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Pathways for adaptive and integrated disaster resilience

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Abstract:

The world is experiencing more frequent, deadly and costly disasters. Disasters are increasingly uncertain and complex due to rapid environmental and socio-economic changes occurring at multiple scales. Understanding the causes and impacts of disasters requires comprehensive, systematic and multi-disciplinary analysis. This paper introduces recent multidisciplinary work on resilience, disaster risk reduction (DRR), climate change adaptation (CCA) and adaptive governance and then proposes a new and innovative framework for adaptive and integrated disaster resilience (AIDR). AIDR is defined as the ability of nations and communities to build resilience in an integrated manner and strengthen mechanisms to build system adaptiveness. AIDR provides the ability to face complexities and uncertainties by designing institutional processes that function across sectors and scales, to engage multiple stakeholders and to promote social learning. Based on the review of existing academic and non-academic literature, we identify seven pathways to achieve AIDR. These pathways are a conceptual tool to support scholars, policy makers and practitioners to better integrate existing DRR strategies with CCA and more general development concerns. They describe institutional strategies that are aimed at dealing with complexities and uncertainties by integrating DRR, CCA and development; strengthening polycentric governance; fostering collaborations; improving knowledge and information; enabling institutional learning; self-organisation and networking; and provision of disaster risk finance and insurance. We also examine the implications of these pathways for Indo- nesia, one of the most vulnerable countries to natural hazards and climate change impacts. Our findings suggest that there is an urgent need to commit more resources to and strengthen multi-stakeholder collaboration

at the local level. We also argue for placing the community at the centre of an integrated and adaptive approach to DRR and CCA.

Keywords: Integrated disaster resilience, resilience, disasters, climate change, Indonesia, pathways, adaptive governance

1. Introduction

The increasing recognition of global environmental changes and risks has lead to calls for greater consideration of increasing uncertainties and complexities (UNEP 2012). Com- plexity arises when a problem lacks transparency, is comprised of many variables with significant connectivity, and there is a time delay between causes and impacts (Frensch and Funke 1995). Uncertainty is related to human's incomplete knowledge of complex prob- lems which leads to an inability to predict future dynamics (Berkes 2007) or the likelihood and impact of a decision (Milliken 1987). Addressing these complexities and uncertainties requires an integrated analysis of human–environment or social–ecological systems (SES) (Holling 2001; Turner et al. 2003).

The International Disaster Database (EMDAT–CRED) shows that, while the number of fatalities caused by disasters has decreased significantly in the past century, the number of people affected and the socio-economic effects have increased significantly (EMDAT 2012). The impacts of disasters are socially and environmentally interconnected (Adger 2006; O'Keefe et al. 1976; Wisner et al. 2004). Disasters are becoming more complex and uncertain due to the complex interactions between increasing populations, poorly planned urbanisation and economic development, environmental degradation and climate change (UNEP 2007; UNISDR 2011a; WEF 2012). Increasing population and urbanisation lead to more people living in high-risk areas, while increasing economic development has increased economic exposure to disasters (World Bank and United Nations 2010).

Integrated approaches to complex environmental problems have long been discussed in literature, particularly in environmental and resource management focusing in particular on water (e.g. Huntjens et al. 2011; Pahl-Wostl 2008), coastal (Cicin-Sain 1993), marine and protected areas (Pollard and du Toit 2008). The need for integrated approaches has also been recognised in disaster studies. Scholars such as Paton and Johnston (2006), Klinke and Renn (2011) have examined and advocated for more integrated approaches to DRR. This involves considering not only the frequency and magnitude of hazards, and the geophysical processes that create them, but also understanding the causes of vulnerability, resilience and impacts across SES. This approach is multidisciplinary, using both the natural and social sciences, and takes into account different temporal and spatial scales, multiple sectors and stake- holders, as well as expert and local knowledge (Wisner et al. 2012). However, much work remains to be done to determine how an integrated approach to DRR can best be advanced (IDRC 2012;

Klein et al. 2003; Paton and Johnston 2006). In particular, challenges exist in identifying appropriate pathways to better integrate DRR with related policy areas, par- ticularly climate change and development (United Nations 2010, 2012b).

An emerging approach to increase the ability of societies to cope with, and adapt to, such risks is to increase the overall adaptiveness of the SES (Lebel et al. 2006).

Adaptiveness refers to the ''capacity of a social actor or social–ecological system to adapt in response to, or in anticipation of, changes in the environment'' (Lebel et al. 2010, p. 333). Increasing the adaptiveness to deal with future complexities and uncertainties has been extensive discussion of this concept across a range of literatures, particularly envi- ronmental management (e.g. Brooks et al. 2005; Gallop´ın 2006; Holling 1978; Nathan 2011; Pahl-Wostl 2009; Smit and Wandel 2006). However, calls to increase system adaptiveness within the DRR literature are much more recent and most are theoretical and normative in nature (e.g. Tompkins et al. 2008; Wamsler and Lawson 2011). There are very few studies (e.g. Amendola et al. 2008; ICSU 2008; IRG 2010) of DRR strategies that are aimed at increasing system adaptiveness in practice.

The concepts, methods and a comprehensive knowledge base for integrated and adaptive approaches in DRR concerned with global environmental change are not yet well developed. Responding to this research gap, we argue that there is a need for an analytical tool that allows for a systematic examination of the links between environmental, social and economic changes and risks in SES and the influences of uncertainties and com- plexities on current efforts to reduce such risks. Our research questions are as follows: (1) What factors make DRR approaches more integrated and adaptive? (2) What are the pathways to achieve an integrated and adaptive approach to building resilience? and (3) How can a country such as Indonesia that is highly vulnerable to disasters implement these pathways in practice?

We present our analysis in three stages. First, we briefly review the current state of knowledge on adaptive approaches and integrated approaches to manage social–ecological systems in DRR. This informs our conceptualisation of adaptive and integrated disaster resilience (AIDR). Second, we develop and present a new and innovative framework that integrates the concepts of resilience, DRR, climate change adaptation (CCA) and adaptive governance (AG). We explain the key factors and processes included in the framework. Building on the definition of disaster resilience by the United Nations International Strategy for Disaster Reduction (UNISDR) (2009b), we define AIDR as the ability of communities or nations to build resilience to disasters in an integrated, systematic and adaptive manner. Integration and system adaptiveness are the two underlying principles. Integration relates to the linking of DRR with climate change and development and the synergies between the different pathways for AIDR. Adaptiveness is concerned with the need to develop institutional mechanisms within an SES that are able to deal with uncertainties and complexities of current and future disasters. Third, we identify and describe seven pathways for AIDR. They are

intended as strategies to assist policy makers, practitioners and scholars to reorient current DRR approaches to be more integrated with climate change and development and provide a conceptual underpinning to better under- stand and respond to complexities and uncertainties.

An important aim of our analysis is to examine the implications of the pathways for countries that are highly vulnerable to disasters. To do this, we focus on Indonesia as a case study because its strong progress in DRR has recently been highlighted (UNISDR 2011c) and because the country is highly vulnerable to a range of natural hazards (UNU-EHS 2012) and climate change impacts (Maplecroft 2012). Our research indicates that despite considerable advances in establishing adaptive and integrated approaches to DRR at the international and to a lesser extent national level, progress has been much slower at the local level. We provide important insights for policy and practice by proposing strategies for implementing AIDR in Indonesia based on the proposed seven pathways. Our findings are based on an extensive review of the academic literature across several related disci- plines that has documented the range of adaptive and integrated approaches that draw concepts of vulnerability, resilience, DRR, CCA, ecology, environmental governance and management. We have also reviewed organisational reports and information related to experiences in policy and practice to inform our analysis of the progress and challenges of the proposed seven pathways for AIDR. The literature on Indonesia is sourced from journal articles and reports published by the Indonesian government and other organisations engaged in activities relating to DRR, CCA and development.

