

Resilience in the context of tsunami early warning systems and community disaster preparedness in the Indian Ocean Region

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This paper discusses insights from post-tsunami early warning system (EWS) development in Thailand, Sri Lanka and Indonesia by analysing selected elements of resilience, based on the Coastal Community Resilience (CCR) framework, and by distinguishing between the cognitive, normative and procedural dimensions of EWSs. The findings indicate that (1) recent calls to develop participatory and people-centred EWSs as promoted by the Hyogo Framework for Action 2005 – 2015 have not been sufficiently translated into action in the implementation of national policies and strategies for early warning; (2) policy and guidance places significantly more emphasis on the procedural compared to the normative and cognitive dimensions of EWSs; (3) practitioners engaged in early warning and disaster risk reduction operate in contexts shaped by multiple stakeholder agendas and face considerable challenges in negotiating diverse needs and priorities; and (4) few platforms currently exist that enable stakeholders to coordinate and reconcile agendas, negotiate joint targets, share knowledge and critically reflect on lessons learnt, and to improve the integration of early warning with other priorities such as livelihoods improvement, natural resource management and community development.

Keywords: community-based disaster risk management; early warning system; Indian Ocean; last mile; resilience

1. Introduction: Linking early warning with communities at risk

Following the 2004 tsunami, the development of the Indian Ocean Tsunami Warning and Mitigation System was initiated at the World Conference for Disaster Reduction in 2005 under the lead of the United Nations Education Scientific and Cultural Organization's Intergovernmental Oceanographic Commission. Initial consultations undertaken by the Stockholm Environment Institute (SEI) with stakeholders in 2008 emphasized that a large number of organizations were engaged in early warning system (EWS) development and community-based disaster risk management (CBDRM) in the region and that considerable knowledge regarding community linkages of the EWS existed. However, concerns were voiced that the technological aspects of

EWS development had been receiving considerably more attention than human aspects such as hazard awareness, disaster preparedness, reconciling priorities in the context of multiple agendas, and motivation and support for CBDRM activities that link with early warning efforts. Even though the importance of addressing community linkages in EWSs is strongly emphasized in current guidance, practitioners face considerable challenges in applying these insights in their operational contexts. Based on these findings, SEI, together with regional partners, conducted a multi-stakeholder participatory assessment to provide a platform for EWS stakeholders, to create an improved understanding of the challenges and enabling conditions for practitioners to implement recommendations and guidance.

In hazard early warning systems (EWSs), the term 'last mile' or 'last kilometre' is frequently

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used to describe the dissemination of a warning of an impending hazard to the largest number of people at risk in the shortest possible time. The development and implementation of effective systems and procedures for the delivery of credible warnings is typically seen as a considerable challenge – so much so that some actors refer to the ‘last 99 miles’ (e.g. Hollister, 2008, personal communication). The term ‘last mile’ has been criticized by some researchers (e.g. Richardson and Paisley, 1998; Twigg, 2003; Lassa, 2008; Kelman, 2009) because it refers to an approach in which the delivery of warnings to the people at risk is the last step in a top-down approach to EWS development. In their view, EWSs should be developed using a bottom-up approach that prioritizes the needs of the communities/users and engages them more actively in the development of the system. In this approach, the interface of the community with the EWS is seen as the ‘first mile’. Others regard this distinction as semantics. Some actors refer to integrated ‘end-to-end’ or ‘people-centred’ EWSs that address all stages of early warning, from hazard detection and warning to community-level response (US-IOTWS, 2007).

The notion of the last mile has been popularized in the Indian Ocean in relation to tsunami EWS development. As a notion, it is understood and interpreted differently by different actors. For example, LIRNE Asia in Sri Lanka regards the last mile as a challenge for rural communities to access media and address this by supplementing traditional media channels for warning dissemination with additional technologies (LIRNE Asia, 2008). The US Indian Ocean Tsunami Early Warning System (IOTWS) distinguishes between ‘upstream’ and ‘downstream’ components of the EWS and identifies education, mitigation efforts, identification of safe areas and development of local decision-making procedures as priorities for ‘last mile’ assistance (US-IOTWS, 2007). Singh Bedi (2006) understands the ‘last mile’ as the capacity of the community to take action in response to a received warning and therefore supports the development of the capacities of local institutions. From the

perspective of policy implementation, it is not relevant to seek a universal definition of the first mile/last mile. Rather, the diversity in interpretations hints at the complexities associated with the links between technology and communities in the development of national EWSs in the Indian Ocean Region and the current challenges associated with improving this link.

After the 2004 tsunami, the United Nations Educational, Scientific, and Cultural Organization’s (UNESCO) Intergovernmental Oceanographic Commission (IOC) received a mandate from the international community to coordinate the establishment of the IOTWS at the World Conference on Disaster Reduction (WCDR) in 2005. The *Hyogo Framework for Action 2005–2015* (HFA) was adopted at the WCDR and recognizes early warning as an effective tool to reduce vulnerabilities, save lives and help protect livelihoods and national development gains, and to improve preparedness and response to natural hazards. The HFA takes on the more critical perspective of the ‘last mile’ in stressing that disaster risk reduction (DRR) must be ‘underpinned by a more pro-active approach to informing, motivating and involving people in all aspects of disaster risk reduction in their own local communities’ through multi-stakeholder and cross-sectoral partnerships (UN/ISDR, 2005, p. 2). One participant concluded that a core message from the WCDR was that ‘to be effective early warning systems must be embedded in, understandable by, and relevant to the communities which they serve’ (Moench, 2005).

