dealing with the increasing climate hazardous impacts. It is identified during the interviews, the local governments in general are anxious about climate change's invisible but potential hazardous impacts. Even the municipalities that scored lowest on the checklist (mostly the municipalities in rural area), demonstrated their conceptual understanding of the importance of climate hazardous impacts incorporation in local development planning, especially in the agriculture and tourism sectors that are important for their local economy. An example is seen from the municipality of Desamparados, saying that agriculture production of the local area has been reduced due to long-lasting intense rains, according to their daily informal communication with communities. Additionally, the municipalities receive information related to the increasing climate disasters from a variety of media or sources including international policy bodies (e.g., COP or IPCC meeting information received via Internet or TV) and international organizations (e.g., ENCC's promulgation events that organized United Nations Development Programme (UNDP) in San Jose that municipalities invited). Local governments' general understanding of the negative impacts due to climate hazardous events may be an outcome of the initiative of international and national policy or technical entities. However, these municipalities are uncertain about how to realize their preparation against the increasing impacts. The challenge here is to have a clear framework for the technical knowledge transfer to the local level.

Prabhakar and Srinivasan (2009) suggest that climate hazardous risk mainstreaming into local development planning should be initiated with capacity building by local DRM personnel. This concept corresponds to Perez (2008), explains the importance of local key stakeholders' critical understanding of CCA. Vignola et al. (2009) assert, from another perspective, that national policymakers should empower local actors to facilitate adaptation processes. Capacity building and empowerment of local actors is thus considered as a key factor for establishing and enhancing the capacity of local development planning.

The second reason relates to the local governments' other priorities. For the majority of cities globally, addressing climate hazardous concerns is not

their top priority (Bai, 2007). This issue is additionally evidenced by the comments from the interviewee of Cartago including their concern about short-term local economic development as a high priority. Moreover, certain municipalities in this study asserted during the interview that there are a variety of urgent local operational demands and busy with these, including licensing for housing construction (the municipality of Aguirre), permission for the development of commercial construction (the municipality of Desamparados), reduction of unemployment (the municipality of Esparza), or reconstruction of infrastructure damaged by recent disasters (the municipality of Garabito). The challenge is how local governments can have priority to engage in potential climate hazardous risk reduction. Indeed, the incorporation of climate hazards into local development planning requires broad cooperation among partners different from the local government's conventional sectors (Bedsworth & Hanak, 2010; Lindseth, 2004). However, most of the municipalities in this study have no human resources taking comprehensive responsibility for coordinating with new partners. This situation might constrain the increasing climate hazardous risk incorporation into local development planning from being mainstreamed in municipalities' priority. As a result observed in the interviews, municipalities were having to be scheduled separately with each sector specialist. Therefore, the challenge is how to mainstream the increasing climate hazardous concerns in each sector, coordinating with other priority issues as one of the variables of the development process. Assigning a CCA or DRM advocate at the municipality level may be a first step to binding eventual local priorities and DRR initiative.

The third reason relates to the inappropriate scale of information required for the local development planning. This is seen particularly in the agriculture sector in the present case study. RI category in agriculture sector at the national level scored 42% completion (see Chapter 3). This relates to MINAET's issuance of a technical study that identifies potential impacts of climate hazardous events in the agriculture sector. In contrast, the present checklist interviews found only 4% completion in the same category at the local level. The reason for this wide difference is probably that MINAET's national level information is not appropriately scaled for local development planning at the local use. As mentioned explicitly the municipality of Santa Ana, information at the national scale seems too low density and inappropriate for local agriculture planning. In fact, certain rural municipalities including Naranjo, Alfaro Ruiz, Grecia, and Poas were highly dependent on agricultural production for economic sustainability, but did not have access to the national level's information including

ENCC's study result. As a result, no municipalities have developed comprehensive local disaster risk information as an input for local development planning.

Alternative method for addressing this challenge is suggested by Santa Ana's approach found during the interviews, installing pluviometers in the agriculture fields of certain communities, accumulating the precipitation data by communities, analyzing climatic variability and change on the local scale, and applying such local hazardous data for local agricultural sector analysis. The municipality mentioned that communities' daily precipitation monitoring collaborate local governments' understanding of the increasing number of small climate hazardous events. Such "locally adaptable" technology may be applicable for other municipalities without the need for high technologies applied by national or international science communities.

The last reason relates to the long time taking circumstance for local development planning. Indeed, it takes much longer for many municipalities to develop their PRs. One representative example is the municipality of San Ramon, which took more than eight years to develop its PR (IFAM, 2003). The possible reason for this situation, as indicated by Ivey, Smithers, De Loe, and Kreutzwiser (2004), is that local development planning encounters a variety of constraints on appropriate preparation. It is also true that many of the municipalities in Costa Rica lack technical knowledge, human and financial resources to develop the PRs. Indeed, there are 50 out of all 81 municipalities in Costa Rica that have not issued the PR as of 2003 (IFAM, 2003). It is important to understand this reality and consider strategies for better scope of local development planning in a longer time scale. A good example is the CNE action reviewed in the earlier section, which plays an important role in providing technical support to municipalities on DRM planning, attempting to convince local stakeholders and support incorporating DRM aspects into the PR further even though it takes longer time, energy, knowledge, and a greater budget. Notwithstanding, it is additionally true that the national government has a certain limitation in terms of their human, budget, and time resources to support all the municipalities.

Potential Role of National Stakeholders

The study found that the municipalities are uncertain about how to incorporate measures and options into local development planning to reduce the impacts. The municipalities do not recognize specific relevant measures

that some of the recent national policies have identified, including National Tourism Development Plan 2010–2016 and ENCC. On the other hand, local governments, independent from national policies or priorities, implement small but necessary planning actions concerning climate hazardous impacts when they recognize this necessarily in practice. National stakeholders should recognize such local governments' nature and understand each municipality's specific problem and needs. This may help national stakeholder's DRM policy implementation or policy decentralization toward local actors, and provide effective technical support to municipalities. This demand seems to take longer time and more energy, such as the example of the CNE seen in the earlier section. Nonetheless, this scope of action from national stakeholders may play an important role for responding to local governments' specific needs including reducing the increasing climate hazardous impacts at the local level, even though it takes longer time, more energy and knowledge, as well as a greater budget.

Checklist's Limitations

The checklist focuses on only three sectors, tourism, water, and agriculture. These three sectors are commonly concerned the increasing impact of climate hazardous impacts in Latin America. However, during the checklist interviews to the local actors, certain other sectors were additionally found to be highly concerned about the increasing climate hazardous impacts at the local level. These include housing, local public infrastructure (roads, bridges, and waste management), and new business investment (urban hotels, and high-technology communication facilities), which were not included in the checklist.

SUMMARY

This chapter found overall unsatisfactory progress in incorporating climate hazardous concerns into local development planning. However, it is additionally found that local governments' small actions on climate hazardous impacts reduction, according to their own needs and decisions independent of the national policy priorities, are a key element in future improvement of climate hazardous impacts risk reduction. Furthermore, this chapter also identifies four challenges for further enhancing the capacity of

incorporating the increasing climate hazardous concerns in local development planning. These include (i) the shortage of local experience, (ii) the competition with other priorities in the local development agenda, (iii) the information's inappropriate scale for local use, and (iv) the time gap between the development of national policies and local development practice. Some of these challenges correspond with available literatures. For example, Gero et al. (2011), van Aalst et al. (2008), and Vignola et al. (2009) regarding the first of the four challenges; Bai (2007) regarding the second; Bedsworth and Hanak (2010) and Thomalla et al. (2006) regarding the third.

The application of the checklist in this chapter emphasizes the key elements to overcoming these challenges includes empowering local municipalities to understand the importance of the increasing climate hazardous events, and information generation specifically for local use. National stakeholders should provide customized technical support to municipalities, even it demands long time and energy.

Although this chapter encountered certain difficulties in its implementation, it did confirm that this checklist seems to be a unique tool and is applicable at local use. The categories and items included in the checklist will provide a framework within which municipalities can identify opportunities and weakness to improve local development planning and further collaboration for sustainable development. The challenge in this case is how to approach other sectors that are not included in the checklist.

This chapter should emphasize the difference between the incorporation of hazardous concerns into development planning and DRM itself. As reviewed in Chapter 1, DRM requires comprehensive approaches including risk identification, prevention and mitigation, disaster preparedness, financial management for risk transfer and retention, and ex post rehabilitation and reconstruction operations. Even such a comprehensive engagement sometimes fails to achieve a straightforward outcome of reducing human and economic losses due to disasters. Incorporation of the increasing climate hazardous concerns into development planning at the local level is one element of a comprehensive DRM approach, which should be examined in the near future to demonstrate the linkages among the implementation of this incorporation, local DRR in practice, and achievement of sustainable development.

Although the application of the checklist in this chapter identifies opportunities and challenges to improve the incorporation of the increasing climate hazardous concerns into local development planning, and analyzes its influence from national policy level, it also has the limitation of analyzing

it from the community perspective. Communities' knowledge and awareness of daily climate hazardous impacts influences policy as strongly as do technological and scientific risk assessments (Correia, Fordham, Saraiva, & Bernardo, 1998; Slaymaker, 1999). DRR is more likely to be effective if the community itself feels motivated to participate in DRR (Benson, 2009). The influence of communities upon local development planning and practice should be examined, thus this will be a subject of the next chapters.

CHAPTER 5

ELEMENTS FOR SUSTAINABLE COMMUNITY-BASED DISASTER RISK MANAGEMENT

ABSTRACT

One important element for effective local disaster risk management (DRM) is community participation. However, this is not automatic in Costa Rica. Moreover, communities do not always continue DRM activities after a project or promotional campaign by the government. Indeed, little knowledge exists regarding long-term project sustainability of local DRM activities. Based on this, the present chapter discusses whether and how communities realize long-term DRM activities, an important factor for enhancing local DRM capacity, in a sustainable manner. The study conducts semi-structured interviews in the communities in Cartago City, Costa Rica as a means of evaluation; these are communities where the local DRM project has been implemented for more than ten years.

Keywords: Local disaster risk management; community early warning system; project legacy; illegal immigrants; Costa Rica

CASE STUDY PROFILE

General Characteristics of the Project City

In order to identify elements for sustainable CBDRM through community ownership, this chapter reviews a project as a case study titled "Strengthening

Local Structures and Early Warning Systems (Reforzamientos de Estructuras Locales y Sistemas de Alerta Temprana, or RELSAT)," implemented in Cartago during 1999–2001. RELSAT is a type of project related to CEWS operation. CEWS is defined by the United Nations International Strategy for Disaster Reduction (UNISDR) thus: to empower individuals and communities threatened by hazards to act in sufficient time and in an appropriate manner to reduce the possibility of personal injury, loss of life, and damage to property and the environment (UNISDR, 2006). As the UNISDR (2010) reported, CEWS has been implemented in many countries around the world, especially for poor rural communities in developing countries. CEWS is reported its advantage in three characteristics. First is its effectiveness, as "Last-Mile" potential disaster preparation measure realizing with community participation (Taubenbock, 2009). Second is related to an appropriate way to reduce the possibility of personal injury, loss of life, and damage to property and the environment even in vulnerable communities (UNISDR, 2006). Third is its cost performance, because community participative approach is inexpensive and requires little technical expertise (Dangles et al., 2010; OAS, 2010).

The objective of the RELSAT was to establish effective CEWS and increase community capability for local flood preparedness in the poverty area of the city. There are three major reasons to select this project as a case study. First, it has taken more than ten years since the project implementation, so that it is possible to review the status of the projects legacy or activities' continuity ten years after the RELSAT implementation. Second, the target beneficiary of this project was one of the poorest areas of Cartago, Dique de Taras (Dique), an informal community, or where residence is prohibited by national law. This particular social environment will allow analyzing elements for project sustainability even in poorer communities. Third, the project has involved national authority, local authority, and local NGO as project executing entities, thus allows reviewing through different angles of the project implementation, which is useful for analysis of this pilot project.

Project Background

Cartago, situated at the southern foot of the Irazu volcano and characterized by rugged mountainous topography, the city in general is exposed to multiple natural hazards including floods, volcanic eruption, pyroclastic flows, and landslides (see Chapter 1). Following the 1963–1964 catastrophic event in Cartago, the Ministry of Public Works (Ministerio de

Obras Publicas, or MOP) built a 12 km dike along the Reventado River in 1965 in order to reduce the city's flood risk. The same ministry approved Law No. 3459 in 1964: Creation of the National Reserve area of Reventado River (Creación de la Reserva Nacional del Río Reventado, in Spanish language). Articles 3 and 4 of this law state that any construction for residence, commercial, and industrial use upon and inside the dike is prohibited. The area is now called the Dique area (Fig. 1). Nonetheless, poor families gradually entered this prohibited area and built their homes illegally in the 1970s.

The first illegal community built in this area was called Maria Auxiliadora. In the 1980s and 1990s, three other communities, Linda Vista, Barrio Nuevo, and Miraflores, were additionally established (Fig. 2). To date, there are four illegal communities in this area living 50–100 families in each, where most houses are self-constructed, look humble, and have limited access to basic human needs (Fig. 3). Mora (2003) reports that residents in this area primarily include illegal immigrants from neighboring countries.

Project Inception

Project RELSAT was financed by the Deutsche Gesellschaft fur Technische Zusammenarbeit (German Technical Cooperation, GTZ), implemented in

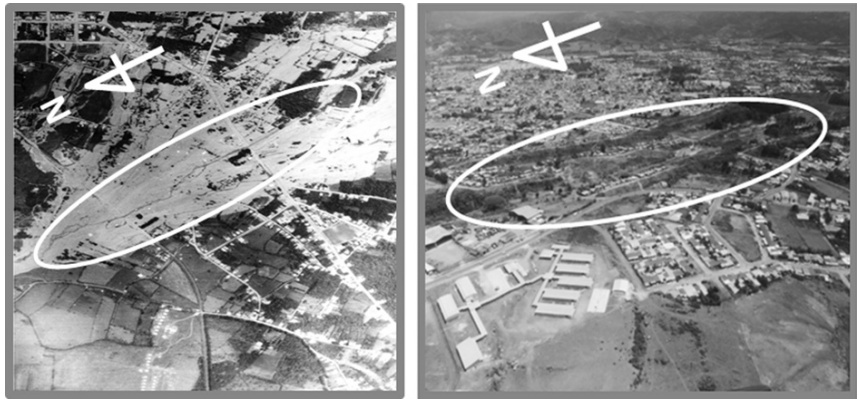

Fig. 1. Affected Area due to the Catastrophe of Cartago in 1963–1964 and Present. Circle in both Photos Are the Same Area, where the Most Affected Area in 1963–1964 (Left) Catastrophe and Now Called the Dique Area (Right). *Source*: Left, CNE, Right: Cartago Municipality.

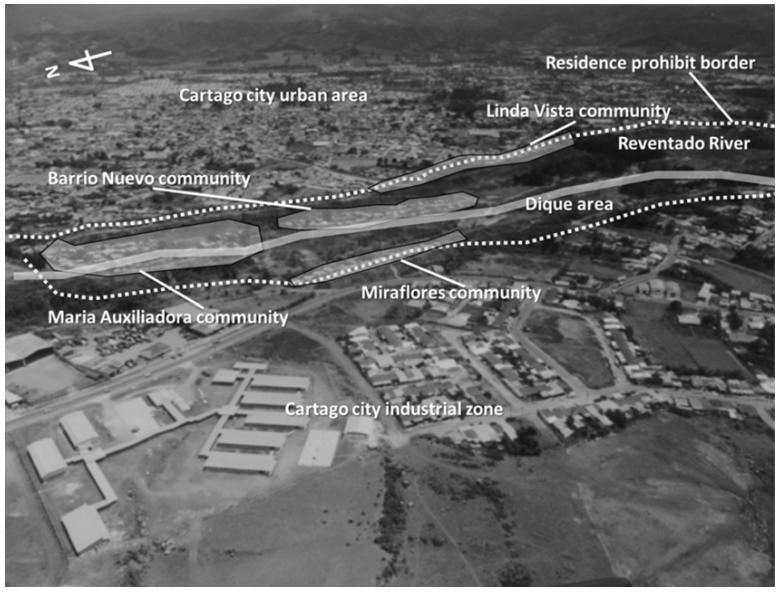

Fig. 2. Image of Dique Area. *Source*: Photo by Cartago Municipality.

Fig. 3. Typical Poor Houses in Dique Area. *Source*: Photos by author.

six Central American countries including Costa Rica. Regional coordination was performed by the CEPREDENAC, a regional DRM organization of Central America. The National Emergency Commission (CNE) took responsibility for the project execution in Cartago, in coordination with the Cartago municipality.

CNE began to design this project in 1997. Prior to project area selection, CNE conducted a preliminary research of local hazard and vulnerability conditions for the entire country. After the study, CNE identified the Dique area as one of the areas with the highest disaster risk, because of multiple hazardous conditions as well as physical and social vulnerability related to illegalities. CNE conducted the first community workshop in the Dique area in 1998 with 20 local participants. CNE explained the purpose of RELSAT and the participants finally agreed upon flood risk reduction as a project target, despite the fact that their primary requirement is a poverty reduction.

Project Design and Activities

Fig. 4 displays the overall design of the CEWS operation. RELSAT served as a pilot CEWS project for future implementation in other areas by the CNE or other public entities. Therefore, community involvement of RELSAT was limited to only two beneficiary communities: Miraflores and Barrio Nuevo. Other two areas are involved in the complete operation of this CEWS – the upper site of the Reventado River, which called Tierra

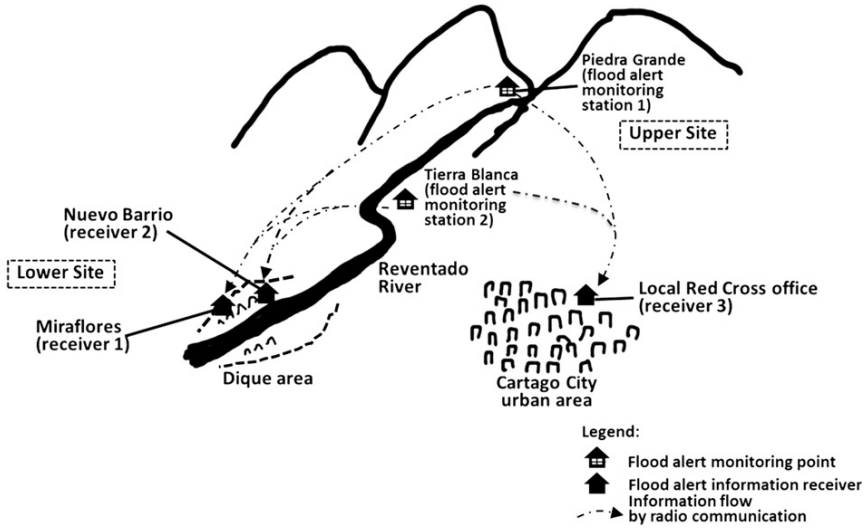

Fig. 4. Overall Design for the CEWS Operation.