2 Adaptive and integrated analyses in DRR

In the DRR literature, the importance of integrated analysis has long been considered. Vulnerability research draws on an integrated approach since understanding vulnerability requires an analysis of exposure, sensitivity and adaptive capacity and the interaction of physical and social characteristics and processes in the creation of disasters (Alexander 1993; O'Keefe et al. 1976; Timmerman 1981; Wisner et al. 2004). The changing paradigm of DRR from hazard to vulnerability assessment, from natural science to integrated natural and social science and humanities, from single to interdisciplinary, and from relief and recovery to preparedness and prevention also demonstrates a growing trend of integration (Alexander 1997; Christoplos et al. 2001; Henstra and Gordon 2005; McEntire 2001; Pelling 2003).

The nature of hazards and risks are also constantly changing (WEF 2012) and are more complex and uncertain than in the past (Renn 2008). Natural and man-made hazards might occur at the same time (Okada et al. 2011), and hazards occurring at one scale can have unexpected and profound impacts at different scales (Cosgrave 2007). The consequences of today's actions or inactions in DRR are likely to be felt in the short and long term (Mechler 2003). Such insights have lead to increasing calls to create institutions that are more adaptive and thus better able to accommodate uncertainties and complexities (Ahrens and Rudolph

2006; Carren˜o et al. 2007; O'Brien et al. 2008).

Many suggestions have been put forward to improve the integration and adaptiveness of current DRR efforts, and many are driven by concerns over climate change (Birkmann et al. 2011; Heltberg et al. 2009; Schipper and Pelling 2006; Thomalla et al. 2006). For example, Wisner et al. (2012) argue that DRR should be undertaken across multiple sectors and scales, include actions that are both top down and bottom up, be informed by the assessment of knowledge ranging from the present and short term to centuries past as well as projections into the future, and that it requires dialogue between experts with scientific knowledge and people with local knowledge. Klinke and Renn (2011) propose the concept of adaptive and integrated risk governance and define it as the ability of creating institutional settings that are able to resolve cognitive, evaluative and normative problems and conflicts in responding to risks, relating to complexity, scientific uncertainty and social–political ambiguity. Birkmann (2012) similarly suggests that adaptive DRR requires a multi-hazard approach, the consideration of changes in time and spatial scales of DRR, and an evaluation of the adaptiveness of DRR measures. While each of the above proposals is unique in approach, they notably share a common emphasis on fostering adaptiveness in DRR through sup- porting decision making in dynamic environments, increasing the role of knowledge to inform learning processes and the need for resilient risk-governing institutions.

Other scholars have focused on integrated approaches within specific issues in DRR such as mitigation (Delladetsima et al. 2006), knowledge (Jonkman et al. 2008; Mercer et al. 2009), governance (Cash and Moser 2000; May and Plummer 2011) and post-disaster recovery (Chang et al. 2011; Sudmeier-Rieux et al. 2011). Some studies have shown that a lack of integration has increased vulnerability in coastal communities (Duxbury and Dickinson 2007; Pelling and Manuel-Navarrete 2011) and urban areas (Birkmann et al. 2010). The relevance of the work presented in this paper is the importance of systemati- cally assessing and preparing for risks across the spectrum of DRR issues.

Concurrent with these developments in the academic literature, there have been notable emerging global policy initiatives to examine natural hazards and other risks in an inte- grated and adaptive manner. These include the Integrated Risk Governance (IRG) Project (IGRP 2010), the Integrated Research on Disaster Risk (IRDR) Project (ICSU 2008) and the Integrated Framework for Disaster Management (IDRIM) (Amendola et al. 2008; Ikeda 2004). The IRG Project focuses on improving understanding disasters within an integrated social–ecological system, the dynamic patterns of agents and their learning, and how to strengthen institutional capacities when dealing with catastrophic or complex disaster events (IGRP 2010). Similarly, the IRDR focuses on the characterisation of hazards, vulnerability and risks, understanding decision making in complex and changing risk contexts, and reducing risks and losses through knowledge-based actions (ICSU 2008). IDRIM's goal is to promote an overall improvement in the quality of community safety and security through integrated disaster planning and management, that is, proactive, anticipatory and precautionary approach to

risk, adaptive management, comprehensive policy and bottom-up governance (Amendola et al. 2008; Okada 2009). While each of these developments confirms the importance of integration and adaptiveness in DRR, the sheer novelty of these policy approaches means that there is much scope to improve our understanding of how these goals can be achieved in practice.

3 Towards a new and innovative framework for adaptive and integrated disaster resilience

This section builds on the theoretical development of the integration and adaptiveness in DRR research described above to introduce a new and innovative conceptual framework for AIDR (see Fig. 1).

A major task in developing a new framework is the integration of different conceptual analyses addressing specific aspects into a meaningful whole (Pahl-Wostl 2007). There are three layers within this framework. The inner layer describes integrated disaster resilience and builds upon previous work of Djalante and Thomalla (2011). The middle layer describes the integration of climate change within DRR strategies, based on work by Djalante (2013b). The outer layer describes the relationships between resilience and AG. It includes four factors relating to AG that facilitate system adaptiveness (Djalante et al. 2011). The inner and middle layers are overlaid and then placed in the centre of the outer layer to form the new AIDR framework presented in this paper. We discuss each layer below in more detail.

3.1 Integrated disaster resilience

The inner layer of Fig. 1 describes the conceptualisation of integrated disaster resilience. Integrated disaster resilience calls for the integration of DRR strategies with development while placing the community at the centre of these efforts. Resilience is generally defined as the ability of a system to self-organise, learn and adapt (Carpenter et al. 2001; Folke 2006). In the context of disasters, resilience is understood as the ability of a community or society to resist, absorb, accommodate and recover from disasters timely and efficiently (UNISDR 2009b). The resilience concept received international attention in DRR after the adoption of the Hyogo Framework for Actions (HFA) 2005–2015: Building the Resilience of Nations and Communities to Disasters (UNISDR 2007). DRR offers a systematic and comprehensive method of identifying, assessing and reducing the risks of disaster within disaster management cycle from prevention, mitigation, emergency management to rehabilitation (UNISDR 2007).

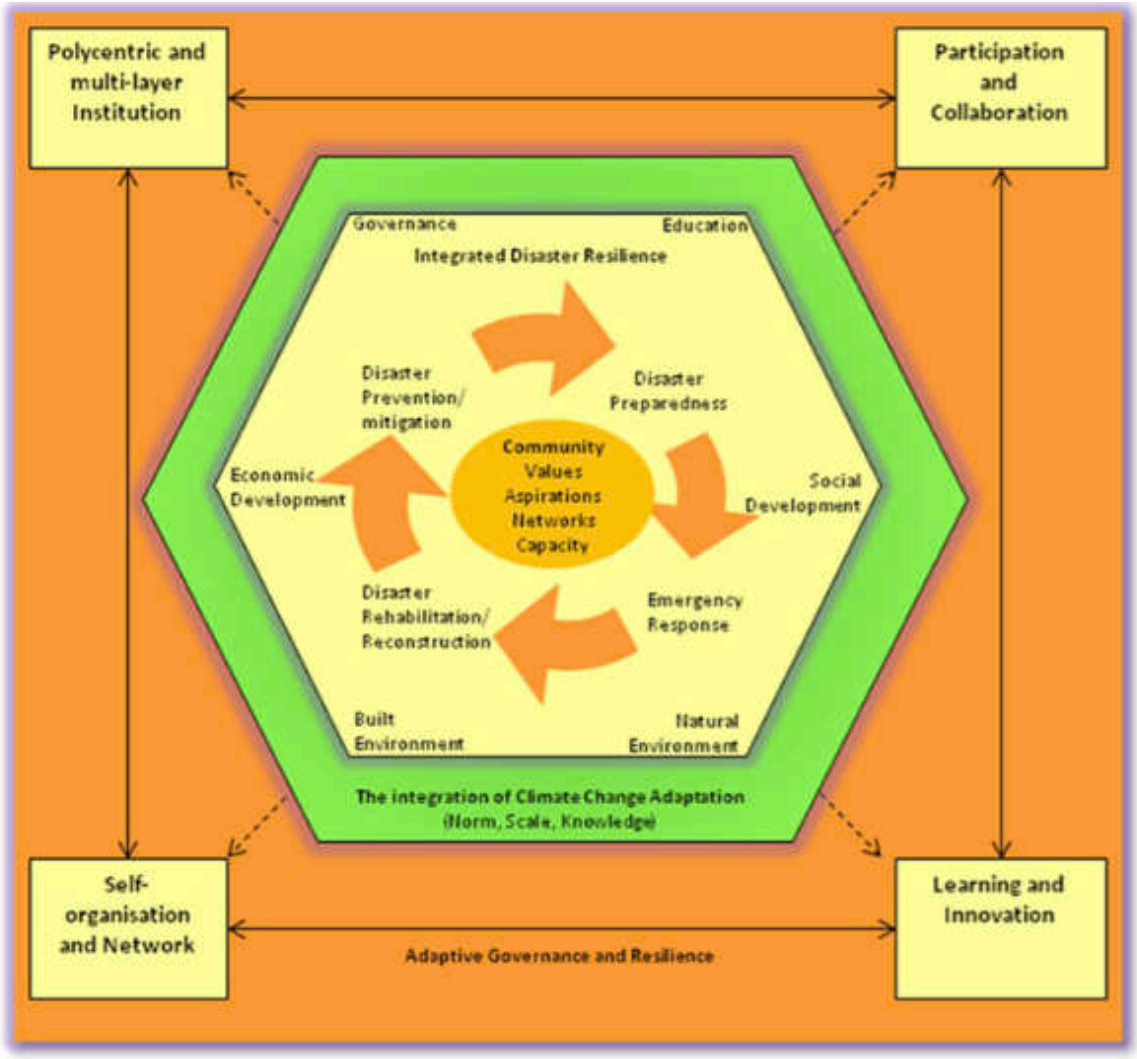

Fig. 1 An adaptive and integrated disaster resilience framework

The conceptualisation of integrated disaster resilience is based on a review of the conceptual development of resilience from its early application in the fields of ecology, psychology and engineering to more recent interpretations and applications in the fields of disaster studies and humanitarian aid. Djalante and Thomalla (2011) argue that the resil- ience concept should be considered both a process and an outcome and identify three important elements of integrated disaster resilience: sustainable development (SD), DRR and community characteristics. The SD components provide a supporting environment for resilience building to take place and represent key elements of development: governance and institutions; education, awareness and capacity building; social and economic devel- opment; the built-environment (physical infrastructure); and the natural environment (ecosystems). In the context of disasters, effective resilience building activities need to target the different stages of DRR (risk knowledge, mitigation, preparedness and emergency management, and recovery and reconstruction). In all of these efforts, the community needs to be considered as an active agent of change because disaster effects are locally determined and context-specific (Djalante and Thomalla 2011).

3.2 Integrating DRR and CCA

The middle layer of Fig. 1 describes the integration of DRR, development and climate change. It shows the importance of considering climate change issues in the context of all factors influencing resilience. The Intergovernmental Panel on Climate Change (IPCC) defines CCA as ‘‘an adjustment in natural and human systems in response to climatic stimuli and their effects in order to reduce harm or obtain benefits’’ (IPCC 2001, p. 869). In its Fourth Assessment Report, the IPCC stated that the frequency, variability and intensity of hydro-meteorological hazards are likely to increase due to climate change (IPCC 2007). It is therefore crucial that there are strong synergies between the goals, strategies, frameworks, measures, tools, methods and funding mechanisms of DRR and CCA (IPCC 2012b). The recent IPCC Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Adaptation (SREX) suggests that to increase resilience, diversification and a combination of incremental and transformational changes are needed to reduce vulnerability to current and future climate extremes (IPCC 2012b).

Djalante (2013b) proposes that climate risk considerations should be integrated with the three key components and processes for building resilience, SD, DRR and the community. This integration can also take place in the different spheres of norms, scale and knowledge (Birkmann et al. 2011; Birkmann and von Teichman 2010). For example, for the SD component, an integration of norms can take place by improving exchanges, links, mechanisms and agreements between key development sectors that are highly sensitive to hazard and climate change impacts, such as agriculture, health, public works and infra-structures. For the DRR component, DRR and CCA can be integrated by providing knowledge on vulnerability and risk assessments for DRR and CCA, as well as developing an early warning system for both slow- and sudden-onset hazards linked to climate change. For the community component, integration can take place by enhancing local knowledge by considering climate change implications on local risk profiles or providing community- centred climate services (Djalante 2013b).

3.3 Adaptive governance and resilience

The outer layer of Fig. 1 describes the characteristics of AG that can help to increase system adaptiveness to future uncertainties and complexities. AG is characterised by notions of governance that are more flexible and innovative and that encourage learning to better manage uncertainties and system complexities (Brunner et al. 2005; Dietz et al. 2003; Folke et al. 2005). AG derives from three major areas of work: adaptive management (Holling 1978; Lee 1993), cooperative management (Olsson et al. 2004) and collaborative governance (Holley et al. 2011; Ostrom 1990, 2000).

Four key characteristics can significantly influence disaster resilience: polycentric and multi-layer institutions, participation and collaboration, self-organisation and networks, and learning and innovation (Djalante et al. 2011). While other characteristics of gover- nance also

contribute to resilience (e.g. Ahrens and Rudolph 2006), these four are highly relevant to building disaster resilience and enhancing system adaptiveness. Djalante et al. (2011) argue that polycentric institutions influence the capacity to manage resilience, due to the existence of different organisations at different scales, which allows for a better matching of organisational and ecological scales (Folke et al. 2005), an improved fit between knowledge and action (Lebel et al. 2006), and the moderation of vertical interplay (Young 2002). Participation and collaboration can improve effectiveness and efficiency and reduce uncertainties in managing environmental problems (Lane and Robinson 2009). Self-organisation and networks are important to build resilience especially at the com- munity level (Kendra and Wachtendorf 2003). Agency (Larsen et al. 2011), collective action (Ireland and Thomalla 2011) and social capital (Adger 2003; Pelling and High 2005) are all important in positively influencing the ability to self-organise and build networks and have been shown to increase community adaptiveness to environmental risks (Kithiia 2011). The process of social learning (Lave and Wenger 1991; Scholz and Stiftel 2005) enhances resilience by providing access to knowledge (Ostrom 2010; Pahl-Wostl 2009) and platforms for coordination, negotiation and knowledge sharing (Thomalla and Larsen 2010). The process of inter-organisational learning during emergency situations and stress can lead to innovation (Comfort and Kapucu 2006; Comfort et al. 2004).

The proposed AIDR framework is designed to meet the need for integration through consideration of CCA and development within DRR strategies and to strengthen system adaptiveness through creating institutions and governance mechanisms that are polycentric and participatory and enable self-organisation and learning.

4 Pathways for implementing adaptive and integrated disaster resilience

In this section, we present strategies to implement our conceptual AIDR framework in practice. We propose seven pathways (Table 1) that are intended as guidance to researchers, policy makers and practitioners on how existing DRR strategies can be better integrated with CCA and development efforts and how institutions in DRR can be better designed to deal with the complexities and uncertainties arising from a range of envi- ronmental changes and risks.