Blanca and Piedra Grande that perform flood monitoring and provide the flood alert information to the lower site. Dique area, a beneficiary site, receives alert information from the upper site and organizes self-preparation for eventual flood events.

RELSAT includes three functions: flood hazard monitoring at the upper site; alert communication between the upper and lower sites; and community organization for eventual flood emergency at the lower site. This section explains project input (goods and activities provided) of the project from the time it was implemented.

Flood Monitoring

The project installed a transparent plastic pluviometer (Fig. 5a) in two sites of the upper river basin: Tierra Blanca and Piedra Grande. This equipment was installed at each house of assigned volunteer families. Usage of this

Fig. 5. Image of the Equipments and Material Used for the RELSAT. (a) Plastic Pluviometer; (b) Equipment to Gauge River Water Level Installed in the Upper Area; (c) Data Sheet to Record the Daily Precipitation; (d) Radio Communication Equipment. *Source*: Photo by CNE.

equipment was simple; observing the precipitation accumulated in the pluviometer.

Another equipment was installed to gauge river water level at the same two sites (Fig. 5b). The structure of this equipment was also simple; it used a plastic bar and electronic sensor to calibrate water level digitally. The bar is installed in the river and connected with electronic wires to each volunteer family's premises (Fig. 6). These families perform real-time water level monitoring from 0 (low) to 8 (high). Each level on the bar marks 20 cm height. For example, level 1 implies the river water level is 20 cm higher than the normal level, and level 4 indicates 80 cm higher.

The two volunteer families accepted responsibility for flood hazard monitoring at the first workshop. After that, the CNE organized a one-day seminar for the use of these equipments. The two volunteer families learned to use these equipments and agreed to monitor (i) river water level every day at 6 am and during intense rainfall and (ii) precipitation accumulation in the pluviometer three times every day (6 am, 12 pm, and 6 pm). The CNE formatted a data sheet to record the daily precipitation accumulation data (Fig. 5c).

Flood Alert Communication

The project provided radio communication equipment for flood alerts from the upper to the lower sites (Fig. 5d). This equipment is installed at five

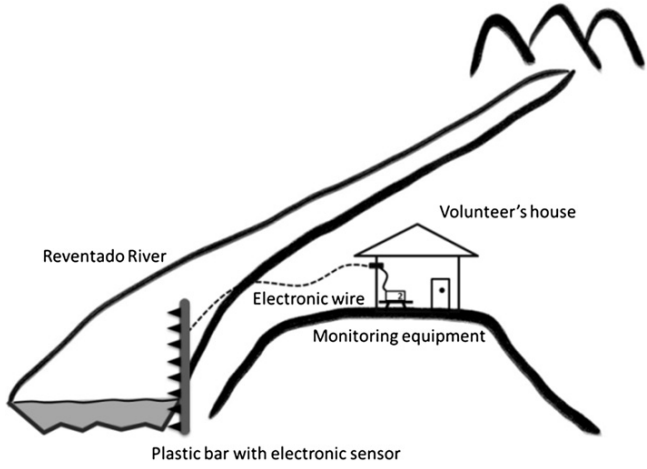

Fig. 6. Function to Gauge Real-Time River Water Level at the Upper Site.

nodes: at the residence of one family each in Tierra Blanca and Piedra Grande at the upper site (the same two volunteer families responsible for flood hazard monitoring); at the residence of one family each in Miraflores and Barrio Nuevo at the lower site (the Dique area); and at the local Red Cross office in Cartago (Fig. 7). The radio communication equipment works by both electric power and batteries. Since the Dique area has limited electric power supply, the project also provided batteries for their emergency use.

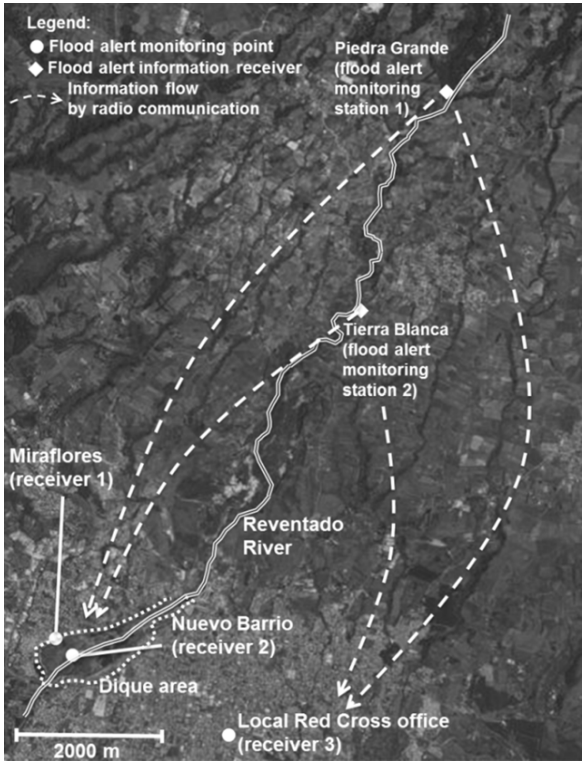

Fig. 7. Five Sites that Have Been Installed Flood Alert Equipment. Including Two Upper Sites: Piedra Grande (Monitoring Station 1) and Tierra Blanca (Monitoring Station 2); Two Lower Sites (Dique Area): Miraflores (Receiver 1) and Barrio Nuevo (Receiver 2), A Volunteer House; and Cartago Local Red Cross Office (Receiver 3). Image: Ministry of Housing of Costa Rica.

The two families responsible for the use of radio communication equipment at the lower site also volunteered at the first workshop. CNE organized a one-day seminar at the local Red Cross office in March 1999 to provide instructions regarding its usage. The four families responsible for flood alert communication and a member of the local Red Cross participated in the seminar and learned the basic protocol for flood alert communication. The protocol is as follows: during intense rainfall, at least one of the two families at the upper site observes precipitation greater than 30 mm within 30 minutes, or when a gauge shows a level of 5 (1.0 m higher than normal) or higher, they use the radio communication equipment to send a flood alert to the two assigned families at the lower site and the local Red Cross office.

Community Organization

The CNE in coordination with the municipality organized a total of 12 workshops to (i) sensitize community for proactive response in flood hazard events; (ii) create community organizations for flood preparedness; and (iii) develop a community emergency plan to draw evacuation routes to assigned shelters (primary schools in neighboring communities).

The CNE also conducted two drills for self-organized evacuation in flood events in each lower site community – Miraflores and Barrio Nuevo (Fig. 8). The local Red Cross and the municipality of Cartago also observed in these activities. Previously, the two beneficiary communities in Dique area had no form of community organization. Thus, the family in Miraflores and Barrio Nuevo was assigned as flood radio alert receivers subsequently became community leaders.

Fig. 8. Drills for Self-Organized Evacuation in Flood Events. *Source*: Photo by CNE.

Table 1. Summary of the RELSAT Project Inputs.

	Piedra Grande	Tierra Blanca	Miraflores	Barrio Nuevo	Local Red Cross
F.M.	Installed	Installed	–	–	–
R.C.	Installed	Installed	Installed	Installed	Installed
C.O.	–	–	Organized	Organized	–

F.M.: Flood monitoring.
R.C.: Flood alert communication (radio communication).
C.O.: Community organization for flood preparedness.

Table 1 summarizes project input of flood monitoring (F.M.), flood alert communication via radio communication (R.C.) and community organization for flood preparedness (C.O.) in each upper and lower site.

Follow-up after Project Implementation

The RELSAT project began its implementation in January 1999 and ended in December 2001. Since then, neither the CNE nor other institutions have provided any official follow-up, or maintenance activities. The CNE periodically visit (every six months) the two families at the upper site to collect datasheets recording the daily precipitation observed. Additionally, the CNE occasionally meets (every two or three years, usually on weekends) on a voluntary basis with community leaders in Miraflores and Barrio Nuevo to check if the CEWS installed in this area functions effectively.

FUNCTIONING OF CBDRM AFTER TEN YEARS

This section reviews the status of CEWS maintenance (both hard and soft components), and identifies outcomes (positive long-term impacts) and lessons ten years after the project implementation. In doing so, a qualitative interviews have been conducted to those who have participated the RELSAT project. There were four selected interviewees who participated to the RELSAT in Tierra Blanca, Piedra Grande, Miraflores, and Barrio Nuevo. The interviews have been conducted in August and November in 2010. Duration of each interview was approximately one hour. The interviews were included principally the following two questions:

- Do you continue to maintain CEWS activity and equipment? Which, and why?

- Have you experienced any effectiveness or usefulness of CEWS for flood preparedness or other purpose, why?

After the interviews, discussions with the local Red Cross, municipality of Cartago and the CNE have been conducted to hear the project executor's experience of project sustainability. The discussions have been conducted several times in February 2011. Then analytical desk-top work has been conducted for identifying in a qualitative manner, elements necessary for project sustainability at community level, a main subject of this chapter. Followings are the results of the qualitative interviews.

Status of Project Legacy

The complete status of the project's legacy (both hardware and soft component) is summarized in Table 2. A man in the family at Tierra Blanca has faithfully continued his assigned daily flood-monitoring duty even after the project's completion. He has observed the precipitation accumulation in the pluviometer three times a day at the assigned hours (6 am, 12 pm, and 6 pm) and the river water level at 6 am every day since March 1999. The other family in Piedra Grande, however, discontinued their duty in late 2006. The equipment of the river water level gauge and radio communication became faulty and ceased to operate and they discontinued its use, thus subsequently discontinuing their flood-monitoring duties. The family at Barrio Nuevo also discontinued its usage in 2008.

The radio communication equipment installed in the family at Tierra Blanca, Miraflores, and local Red Cross office has maintained it effectively, thus flood alert communications are also effective only among these three nodes. The Miraflores community organization is effective. When the community leader in Miraflores receives alert information from Tierra Blanca, she informs approximately 50 other families in the community,

Table 2. Status of the RELSAT Project Legacy after Ten Years.

	Piedra Grande	Tierra Blanca	Miraflores	Barrio Nuevo	Local Red Cross
F.M.	Discontinued	Effective	–	–	–
R.C.	Discontinued	Effective	Effective	Discontinued	Effective
C.O.	–	–	Effective	Discontinued	–

F.M.: Flood monitoring.
R.C.: Flood alert communication (radio communication).
C.O.: Community organization for flood preparedness.

recommends evacuation, and requests support from the local Red Cross office. She cannot contact all 50 families in the community alone, and therefore asks neighbors to spread the word.

Outcomes

Three types of outcomes have been identified ten years after the project's implementation. The first is the improvement in proactive disaster preparedness in this area. Indeed, no major floods, mudflows, or avalanches have occurred in the Dique area since RELSAT began. Nevertheless, successful partial use of CEWS has been observed when minor flood occurred in this area. In October 2006, the man in the volunteer family at Tierra Blanca observed the river water reaching level seven, and informed Miraflores and Barrio Nuevo as well as the local Red Cross. Two leaders have responded, informed neighbors, organized and collaborated with each other to close a bridge across the Reventado River on a road in the Dique area (this action was not considered an original project design, though). Both leaders guided families in their communities to evacuate, and requested from the local Red Cross by radio for further support of evacuation. Hours later, Red Cross officials arrived and closed the bridge, guided vehicles to the detour, and provided support for refugees from the Dique area. This is just an experience of CEWS function and indeed, the man in Tierra Blanca reports flood alert to the Dique area and local Red Cross, including the above experience, one to three times a year.

The second is collaborating to establish community solidarity. The Miraflores community leader uses radio communication equipment in a variety of ways, including requesting local Red Cross support other than flood disaster preparedness. For example, in May 2010, her neighbor came and said that the floor of his house was cracked and he feared ground erosion. She radioed for support from the local Red Cross. A few days later, the local Red Cross staff visited his residence and made a temporary repair. Another example occurred in October 2010, when an elderly woman suddenly fell sick, and the family came to the community leader asking her to call an ambulance. The community leader radioed the local Red Cross, and the ambulance arrived an hour later. The local Red Cross stated that they receive such requests from Linda Vista three to five times a year. The Miraflores community leader said that direct communication with the local Red Cross makes the entire community feel safer. Miraflores is located in the illegal Dique area and so in general receives little social benefit or

support from the local and national government. The community leader of Miraflores stated that people in this community feel abandoned by the city, but the community connects directly to the local Red Cross by radio, and its responses are so prompt that people believe they can rely on both the radio communication facility and the local Red Cross. According to the community leaders, such integrative force has established more community solidarity over time.

The third is regarding collaboration for raising residents' awareness of disaster risk phenomena, which is specifically seen in Tierra Blanca. In general, community leaders and city planners tend to underestimate or deny disaster risk (Nathan, 2008). This problem is caused often a lack of local risk information based on experience (Burningham, Fielding, & Thrush, 2008). Despite these reports in general, the man in the family at Tierra Blanca has continued the precipitation observation and data recording three times a day since March 1999. This continuous work makes him more sensitive to climate variability or change. He said that he has noticed signs of climate variability or climate change since 2005. Although the accrued data indicates that the annual average precipitation has been nearly the same since 1999, he has noticed certain changes from the details of the data: since 2005, the frequency of intense rainfall in a short duration (less than one hour) has been increasing during the rainy season, and the duration of the dry season is additionally being longer. He owns a small farm and produces potatoes and onions. Based on what he has learned from his daily precipitation observation, he is now planning to upgrade to other species of potato breed for adaptation to frequent intense rainfall.

Lessons

The volunteer families at Piedra Grande and Barrio Nuevo had discarded their CBDRM responsibility (or specifically, CEWS duty) five to seven years after the project implementation. This experience offers lessons related to the difficulty of continuing each actor's assigned CBDRM responsibility at voluntary base for a longer period. The elderly woman in Piedra Grande who discontinued flood-monitoring duty since late 2006 said that she wanted to continue helping other people in the city through her assigned duty. However, because the river water level gauge broke, as did the radio communication equipment, she could not continue. She said that she continues to hope that CNE people will visit her house and repair both pieces of equipment, and that she feels honored to communicate

directly with representatives of the national authority and to collaborate in the CEWS initiative, a "big national" project for her. She also said that radio communication helped her to know and communicate with people in other communities at the lower site, because Piedra Grande is located far from there and both sites' residents have no other means of knowing each other.

The woman of the family in Barrio Nuevo also stated that a technical problem forced her to discontinue using the radio communication equipment. She said that she wants to continue using it and collaborate in the CEWS initiative, and that the radio communication equipment was helpful in communicating with other people in Miraflores or the volunteer family in Tierra Blanca, not only for flood alerts but also for casual chats. Her child also liked to communicate via the radio. She feels a sense of worth or "power" from representing the community for requesting local Red Cross support and possessing the radio communication equipment, because neighbors rely on her, and come to discuss their daily problems. She explained that the problem with the radio communication equipment seems to be just the battery or power source, so she is waiting for CNE staff to repair it. According to her, the community would feel abandoned if CNE does not visit periodically.

These two examples offer the following lessons for sustainable CBDRM: (i) equipment failure is the primary reason that volunteers discontinue their CBDRM activities; (ii) both families who discontinued their CEWS activity remain interested in continuing their responsibilities if the equipment is repaired; (iii) the radio communication equipment serves additional purposes, such as general communication with other communities, or calling for local Red Cross support; and (iv) national government (CNE) represents an important presence for these communities, in that people feel honored to participate in the project initiative and eagerly anticipate CNE visits (Fig. 9).

DISCUSSION – ELEMENTS FOR SUSTAINABLE CBDRM

Residence in the Dique area is illegal. The area suffers from poverty and lacks basic human needs, including lifelines and other social services. This social vulnerability is one of the reasons CNE selected this area as a RELSAT beneficiary.

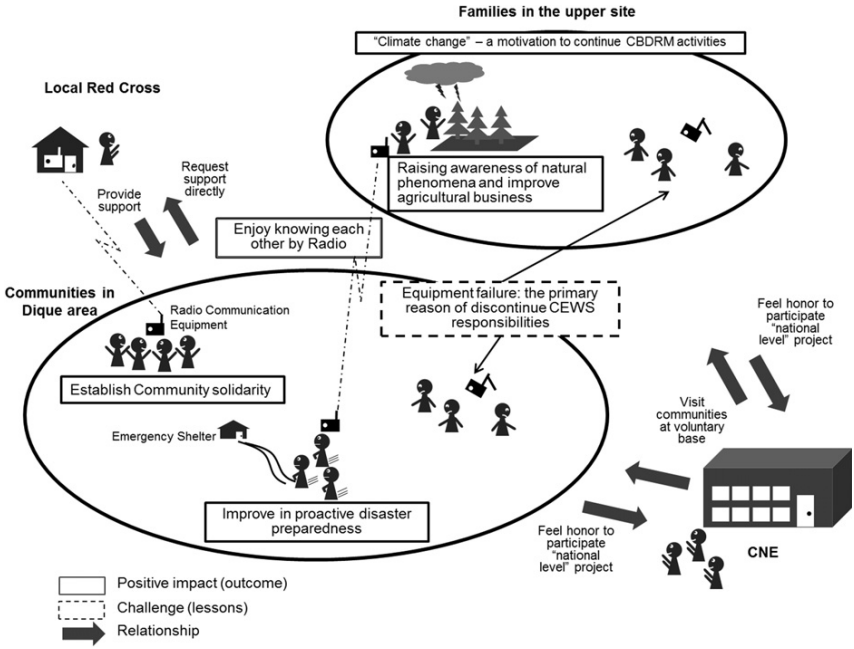

Fig. 9. Elements for Sustaining CBDRM.

CEWS projects involve complex tasks to implement an end-to-end, people-centered early warning system (Lavell, 1994; Spahn, Hoppe, Vidiarina, & Usdianto, 2010). Ardalan et al. (2009) state that the success of local initiatives requires a political climate that understands and supports community participation. Project duration is another consideration. The RELSAT execution period in Cartago was short (two years), and no major follow-up activity has been performed after the project completion, other than the occasional CNE visits to the area on a voluntary basis just to monitor the radio or other equipment operations. Despite the local insufficient resources and non-supportive political climate because of the area's illegality and poverty, the CEWS function in Cartago remains operational in more than ten years insofar as technologically possible. The volunteer family in Tierra Blanca has continued to perform daily flood observation for more than ten years; the family in Miraflores still receives alert information and organizes flood preparedness, and the local Red Cross supports these activities. Why have the people in this poverty area continued

supporting the CBDRM activities for more than ten years? What are the elements for sustainable CBDRM initiative? This section discusses four probable elements to respond these questions.

The first element for sustainable CBDRM may be the use of CEWS equipments by communities in their daily lives. This is seen in the use of the radio communication equipment for purposes other than emergency situations. Although the equipment was originally intended for flood alerts, the community uses it for other purposes. The Miraflores community leader uses it to request a support from the local Red Cross other than flood alerts. She stated that radio communication is more useful than telephones for emergency use, because of direct calls made to the local Red Cross office free of charge (indeed, she owns a prepaid mobile phone). She feels privileged to be able to help community members through radio communication. This radio communication's capability has opened the door to establishing community solidarity in Miraflores. The Barrio Nuevo community leader also feels a sense of "power" in possessing the radio equipment because neighbors rely on her. She regrets having to discontinue its usage because of its failure.

As the OAS (2010) states, radio communication equipment for CEWS can serve a variety of purposes, such as health emergencies, announcing important municipal meetings, and transmitting other important community-related messages. This concept corresponds with the experience in this case study, and explains the volunteers' sense of benefits and privilege in possessing the equipment. This feeling may be one of the major factors in their continued use of it for more than ten years.

The man in the Tierra Blanca family provides another good example of an auxiliary use of the CEWS equipment. He uses precipitation observation including for his own agriculture business. Although observing precipitation alone is quite simple – just watching and recording the water level in the pluviometer – it takes real dedication to perform this daily duty for more than ten years. Originally, he began this observation as a volunteer only for flood monitoring and alerts, but after about five years, he became aware of an increasing climate hazards. He owns a small farm and is now planning to upgrade to species of potato breed for adaptability to eventual climate disaster impacts. This link between precipitation observations, originally for flood alert monitoring, and his business benefit of crop production improvement may be another reason for his faithful fulfillment of his CEWS duty in a sustainable manner.

The second element identified here for sustaining CBDRM may be the participants' perception of climate variability and change for their own

purposes. This is observed again in the example of the man in Tierra Blanca, who developed a fine sense of climate variability and change through his daily precipitation observation duty. Climate change is only one of the many underlying vulnerability factors (Glantz, 1994; Mercer, 2010). However, it may be a significant factor for agriculturists. Farmers use many specific adaptation strategies to respond to climate hazardous impacts (Thomas, Twyman, Osbahr, & Hewitson, 2007). His personal use of the detailed CEWS data from his observations made him thinking to upgrade the species of potatoes that was more adaptable to increased intense rainfall probably. This may increase his motivation to continue his CEWS duties for more than ten years.

Third element may be related to the feeling of gratitude and loyalty. All four direct participants in CEWS operations (the man in Tierra Blanca, the elderly woman in Piedra Grande, and community leaders in Miraflores and Barrio Nuevo) have a sense of honor in participating national authorities' initiative. For example, the elderly woman in Piedra Grande said that she feels honored to participate in the CNE's national "big project." The man in Tierra Blanca said that it is an honor for him to participate in the CNE project implemented directly by national authority. Such specific element of people's feelings of loyalty to the project, motivating their "volunteer spirit" for a long period, and enabling continued CEWS activity for more than ten years.

CNE implemented directly all RELSAT activities in Cartago with no third party outsourcing, such as local consultants, NGOs, or community organizations. After RELSAT's implementation, the CNE staff occasionally visits the project area on a voluntary basis to monitor CEWS operations. However, they did not provide further official support to the communities. On the other hand, from the community's perspective, these visits provide good opportunities to discuss their daily problems with national authority. The woman in Miraflores said she always looks forward to meet the CNE people, not only to talk about CEWS but also to discuss all kinds of problems in the community. The woman in Barrio Nuevo said that she feels abandoned if the CNE does not come for a while. Both the elderly woman in Piedra Grande and the community leader in Barrio Nuevo said that they are waiting for CNE to repair the equipment. Over time, the CNE's direct project engagement and their ongoing voluntary visits to the project area may have made community residents respectful of this national authority, and that feeling may continue to positively influence the volunteers' sense of honor from their participation in CEWS activity.

The woman in Miraflores said that not much support from the government is received or expected because of the community's illegal status. The community was established in the 1970s and the number of inhabitants has grown, with new groups never disintegrated for social development and increased drug trafficking, alcoholism, and domestic violence, among other problems. Despite this difficult social environment, CNE has supported the community through RELSAT project. This background stimulates additional feelings of gratitude and faithfulness in performing their CEWS responsibilities. Eventually, these feelings of trust, respect, honor, gratitude, and faithfulness toward the project initiator may engender the loyalty necessary for participating in CBDRM for a long period.

Last element may be related to the equipment durability and easy to operate. When communities can take advantage of CEWS equipment in their daily lives and develop a feeling of gratitude and faithfulness toward participating in the national authority's initiative, once the equipment fails to operate, they cannot continue the CBDRM activities. Indeed, those who have ceased performing their CEWS responsibilities at Piedra Grande and Barrio Nuevo have directly attributed their behavior to equipment failure, and both would prefer to continue collaborating with CEWS.

The user-friendliness of equipment operation may be another key element for sustainable CBDRM activity. Those involved in radio communication were given only a one-day seminar at the beginning of the project, which was sufficient for its operation. One child of the family in Barrio Nuevo could even operate the radio. This indicates that such simple and user-friendly equipment is best for CBDRM initiatives, as long as it can be maintained in working order.

SUMMARY

An overriding goal of CBDRM is to empower local people by supporting them in becoming increasingly self-reliant (Christie & Hanlon, 2000; Uphoff, 1991). The outcomes identified in this research coincides with this concept and support the conclusion that CEWS empower even illegal communities in (i) improving proactive disaster preparedness; (ii) establishing community solidarity; and (iii) raising awareness of climate hazardous risk.

In addition to these findings, this chapter identifies four elements for sustainable CBDRM operations through community ownership. These include the following implications of the role of stakeholders or project planners for sustainable local DRM:

(i) Provide components, or equipment of CBDRM not only for flood preparedness but also to bring additional advantages to communities in their daily lives. This seems key to raising communities' sense of ownership for sustainable CBDRM. Radio communication equipment and precipitation observation gauges for agriculturalists are good examples of such multi-purpose items;
(ii) Provide processes for increasing local awareness of climate hazardous risk. The man in Tierra Blanca who continues to observe daily precipitation exemplifies this principle. Awareness of climate hazardous risk may motivate volunteers to continue monitor climate phenomena and related risks, and to adapt their own resources for agricultural applications for a long period. The action made by the man in Tierra Blanca seems to be a good case of what Prabhakar, Srinivasan, and Shaw (2009) states, where there is a need to move from the attitude of considering local level players as "implementers" to "innovators";
(iii) Establish direct trust and respect between the project executing organization and beneficiary community. This seems to be the foundation of community participants' growing feelings of gratitude and loyalty toward that authority so that this motivates their activities under their own initiative for sustainable CBDRM; and
(iv) Select durable and user-friendly equipment. This directly affects the community's ability to continue their duties. Ongoing support for equipment maintenance would also be effective.

This chapter has several limitations and implications. It did not interview the people who did not participate actively in RELSAT, such as community members in Maria Auxilliadora and Linda Vista, and other local institutions and organizations. This omission limited the ability to verify the results of this chapter with the comments of external parties. Although the chapter identified four elements for sustainable CBDRM, the present case study covers only ten years from the project's implementation; thus, a follow-up is needed to monitor CBDRM operation for a longer period.

Regarding the increasing climate hazardous risk incorporation in DRM planning and practice, the initial approach of this was dominated

by top-down thinking (van Aalst et al., 2008), and this conventional top-down decision making process sometimes become inadequate for the local needs (Rojas Blanco, 2006). The case of the man in Tierra Blanca, who continued daily precipitation observation for more than twelve years and adapting its data for his own agricultural production strategy, seems to merit further analysis to identify elements for enhancing local DRM from bottom-up approach.

CHAPTER 6

CLIMATE CHANGE PERCEPTION AND LOCAL RISK AWARENESS FOR SUSTAINABLE COMMUNITY-BASED DISASTER RISK MANAGEMENT

ABSTRACT

Community perception of climate change is a factor in increasing local awareness of climate disaster risk. This encourages more disaster risk reduction actions by the communities themselves, and thus, provides a driver for sustainable community disaster risk management (DRM) initiatives. Using these hypotheses, this chapter assesses whether the communities' climate change perceptions, awareness of climate hazardous risk, and subsequent actions on DRR enable local DRM capacity to reduce the increasing climate disaster risk. The study conducts household surveys with an original questionnaire in four communities in Cartago City, Costa Rica.

Keywords: Climate change perception; flood risk awareness; community disaster risk reduction; Costa Rica

FRAMEWORK

Communities' climate change perception and disaster risk awareness are key factors for successful and continuous local DRM (Alexander, 2000;

Burton, Wilson, & Munn, 1983; Kasperson & Palmund, 2005; Van Sluis & van Aalst, 2006). Especially, Buys, Miller, and van Megen (2011) report that the perception of climate change provides an opportunity to improve community's disaster risk awareness. Furthermore, a community with improved local disaster risk awareness can take more actions for reducing hazardous impacts (Bone et al., 2011; Mercer et al., 2009; van Aalst et al., 2008). On these bases, overall, this chapter hypothesizes that there is an interrelation among communities' perceptions of climate change, their climate hazardous risk awareness, and motivation to have DRR actions.

Specific aspects that are examined in this chapter are as follows (Fig. 1): (i) the communities' perception of climate change, which may influence their climate hazardous risk awareness; (ii) the communities' climate hazardous risk awareness, which may influence their having DRR actions; and (iii) the communities' DRR actions, which may complement local governments' or municipalities' local DRM efficiency. Details of each aspect are represented in the following way.

Perception of Climate Change

In this chapter, "perception of climate change" refers to the ability to become sentient of unusual climatic phenomena in daily life (e.g., unseasonable heat or heavy rains) and perceiving such phenomena occurs due to climate change. Available studies report worldwide trend of community's growing perception of climate change in latest decades (Agho, Stevens, Taylor, Barr, & Raphael, 2010; Buys et al., 2011; Lata & Nunn, 2012;

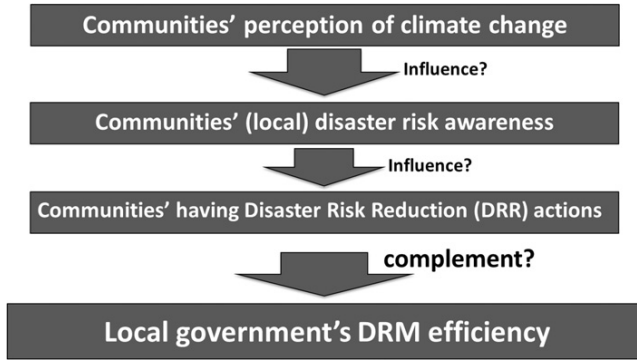

Fig. 1. General Approach of This Chapter.

Leiserowitz, 2003, 2005; Maharjan, Sigdel, Sthapit, & Regmi, 2010; Paeth & Otto, 2009; Semenza et al., 2008). Therefore, this chapter focuses on whether the communities' perception of climate change is increased in Cartago and why.

In general, community's climate change perceptions are influenced by various factors (Slovic, 1987, 2000). One of which is the role of the media in disseminating explicit images of climate change to the public (Karl & Easterling, 1999; Lata & Nunn, 2012; Lowe et al., 2006). In addition, climate change perceptions are influenced by levels of education (Agho et al., 2010); higher education is associated with greater knowledge about this phenomenon (Harwitasari & van Ast, 2011). Communities associated with specific sectors such as agriculture or ecotourism, where productivity is directly related to the climatic condition, are more perceptive of climate change (Patt & Schroter, 2008). Communities in urban areas are more likely to think that climate change is occurring (Agho et al., 2010; Harwitasari & van Ast, 2011). Women and young people are more likely to be concerned about the risk of climate change (Alhakami & Slovic, 1994; Krosnick, Holbrook, Lowe, & Visser, 2006; Raphael et al., 2009; Semenza et al., 2008).

Studies related to the communities' perceptions of climate change in Costa Rica are few. Smith and Oelbermann (2010) reported on the situation in the Buenos Aires Municipality, a remote agricultural community in the southeast area of Costa Rica. They found that community members had observed changes in local weather patterns over the past decade and had a good understanding of climate change, including its potential impact on local agricultural production. Smith and Oelbermann's study was, however, limited to analyzing the reasons for the growing perception of climate change. There have been no similar studies to date on Cartago.

Awareness of Local Climate Hazardous Risk

"Awareness of local climate hazardous risk" is defined as the extent of knowledge about risks due to the increasing climate hazardous impacts (e.g., intense rains, floods, and landslides) that may affect communities. Awareness of local climate hazardous risks draws from many sources such as media report, scientific and technical descriptions (Rebetez, 1996; Slovic, 2000). Psychological and social factors are other elements that influence local disaster risk awareness (Karl & Easterling, 1999). Local disaster risk awareness varies with the educational background, origin and age (Kangabam, Panda, & Kangabam, 2012). Overall, communities with

experienced disasters report a higher awareness of disaster risk (Jiang, Yao, Bond, Wang, & Huang, 2011; Karl & Easterling, 1999; Kates, 1971). Traditional experiences may be another factor that increases local disaster risk awareness; indigenous with traditional skills and agricultural experience shows the greater awareness (Maharjan et al., 2010).

The correlation between communities' perception of climate change and local disaster risk awareness is still unclear (Bray & Shackley, 2004). Even if communities perceive climate change as a phenomenon, many seem unconcerned about the increasing local climate disaster risks resulting from these changes (Griggs & Kestin, 2011; Patt & Schroter, 2008; van Aalst et al., 2008). Therefore, this chapter analyses whether the communities' perceptions of changing climate in Cartago influence their climate disaster risk awareness and why.

A small number of studies have been conducted on awareness of local climate hazardous risk in Cartago. CNE (2003) reported that in 2001, 30% of the people were aware of their flood risk in an illegal, poor, and high flood risk community. In 2005, Castillo, Zuniga, and Brenes (2006) studied the same poor community and found that 35% of the people were aware of flood risk. Solano (2003) argues that the low awareness levels in this poverty area are due to limited learning opportunities about disaster risk and preparedness, as well as lack of interest, time constraints, and the sense that they would provide no personal benefit. Yet, it is unclear whether perceptions of climate change influence local climate hazardous risk awareness in the same poor community and other areas of Cartago.

Community Action for DRR

Community action for DRR in this chapter refers to the individual and collective actions taken by community or individuals, to minimize vulnerabilities of hazardous impacts throughout prevention, mitigation, and preparedness measures at the micro level (families, communities, or individuals). Even though some literature reports that local actions to reduce disaster risk first require an awareness of disaster risk (Lata & Nunn, 2012; Sharma, Patwardhan, & Parthasarathy, 2009; Vedwan & Rhoades, 2001; West, Roncoli, & Ouattara, 2008), others additionally report that communities do not always take action for DRR even when they are aware of the risk (Kelman, Mercer, & West, 2009; Lopez & Yarnal, 2010; Myatt, Scrimshaw, & Lester, 2003). One reason for this may be that DRR does not seem to be a priority of daily life of communities and instead, they

focus on other concerns such as health, family well-being, economic factors, and land tenure (Lopez & Yarnal, 2010). However, it is still unknown whether the climate change perception influences the communities' daily living concerns and priorities. Therefore, the present chapter focuses on this question and identifies factors that increase community actions for DRR.

Climate change is a widely recognized term, particularly among younger, better-educated people. However, as a call to action in many cases it is ignored (Barnett & Campbell, 2010). Even where climate change is identified as an external risk to communities, DRR action is rarely discussed in depth (Kelman et al., 2009). Communities should apply appropriate and sustainable actions for DRR (Shackley & Deanwood, 2002; van Aalst et al., 2008); however, this does not always happen.

To date, no study has reported on this specific subject in Cartago, with the exception of the finding from Chapter 5, noting that perceptions of climate change and local climate disaster risk awareness have had influence to farmers' continuous flood early warning observation initiatives and consequently has led to more fruitful agricultural production in these farmlands (see Chapter 5).

METHODOLOGY AND RESULTS

Questionnaire

Based on the framework described in the previous section, an original questionnaire was prepared to conduct household surveys. This questionnaire covers the following four questions: (i) how communities perceive climate change (questions include whether, how, and when to start perceiving climate change); (ii) how communities' climate change perception influences their local climate hazardous risk awareness (questions comprise communities' experience of disasters, whether and why they are aware of local climate hazardous risk as well as other types of risks); and (iii) how communities' awareness influences their DRR actions (questions include whether and what actions for climate hazardous risk reduction are taken by the communities and why). This third point includes the questions related to communities' intention to participate future DRR projects that national or local government organizes. The questionnaire includes 42 questions.

Survey Communities

Geographical focus of the surveys is Cartago, Costa Rica. The household surveys covered four communities along with the Reventado River, which were affected by floods or landslides in 2010 (DesInventar, 2013). The four communities are: Central Tierra Blanca (hereafter Tierra Blanca), on the upper and west side of the river basin rural area; Central Llano Grande (hereafter Llano Grande), on the upper and east side of the river basin rural area; Central Cartago, on the east side of lower river basin urban area; and part of San Nicolas (hereafter Dique), along the lower river basin and slum area (Fig. 2). According to INEC (2000), the number of households in the four communities are: 100 in Dique, 89 in Tierra Blanca, 122 in Llanos Grande, and 223 in Centro. Tierra Blanca and Llano Grande were the communities that have devastated by the eruption of Irazu in 1964 (CNE, 2010) – see Chapter 1.