In the following sections, we define and describe each pathway in more detail, explain how each pathway relates to the AIDR framework, how it addresses integration and/or strengthens system adaptiveness, and identify the relationships between the pathways. Following this, we undertake a global review of current developments on initiatives and activities conducted by organisations working on DRR, CCA and development. These provide the rationale for selecting the pathways as important strategies with which to build resilience and system adaptiveness in DRR using an integrated approach. We conclude by discussing each pathway in the context of Indonesia, focussing on documenting current progress and challenges, and identifying strategies that would help Indonesia to improve its progress along the pathways for AIDR.

4.1 Pathway 1: integrate DRR with CCA and development strategies

This pathway addresses the inner and middle layers of the AIDR framework which places development, DRR and the community at risk at its core and advocates the integration of DRR and CCA. This integration is vital for successful and sustainable DRR. Climate change, disaster management and international development are key areas where an interdisciplinary and integrated approach is needed (McBean 2011; Schipper and Pelling 2006). Reducing losses of weather- and climate-related hazards, meeting development objectives, as well as developing successful CCA approaches can be only be accomplished in an integrated manner (Cannon and Mu¨ller-Mahn 2010; Thomalla et al. 2006). DRR is essentially a development issue since least developed countries tend to be the ones most vulnerable to disasters (UNU-EHS 2012).

Table 1 Seven pathways for adaptive and integrated disaster resilience

Focus	Pathways for adaptive and integrated disaster resilience
Integrated agendas	1. Integrate DRR, CCA and development strategies
Governance	2. Strengthen polycentric governance architecture for DRR
Sectoral integration	3. Increase and coordinate cross-sectors and multi-stakeholders collaborations
Information management	4. Improve knowledge and information through comprehensive and systematic assessments of hazards, risks, vulnerability and impacts
Institutional learning	5. Facilitate institutional learning from implemented policies and experiences
Self-organisation and networks	6. Encourage and nurture self-organisation and networking
Finances and risk	7. Develop comprehensive disaster risk finance and insurance using a broad set of private and public instruments

The interlinkages between these agendas have been acknowledged in various global activities by the UN organisations, international development agencies and international finance institutions. Natural hazards and climate change are part of the thematic areas and cross-sectoral issues within the sustainable development framework (United Nations 2012a). Addressing poverty and improving livelihoods are frequently the focus of this integration (ADB et al. 2011; Few et al. 2006; IISD 2003; Kok and de Coninck 2007; Mitchell et al. 2010; O'Brien et al. 2006; UNISDR 2009a, 2011a, b; World Bank 2011a, b). Benson and Twigg (2007) note that mainstreaming includes awareness raising, cre- ating an enabling environment, developing tools, training and technical support, changes in operational practice, measuring progress and learning and sharing experience. Overall, there has been considerable progress in such mainstreaming. Many countries have acknowledged DRR and CCA issues within their development planning, including the Philippines (RoP 2009) and Indonesia (GoI 2010). International funding institutions, humanitarian aid and development agencies increasingly include DRR and CCA in their operations [e.g. AusAID (2013a); USAID (2012)], and tools for assessing climate and disaster-related activities in development programmes have been developed (Klein et al. 2007; Olhoff and Schaer 2010). This progress has largely occurred at the global level and now needs to be further advanced at the national and sub-national levels.

4.1.1 Implications for Indonesia

The strong progress at the global level has brought positive influences to the integration of DRR strategies in countries vulnerable to hazards and climate change impacts, including Indonesia. International agencies, non-government organisations (NGOs) and other stakeholders increasingly acknowledge the importance of integrating DRR and CCA within pre-existing development strategies and programmes. The appointment of the President of the Republic of Indonesia, Susilo Bambang Yudhoyono, as the Global Champion for DRR (UNISDR 2011c) and a member of the High Level Panel of eminent persons on the Post-2015 Development Agenda (United Nations 2012d) has created momentum for stronger integration in the country. At the national level, natural hazards and climate change are recognised as one of the nine development priorities in the current mid-term development plan (GoI 2010). Djalante et al. (2012) observe that key government stakeholders such as Bappenas (the development agency), BNPB (national disaster management agency), the Ministry of Environment and DNPI (climate change council) all acknowledged the importance of these linkages. However, many challenges remain at the local level. For example, Djalante et al. (2012) find that the experience in the two local governments of Kendari and Makassar show that addressing disaster risk is considered less important than addressing other priorities such as poverty reduction and economic development. There is a considerable gap between DRR planning and implementation in that there remains a strong focus on emergency management and post- disaster response, rather than preparedness and risk reduction through improved devel- opment and other social economic strategies (Kusumasari and Alam 2012; Lassa 2011). Lassa (2011) suggests that recurrent and frequent disasters, as well as a current lack of capacity for DRR, makes it especially difficult for local governments to develop and implement DRR policies in an integrated fashion and to place the community at the centre of the strategies.

In our view, strategies to facilitate a better integration of these issues should include the training of local stakeholders in development planning (that integrates DRR and CCA), the implementation of more resilience building projects through local governments and NGOs (funded from higher level agencies) that are also embedded with development and the provision of incentives for local integrated approaches to DRR.

4.2 Pathway 2: strengthen polycentric governance architecture for DRR

This pathway describes the outer layer of AIDR that focuses on polycentric governance. It relates to the governance component of integrated disaster resilience (inner layer). Ostrom et al. (1961) use the concept of polycentric governance system to describe the traditional pattern of government in a metropolitan area with its multiplicity of political jurisdictions. McGinnis (1999) characterises it through the existence of various kinds of governing authorities at different governance scales. Creating a polycentric structure is important for AIDR because it is the catalyst for enabling other pathways. It increases system adap- tiveness

by enabling scale matching between different social and ecological scales (Folke et al. 2005), improves the fit between knowledge, action and societal processes (Lebel et al. 2010), increases opportunities for learning (Ostrom 2010) and collaboration (Folke et al. 2005) and allows the pooling of knowledge (Berkes and Folke 2002).

There are currently 5,134 organisations worldwide engaged in DRR, including gov- ernment agencies, NGOs, international organisations and private sector (UNISDR 2012d). These operate at different scales of governance (Lassa 2011) which suggests a high level of polycentricity. An important recent development is the existence of transnational muni- cipal networks (Bulkeley and Betsill 2005) such as the Climate Resilient Communities (ICLEI 2012), the Resilient Cities Network (UNISDR 2012b), United Cities and Local Governments (2013) and Local Leadership for Climate Action (UN-HABITAT 2011), all of which actively promote resilience and adaptation amongst their members.

We suggest that to increase system adaptiveness, polycentric structures need to be strengthened by diverting resources and decision making power over the use of resources to local governments and communities since they are most affected by disasters (Cosgrave 2007), tend to be the first responders, provide safeguards for people and infrastructure, are the coordinators between stakeholders and have the best local knowledge of hazards and vulnerability (King 2008). Strengthening the capacity of local actors involves increasing human capacity, mobilising resources and engaging relevant public/private organisations, providing financial and technical support and building local leadership (Kusumasari et al.

2010).

4.2.1 Implications for Indonesia

Indonesia has recently undergone a major transformation in DRR most importantly through the formation of BNPB (National Disaster Management Agency) and the Disaster Man- agement Law 24/2007. A polycentric governance arrangement is now established and is marked by the presence of 786 organisations officially involved in different aspects of DRR (OCHA 2012) at different scales of governance (Lassa 2011). Despite these positive developments, there is an urgent need to further bolster polycentric arrangements by improving the capacity of local stakeholders. Institutional capacity varies widely between national and local governments and also within the local governments. Studies on DRR on some local governments reveal a lack of capacity to implement DRR; a low understanding of the importance of strategies to integrate DRR and CCA into development; a lack of financial resources to implement integrated approaches; competing agendas of poverty reduction and local economic development; and a focus on post-disaster management (Djalante et al. 2012; Lassa 2011). Chang-Seng (2010) argues that polycentric institutions build resilience by providing support for development of tsunami early warning system technology and increased national government capacity for planning and operation. He also highlights a need to develop local capacity in operationalising the warning system and strengthening responses

and evacuation. Spahn et al. (2010) add that strengthening the institutional capacity of local government is also needed to ensure the sustainability of the tsunami early warning system.