The surveys were conducted between April and May 2012. Sixty interviews were carried out in each community, with a total of 240. The households were selected at random in the communities and were visited each of them with no previous appointments.

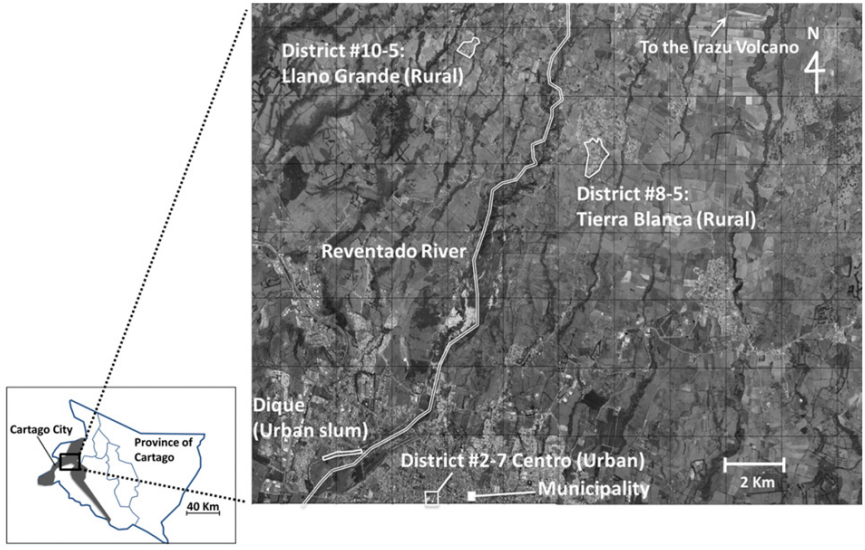

Fig. 2. Locations of Four Selected Communities of the Household Surveys. Map: Ministry of Housing of Costa Rica.

Results of the Household Surveys

Social and Economic Characteristics and Disaster Experiences

General social and economic characteristics of the interviewees are summarized in Table 1. Table 2 and Fig. 3 show the nature of risks that communities recognize apart from climate hazardous risk. Between 76.6% and 95.0% of the interviewees in each community have recognized any risk apart from the climate hazardous (Table 2); the community's recognition of risk includes social violence, drug, unstable job conditions and malnutrition. Additionally, 10−30 individuals in each community have recognized non-climate disaster risk such as volcanic eruption and earthquake (Fig. 3).

Table 3 summarized the communities' experiences of recent disasters. All four communities have been affected by at least floods or landslides in 2010 according to the database (DesInventar, 2013). However, the result of the household surveys shows not all of the individuals have affected from these disasters. Including the climate disasters in 2010, in total 11 individuals of the 240 interviewees have experienced a complete house collapse, or serious household damages. Other damages and losses are relatively small scale, for example, no damage but evacuated to refuges, or public service stopped.

Climate Change Perception

Prior to assessing the four communities' perception of climate change, the questionnaire asked whether the individuals in these communities had heard about the term "climate change." On average, 70% of interviewees (170 people of all 240 interviewees) in the four communities had heard about this term (Fig. 4a). Dique had the lowest levels (57%), and other three communities were higher: Tierra Blanca (70%), Centro (75%), and Llano Grande (82%). The majority of who have heard about climate change (90%, or 153 people of all 170 individuals) had heard this term from the media, on radio, television or seen it in newspapers (Fig. 4b). Fourteen percent (24 out of 170 people) of those who have heard about this term had heard it being discussed in the neighborhood, and 12% (20 of 170 people) had learnt it in school. The lower levels of knowledge of this term in Dique are echoed of people who had heard about it in the media (28 people), which is lower than the other three communities (38, 41, and 46 people in Tierra Blanca, Centro, and Llano Grande, respectively). Media is, thus, a factor that dominates community knowledge of the term climate change in Cartago. No major differences or specific characteristic

Table 1. General Social and Economic Attributes of the Four Target Communities.

		Tierra Blanca	Centro	Llano Grande	Diques
Gender	Male	28 (47.6%)	36 (60.0%)	29 (48.3%)	18 (30%)
	Female	32 (53.4%)	24 (40.0%)	31 (51.7%)	42 (70%)
Age	20 or less	2 (3.3%)	10 (16.6%)	6 (10.0%)	5 (8.3%)
	21–60	29 (48.4%)	30 (50.0%)	26 (43.3%)	46 (76.7%)
	61 or more	27 (45.0%)	19 (31.7%)	25 (41.7%)	8 (13.3%)
	N/A	2 (3.3%)	1 (1.7%)	3 (5.0%)	1 (1.7%)
Education	Primary or less	36 (60.0%)	18 (30.0%)	33 (55.1%)	39 (64.8%)
	Secondary	22 (36.7%)	30 (50.0%)	8 (13.3%)	13 (21.8%)
	University or more	2 (3.3%)	11 (18.3%)	8 (13.3%)	1 (1.7%)
	N/A	0 (0%)	1 (1.7%)	11 (18.3%)	7 (11.7%)
Occupation	Agriculture	21 (35.1%)	0 (0%)	13 (21.8%)	0 (0%)
	Industrials	2 (3.3%)	8 (13.3%)	3 (5.0%)	7 (11.7%)
	Services	4 (6.7%)	15 (25.1%)	9 (15.0%)	9 (15.0%)
	Housewife	25 (41.6%)	10 (16.6%)	25 (41.6%)	33 (55.1%)
	Student	4 (6.7%)	16 (26.7%)	5 (8.3%)	4 (6.7%)
	No work	0 (0%)	1 (1.7%)	0 (0%)	5 (8.3%)
	Retired	2 (3.3%)	8 (13.3%)	5 (8.3%)	2 (3.3%)
	N/A	2 (3.3%)	2 (3.3%)	0 (0%)	0 (0%)
Number of people in your family	One	1 (1.7%)	2 (3.3%)	3 (5.0%)	2 (3.3%)
	2–5	35 (58.2%)	41 (68.3%)	26 (43.3%)	25 (41.6%)
	More than five	21 (35.1%)	17 (28.4%)	24 (40.0%)	33 (55.1%)
	N/A	3 (5.0%)	0 (0%)	7 (11.7%)	0 (0%)
Years of living in your community	5 years or less	0 (0%)	11 (18.3%)	2 (3.3%)	17 (28.4%)
	6–15 years	1 (1.7%)	17 (28.4%)	4 (6.7%)	7 (11.7%)
	16 years or more	56 (93.3%)	30 (50.0%)	42 (70.0%)	34 (56.6%)
	N/A	3 (5.0%)	2 (3.3%)	12 (20.0%)	2 (3.3%)
Property condition	Owner	49 (81.7%)	46 (76.7%)	45 (75.0%)	44 (73.3%)
	Rent	5 (8.3%)	11 (18.3%)	4 (6.7%)	7 (11.7%)
	Public sponsored	0 (0%)	0 (0%)	0 (0%)	4 (6.7%)
	N/A	6 (10.0%)	3 (5.0%)	11 (18.3%)	5 (8.3%)
Income level	More than average	4 (6.7%)	0 (0%)	0 (0%)	0 (0%)
	Average	12 (19.8%)	29 (48.3%)	22 (36.7%)	1 (1.7%)
	Less than average	13 (21.8%)	31 (51.7%)	22 (36.7%)	45 (75.0%)
	N/A	31 (51.7%)	0 (0%)	16 (26.6%)	14 (23.3%)
Do you want to live in your community continuously?	Yes	57 (95.0%)	57 (95.0%)	58 (96.6%)	36 (60.0%)
	No	0 (0%)	2 (3.3%)	1 (1.7%)	24 (40.0%)
	N/A	3 (5.0%)	1 (1.7%)	1 (1.7%)	0 (0%)

N/A: No answers.

Table 2. Number of People that Recognize Any Risk Apart from Climate Hazardous Events.

	Tierra Blanca	Centro	Llano Grande	Diques
Yes	46 (76.6%)	53 (88.3%)	57 (95.0%)	52 (86.6%)
No	10 (16.7%)	7 (11.7%)	3 (5.0%)	7 (11.7%)
N/A	4 (6.7%)	0 (0%)	0 (0%)	1 (1.7%)

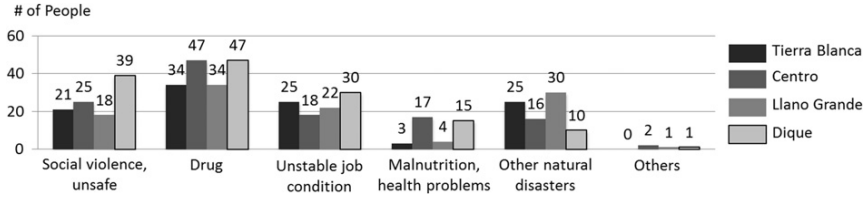

Fig. 3. Recognition of Risk Apart from Climate Hazardous Risk. Multiple Answers.

of this knowledge was found with respect to gender, occupation, or education carrier (Fig. 4c).

The proportion of people who perceives the effect of changing climate in their daily lives (83% in the four communities, Fig. 4d) was higher than those who had heard about the climate change (70% in the four communities, Fig. 4a). This result indicates that individual experience is a predominant factor in perceiving the effect of changing climate rather than learning it theoretically from media, neighbors, or school.

Among the people in the four communities who perceives changing climate in their daily lives, 69% (138 people, out of the 200 that have perceived climate change) felt unseasonably warm or cold weather, 46% (89 out of 200 people) said that very recently it has caused greater intensity of rains, 14% (27 out of 200 people) had noticed changes in business conditions (e.g., lower agriculture product yields than those of previous years), and four people felt that they had been obliged to change their lifestyles (e.g., using air conditioners at unseasonable times) (Fig. 4e). The majority of those who perceived changing climate in their daily lives had started to feel the change only very recently: 61% (122 out of all 200 people that have perceived climate change) in the last one to two years, 25% (50 out of 200 people) in three to five years, and only 14% (28 out of 200 people) for over more than five years (Fig. 4f).

Table 3. Number of People that Have Experienced Recent Disasters and Its Details.

		Tierra Blanca	Centro	Llano Grande	Dique
Have you experienced floods or landslides in your community?	Yes (Average: 33.8%)	16 (27%)	22 (37%)	32 (53%)	11 (18%)
	No (Average: 66.2%)	44 (73%)	38 (63%)	28 (47%)	49 (82%)
Who answered yes: How many times did you experienced disasters (% of "yes")?	Once	9 (56.3%)	5 (22.7%)	21 (65.6%)	5 (45.5%)
	Twice	2 (12.5%)	6 (27.3%)	4 (12.5%)	2 (18.2%)
	3 or more	5 (31.2%)	11 (50.0%)	7 (21.9%)	4 (36.3%)
When did you affected (% of "yes")?	Recent 1–2 years	4 (25.0%)	5 (22.7%)	6 (18.7%)	8 (72.7%)
	3–5 years	3 (18.8%)	4 (18.2%)	8 (25.0%)	1 (9.1%)
	5 years or more	9 (56.2%)	13 (59.1%)	18 (56.3%)	2 (18.2%)
How did you affected?	Complete house collapse	2	3	2	4
	Partial house collapse	5	14	11	5
	No damage but evacuated	0	1	10	4
	Public infrastructure damage and service stopped	14	17	15	2

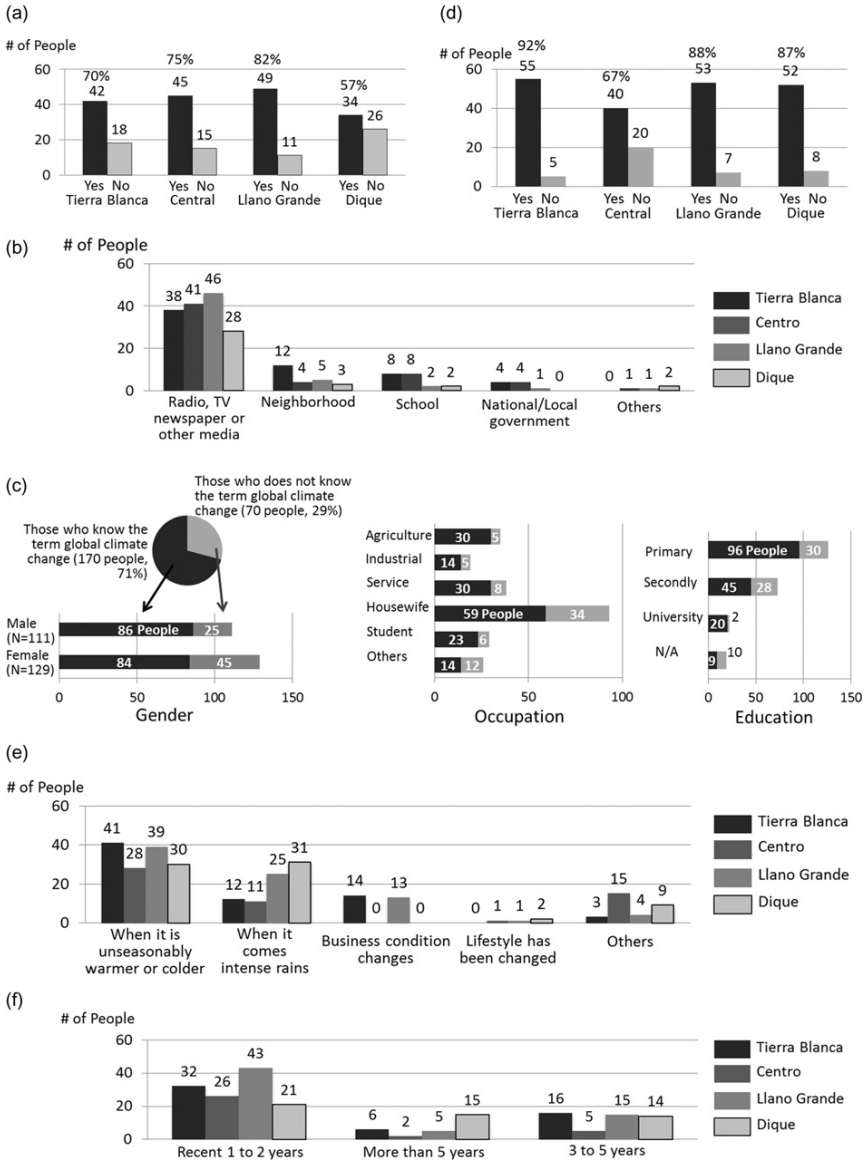

Fig. 4. Results of the Household Surveys Regarding Communities' Climate Change Perception. (a) Number of Individuals that Have Heard about the Term Climate Change. (b) Information Source of Communities that Have Heard about Climate Change. Multiple Answers. (c) Those Who Have Heard the Term Climate Change by Social Attributes (Gender, Occupation, and Education Carrier). (d) Number of Individuals that Perceive the Effect of Changing Climate in Their Daily Lives. (e) How the Climate Change is Perceived. Multiple Answers. (f) When the Perception of Changing Climate Started.

Awareness of Local Climate Hazardous Risk

In all, 57% (137, out of all 240 interviewees) were aware of climate hazardous risk (Fig. 5a). Responses to this question varied by community: Dique (83%) had the highest proportion, and Centro (35%) the lowest. Local climate hazardous risk awareness was higher among those who had perceived changing climate than those who had not (Fig. 5b).

Of all the 137 individuals who were aware of climate hazardous risk, 74% or 101 people were aware that because the community was located in a hazard-prone area (Fig. 5c); and 54% or 74 out of 137 individuals were aware of the risk because intense rains were increasing due to climate change. 25% or 34 out of the 137 individuals were aware of it because the community was socially vulnerable. Of all the individuals who were aware of local climate hazardous risk, those who had experienced disasters had a higher awareness (70%, 50%, 69%, and 91% in Tierra Blanca, Centro, Llano Grande, and Dique, respectively) than those who had not (46%, 25%, 50%, and 85% in Tierra Blanca, Centro, Llano Grande, and Dique, respectively – Fig. 5d).

These results show a growing trend in local climate hazardous risk awareness compared to the previous studies by CNE (2003) and Castillo et al. (2006), specifically in Dique. According to these previous studies, only 30% of the individuals in Dique had some flood risk awareness in 2001 (CNE, 2003), and 35% in 2005 (Castillo et al., 2006). The methodologies of these previous studies are not entirely the same as that of the present surveys. Specifically, these previous studies had focused on the flood risk awareness and not on a broader concept of climate hazardous risk. Thus, strictly speaking, the three studies are not comparable. However, in qualitative terms, it can probably be argued that local climate hazardous risk awareness in Dique has increased recently, certainly after the early or mid-2000s.

Actions for DRR

On average, 23% of interviewees (56 out of all 240 interviewees) in the four communities had taken actions for DRR (Fig. 6a). Tierra Blanca is the highest (27%), then Llano Grande (23%), Dique (23%), and Centro (17%). The number of individuals who have taken DRR action is much lower than those who were aware of the local climate hazardous risk. This result indicates communities' few DRR actions in Cartago, despite the increasing local climate hazardous risk awareness.