The roles of multiple stakeholders are increasingly recognised and their efforts are significant at the local level. National and international NGOs represent more than half of the organisations working in DRR in Indonesia (OCHA 2012). The availability of resources (financial and technical) and the ability to disburse them quickly, experience working with communities and more flexible institutional structures enable NGOs to respond more quickly and effectively than more rigidly structured and sometimes less resourced governments agencies (Acosta et al. 2011; UNISDR 2006). There is a great potential for increasing the role of NGOs in Indonesia through better coordination to avoid overlaps, increase synergies, improve trust and collaboration between local governments and NGOs and recognise NGOs' efforts in local policy formulation and planning.

4.3 Pathway 3: increase and coordinate cross-sectoral and multi-stakeholder collaboration

This pathway describes the outer layer in the AIDR framework relating to the collaboration characteristics of AG. It also relates to the middle layer of the framework since collabo- ration between sectors working on DRR and CCA is important. This pathway is closely related to Pathway 1 on integrating DRR with CCA and development since cross-sectoral collaboration is the key to ensure that integrated DRR is achieved. This pathway is also related to Pathway 2 on polycentric governance, since strong multi-stakeholder collabo- ration can increase redundancies of polycentric structures, which in turn increase system adaptiveness to future complex problems (Ostrom 2010). This pathway seeks to capture the processes within the DRR architecture. Collaboration is characterised by processes in which various stakeholders pool their resources to solve shared problems or dilemmas (Shaw and Goda 2004). This is important in building system adaptiveness to future changes and complexities since it creates mechanisms to increase redundancies.

Sectoral integration between agencies has received significant recognition in interna- tional DRR strategies (UNISDR 2009a, 2011b). The HFA Mid-Term Review states that sectoral integration is of concern at the national level where agencies in DRR, CCA, development and environment still work in silos and hence sectoral fragmentation exists widely (UNISDR 2011b). This calls for over-arching authority at a government level which can set policies, drive the process and ensure budget allocations for all different aspects of DRR (UNISDR 2011b). A more promising collaboration seems to take place at the local level where networks work together to build resilience in new and innovative ways. Examples are the Asian Cities Climate Change Resilience Network (2012), the Coastal Cities at Risk Network (2012) and Climate Resilient Cities (World Bank 2009a). Common characteristics of these initiatives include the collaboration between different stakeholders, funding and technical expertise by international organisations and imple- mentation through local institutions (universities and NGOs). They also frequently involve conducting hazard, risk and vulnerability assessments,

collaboration with local government agencies to support disaster and climate change planning, and capacity building of local actors.

4.3.1 Implications for Indonesia

There is urgent need for better sectoral collaboration in Indonesia. Despite the recognition of the importance of integrating DRR and CCA within national development planning, collaboration between sectoral agencies involved is not yet significant (Djalante 2013a; Djalante and Thomalla 2012). Bappenas, UNDP and the World Bank play crucial roles in this integration (Djalante and Thomalla 2012). Bappenas facilitates national integration through development planning (GoI 2004). UNDP and the World Bank are involved in the financing, planning and operations of DRR, CCA and development (UNDP Indonesia 2007, 2012; World Bank 2009b). Better coordination is required to achieve more com- prehensive DRR efforts in mitigation, emergency management, recovery and reconstruc- tion. Flood management is an example where considerable overlaps of mandate hamper coordination and collaboration. The management of watershed and catchment areas is under the Ministry of Forestry (MoF 2010), water resources and flood protection is under the Ministry of Public Works (MoPW 2010), emergency management for flood hazard is overseen by BNPB (GoI 2008b), and the Search and Rescue Office can also be involved during disaster emergency (Basarnas 2012). These blurred lines of responsibility between these various agencies cause significant confusion and inaction, which in turn hinder collaboration and lead to poorly integrated DRR. Sectoral coordination and collaboration is better at the local level because the structures and mandates are not as complicated as those at the national level. While there are 34 ministerial agencies (GoI 2009), local government structure is developed based on local needs (GoI 2004) and is hence simpler. Bappeda (local development planning), BPBD (local disaster management) and the environment department play an important role in supporting integration and collaboration at the local level (Djalante 2013a; Djalante and Thomalla 2012).

In our view, better coordination is needed so that overlaps of mandates do not lead to a vacuum of responsibility or to a shifting of blame. Strategies to increase collaboration could include provision of financial and other incentives, the showcasing of innovation in practice that has arisen through the pooling of knowledge and resources, and the creation of umbrella organisation responsible for coordinating the activities of different stakeholders.

4.4 Pathway 4: improve knowledge and information through comprehensive and systematic assessment of hazards, risks, vulnerability and impacts

This pathway describes the outer layer of the AIDR framework which focuses on learning and knowledge. This pathway relates to the inner layer on education, and the need for improved knowledge in the risk mitigation stage of the DRR cycle. It also addresses the core of the framework, which is the inclusion of the community and its own knowledge in the assessments of hazards, risks, vulnerabilities and impacts. Comprehensive assessments also need to take account the interlinkages between DRR, CCA and development (Pathway 1) and

foster cross-sectoral collaboration in order to integrate different types of knowledge (Pathways 2 and 3). By diversifying the sources and processes in the production of knowledge, it is more likely to be more accurate, relevant and appropriate.

A considerable amount of research on knowledge of hazards, risks, vulnerabilities and impacts has been undertaken, and a multitude of different assessment methods exists (PreventionWeb 2012a). Several recent initiatives aim to implement comprehensive and systematic assessments; these include the Earth System Science Partnership (Leemans et al. 2009) and the Future Earth initiative (Future Earth 2012). Data for such assessment are provided by the Global Framework for Climate Services (WMO 2012) and the Emergency Database (EMDAT 2012). Other data portals, online platforms and commu- nities include WeADAPT (2012), PreventionWeb for DRR (2012b), World Bank Data (2012), United Nations Data (2012c), the IPCC data distribution centre (2012a) and the Global Risk Information Platform (2013). Information is increasingly presented in the form of dynamic and interactive Internet-based reports (UNEP and UNISDR 2012) that are available to anyone, and indigenous knowledge is increasingly recognised and acknowl- edged in CCA (IPCC 2007) and DRR (UNISDR 2008). These developments represent a positive and innovative change towards the provision of knowledge. A lot of knowledge is now freely available (Currion et al. 2007), easily accessible from the Internet (Birney et al. 2009), presented in a more interactive and dynamic form, customisable and more user friendly (Bullinger et al. 2002). Previously, many hazard and risk assessments were copyright protected, had to be purchased and were presented in a form not easily under- stood. Data are no longer produced exclusively by universities, research institutes and government agencies, but also increasingly by NGOs, Civil Society Organisations (CSOs) and the private sectors (e.g. Germanwatch 2012; Maplecroft 2012). These changes have the potential to increase the role of different types of knowledge in informing decision making (Kates et al. 2001), in being more relevant in practice and in improving communication to the general public (Vogel et al. 2007).

4.4.1 Implications for Indonesia

The majority of documented data on Indonesia are accessible from global database. The challenge is to make them more accessible for Indonesian stakeholders and more appli- cable within their operational contexts. Notable progress on government-led data provision includes the Indonesian Disaster Database (DIBI) (BNPB 2012). Some recent studies (e.g. DESDM et al. 2012a, b; OCHA-ROAP 2011; Yusuf and Francisco 2009) represent a positive step in the provision of hazard information since they were conducted collabo- ratively between international and Indonesian agencies, and the results were distributed free of charge through the Internet. However, many of these assessments are still ad hoc in nature rather than being planned systematically across Indonesia. Djalante et al. (2012) review the country's progress in implementing the HFA and observe that data on hazards, risks and vulnerabilities tend to reside within certain organisations without being available to others.

In our view, research agendas for DRR need to be developed that identify existing research on hazards and better integrate a range of other changes and risks, including climate change. A data platform is needed in which data from all relevant government authorities are collected and are made accessible to other stakeholders. There is also a need to strengthen collaboration and networking between research agencies and universities, nationally and internationally, local governments and communities, to provide compre- hensive data that can be utilised to inform decision making for resilience and climate adaptation. Finally, Indonesians have traditionally lived in the coastal areas, and knowl- edge of how traditional communities survived earthquakes or tsunamis needs to be better documented and utilised.

4.5 Pathway 5: facilitate institutional learning based on implemented policies and experiences

This pathway describes the outer layer of the AIDR framework, which focuses on the learning characteristics of AG. It also relates to the importance of education in integrated disaster resilience of the inner layer and to the need for learning in the different stages of the DRR cycle. The relationships with the other pathways can be described as follows: diversity in learning can be facilitated by a polycentric governance system (Pathway 2), while cross-sectoral collaboration (Pathway 3) can enable and strengthen learning pro- cesses. The availability of knowledge (Pathway 4) is both a prerequisite and a result of learning. Learning is crucial to ensure adaptiveness, because it enables feedback on current policies and strategies which can help to revise existing or create new strategies (Pahl- Wostl 2008).

Theories of learning include social learning (Bandura 1977), organisational learning (Argyris and Schoen 1974), situated learning (Lave and Wenger 1991) and institutional learning (Folke et al. 2005). Bandura (1977) states that learning occurs from experimenting with the environment. Wenger (1998) proposes ‘communities of practice’, in which stakeholders share their concerns and interact through practice to advance knowledge. In organisational management, Argyris and Schoen (1974) propose a theory of learning called ‘double-loop learning’ (in contrast to ‘single-loop learning’), which calls for changes in the underlying values and assumptions. Single-loop learning refers to routine learning, whereby small adjustments are made in response to errors. Double-loop learning involves changes to protocols and norms when errors are detected (Argyris 1976), and triple-loop learning involves fundamental changes within management or governance processes (Keen and Mahanty 2006).

For the purpose of this paper, we consider all of these definitions within the concept of institutional learning. The occurrence of institutional learning has been shown to help increase disaster resilience and improve system adaptiveness (Gunderson 2010; Gupta et al. 2010) by reducing information uncertainty, empowering stakeholders in choosing appropriate resilience strategies, reducing conflicts and improving fairness of decisions and actions (Lebel et al. 2010). The process of learning is also important in the disaster recovery phase because it enables critical reflection on the appropriate interventions for transforming

a recently disturbed system into a more resilient state (van Oudenhoven et al.

2011). In her research on organisational learning during crises and disasters, Comfort (1985, 1994, 2005) suggests that continual inquiry, informed action and adaptive learning is a more flexible and robust strategy rather than command and control practices.

Suggested strategies to improve learning in DRR include a 'Transition and learning- zone', in which single-loop learning used in the conventional disaster management cycle is replaced by double-loop learning in which resilience building is approached by conducting institutional review and focussing on pre-disaster planning (O'Brien et al. 2010). A 'Shared-learning-dialogue' (Reed et al. 2011; Tyler and Moench 2012) is a stakeholder deliberation and learning processes in which different actors, knowledge and perspectives are deliberated and negotiated in order to achieve a common understanding, build trust and enable responses to different interests. A 'Scenario-based learning' involves the discussion of sets of scenarios of different hazards, exposures and vulnerabilities (Tsubokawa et al. 2008). Finally, learning by communities and local organisations can be facilitated by strengthening leadership, creating opportunities for dialogue and providing incentives for learning (Marschke and Sinclair 2009).

Boyd and Osbahr (2010) observe how organisations learn to consider CCA issues within a development programme and identify the following challenges: incorporating scientific uncertainties into planning, scaling up climate information based on local experiences, a lack of local knowledge of the system, an inability to process new scientific knowledge and limited resources (time and money).

4.5.1 Implications for Indonesia

Despite the recognised importance of learning and the abundance of literature on social learning, our impression is that institutional learning in Indonesia focuses more on out- comes than processes. Most publications on disasters in Indonesia report on the lessons learnt from disasters (Cosgrave 2007; Josef 2007; Schiller et al. 2008), not on how learning processes could be improved (e.g. Corbacioglu and Kapucu 2006; Moore et al. 2009). O'Brien et al. (2006) observe that lessons learnt (from DRR) are rarely incorporated into wider governance processes. Rather than critically reflecting on the underlying causes of disasters, the focus tends to be on how to better respond to anticipated risks.

Moving from single- to double-loop or transformative learning is critical in building resilience. A rare example in which double-loop learning occurred is the ACCCRN project in Semarang and Bandar Lampung. In this project, a 'shared-learning-dialogue' (SLD) was conducted through which the local governments from the two cities collaborated in developing a hazard and vulnerability assessment (ACCCRN 2012). But even here, the learning was driven by external stakeholders, and it is unclear to what extent the results from the SLD influenced the two local governments in developing their climate resilience policies. Another approach is to develop complex, but locally contextualised, disaster scenarios (e.g. a high magnitude

earthquake, coinciding with an extreme flood, a high tide and/or a terrorist attack) for a major city like Jakarta. Learning could be strengthened amongst local actors, governments and NGOs, through the use of such scenarios. Com- munity learning can take place in the context of efforts aimed at increasing public awareness and education (IFRC 2011) if these initiatives are conducted in a way that promote self-reliance (YEU and GN-DRR 2009), include local training opportunities (e.g. community-based disaster risk management, search and rescue, first aid) (ADPC 2008; YEU and GN-DRR 2009) and prioritise disaster preparedness activities at the community level (James 2008). For such initiatives to be effective, they need to be participatory (Pelling 2007), utilise locally accepted methods, have relevance to local needs and pri-

orities (YEU and GN-DRR 2009) and employ popular social media (Shankar 2008).

4.6 Pathway 6: encourage and nurture self-organisation and networking

This pathway describes the outer layer of the AIDR framework. It is relevant to stages of disaster risk management and usually involves communities at risk (inner layer). The relationships with the other pathways can be described as follows: networking can be facilitated by a polycentric governance system (Pathway 2), while cross-sectoral collaboration (Pathway 3) can strengthen self-organisation and networking. Networks are closely interlinked with knowledge/information (Pathway 4) and learning (Pathway 5) and to facilitate transformational processes for AIDR. Self-organisation is interpreted as a process by which a group of people organise themselves to pursue a common cause (Humphrey 2000). A network is a self-organised, usually informal system of governance that contains multiple actors that relate together to focus on common problems (Folke et al. 2005).

Networks can be utilised to buffer perturbations or shocks (Folke et al. 2002) or to deal with more complex problems at larger scales (Berkes 2009). In practice, networks tend to involve boundary organisations (Guston 2001), bridging organisations (Brown 1991) or epistemic communities (Folke et al. 2005). A boundary organisation is an arena for actors to reach a common understanding (Corfee-Morlot et al. 2011), for example, a forum for sci- entists and decision makers (Guston 2001). A bridging organisation is similar to a boundary organisation but has a broader scope of issues (Brown 1991), for example, an assessment team composed of different actors in a particular social–ecological system (Garmestani et al. 2008). An epistemic community is comprised of different actors with similar interests, in a formal collaboration or co-management structure of shared authority (Folke et al. 2005).