Fig. 6b presents the positive outcomes stemming from communities' local climate hazardous risk awareness and DRR actions. The majority of

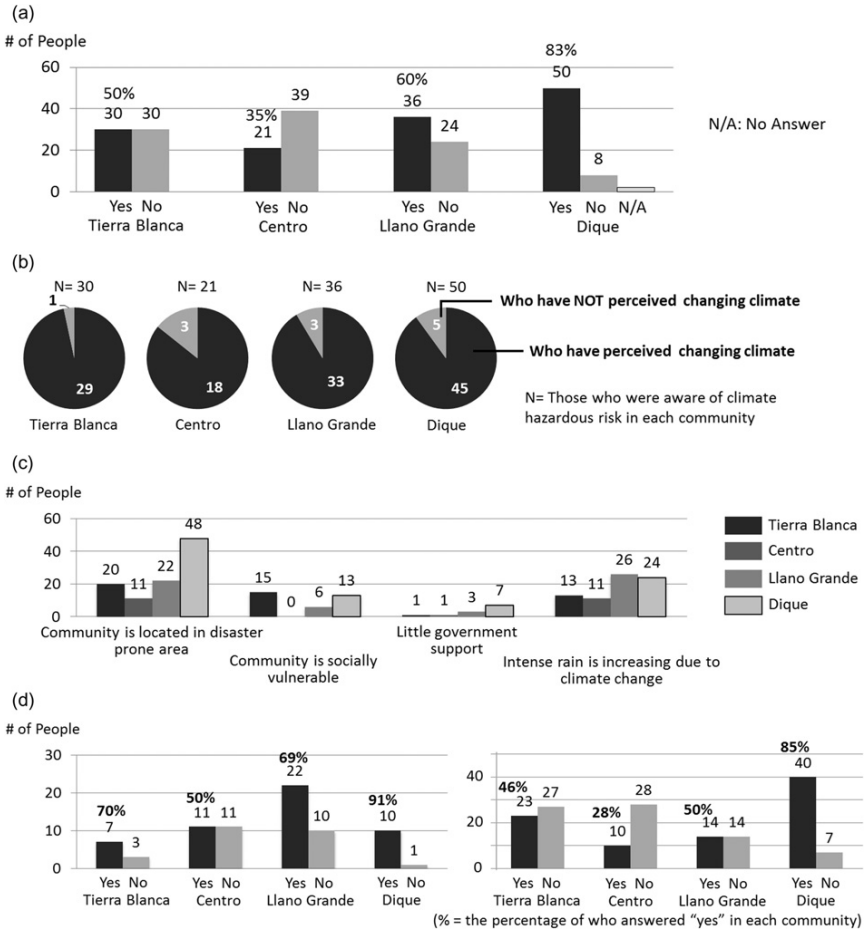

Fig. 5. Results of the Household Surveys Regarding Communities' Hazardous Awareness. (a) Number of Individuals Who Were Aware of Local Climate Hazardous Risk. (b) Community's Local Climate Hazardous Risk Awareness, Comparing between Those Who Have Perceived Changing Climate and Those Who Have Not. (c) Reasons for Having Local Climate Hazardous Risk Awareness. Multiple Answers. (d) Local Climate Hazardous Risk Awareness of Those Who Have Experienced Disasters before (Left) and Those Who Have Not (Right).

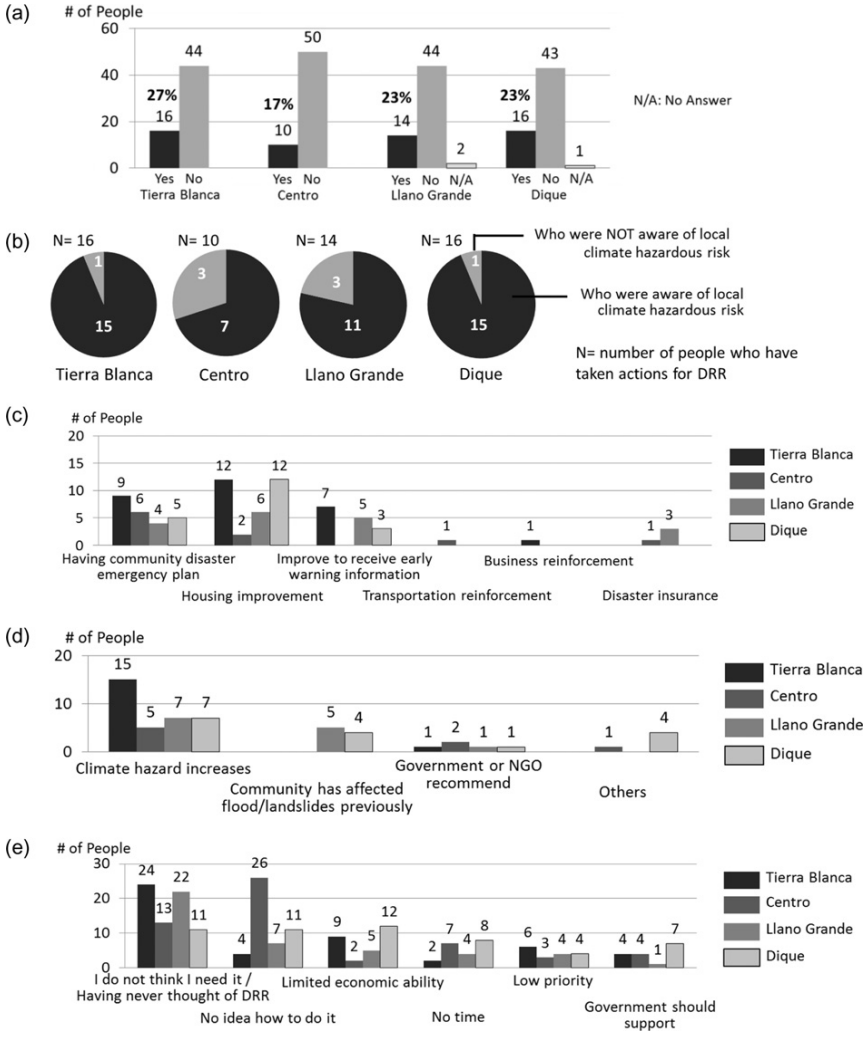

Fig. 6. Results of the Household Surveys Regarding Communities' Actions for DRR. (a) Number of Individuals Who Have Taken DRR Action. (b) Number of Individuals Who Were Aware of Climate Hazardous Risk, of Those Who Have Taken DRR Action. (c) Measures of DRR Actions Taken by the Communities. Multiple Answers. (d) Reason for Taking DRR Actions. Multiple Answers. (e) Reason for Not Taking DRR Actions. Multiple Answers.

individuals who had taken actions for DRR (94%, 70%, 79%, and 96% in Tierra Blanca, Centro, Llano Grande, and Dique, respectively) are those who were aware of local climate hazardous risk. DRR actions include collective measures taken by communities (e.g., preparing community disaster emergency plans, and reinforcement of agricultural business against increasing the number of climate hazardous events), as well as individual measures, including housing improvements (e.g., reinforcement of ceilings or windows), and greater receptiveness for early warnings from media or community radio communication system (Fig. 6c).

The reason for taking DRR actions include: the recent increase in climate hazardous events (34 people); the previous community experiences of flooding or landslides (9 people); and government or NGO's recommendations (5 people) (Fig. 6d). Reasons for not taking DRR actions include: feeling of no need for such actions, or having never thought about DRR (70 people); no idea of how to do it (48 people); limited economic ability (28 people); time constraints (21 people); low priority compared to other more urgent issues (17 people); and DRR being a government responsibility (16 people) (Fig. 6e).

The surveys continued additional questions regarding community's expectations of external support for DRR. The majority (203 of all 240 interviewees) thought that they needed support from external organizations to improve community DRR (88%, 82%, 86%, and 82%, in Tierra Blanca, Centro, Llano Grande, and Dique, respectively) (Fig. 7a). Of those who identified a need for support (203 people), 71% (144 people) thought that they needed community sensitization or education to learn how to prepare for DRR, 64% (130 people) wanted advice on how to measure CCA at the community level, 56% (114 people) wanted help with flood evacuation simulation, and 55% (112 people) wanted to understand the methodology for early warning flood monitoring (Fig. 7b).

The majority of the interviewees were willing to participate in future community DRR projects (187 people, 83%, 70%, 78%, and 80%, in Tierra Blanca, Centro, Llano Grande, and Dique, respectively) (Fig. 7c). Of all those who showed willingness to participate (187 people), 76% (145 people) said that it was because it is important for the community to improve the quality of life in a longer term, 52% (98 people) said that it was important for individuals, and 51% (95 people) said it was important for families (Fig. 7d). Fewer individuals thought because of its importance for the municipality (12%, 24 people) or the country (4%, 7 people). Within the majority of interviewees expressed a willingness to participate in any future community DRR projects, there are 20, or 11%, out of

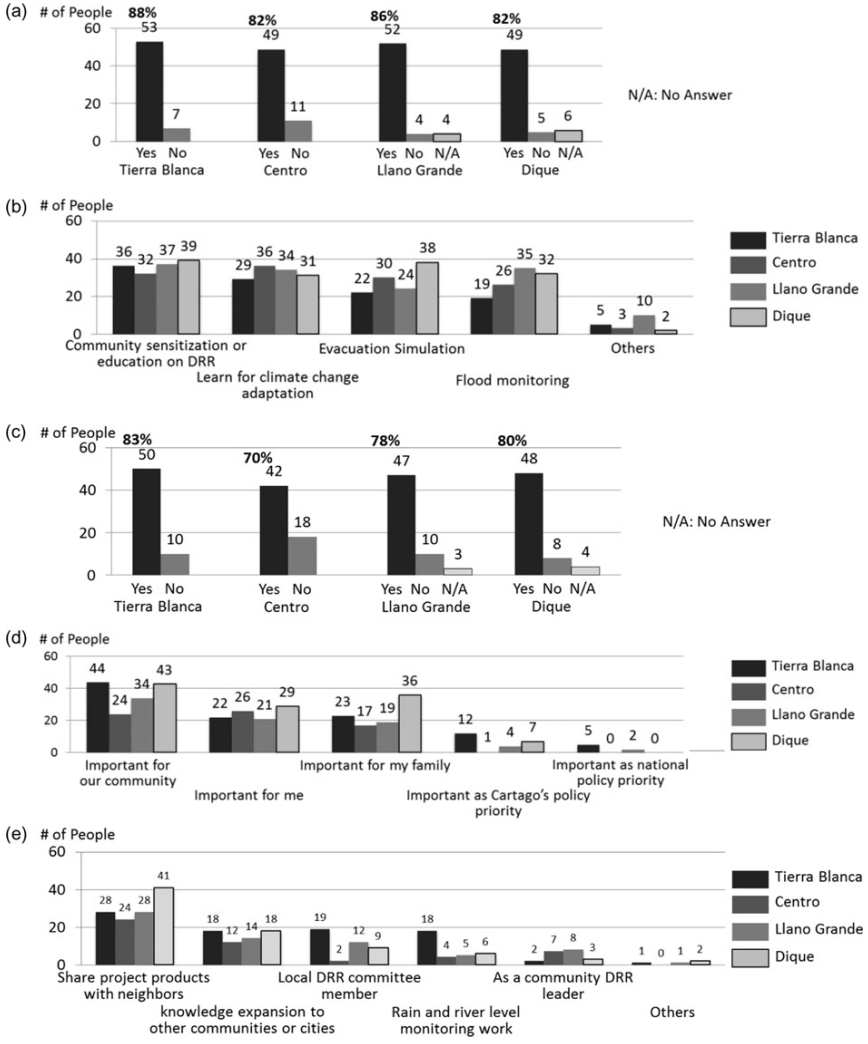

Fig. 7. Results of the Household Surveys Regarding Communities' Expectation of External Support for DRR. (a) Number of Individuals Who Saw the Need for Support from External Organizations for DRR. (b) Activities Needed in External Support for DRR. Multiple Answers. (c) Number of Individuals Willing to Participate in Community DRR Projects. (d) Reasons for Participating in Community DRR Projects. Multiple Answers. (e) Nature of Participation in Community DRR Projects. Multiple Answers.

187 people (all those who showed willingness to participate) wanted to participate as community leaders for project implementation. Other 65% (121 out of 187 people) expressed willingness only to share project products to neighbors (Fig. 7e).

Summary – Results of the Household Surveys

The household surveys resulted that most interviewees in the four communities had already heard about the term climate change. This term is known equally, irrespective of gender, occupation, or education carrier. The majority of people had heard about climate change from media, neighbors, or learned it in school. Most interviewees in the four communities had already perceived climate change in their daily lives. The number of those who had actually perceived changing climate in their daily lives is greater than that of people who had heard about it from media, neighbors, or school. Perceptions of climate change were started within the last few years in Cartago.

More than half of the interviewees were aware of local climate hazardous risk. The surveys found positive outcomes stemming from communities' perceptions of changing climate and local climate hazardous risk awareness. The location of communities to disaster-prone areas and the threats from recent climate hazardous events (e.g., intense rain) were identified as the two major reasons for the awareness. Those who had experienced disasters had greater awareness than those who had not. Dique, a poverty slum area (see Chapter 5), recorded the highest level of awareness among the four communities. Comparing this with results from previous studies in 2001 and 2005, awareness in Dique seems to be improving.

The surveys show other positive outcomes stemming from communities' local climate hazardous risk awareness and DRR actions. However, it is additionally found that few individuals have taken DRR actions even when many of them were aware of local climate hazardous risk. The reason for this relates to the low priority given to the issue and limited knowledge within the community on taking actions for DRR. Those who have already taken action reflected higher levels of concern for climate change impacts.

The surveys found finally that most interviewees in the four communities expected external support for community DRR. Many thought that such support is important for better quality of life at community and family level. The majority of the four communities expressed a willingness to participate in future DRR projects. Most would prefer to participate just by

disseminating the project results to neighbors. Furthermore, there were numbers of individuals who were willing to act as leaders for future DRR projects.

DISCUSSION

The household surveys found a positive outcome stemming from the communities' climate change perception and local risk awareness; the majority of those who have perceived the effect of changing climate in daily life were aware of local climate hazardous risk (Fig. 5b). In all, 54% or 74 out of 137 people who were aware of local climate hazardous risk said that their awareness was due to the recent threat from climate change (Fig. 5c). Majority of the interviewees started noticing this within the last few years. Hence, recent perceptions of changing climate are considered as a key aspect underpinning the increase in awareness of local climate hazardous risk. However, this was not the case in all four communities; perceptions of climate change in Dique were on average among four communities (Fig. 4d), while the awareness of local climate hazardous risk here was relatively higher than other three communities (Fig. 5a). Thus, it would seem there are other factors that can increase awareness of climate hazardous risk. This is discussed further below.

The surveys additionally found that there was other positive outcome stemming from local climate disaster risk awareness and the community's DRR actions. Those who were aware of local climate disaster risk were more likely to take DRR actions (Fig. 6b). This finding coincides with McIvor and Paton (2007), when individuals are motivated to be aware of the risk, higher DRR outcomes can be expected. Despite this finding, it is also the case that overall, few individuals in the communities have taken any DRR action in Cartago (Fig. 6a). Hence, there are expected to be other factors that motivate community DRR actions. This is additionally discussed further below.

Factors That May Increase Climate Hazardous Risk Awareness

Satterthwaite (2011) found that low-income and vulnerable groups living in informally built settlements have lower disaster risk awareness in general. Despite the fact that Dique is a poverty slum community located in an

illegal area, individuals in this area reflected higher awareness compared to other three communities involved in the household surveys. Furthermore, individuals in Dique seem to be improving their awareness in recent years, compared to the previous studies by CNE (2003) in 2001 and Castillo et al. (2006) in 2005. Therefore, there may have been specific reasons that explain why this poverty slum area has shown higher awareness, and additionally, why the community seems to be improving its awareness in recent years.

Factors that have been identified as increasing local climate hazardous risk awareness include the cultural and social environment (Dake, 1992; Hardin & Higgins, 1996; Marris, Langford, & O'Riordan, 1998; McIvor & Paton, 2007; Rippl, 2002; Rohrmann, 1994), and an individual's experiences (Kates, 1971). On this basis, the following discusses probable factors that may have increased the local awareness even in the poverty community.

First factor relates to the community's disaster experience. The surveys found that 33.8% of interviewees of all four communities had experienced disasters previously (Table 3). The result of the household surveys clarify those who had experienced disasters had greater awareness than those who had not (Fig. 5d). The majority of the damage due to these experienced disasters had been minor, including partial public infrastructure damage (e.g., road submerged and impassable), public services influences (e.g., traffic signal stopped), or no damage but the community was evacuated. The ability to be aware of disaster risk is related to an individual's life experience with repeated occurrence (Lavell, 2003; Maskrey, 1989, 2011; Wisner et al., 2004). The result of the surveys coincides with this point, and additionally found that disaster experience even with minor damages is a predominant factor that increases the awareness.

Disaster risk awareness in general is influenced by the theory of a "prison of experience," in which people's behavior is determined by previous experiences (Kates, 1962, 1971). This theory coincides with the results of the surveys (Fig. 5d). However, in the particular case of Dique, fewer individuals had experienced disasters than other areas (Table 3), while the community reflected a higher awareness of local climate hazardous risk (Fig. 5a). This does not always coincide with the Kates' prison of experience theory.

In fact, the majority of those who experienced disasters in Dique (72.7%, 8 out of 11 people that experienced disasters) have had the experiences within the last one to two years, which is much higher than other communities (25.0%, 22.7%, and 18.7% in Tierra Blanca, Centro, and Llano Grande, respectively, Table 3). This indicates that the theory of Kates' "prison of experience" is limited only within a few year experiences

in the case of Cartago. In summary, community's disaster experience may be a factor that increases local climate hazardous risk awareness, especially from the experiences of small-scale events within recent years. The challenge is thus, how to share among other communities their experiences and lessons of recent occurred small-scale disasters, which national or local database would not record.

Second factor is related to community's recognition of social risks. As shown earlier, majority of the individuals recognized a variety of risks facing communities in Cartago (Table 2). Overall, the communities faced three major social risks: drugs, unstable job conditions, and social violence (Fig. 3). These recognition of risks were particularly noted in Dique, where 78% (47 out of all interviewees in Dique) recognized the threat of drugs and 65% (39 out of 60) recognized the risk associated with social violence; both higher than the other three communities. Moreover, this household surveys found those who have recognized two or more social risks have a greater awareness of climate hazardous risk: 76.4% in Tierra Blanca (26 people who recognizes two or more social risks, out of 34 who are aware additionally local climate disaster risk), 52.9% in Centro (18 out of 34), 69% in Llano Grande (29 out of 42), and 89.7% in Dique (44 out of 49).

Hazard risk awareness increases if social conditions deteriorate (Wisner et al., 2004). The Dique community was built in the area where residential construction is prohibited by national legislation. The community in Dique is vulnerable (van Aalst et al., 2008). Vulnerable living conditions may have made the community more sensitive to complex social risks and consequently, this complex risk recognition may have forced them to increase their awareness of local climate hazardous risk.

Elements for Improving Community Disaster Risk Reduction

The household surveys found other positive outcomes stemming from communities' local climate hazardous risk awareness and DRR actions. This finding coincides with Bone et al. (2011) and Prabhakar et al. (2012), indicating that local disaster risk awareness plays a crucial role in the ability of community to reduce its vulnerability.

However, the surveys additionally found that overall, only few individuals had taken any DRR action in the communities in Cartago. Indeed, decisions to change behavior are a multi-step process in which recognition of the risk is only a first step (Daniel, 2008; Martin, Bender, & Raish, 2008;

McCaffrey & Kumagai, 2007). Thus, communities may require other steps to take greater DRR actions. Sarah, McCaffrey, Stidham, Toman, and Shindler (2011) explain that the reasons for this gap include lack of knowledge, time limitation, competing priorities, and the expectation that other actors (e.g., local government) will get involved. On this basis, the following analyses the three most likely factors for achieving greater community DRR actions.

First factor relates to the living conditions for communities, and how the lack of basic living conditions may limit communities' having greater DRR actions. Indeed, the surveys found the biggest reason that communities fail to take DRR action is related to their priorities. Reasons given for not taking any DRR action included the context of community's low priority; "I do not think I need it/I have never thought of DRR" (38.7%, 70 out of all 181 people who have responded with "no action on DRR", Fig. 6e), "I have limited economic ability" (15.4%, 28 out of 181), and "No time for taking DRR" (11.6%, 21 out of 181).

Community development goals include achieving a better quality of life, having sufficient economic stability and social fulfillment. With this regard, DRR action, at least from an individual economic perspective, may not be attractive especially for the poor or low-income communities. DRR action will not increase incomes in the community over the short term, but are necessary in the context of longer-term development effectiveness and for the sustainability of socioeconomic development (Lavell, 2003; Wisner et al., 2004).

As discussed earlier, the four communities in Cartago faced multiple risks. Specifically in Dique, many of these faced critical living conditions due to the risks. For example, those who feel risk in their daily lives, 30 people in Dique were threatened by job insecurity, and 15 people feared malnutrition (Fig. 3). It is a priority especially for poor communities to resolve these critical living condition issues. CNE (2003) reports that communities' priorities in Cartago included better access to food, medical services, and stable jobs, and only then the community would finally take responsibility for DRR. This indicates that basic social and economic conditions should be a minimum requirement for stability in the daily life of communities, as well as minimum condition for having greater action on DRR.

Second factor relates to the knowledge of communities regarding measures to incorporate DRR in their daily lives. Reviewing the concrete DRR actions having been taken by the communities in Cartago, the surveys found that the majority of these are not actions specifically for DRR (Fig. 6c). For example, 32 out of all 56 people who had taken DRR actions

had undertaken housing maintenance, for example, installation of waterproof roofs or windows. Other 15 out of 56 people said they received flood warnings from radio or television when it rained heavily. This book has limited to evaluating the effectiveness of these community actions for risk reduction. However, these small actions taken by the communities may be efficient interventions combined with other purposes to improve the quality of their daily lives. The installation of waterproof roofs or windows would be undertaken as part of general housing maintenance and receiving media information on a daily basis individual activities; that is, these are not specific actions for DRR. If the interviewer had asked in a direct manner as follows: "Do you receive early warning information about heavy rains or flood by listening to the radio or watching TV?" it is likely more individuals would have answered yes, because majority of all interviewees in the four communities said they heard about climate change via radio, television, or other media (Fig. 4b).

The present surveys has analyzed why some of the individuals have answered in not taken DRR action even though some of them might have taken action unconsciously. The reason may relate to the limited knowledge of communities regarding DRR measures: 48 out of all 181 people who have responded with "no action on DRR" thought because they have no idea of how to do it (Fig. 6e). Even while some members of the communities might be receiving flood alert information by radio or other media, some of them may not recognize this as one of the DRR measures that individuals can take. Poor community knowledge of DRR measures is reported similarly in available literature (Hurnen & McClure, 1997; Johnston, Bebbington, Lai, Houghton, & Paton, 1999; Lechliter & Willis, 1996; Rustemli & Karanci, 1999). Lack of knowledge is due to a lack of access to information (Agrawal, McSweeney, & Perrin, 2008). Obviously, knowledge is not a single element that improves community DRR actions, but may additionally require other elements including interest and desire, necessary to promote to take DRR actions (Shaw et al., 2009). Learning opportunities to encourage knowledge, interest, and desire for having communities DRR actions may be additionally required.

Third factor is related to the community's sense of willingness to support neighbors. Of all the interviewees who had taken DRR action (56 people, Fig. 6a), 85.7% or 48 people answered they were interested in participating in future DRR projects if the local or national government or an NGO would organize it for the community. Moreover, of all the interviewees who had wanted to participate in future DRR projects as a community leader (20 people, Fig. 7e), 90% or 18 people of these answered they have

taken DRR actions. This result may indicate a positive outcome stemming from a sense of willingness to help neighbors and initiative for taking DRR action. In contrast, of all who indicated the reason for not taking DRR action was because "governments should take action for DRR," (16 people, Fig. 6e) or insisting DRR not a part of community responsibility, 75% (11 people) responded that they had no interest in participating in future DRR projects. It is a fundamental part of human nature to feel dignity when interacting with neighbors. Chapter 2 of this book identified that residents, including socially vulnerable groups such as the poor, women, the elderly, and children even wanted to collaborate with their neighbors. When someone helps their neighbors, even in a small way, they feel a sense of accomplishment that improves their own identity.

Sense of willingness to support neighbors may relate to the context of social capital, which increases the ability of communities to participate, cooperate, organize, and interact over the long term (Cavaye, 2004). Community participation is an important factor for sustainable DRR (Micangeli & Esposto, 2010; Osland, 2010; Sagala & Okada, 2007). Therefore, social capital may need to be enhanced for having more willingness of the community to help neighbors. Since community's social capital is beyond the scope of the present surveys, further analysis is needed to clarify the relationship between community awareness of local climate hazardous risk, actions for DRR, and social capital.

SUMMARY

This chapter found positive outcome stemming from communities' perception of changing climate and climate hazardous risk awareness. The perception of climate change is a key factor underpinning increasing the local awareness in Cartago. Moreover, this chapter identified two additional factors that may increase communities' local awareness. These were sharing recent and even small disaster experience among broader communities or cities, and recognizing more of the unconscious social risk that a community faces.

Despite the communities' higher awareness of local climate hazardous risk, this chapter additionally found communities' few actions for DRR due to a variety of reasons. Additionally, this chapter identified three factors for promoting communities' greater future DRR action. These were improving daily living conditions accordingly; providing learning

opportunities that community can incorporate DRR in daily life; and increasing sense of willingness to support for neighbors in achieving a better quality of life. These factors are crucial for enhancing local government's DRM capacity in the context of the increasing climate disasters. Local governments should incorporate these factors into local policy and development planning for effective local DRM governance framework.

One of the factors identified in this chapter was related to the context of social capital for having greater DRR action. Sense of willingness to help neighbors may be needed for greater DRR action in a community, and this may be increased when community social capital is more effective. The relationship between local climate hazardous risk awareness, actions for DRR, and social capital need to be studied in greater detail.

CHAPTER 7

FACTORS FOR ENHANCING LOCAL DRM CAPACITY

ABSTRACT

Drawing on the results of the previous chapters, this chapter looks at current progress in terms of climate disaster risk incorporation into development planning and practice at three levels (national government, municipalities, and communities) and analyzes gaps, challenges, and opportunities. The chapter also discusses potential factors for enhancing local disaster risk management (DRM) capacity by collaborating with three levels of stakeholders.

Keywords: Disaster risk reduction; climate change; development planning; role of three levels of stakeholders (national government, municipalities, and communities); Costa Rica

GAPS AT THE NATIONAL, LOCAL, AND COMMUNITY LEVELS

To identify the gaps at three levels (the national government of Costa Rica, municipalities in Costa Rica, and communities in Cartago), this section first reviews the progress made in incorporating climate hazard risk considerations in development planning and practice at each level. In doing so, this chapter continues to use a 3 × 3 matrix (see Chapter 1) as its analytical framework. This 3 × 3 matrix includes three categories of action as its horizontal levels: risk identification and awareness, development policy framework, and development practice. Each of the three components is

considered at the three levels of government – national, municipal, and community.

Risk Identification and Awareness

National Government

It was already seen that the national government of Costa Rica was well aware of recent increases in climate-related hazards. For example, the National Strategy on Climate Change (ENCC) clearly recognized the increasing frequency and intensity of precipitation over recent decades and indicated that this change had led to a greater extent of hazardous climate impact in the country (Chapter 3). Other national policy instruments, such as the Climate Change Adaptation Strategy on Water, also reflected the national government's concern about the increasing risks. The national government has developed the National Plan for Disaster Risk Management 2010–2015 (PNGR 2010–2015), which incorporates a comprehensive risk analysis including the context of increasing climate-related hazards and their impact (Chapter 3). Furthermore, during the checklist interview, staff members of the National Emergency Commission (CNE) expressed their concerns about the increasing risks and potential negative impacts on national development. The national government scored an overall result of 27.7% in the checklist's category of risk identification (RI). This performance suggested that national government activity was still at an early stage; however, this score was higher than those obtained in the other two checklist categories: policy and institutional framework (PIF) and development practice (DP) (see Chapter 3).

Rapid national policy reforms sometimes result from the recommendations of international organizations (Delmartino, 2009; Wang et al., 2004). Costa Rica is a member country of the UNFCCC and the IPCC. The MINAET participates in the UNFCCC, and the National Meteorological Institute (INM) is involved in the IPCC (Chapter 3). Additionally, the CNE participates in the international conferences that have organized, among other plans, the UNISDR. As a result, the ENCC has referenced 10 IPCC technical studies and six guidelines developed by United Nations (UN) organizations that address potentially hazardous scenarios related to global climate change and establish international standards on how to manage their impacts. The national government's concern, therefore, seems to have been influenced by the international organizations' inputs.

National institutions including the CNE, IMN, and MINAET contact other relevant national organizations prior to international meetings in order to develop a national-level consensus. As a result, Costa Rica's national government has established an environment for inter-institutional coordination; in all, 93 national institutions and universities have participated in the ENCC's development (Chapter 3). Additionally, 91 institutions, mostly national entities including MINAET, IMN, and several national universities, have participated in the development process for PNGR 2010–2015. Consensus positions agreed upon by the broader national institutions are then brought to international meetings. This coordination among the national institutions of Costa Rica may be an important reason for the shared awareness of potentially climate hazardous impacts among these institutions.

Although the national government enjoys effective inter-institutional coordination, no mechanism seems to exist for transferring information on climate hazard risks from the national to the local level. This weakness was evident in the checklist interview: staff of the Ministry of Agriculture and Livestock (MAG) said that there was no communication mechanism between the MAG and municipalities for sharing risk information, and the MAG disseminates information to municipalities only through published documents (Chapter 4). Intergovernmental management and information sharing are important means of transferring risk information from the national to the local level (Zeemering, 2012). Even though one of the priorities of PNGR 2010–2015 is the "decentralization of risk information at the local level" (Chapter 3), this approach is yet to be implemented in Costa Rica.

Municipalities

Municipalities expressed their concerns about the increasing impact of climate hazards at the local level; even municipalities that scored lowest on the checklist, such as Esparza and Garabito – both of which scored 0% in all three sectors of the RI category – indicated concerns about increasing climate hazards (Chapter 4). However, many of them were only vaguely aware of it, expressing these concerns without any detailed analysis of the possible impacts or any plan to combat these hazards. As a result, no municipalities have developed local climate hazard risk information as a reference point in their local development planning. Some municipalities have incorporated risk information within their local sector development plans. These include the local tourism development plan of the municipality of Tibas and the water management plan of Cartago,

both of which have incorporated hazard risk estimation (Chapter 4). Such instances, however, appeared in only a few specific sector plans and have not yet become a common local experience. This situation was reflected in the checklist scores: municipalities attained average scores of just 4%, 28%, and 6% in the RI categories of tourism, water, and agriculture, respectively. When compared to the national scores for the same three sectors (16%, 25%, and 42%, respectively), the municipal score for water was actually higher but the other two were much lower (Chapter 4).

Development of comprehensive local risk assessments is necessary to enable long-term, sustainable local development planning (O'Brien et al., 2012). However, municipalities and local institutions have limited technical capacity to develop such information; for this reason, establishment of coordination mechanisms with national authorities is necessary to achieve this goal (Chapter 4). Indeed, this book has identified efforts at the national government level to provide support for the development of local hazard risk information for municipalities. The CNE, the UCR, and the UNA provided such support to the municipality of Cartago. However, the coordination has had limited effect, largely because there was no permanent counterpart in the municipality to receive the support provided by the national institutions.

When municipalities do not receive appropriate support from the national government and do not have the capacity to develop comprehensive local hazard risk information, where do they get the information needed to raise awareness? O'Neill and Ebi (2009) indicated that risk communications (co-knowing, co-thinking, co-working, and co-deciding) between local governments and communities are an effective way to increase municipalities' risk knowledge. Indeed, several municipalities in Costa Rica recognized the importance of risk communication between municipalities and communities. During the checklist interview, representatives of the municipality of Desamparados described informal communications from communities, claiming that their agricultural production had been reduced in recent years because of long-lasting, intense rains (Chapter 4). The municipality of Santa Ana stated that communities were implementing daily precipitation monitoring in coordination with the municipalities' understanding of the increasing number of small hazardous, climate-related events. The municipality of Cartago indicated that the local Reventazon Model Forest Committee has collaborated in gaining an understanding of the municipality's hazardous climate-related impacts. These experiences in the municipalities of Costa Rica imply that formal

and informal communication between municipalities and communities is a key factor in raising local risk awareness.

Communities

A similar checklist evaluation was not implemented at the community level. Instead, according to the results of the household surveys, 83% of the four communities in Cartago perceived the effect of climate change in their daily lives (Chapter 6).

A leading information source influencing this perception of climate change was residents' personal experience of unseasonably warmer or cooler weather conditions. Radio and television broadcasts also contributed to community knowledge. Daily feelings of weather conditions and media information were thus two key drivers that heightened risk awareness.

An agricultural community in the upper river basin of Cartago has observed local daily precipitation (three times a day) for more than ten years continuously, motivated by personal preoccupation with climate change and its negative influence on the agriculture industry (Chapter 5). Agriculture is traditionally a leading industry in Cartago and was one of the most common occupations among the 240 community-level interviewees in this study (Chapter 6). This high dependence on farming is one reason why communities in Cartago are very sensitive to changes in climate conditions and are raising awareness of climate-related risks.

Furthermore, it was found that international organizations have supported municipalities in Costa Rica by increasing their understanding of negative impacts resulting from climate change (Chapter 4). The UNDP organized an event to promulgate the results of the ENCC to the municipality of Cartago, and the municipality shared this information with its communities. The Reventazon Model Forest Committee was found to be a good place for information sharing on climate hazard risks between the municipality and the communities of Cartago (Chapter 4).

Development Policy Framework

National Government

This book has identified some national government initiatives related to the incorporation of climate hazard risks into national policy instruments; the National Development Plan 2011–2015 (PDN 2011–2015) has already incorporated risk reduction as a factor necessary for the country's long-term sustainable development. The PNGR 2010–2015 has incorporated

measures for reducing the risk and considered addressing this issue as necessary for accomplishing sustainable development. "Long-term development" or "sustainable development" was thus a key factor in this regard.

Chacon and Pratt (1996) explained that Costa Rica's long-term or sustainable development priorities were established earlier in the 1990s on the basis of the national policy constitution, the first chapter of which clearly expresses the country's most important values for citizens' high quality of life, including sustainable environmental diversity. In fact, the country has suffered serious national forest and biodiversity losses since the 1960s (Sanchez, Daily, Pfaff, & Busch, 2003). The national government has reformed its national policy and strategy, including the creation of several national parks, and this policy reform has led to the development of eco-tourism as a new industry in Costa Rica. This win−win experience (forest conservation and a growing eco-tourism industry) has encouraged the country to support this approach to long-term sustainable development (Blum, 2008; Eben et al., 2012; MINAET, 1992; Myers, Mittermeier, Mittermeier, da Fonseca, & Kent, 2000; Soto, 1992). Consequently, recent national development policy instruments, such as the PDN 2011−2015 prepared by the Ministry of Development Planning (MIDEPLAN), PNGR 2010−2015 developed by the CNE, and ENCC elaborated by the MINAET, have incorporated a perspective of sustainable development. Furthermore, these policy instruments have embedded climate hazard risks as one of the important issues for sustainable development. As a result, the national government attained an average score of 25% in the category of policy and institutional frameworks (PIF), which is still at a very early stage although relatively more advanced than the municipal level (Chapter 3). Notwithstanding this national development policy framework, it is not still clear how to disseminate this national priority down to the local level (Chapter 3).

Municipalities

In contrast with the national government, the municipalities tended to emphasize short-term economic development priorities instead of having a long-term development perspective. The municipalities' average checklist score in the PIF category was a very low 6.3% (Chapter 4). In general, local development planning tends to focus on short-term perspective trajectories (Adger, Neil, Chapin, & Ellemor, 2012; Bohle, 2001; Burton, Soussan, & Hammill, 2003; Cutter et al., 2012; Ghai & Vivian, 1992; Gibbs, Longhurst, & Braithwaite, 1998; Platt, 1999), which was the case observed in Costa Rica. During the checklist interview, the municipalities of Aguirre, Desamparados, Esparza, and Garabito insisted that they were

busy with daily operational responsibilities (e.g., licensing for housing construction), and all of them considered climate hazard risks as a low priority in their local development agenda (Chapter 4). Opinions in the municipality of Cartago were more explicit, indicating that the impact of climate hazards was a low priority compared to other emergent economic development issues such as the global economic crisis and the effect of the FTA between Central American countries and the United States.

Costa Rica's public administration system was centralized until recently (IDD, 2011; Segura, 2008; USAID, 2004), and it was in 1995 that the Urban Planning Law (Ley de Planificación Urbana, Ley No. 4240 of 1968) first promoted policy and planning decentralization to the municipalities (Chapter 4). In the present legal climate, municipalities in Costa Rica must prepare a local Regulatory Plan (PR). However, the municipalities still did not have enough experience to prepare it, and indeed 50 of the country's 81 municipalities had not issued a PR as of 2003 (Chapter 4). Even the municipalities that had already issued a PR displayed lack of experience in incorporating assessment of long-term climate hazard risks within it. During the checklist interview, the municipalities of Desamparados, Esparza, and Garabito said that they recognized the increasing climate-related impacts but had no idea as to how to combat it as part of their local development planning (Chapter 4).