The UNISDR has developed networks of organisations working in DRR called Multi-Stakeholder Platforms (MSPs) for DRR (UNISDR 2012e). There is the Global Platform, 5 regional MSPs and 78 National MSPs (UNISDR 2012a). There are also local level MSPs and Thematic Networks based on the HFA on warning, hazard assessment and recovery networks/platforms. Djalante (2012) examines the roles of these MSPs and finds that while higher level MSPs tend to have more resources, local level MSPs have more direct impacts in

building resilience locally.

Comfort (1994) states that in the DRR context, communities need sufficient flexibility and capacity for self-organisation to manage their own risk, and hence, efforts are needed to invest in building community capacity for rapid and effective self-organisation. The availability and dissemination of information is the key to building the capacity for self-organisation. It requires a system that allows the exchange of accurate and timely information, as well as giving feedback to participants and revising actions based on new information (Comfort 1994). Building a community's capacity for rapid transition in the event of a disaster is fundamental to effective disaster response. Documented cases of self-organisation focus more on network reorganisation during the emergency stage of DRR. For example, in Japan, communities reorganised them- selves in the wake of the Kobe earthquake, and neighbourhoods with stronger community involvement and organisations reportedly coped and recovered better (Bajek et al. 2008). A study on inter-organisational reorganisations in the wake of the September 11 attack in the United States shows that the capacity for network coordination depends upon the availability of information to support decision-making processes (Comfort and Kapucu 2006). These exam- ples demonstrate that self-organising networks can be critical during emergency periods and that the availability and flow of information to affected communities and organisations working in the emergency situation is crucial to foster an effective network and response.

If community self-organisation can be strengthened and maintained over a longer period of time, it can be an opportunity to initiate institutional change for coping with and increasing adaptiveness to future hazards and climate change impacts (McSweeney and Coomes 2011). Goldstein and Butler (2009) give an example of such institutional change within the United States Fire Learning Network (FLN). In this case, the ongoing fire threat became a driver for the FLN to engage in 'collaborative, landscape-scale ecological fire restoration'. The FLN extended its engagement processes, innovated through the use of technology and media (thereby enhancing information flow and access) and developed imaginary scenarios for future fire hazards. Goldstein and Butler (2009) state that these processes helped to create another cycle of innovation in collaboration which in turn helped to reform fire management institutions and fire-adaptive ecosystem in the US.

4.6.1 Implications for Indonesia

Despite the recognised importance of self-organisation and networking in building resil- ience, very little research has been conducted on these issues in Indonesia. Indonesia has established its National Platform for DRR and has two MSPs, in Yogyakarta and Padang (Djalante 2012). There are also the Indonesia National Network as part of the World Eco- nomic Forum Disaster Resource Partnership (APEC 2011a, b) and the Disaster Management Partnership Network of engineering and construction companies (UNISDR 2012c). How- ever, it is not clear how they contribute to DRR activities. Two examples of self-organisation at the

community level following emergency situations include Jalin Merapi (Merapi information network) and Padang community radio. Jalin Merapi was formed during the Merapi eruption in 2006 by three community radio stations in the area (Jalin Merapi 2012). In 2010, following another eruption, the network expanded to include NGOs and community- based organisations (CBOs) from the neighbouring Central Java province and to link to the Yogyakarta DRR platform (Jalin Merapi 2012). Information on the extent of damages, evacuations processes and community conditions onsite was distributed not only through radio, but also through a website, Twitter and Facebook, SMS, telephone and volunteers in the field. The Padang community radio was formed after the West Sumatera earthquake in 2009. Because of a perceived lack of the ability of the government to handle the emergency, four community radio stations in Padang city formed a network to provide information to the public on evacuation places and routes (RKPS 2012).

These examples show that community-based networks are able to form and self-orga- nise within a short time-frame in response to hazards and that they are able to connect with more formal networks for DRR. While more research is needed to understand how such forms of self-organisation are initiated and maintained and how they contribute to disaster resilience, it is clear that such networks play an important role in building resilience and opportunities to foster them should be a strategic goal. Existing community networks should be strengthened by connecting them with other strategic networks such as the HFA thematic networks (UNISDR 2013) and by enhancing their continuity and sustainability and relevance through targeted resources and assistance.

4.7 Pathway 7: develop comprehensive disaster risk finance and insurance through private and public instruments

The provision of adequate financial resources is an important economic factor of integrated disaster resilience (inner layer of AIDR framework). The financing for DRR and CCA needs to be better integrated (middle layer) and calls for greater collaborations of multiple stakeholders (outer layer). This pathway is strongly influenced by all other pathways. Funding for DRR can be potentially sourced from CCA and development funding (Path- way 1). The existence and collaborations of organisations within the DRR polycentric governance can help pooling of funding (Pathways 2 and 3). Improved risk assessment can help to facilitate design of the financial and insurance instruments (Pathway 4). Learning from successful funding schemes in one place can be replicated in other places (Pathway 5), and especially at the community level, micro-finance can be sourced through self- organisation and networks of affected communities (Pathway 6).

The diversification of financial resources from private and public instruments is vital to deal with complexities and to anticipate uncertain impacts from hazards and climate change. The global economic losses from disasters are enormous, totalling US$ 3.5 trillion in the last three decades and weather-related disasters account for US$ 2.6 trillion of the losses (GFDRR

2012b). Increasing population and economic growth, and the growing impacts of climate change, can be expected to increase the costs of disasters in the future (Bouwer 2011; Tol 2003).

The current debate on the financing of CCA focus on the calculation of the contributions to be made by countries to global adaptation financing mechanisms and the separation of adaptation from traditional development funding (Ayers and Huq 2009; Bouwer and Aerts 2006; Huq and Burton 2003; Kelly and Adger 2000). Klein (2010) compares the benefits of stand-alone and mainstreamed adaptation and states that calculating the 'new and additional funding needs' may be easier in stand-alone adaptation, but this can involve higher administrative costs and be in conflict with development. Klein (2010) argues that mainstreamed adaptation has the potential to bring more efficient and effective development, but this would require reorganisation within the current Official Development Assistance (ODA) funding.

The United Nations Framework Convention on Climate Change (UNFCCC), through the Copenhagen Accord and Cancun Agreement calls for developed countries to support the transition of developing countries to low carbon futures through the provision of 'new and additional' finance from public and private, bilateral, multilateral and alternative sources, of US$ 100 billion annually by 2020 (UNFCCC 2009). The Climate Policy Ini- tiative (CPI 2011) observes an imbalance between the funding allocated for climate change mitigation and adaptation, US$ 93 billion of US$ 97 billion are used for mitigation while adaptation only receives US$ 4.4 billion.

In stark contrast to the billions available for CCA in the near future, there is very little international commitment for DRR funding. As Thomalla et al. (2006) describe, the little funding available for DRR usually comes from national civil defence/emergency respon- ses, international humanitarian funding (for instance, UN Office for the Coordination of Humanitarian Affairs (OCHA)), multilateral banks and bilateral aid. The Global Facility for Disaster Reduction and Recovery (GFDRR) is one of the largest sources for DRR funding. The total amount contributed to the GFDRR fund in 2012 was around US$ 322 million (GFDRR 2012a). Given the relatively small amount of DRR funding available, and the availability of considerably larger amount of CCA funding, it is of little surprise that many organisations have been reframing their projects accordingly (Ireland 2010)— the question is to what extent these projects represent business as usual in DRR, rather than genuinely attempting to incorporate CCA considerations.

Development programmes represent another opportunity, where funding for DRR can be accesses through development assistance. To date, this source of funding has been relatively small—the GFDRR (2012b) reports that since the 1980s, only 2 % of total worldwide development assistance (US$ 91.2 billion) has gone to disaster-related activities. Of this, almost 70 % has gone to emergency response, 25 % to reconstruction and rehabilitation, and

the rest to prevention and preparedness. Mainstreaming DRR into development programmes means that a higher proportion of development funding might be accessible for DRR in the future.