O'Brien et al. (2012) observed that numerous barriers hinder the reconciling of short- and long-term development goals at the local level. One barrier is that it is not easy to accomplish this goal without national support (La Trobe & Davis, 2005; Pelling & Holloway, 2006). In the case of Costa Rica, the national government has few mechanisms to support local planning development, except for some support provided by individual institutions (Chapter 4). Second, as Williams (2011) noted, small-scale disasters occurring with increasing frequency at the local level rarely create a local policy consensus as to how to stimulate long-term sustainable development. Third, changing local attitudes about local policy development is generally a slow process (Volkery & Ribeiro, 2009). These observations are consistent with those made in this book. As a result, municipalities in Costa Rica did not see the increasing climate hazard risk as a policy priority for their local development agendas and instead seemed to focus more on short-term economic developments.

Communities

As noted earlier, this study did not utilize the same checklist interview at the community level, relying instead on household surveys in Cartago. Most interviewees thought that they needed support to improve community

DRR measures because they felt that doing so was necessary to improve the quality of life for individuals, families, or communities over the long term (Chapter 6). Additionally, 60% of the 240 interviewees said that they needed community sensitization or education to learn how to prepare for DRR, and 54% said that they needed advice on how to measure CCA at the community level; the respondents indicated a belief that these activities were necessary for their communities' social and economic sustainability. These results indicated the communities' intention to think about long-term development perspectives, and to incorporate climate hazard risk reduction into that thinking, but also that the communities would need much support to improve their actual DRR in practice (as discussed further in the next section).

The community-level interest in prioritizing long-term development effectiveness may be based on two concerns. One is business sustainability, primarily in the agriculture sector. The man in the Tierra Blanca, in the upper river basin of Cartago, who had performed daily flood observations for more than ten years had used his experience in precipitation observation to assist the community's agricultural sustainability (Chapter 4). This is a case in which DRR action has raised the community's awareness of long-term economic development needs. The second factor is related to social concerns. Many people in the communities understood the value of DRR in helping communities to attain a better quality of life and sustainable social development, even though they thought that DRR action would not increase their incomes over the short term (Chapter 6); thus they recognized that DRR could stimulate achievement of the community's long-term social development goals. This finding coincides with those of Lavell (2003) and Wisner et al. (2004), indicating that DRR actions do complement the sustainability of socioeconomic development over the long term.

Development Practice

National Government

This study has shown that the national government of Costa Rica moderately improved its climate hazard risk reduction actions in the past few years. The main reason for this improvement was that new national policies, especially the ENCC, stimulated the national government's implementation practice related to climate hazard risk reduction. Recent accomplishments include the Water and Sanitation Institute's (AyA) water reuse assessments and its implementation of a used-water supplementation project, and the MAG's contribution through participating in the Central

America Agriculture Council (CAC) and sharing experiences of development practice with neighboring countries. As a result, the average score on the checklist category of development practice (DP) improved from 10.3% before ENCC approval to 20.7% post-approval (Chapter 3). Cardona et al. (2012) explained that the approval of national policies often stimulates putting DRR actions into practice in the short term; this result was observed in the case of Costa Rica.

Despite this recent progress, the national government's checklist score on DP was still relatively low, and the remaining challenges include the national government's limited capacity to implement actions. Even the CNE, the national DRM authority, counted only a few specialists engaged in the subject of climate hazard risk reduction measures. Consequently, this national authority had limited capability to translate its knowledge to the municipalities (Chapter 4).

Municipalities

This study found that municipalities in Costa Rica had not implemented much action related to climate hazard risk reduction. As discussed earlier, even municipalities that scored lowest on the checklist expressed concerns about the increasing impact of climate-related hazards (Chapter 4), but few of them were taking actions to reduce the impact. As a result, the average score on the checklist's DP category at the municipality level was very low, at 6.3% (Chapter 4). Although municipalities often manifest a general understanding of local risks, implementation of measures to reduce risk is sometimes harder to achieve (Bulkeley, 2006; Burch & Robinson, 2007); this was observed in the municipalities of Costa Rica.

This book has pointed out several challenges in achieving local actions related to climate hazard risk reduction. These include insufficient local information, the limited human resources available in the municipalities, and limitations of local leadership (Chapter 4). These findings coincide with those in the existing literature on obstacles with regard to local DRM practice (AAG, 2003; Cutter et al., 2012; Flugman, Mozumder, & Randhir, 2012; Kasperson et al., 1988; Marx et al., 2007; Patt & Gwata, 2002; Stern & Easterling, 1999). On the other hand, some municipalities have taken actions aimed at climate hazard risk reduction. One example comes from Cartago's local tourism sector, which was seeking new business opportunities through exhibiting the impact on natural resources due to climate change (Chapter 4). The two drivers that stimulated the local actions in this case were (i) the municipalities' empowerment to understand the importance of the increasing climate hazards for sustainable local

development planning and (ii) information generation specifically for local use (Chapter 4).

Communities

Results of the household surveys at the community level showed that communities had taken few actions related to climate hazard risk reduction unless they were relatively well aware of specific local risks (Chapter 6). The reasons for this gap included lack of three things: (i) adequate daily living conditions, (ii) learning opportunities to understand how to incorporate climate hazard risk reduction measures in communities' daily lives, and (iii) willingness to support neighborhoods in order to improve the quality of life of their community (Chapter 6).

Communities in developing countries generally have limited resources and knowledge to implement DRR actions (Bhattamishra & Barrett, 2010); therefore, they need a mechanism for learning ways to encourage these actions. Agrawal et al. (2008) explained that the lack of learning opportunities for local residents has critically restricted improvements in knowledge and has consequently prevented development of implementation skills. Voss and Wagner (2010) found that having a community learning space was a common prerequisite for a community to begin taking greater action. Learning opportunities are thus a key factor in guiding communities to engage in DRR actions.

Even though communities in Cartago have taken only a few actions related to DRR, most of them were willing to participate in future DRR projects (Chapter 6). However, when a local DRM project was designed by donor agencies without community participation, the community's residents did not always continue the program after the project period (Chapter 2). Related to this issue, an interesting anecdote was described in Chapter 5. When CNE staff voluntarily visited the community, the community members began to show respect for the CNE, developed trust in this national organization, and continued their DRR actions. In sum, communities' willingness to participate in future projects may be an opportunity to bridge gaps in cooperation and, in so doing, establish higher trust levels between communities and project executors (such as international or national organizations). This is one of the important requirements for increasing community-level DRR involvement, according to the findings of this book.

Summary: Gaps at the Three Levels

This chapter reviewed the gaps at three levels (the national government of Costa Rica, municipalities in Costa Rica, and communities in Cartago)

related to the progress made in incorporating climate hazard risk considerations into development planning and practice. All the gaps were evaluated using this book's analytical framework, including the categories of risk identification and awareness, development policy framework, and development practice. The findings in each category can be summarized as follows.

Risk Identification and Awareness

Costa Rica's national government has established an inter-institutional coordination environment for sharing information on climate hazard risks. This phenomenon has positioned the national institutions to raise awareness of climate hazardous impacts. Their participation in international meetings enabled the country to receive the latest information related to the impact of climate change. However, there has been no coordination mechanism between the national government and municipalities to transfer risk-related knowledge. Even though some efforts were made to deliver technical support from the national institutions to the municipalities, these failed owing to weak local institutional capacity to absorb support from the national institutions. Moreover, no municipalities have developed climate hazard risk information to support sustainable local development planning.

The communities in Cartago perceived the effect of changing climate in their daily lives. Daily experiences of weather conditions and media information were two key drivers that increased awareness of climate hazard risks. In particular, farmers were more sensitive to the unpredictable weather. International organizations have additionally provided municipalities with technical support for increasing the communities' understanding of negative impacts due to climate change. Facilities that allow communication between municipalities and communities (such as the Reventazon Model Forest Committee in Cartago) were found to be an effective space for sharing communities' climate hazard risk perceptions with municipalities.

In summary, the results of this book illustrate some positive activity in Costa Rica in increasing awareness of climate disaster risk. Indeed, it is difficult to transfer critical risk messages to the public, politicians, and policymakers (Lata & Nunn, 2012; Sharma et al., 2009; Vedwan & Rhoades, 2001; Weber, 2010; West et al., 2008). Therefore, this study suggests that further opportunities exist for enhancing local DRM capacity in Costa Rica.

Development Policy Framework

This research found that the progress made in terms of establishing a development policy framework that could effectively incorporate climate hazard concerns in public planning varied among the three levels. First, Costa Rica's national government has already constructed a long-term or

sustainable development policy perspective, which contributed to the incorporation of climate hazards in national development planning. The reason for this national government's policy-based commitment was that the country had a win−win experience in achieving both forest conservation (in the context of sustainable development) and eco-tourism (a short-term industrial development). Nevertheless, this national policy consensus had not yet been passed along significantly to the municipalities of Costa Rica. Second, municipalities' development focus was still on short-term issues, and thus they were not yet achieving incorporation of climate hazard risks into local development planning. The municipalities' lack of experience in local development planning was identified as a reason for this local limitation. Third, communities in Cartago showed their intention to incorporate climate hazard risk reduction into their sustainability plans, mainly to improve the quality of their daily lives.

Development Practice

Each level of Costa Rica (the national government, the municipalities, and the communities in Cartago) was at a different stage of progress with regard to climate hazard risk reduction in practice. First, the national government of Costa Rica has moderately increased its implementation of climate hazard risk reduction measures in recent years, subsequent to the approval of national policies, even though its checklist score was still fairly low because of the national government's limited implementation capacity. Second, the municipalities in Costa Rica had not implemented many actions for the purpose of climate hazard risk reduction, and their checklist score was low due to various obstacles. Third, some communities in Cartago had taken DRR action, but these were described by only a small number of the individuals interviewed. Most communities were willing to participate in future projects, so there seems to be an opportunity for implementing future DRR actions at the community level. External organizations' voluntary support for community-level activity was also identified as an important factor for building trust between communities and project executors. In sum, all three levels showed insufficient progress in terms of the implementation of climate hazard risk reduction in practice, even though some minor initiatives were observed occasionally.

All identified gaps are mapped in Fig. 1. This 3 × 3 matrix summarizes first, four out of all nine items of the matrix were evaluated as items in accomplishing, or about to accomplishing in regard to the incorporation of the increasing hazardous risk concern in development planning and practice, and other five items are not. Second, two out of all six points of

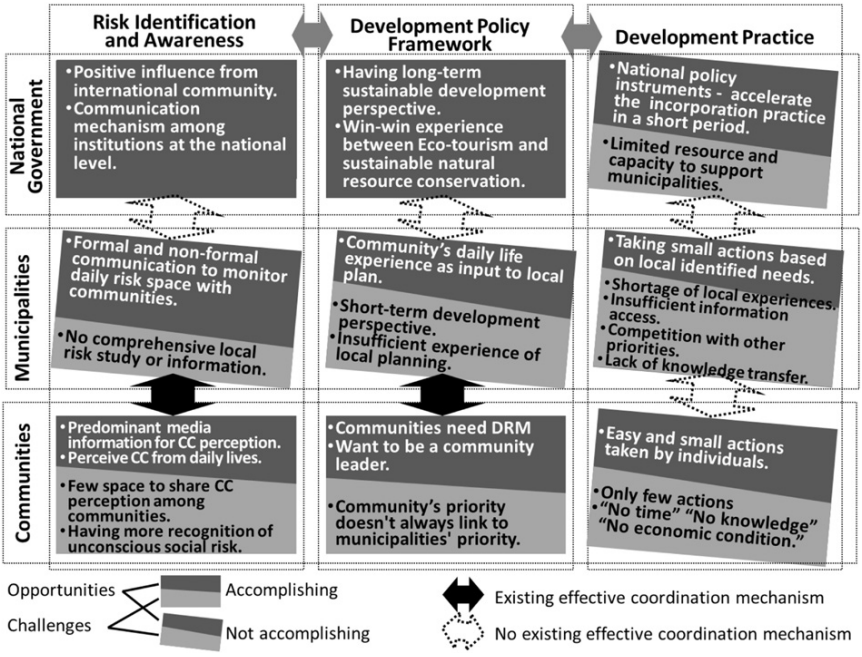

Fig. 1. Gaps, Challenges, and Opportunities Related to the Progress of Increasing Climate Hazards Incorporation into Development Planning and Practice.

coordination, between the national government and the municipalities, and between municipalities and communities in each of the three aspects, were realized, while other four points were not.

On the basis of these analyses, the next section discusses on potential factors for enhancing local DRM capacity in the context of changing climate.

DISCUSSION – POTENTIAL FACTORS FOR ENHANCING LOCAL DRM CAPACITY

On the basis of the analysis conducted previously, this section discusses potential factors necessary for enhancing local DRM capacity in the context of increasing climate hazardous risk. The proposed factors focus on the following four areas, which address all gaps and challenges analyzed in earlier sections: (i) Experience-based, local climate disaster risk information

development mechanism; (ii) Local sustainable development perspective; (iii) Community-identified priorities with effective means of implementation; and (iv) Willingness- and trust-based community actions for DRR (Fig. 2).

Experience-Based, Local Disaster Risk Information Development

This book found that no municipalities in Costa Rica, including Cartago, have developed local climate hazardous disaster risk information as a reference for local development planning. Developing such information encompasses various approaches and techniques ranging from global or national assessments using supercomputers to calculate a high-quality 100-year climate simulation to collecting local community experiences qualitatively (Cardona et al., 2012). A balanced portfolio may be required between a

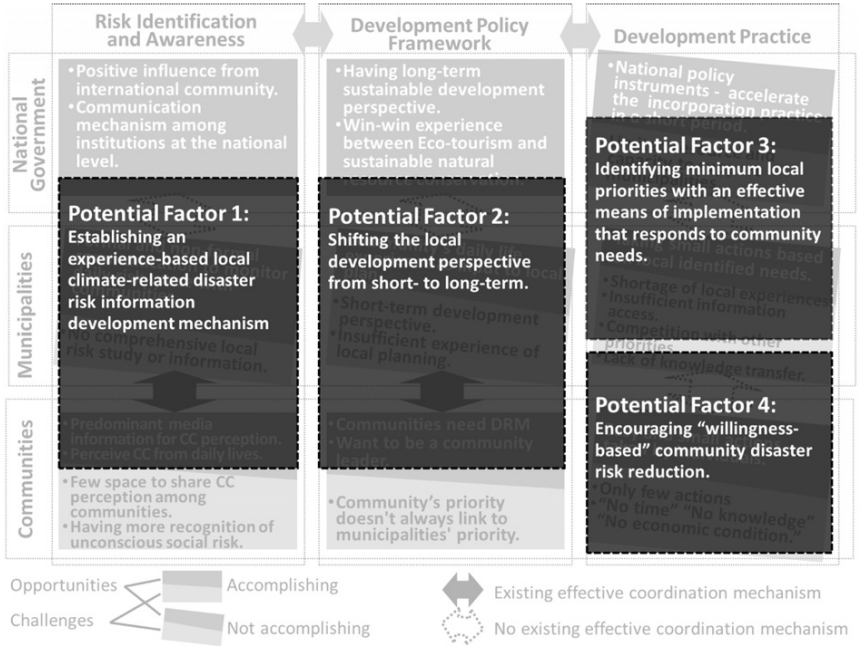

Fig. 2. Four Areas of Potential Factors Addressing All Gaps and Challenges for Enhancing Local DRM Capacity.

sophisticated high-quality scientific assessment and a low-technology qualitative analysis with community participation, depending on the municipality's available resources and capacities.

This book's overall findings emphasize the importance of communities' climate change perception and awareness in their daily lives. These include youth developing hazard maps in school (Chapter 2) and communities' experiences in identifying current changes in precipitation patterns (Chapter 5). In Chapter 6, it was additionally found that community disaster experience increases local climate hazardous risk awareness, especially experiences of recent, small-scale events. Majority of climate disasters in Cartago are small-scale events (Chapter 1) that frequently affect a community's daily lives. Individuals' frequent and daily local disaster experiences are thus important inputs for local climate hazardous risk information development. This characteristic may represent a different DRM approaches from those for conventional disasters in Cartago (low frequency but high intensity events, e.g., earthquakes and volcanic eruptions). Thus it should be determined how to use these individual daily experiences as an input for local climate hazardous risk information. To develop experience-based, local risk information, accumulating information on experiences of communities periodically in a collective manner is valuable (Cardona et al., 2012). Chapter 4 identified the positive impact of communication between a municipality and communities for the municipality's understanding of how to increase communities' awareness of small climate hazardous events. The Reventazon Model Forest Committee in Cartago has also proven effective for that purpose.

This book additionally emphasizes the effectiveness of an inter-institutional coordination mechanism to share each institution's risk information. This mechanism was especially effective at the national level (Chapter 3). However, similar mechanism was also observed at the local level in Cartago. The municipality's new local emergency committee (CGLR) has recently involved 35 public and private local institutions, including local NGOs, CSOs, local public entities, local offices of international organizations, and universities (Chapter 1). A networked collaboration complements each institution's limited capacity for information accumulation (Moynihan, 2009). In addition, NGO and CSO networks are critical in capturing realities of local small-scale events (Bull-Kamanga et al., 2003). Most of these institutions involved in CGLR, including NGOs and CSOs, do not specifically address DRM as their expertise but have broader perspectives on local development. Successful local disaster risk information collection requires a multidimensional perspective

encompassing diverse social, economic, environmental, and institutional aspects (Cardona et al., 2012). This is an additional value provided by diversity of CGLR partner institutions. Moreover, legal agreements with the institutions involved in CGLR may provide another alternative for consolidating its network (ECLAC, 2007). This agreement may also prevent information duplication and incompatibility among institutions.

Chapter 4 found that several institutions, including CNE, UCR, and UNA, have already provided the municipality with technical support for local climate disaster risk information development. Technical support from national institutions is necessary to promote local disaster risk information development in developing countries (UNISDR, 2009d, 2012). However, such supports should be expected only at a minimal level in Costa Rica because, as identified in Chapter 4, each national level institution has limited capacity to provide continuous support to all municipalities. The same chapter additionally found that the reason for the coordination failure between national institutions and a municipality was the municipality's lack of counterpart organization. The new permanent local committee such as CGLR would thus take charge as a permanent entity to coordinate with and receive technical support from national level institutions, even though that support would only complement local experience-based support mechanisms. In summary, establishing local inter-institutional coordination mechanism and accumulating community disaster experiences may be two fundamental actions for experience-based local risk information development.

Local Sustainable Development Perspective

This book found that overall a long-term sustainable development perspective was a prerequisite condition for incorporating climate hazardous risk into development planning. This finding was observed at both national and local levels. In Chapter 3, it was found that Costa Rica's national government has established a long-term sustainable development policy perspective, incorporating the context of climate hazardous risk in it. Furthermore, Chapter 4 concluded with the finding that incorporating climate hazardous risk into local development planning would demonstrate an achievement of local sustainable development. Although the national government has established a sustainable development policy perspective, municipalities have not yet done so, resulting in little progress in incorporating climate hazardous risk into local development planning (Chapter 4).

The level of governance closest to communities should figure prominently in promoting sustainable development (UNEP, 1992). Moreover, effective local sustainable development planning ensures community-centered long-term benefits for disadvantaged and marginalized impoverished groups (Hasan, 2007; OECD/UNDP, 2002). Local sustainable development planning can effectively combine two development values: the short-term local economy and long-term environmental sustainability, including local DRM (Cutter et al., 2012; Grazi, van den Bergh, & van Ommeren, 2008; Handy, Cao, & Mokhtarian, 2005; IDB, 2013). Sustainable development can minimize consequences of climate hazardous risk (Bulkeley, 2006), and in turn, strategies on climate hazardous risk reduction can enhance social and environmental sustainability (IPCC, 2012). The local development perspective, therefore, needs to shift from short to long term.

In Chapter 4, it was found that communities' accumulating local precipitation data influenced the municipality's agricultural productivity analysis as a basis for the local development planning. This community action was effective for influencing municipality's local decision making; communities' knowledge can influence changes in local development policy perspective from short to long term (Burton, Bizikova, Dickinson, & Howard, 2007; Grothmann & Patt, 2005; Maskrey, 2011; Prabhakar et al., 2009; UNISDR, 2009a, 2011; Wolf, Adger, & Lorenzoni, 2010).

Chapter 5 described national institutions including MIDEPLAN, CNE, and MINAET, the institutions that have experience in national level preparation of sustainable development planning, helped the municipalities in preparing local sustainable development plans. Convincing local stakeholders to participate in sustainable development planning requires energy, knowledge, and a greater budget (Chapter 4). Because national institutions have limited capacity to attend to all municipalities, only limited support was provided. It was additionally found that municipalities took a long time in their local development planning. Therefore, municipalities should require long-term, but limited support from national institutions. National institutions' technical support may include working physically with a municipality, ensuring access and appropriate transfer of various rights, and providing sufficient time for the process (Ribot, 2003). CGLR might become a permanent counterpart that obtains national institutions support. Additionally, it was found that national legislative reform could encourage municipalities to establish a long-term sustainable development perspective. Costa Rica's Urban Planning Law, which requires all municipalities to prepare a development plan, thus would need to be updated to support municipalities' long-term sustainable development planning.

everal local cities in neighborhood countries of Costa Rica are beginning to develop local sustainable development planning and embedding DRM in it (IDB, 2013). Sustainable city initiatives have recently been proposed in Latin America by some international organizations, with local experiences being accumulated (IDB, 2013; McKinsey & Company, 2012; UNEP, 2012; UN-Habitat, 2012; University of Oregon, 2012). Worldwide sustainable local development planning experience is additionally accumulated by the International Council for Local Environmental Initiatives (ICLEI), a non-profit network of more than 1,200 local governments (ICLEI, 2012). These experiences can serve as a reference for Cartago and other municipalities of Costa Rica to learn its effectiveness of sustainable local development planning. In summary, communities' local knowledge, national organization's limited support with legislative reform, and learning experiences of neighborhood or worldwide countries may be possible measures for having long-term local sustainable development policy perspective.

Community-Identified Priorities

Chapters 2 and 4 revealed that the municipality's implementation capacity was too weak to achieve multiple measures necessary for local climate hazardous risk reduction. Local government's lack of experience and its human resource capacity limitation are permanent constraints for developing countries to implement local climate hazardous risk reduction measures (UNISDR, 2012). DRM progress has been limited to only research and policy development rather than implementation (UN/DESA, 2010). The real challenge of incorporating climate hazardous risk reduction in development is not planning but implementation practice (Biesbroek et al., 2010; Krysanova et al., 2010; Tompkins et al., 2010).

Chapter 4 demonstrated that certain municipalities did conduct small climate hazardous risk reduction measures. These small measures occurred only when municipalities identified a few priorities and performed small but necessary actions. Therefore, this book suggests municipalities focus on a limited number of self-identified priorities with effective means of implementation, rather than multiple local measures for reducing the risk.

How does a municipality identify a few feasible priorities? The World Bank (2008) explains that identifying appropriate local priorities requires bridging supply and demand sides so that local governments can prioritize community needs. When the community accurately identifies their priorities, skillful planning and implementation can occur (O'Brien

et al., 2012). This method may also engage communities in taking responsibility for implementation and its outcomes, thus ensuring participation in the implementation effort (University of Kansas, 2012).

Indeed, the result of the household survey revealed that communities in Cartago wanted to learn how to prepare for the increasing hazardous risk independently. Facilitating community learning opportunity is a key component of climate hazardous risk reduction (Armitage, Marschke, & Plummer, 2008; Lonsdale et al., 2008; O'Brien, O'Keefe, Meena, Rose, & Wilson, 2008; O'Brien et al., 2012; Pahl-Wostl et al., 2007). Provision of community learning opportunities should thus become a priority in Cartago. CGLR would lead this initiative, and in Chapter 5, a unique instance of such an effective learning opportunity was identified: the project facilitator installed a pluviometer in the upper riverside in an agricultural community, and provided only a one-day seminar on its use. Using this simple equipment, a volunteer family recorded daily precipitation for more than ten years continuously. This family perceived negative effects of climate change on agriculture and independently changed to raising more adaptable crop species. In combination with their perception of negative effects of climate change, business benefits of improved crop production motivated them to long-term daily volunteer behavior. "Learning by the community members themselves," "a small but daily and long-term learning process," and "enjoyable, or beneficial for daily productivity or social activity" may be key concepts for community-identified effective means of implementation.

Willingness- and Trust-Based Community Actions

This book revealed that communities have taken few DRR measures because of various constraints, despite their higher awareness of climate hazardous risk. Even communities in wealthy countries have limited experience to archive and sustain DRR measures (Ford & Ford, 2011; Moss et al., 2010). Cartago is a city in a developing country, where majority of interviewees stated that their income was average or below (Chapter 6). This book's fundamental subject was the increasing low intensity but frequent climate hazardous events and the need to combat them. Communities will be more vulnerable due to the increasing climate hazardous impacts (Patt, Klein, & Vega-Leinert, 2005; Patt et al., 2009). Therefore, communities will increasingly require sufficient DRR measures to combat local climate hazardous risk.

In Chapter 6, measures already taken by communities to combat climate hazards were identified. These included small but efficient interventions that also served other purposes to improve the quality of their daily lives, such as waterproof roofs or windows. Local risk management has traditionally dealt with extreme events without the climate change context (Cutter et al., 2012). In contrast to planning for conventional low-frequency but high-intensity hazardous events, low-technology measures will fit more on high-frequency but small-scale climate hazardous events.

This book additionally found that these small-scale, low-technology measures could generate positive results for the community solidarity because, as a non-economic incentive activity, it accepts all types of participants, including poor, elderly, women, and children, and reduces conflict among communities (Chapter 2). Chapter 5 revealed that radio communication equipment provided to poverty communities for early flood warnings also served other purposes including daily communication among communities, and they felt privileges owing it. Community DRR activity is thus a meaningful investment for sustainable social development from the local government perspective. This finding agrees with that of Cardona et al. (2012), that is, community DRR measures can provide positive impact in the context of poverty reduction, livelihood improvement, natural resource management, and community development.

Increasing high-frequency but small-scale climate hazardous events represents an opportunity to encourage communities to take DRR measures. The key concept is apparently the "willingness" that community members expressed in this book, including their willingness to learn DRR measures, participate in DRR projects, and assume community leadership to implement DRR projects (Chapter 6). The relationship between the communities' sense of willingness and their ability to empower themselves was additionally identified – majority of those who wanted to help their neighborhood stated that they had already taken DRR measures independently. The sense of willingness increases communities' ability to participate, cooperate, organize, and interact over long term (Cavaye, 2004). Communities' feeling of willingness, observed in Cartago, thus presents an opportunity for independently implementing DRR measures.

In Chapter 6, it was found that several individuals indicated their willingness to assume leadership responsibility in participate community DRR projects. Identifying community leaders is the first priority for DRR, particularly in long-term measures (Moser & Ekstrom, 2010; O'Brien et al., 2012). Such individuals may also support those who have not begun taking DRR measures – a volunteer family in an agricultural community in the

Cartago upper river basin said that they felt proud in helping the poorer, lower river basin Dique area (Chapter 5). Of the four communities surveyed, the Dique area exhibited the greatest gap between awareness of climate disaster risk and DRR measures (Chapter 6). Therefore, as Wisner et al. (2004) suggests, community empowerment should be applied to groups whose voice may not be heard or who are more vulnerable.

In Chapter 2, it was found that young people could share information through social communication networks within a community. Creating and maintaining a network for sharing best practices of those who have begun taking DRR measures will help others share and develop common solutions (Cordaid & IIRR, 2011; Crabbé & Robin, 2006). Networks within communities can further promote communication by engaging advocates in promoting preventive behavior (Weibel, 1988).

In Chapter 5, it was found that external organization voluntary visits simply to chat or listen to communities' daily living concerns considerably encouraged communities to engage in long-term DRR measures. External organizations' weekend voluntary visits to project communities occurred only once or twice a year, involving simple conversations with communities, but thereafter, the community trusted them, felt honored to participate in DRR efforts, became willing to participate, and so continued to undertake such efforts over a longer period. A high level of trust in partnerships between communities and external actors can characterize sustainable community DRR efforts (Bicknell, Dodman, & Satterthwaite, 2009; Gero et al., 2011; Pelling, 2010; Pelling & Wisner, 2009; Petal, Green, Kelman, Shaw, & Dixit, 2008; Sagala, Okada, & Paton, 2009). In sum, a willingness- and trust-based approach is crucial for continuous community DRR measures. Social capital capacity development and school education may be effective actions that can realize a willingness- and trust-based approach.

SUMMARY

This chapter analyzed the gaps, challenges, and opportunities that resulted from the progress of incorporating a climate hazardous risk in development planning and practice in three aspects (risk identification and awareness, development policy framework, and development practice) at three levels (national government, municipalities, and communities). On the basis of these analyses conducted, four areas of potential factors, addressing all the gaps and challenges, were identified. These are the experience-based, local

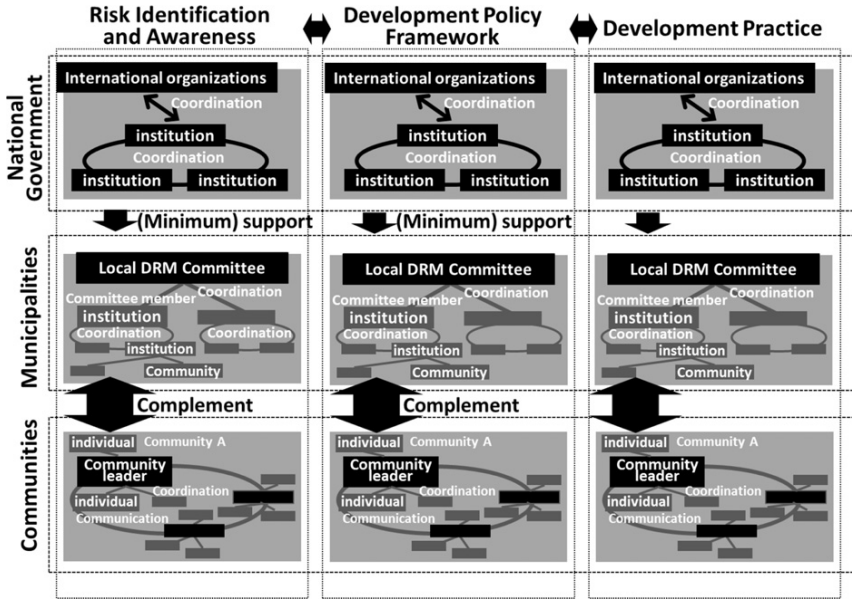

Fig. 3. Model for Enhancing Local DRM Capacity in the Context of Increasing Climate Hazards.

disaster risk information development, the local sustainable development perspective, the community-identified priorities with effective means of implementation, and the willingness- and trust-based community actions for DRR. Furthermore, this chapter discussed the additional actions that should be necessary for achieving these four factors. These four areas of potential factors, as well as additional actions are illustrated in Fig. 3.

CHAPTER 8

CONCLUSION

ABSTRACT

This final chapter responds to the key question of this book and concludes the results of the study, with a brief implication for future studies.

Keywords: Local disaster risk management; increasing climate hazardous impacts; elements for enhancing the local development capacity; opportunity for sustainable local development; Costa Rica

Overall aim of this book was to discuss for effective approaches to enhance the developing countries' local DRM capacity to combat the increasing impact due to climate hazardous events. In so doing, this book raised the two fundamental questions; one was what the roles of national and local governments were for effective local DRM performance in a changing climate, and other was what the community actions were for complementing municipality's DRM capacity.

Effective DRM should require a system-wide approach, including all national, local, and community levels that make up each DRM system (Lavell et al., 2002; O'Brien et al., 2012; UNISDR, 2011), thus, this book used a 3×3 matrix as a framework for analyzing gaps, challenges, and opportunities that resulted from the process of incorporating climate hazardous risk in development planning at three levels (national government, municipalities, and communities). Applying this framework, the book used two methodologies to find answer to the two fundamental questions. One was the checklist that assessed the current progress made in terms of the incorporation of climate hazardous risk in development planning. The other was the household surveys that analyzed whether communities' climate change perceptions and actions did complement the local DRM

capacity. A series of case study were conducted in Costa Rica, including in Cartago, where the number of climate disaster events has rapidly increased since the late 1990s.

DRM capacity should not just the surface expressions of risk, but should address the shared root causes of exposure and vulnerability to hazards (Wisner, 2011). Additionally, DRM requires a balanced portfolio of approaches that capture local knowledge, proactive behaviors, and governmental and nongovernmental initiatives that will prove most successful in managing an increasing climate hazardous risk (Cutter et al., 2012). This book carefully conducted with these fundamental characteristics of DRM and finally, found the following four elements that can enhance the local DRM capacity in the context of changing climate:

- *Local climate disaster risk information*. This is necessary for municipalities as a reference for local development planning. This information should not always be high-technology scientific-based digital information, because communities' perception of climate change and awareness of local disaster risk, experienced in their daily lives, can be important inputs for that. A permanent communication space between municipality and communities is effective for the municipality's understanding of climate hazardous risk by getting inputs from communities. Local inter-institutional coordination mechanism is additionally important to share and gather each local institution's broader risk information.
- *Long-term sustainable development policy perspective*. This element was found as a prerequisite to allow incorporating climate hazardous risk into development planning. Sustainable development perspective can minimize negative effects of climate hazardous risk and in turn, this can strengthen social and environmental sustainability. Effective local sustainable development planning ensures community-centered long-term benefits especially for disadvantaged and marginalized impoverished groups. Communities' local experience and knowledge can influence municipality's understanding related to the importance of local sustainable development. National legislative reform should be an effective means of implementation to support the local initiative. Experiences of the municipalities in the other region of the world that already adopted the idea of local sustainable development planning, can serve as a reference for the developing countries to learn its effectiveness.
- *Municipality's focus on a limited number of priorities*. Local actions should be implemented only in a limited number of self-identified priorities with feasible and effective means of local measures, rather than

multiple local measures given or supported by external organizations. This is because the municipality's implementation capacity is too weak to achieve, administrate, and maintenance multiple measures. To identify a limited number of feasible priorities, municipality should understand communities' priorities and needs from daily conversations. Additionally, communities should accurately identify their priorities in their daily lives. Community learning by its members themselves and a small but daily and long-term learning process in their enjoyable daily productivity or social activity should be key concepts for communities' ability for identifying their development priorities.

- *Communities' willingness and trustfulness*. This will increase communities' ability to implement local DRR measures in a long-term. External organization's voluntary visit, even though only a few times a year, will considerably encourage communities' willingness for their continuous DRR activities. This will contribute to enhance local DRM capacity to combat the increasing impact due to climate hazardous events. Small-scale, low-technology measures will fit on the risk reduction at the community level. These measures can additionally generate positive results for the community solidarity.

The first chapter of this book raised an assumption that the initiative of CCA would provide an opportunity to enhance local DRM capacity. However, this book did not identify the explicit evidence of this assumption. Instead, this book found that climate hazardous events itself motivates the communities' climate change perception and local disaster risk awareness; this makes community consciously or unconsciously to reduce its negative impacts and thus this seems to be an important point that differences from conventional DRM approach mainly focuses on low-frequency but high-intensity disasters. Climate hazardous risk itself is a threat for municipality and communities on one side, but on the other side, dealing with, or reducing this daily threat can be an opportunity for further successful and continuous implementation of community daily activity for DRR. Local and national stakeholders should take into consideration this emphasis.

In the decade of 1990s, international organizations have started to make great efforts for having worldwide consensus of sustainable development. A symbolic event was the United Nations Conference on Environment and Development (Rio de Janeiro Earth Summit) in 1992, and its earmarked product was the Agenda 21. After that, in the decade of 2000s, mainly after the World Summit on Sustainable Development (WSSD) taken place in

Johannesburg, South Africa in 2002, the subject sustainable development was increasingly incorporated into many countries' development agenda, but still at the national level. Thus, the findings of this book would additionally imply that the decades of 2010 and 2020 can be a decade for mainstreaming sustainable development in local development agenda. Increasing small but frequent climate hazardous events and communities' actions to combat the negative impacts from these daily events would be an opportunity to accelerate this implication.

This book has met some limitations. Chapter 6 identified that the context of social capital is one of the important factors for having greater community DRR actions. This seems to be an important element to involve a variety of social activities, including DRR, within a single community development agenda primary for better quality of, and safer community daily lives. However, since community's social capital was beyond the scope, this book did not examine this point; therefore, further analysis will be necessary for further in-depth analysis.

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