Another potential but more controversial source of financing for DRR is insurance. Although the use of insurance as a risk reduction mechanism remains contentious, Kun- reuther (1974, 1996) has long advocated for insurance as an important tool for hazard mitigation. Kunreuther and Pauly (2006) suggest a comprehensive insurance scheme with four layers, from the international to the household level. For example, the Caribbean Catastrophe Risk Insurance Facility (CCRIF) is a risk pooling facility financed by a multi- donor trust fund of regional financial institutions and 16 member countries (CCRIF 2012). Successful examples at the national level are the Turkish Catastrophe Insurance Pool and the Mexican government national catastrophe relief and reconstructions fund (Linnerooth- Bayer et al. 2005). These show collaboration in risk sharing, involving international, regional and national organisations, governments, private insurers and NGOs, and are able to create synergies and positive results, through pay outs after disasters. At the local scale, schemes include local government and private markets by insurance companies. At the individual level, Wamsler (2007) suggests index-based insurance, micro-insurance (Suarez and Linnerooth-Bayer 2010) or targeted transfers (such as workforce and employment guarantee schemes) offered by local governments or NGOs.

Linnerooth-Bayer et al. (2005) suggest that the donor community have enough under-standing (through modelling and estimates) to be able to help low-income and at-risk nations and communities to cope with potential economic losses of disasters by providing assistance prior to disasters occurring. They add that insurance schemes should be coupled with preventive measures. This way, 'donor-supported risk-transfer' would give a mutual benefits to funder and recipients by leveraging limited disaster-aid budgets and freeing recipient countries from being highly dependent on post-disaster assistance.

4.7.1 Implications for Indonesia

Disaster risk reduction funding for Indonesia is generated from a multitude of sources such as national and local government development annual budgets (GoI 2004) and also from international organisations and NGOs (GoI 2008a). The net official development assistance and official aid received reached almost US$ 1,393 million in 2010 (Indexmundi 2013). In 2005, Indonesia received the highest ever ODA of US$ 2,534 million just after the 2004 Indian Ocean tsunami (Indexmundi 2013). Unfortunately, we could not find the percentage of this fund that is allocated for DRR. The donor providing the largest amount, Australian Aid, gave AU$578.4 million (2012–2013) with 4 % allocated to humanitarian aid and disaster response (AusAID 2013b). Indonesia is one of GFDRR priority core countries (GFDRR 2013a). There have been more than US$ 7 million made available since 2007, with 96 % for DRR mainstreaming and recovery (GFDRR 2013b). Losses from disasters have cost Indonesia $US24 billion

accumulatively, almost all from the result of earth- quakes/seismic activities (EMDAT 2013). The country's post-disaster response budget reached approximately US$ 76.4 billion between 2004 and 2010 (World Bank and GFDRR 2011). The annual economic impact of natural disasters is estimated at 0.3 % of GDP and the impact is even larger at sub-national and local levels (World Bank and GFDRR 2011). These increasing disaster losses suggest that countries and organisations need to find more optimal, achievable and affordable mechanisms for financing (Linnerooth-Bayer et al. 2007).

There is some progress in developing comprehensive disaster risk finance and insurance in Indonesia, at least in planning stages. The World Bank and GFDRR (2011) suggest six options for disaster risk financing strategies, for the short, medium and long term. In the short term, Indonesia needs to develop financial disaster risk assessment tools (option 1). Option 2 is to develop a national disaster risk finance strategy in the form of a three-tier insurance: parametric insurance and catastrophic bonds for high risks, contingent credit for medium risks and contingent budget for low risk. Option 3 is to establish a National Disaster Reserve Fund (NDRF) to ensure rapid disbursement of post-disaster financing. In the medium term, Indonesia could establish disaster risk insurance for public assets (option 4). The next option is to promote property catastrophes risk insurance of private dwellings. Finally in the long term, Indonesia needs a Joint Disaster Reserve Fund for Local Gov- ernments (option 6) (World Bank and GFDRR 2011).

In summary, improved stakeholder collaboration and public–private partnerships (Linnerooth-Bayer and Mechler 2007) are crucial strategies to reduce losses. DRR financing and insurance in Indonesia should take place across all levels of governance. Indonesia also needs to utilise multiple sources of funding, including international agen- cies, donor organisations, the reallocation of current national and local development budgets, and private entities and NGOs (Linnerooth-Bayer et al. 2005).

5 Conclusion

We have achieved the aims of the study by, first, proposing a new and innovative framework for AIDR; second, identifying seven pathways for implementing AIDR; and third, examining the implications for Indonesia. The causes and impacts of disasters are expected to become more complex and uncertain and understanding them requires com- prehensive, systematic and multi-disciplinary analysis. Through a systematic analysis of the links between resilience, DRR, CCA and AG, we have developed the AIDR framework as an analytical tool to assist scholars, policymakers and practitioners to determine the important factors contributing to disaster resilience, identify ways to better integrate CCA in DRR and create strategies aimed at increasing system adaptiveness to uncertainties and complexities.

We have outlined seven pathways for AIDR and discussed worldwide progress as to how certain pathways, or elements of them, have been implemented in practice to date. Pertinent for each of these pathways is the need to put the community at risk at the centre of the DRR

strategies and to concentrate resources and attention at the local level. Our first pathway advocated for the integration of DRR, CCA and development, by building on the acknowledgement and progress of DRR, CCA and development integration internationally. The second pathway focused on strengthening polycentric governance and pointed to the high level of polycentricity in international DRR approaches. The third pathway related to fostering collaborations. Our study showed that agencies in DRR, CCA and development and environment still work in silos and work is needed to close such sectoral fragmen- tation. Notably, collaboration seems to be taking place at the local level where networks of cities are working together to build resilience. Fourth was the pathway of improving knowledge and information, where we indentified innovative trends in the provision of knowledge through free, accessible and more user-friendly mediums. For the fifth pathway on enabling institutional learning, we identified several learning techniques that will allow DRR to shift from its current primary practice of single-loop learning approaches. Sixth was the pathway relating to the self-organisation and networking. We identified networks of DRR organisations at different governance levels and argued that self-organisation is a critical process during emergency periods to build community resilience. Seventh and finally was the pathway relating to the provision of disaster risk finance and insurance. We found that there was a large contrast between the amount of funding available for DRR and CCA/development and called for DRR activities to tap those resources. We also discussed how DRR funding and insurance could take place more comprehensively from the inter- national, regional, national, sub-national, local, community and household level.

Having identified the pathways, we then examined the current progress and challenges in building disaster resilience in Indonesia and suggested strategies to align Indonesia's DRR strategies with the seven pathways for AIDR. In our view, it is now time to focus attention and resources at the local level—to actively involve local governments, NGOs and CBOs and to place communities at risk at the centre of integrated resilience building activities. In Indonesia, gaps in capacity have clearly hindered the integration of DRR, CCA and development locally. Preference for reducing poverty and boosting economic development continues to outweigh DRR considerations in local development agendas. Data provision is needed through agency collaboration and increased research capacity. DRR networks especially at the community level also need to be strengthened by con- necting them with other strategic networks and providing more resources and assistance. We found that pathways on learning and financing were the least understood and imple- mented in the country. Community learning needs to happen through increasing awareness and education to increase skills and prioritise disaster preparedness. Research is needed to understand adaptive processes of learning and how it contributes to disaster resilience. Indonesia also needs to utilise multiple sources of funding, which in turn calls for public– private partnerships between international agencies, donor organisations, national and local governments and with private insurers and NGOs.

The pathways are laid out as specific mechanisms to implement the conceptual AIDR

framework in practice and are intended to generate discussion on and further explorations of the processes and trajectories for advancing and transforming (Loorbach 2007; Pelling 2011) current DRR approach to achieve a resilience and sustainable world in general and Indonesia in particular.

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