The WCDR also saw the launch of the International Early Warning Programme (IEWP) and the formation of the Intergovernmental Coordination Group (ICG). The ICG was formed under the auspices of the IOC to serve as the regional body to plan and coordinate the design and implementation of the IOTWS. The ICG initially established four working groups at the First Session of the ICG/IOTWS tasked with developing the technical plans for the warning system. The discussions of this meeting focused on technology transfer, and two additional working groups, one on risk assessment and the other on

mitigation, preparedness and response, were established at the Second and Third Sessions of the ICG/IOTWS, respectively. In 2005 the United Nations Secretary-General requested a global survey of EWSs with a view to advancing the development of a global EWS for all natural hazards (UN/ISDR, 2006a). The report concluded that while some warning systems were well advanced, there were numerous gaps and shortcomings, especially in developing countries and in terms of effectively reaching and serving the needs of those at risk. Also in 2005, national assessments of 16 Indian Ocean countries were conducted to identify capacity-building needs and support requirements for developing an IOTWS (www.ioc-tsunami.org). The assessments investigated the legal state of affairs and national institutional structures, but did not address issues relating to the 'last mile' (IOC et al., 2005).

As part of the international response to the 2004 tsunami, the US Agency for International Development launched the US-IOTWS Program in August 2005 (US-IOTWS, 2008). This two-year programme aimed to provide technical assistance to the region through an integrated 'end-to-end' approach that addressed all aspects of EWS development from hazard detection and warning to community-level response (US-IOTWS, 2008). The programme included regional, national and local as well as cross-cutting activities encompassing all 28 Indian Ocean countries but focused in particular on Indonesia, Sri Lanka, India, Thailand and the Maldives. The Third International Conference on Early Warning in 2006 emphasized the need to strengthen the IEWP and the Platform for the Promotion of Early Warning (PPEW, 2009) as part of the United Nations International Strategy for Disaster Reduction (UN/ISDR) system, and to develop concrete measures and project ideas to implement the HFA (UN/ISDR, 2006b). A key outcome was the establishment of the Indian Ocean Consortium, a multi-agency consortium that aims to support the development of national components of the IOTWS by fostering coordination mechanisms among governments, supporting implementation of national plans for tsunami warning, and creating

linkages between regional efforts (IOC, 2008). In 2007, 25 out of 28 IOTWS participating countries had established official focal points for disseminating warning information (UN/ISDR, 2007b). In December 2007, the US Government and UNESCO/IOC co-sponsored a forum in Bangkok, Thailand, to review progress and define priorities for future development and sustainability of the IOTWS with national and regional partners at a transition workshop (US-IOTWS, 2008).

Enquiries undertaken by the Stockholm Environment Institute (SEI) and partners in 2008 with regional stakeholders, including the UN/ISDR, the United Nations Development Programme Regional Centre for Asia and the Pacific and the Asian Disaster Preparedness Centre (ADPC), indicated that despite the actions taken so far, there was among policy makers and practitioners at international and regional levels a widespread sense of a lack of implementation on the 'last mile' and the mainstreaming of DRR as promoted under the HFA. Following the typology of Smith (2005), there has been significant investment in two of the three inter-related stages of the early warning process, namely evaluation/forecasting (the scientific and technical dimension) and warning/dissemination (the institutional and political dimension), but little attention to the response (the human dimensions of risk perception and decision making) (see also Hamza, 2006). In 2006, 20 of the 28 IOTWS participating countries lacked response plans for early warning (UN/ISDR, 2006b, 2007b). UN/ISDR stated at that time that 'what needs to be done to address the shortcomings is not a mystery, but has been already laid out in general terms in a succession of documents and meetings over the last decade' (UN/ISDR, 2006a, p. vi). The ICG/IOTWS Secretariat noted that 'for all the progress and improvement at the detection end of the system, the hard reality is that much remains to be done to ensure dissemination of effective warnings and improve the preparedness of communities to respond to such warnings' (Elliot, 2006, p. 5).

The aim of this paper is to explore the links between technology and communities in the

development of national EWSs in the Indian Ocean Region. Departing from the challenges associated with implementing policy for EWSs on the 'last mile', it aims to illustrate how the current challenges of implementing the HFA and national action plans derive from the fact that the critical perspective on the 'last mile' espoused in the HFA is not translated into action.

2. Methodology

2.1. Framework for examining EWS policy implementation

While the end users of early warnings have been subject to a great deal of research, very few systemic enquiries have been conducted into the divergent experiences and priorities of actors in the entire warning chain and how these influence policy implementation. In this paper we depart from the appreciation that early warning and DRR address 'over-determined' problems, that is, problems that are characterized by multiple legitimate perspectives on what constitutes the actual causes of a given risk (Powell and Jiggins, 2003). Because 'outsiders' and 'insiders' measure and describe risk in very different ways (Salter, 1996; Twigg, 2003), in over-determined problem situations, the distinction between risk perception and actual risk loses its justification (Beck, 1992). Just as people in a warning situation do not always respond rationally to warnings (e.g. Buchanan-Smith and Davies, 1995; Thomalla and Schmuck, 2004), EWS implementation is not an entirely rational and logical process. Rather, it consists of a wide range of social and organizational processes that employ technological means to reduce risks and losses (Hamza, 2006). Warning channels can thus be described as chaotic patchworks of communication (Andersen, 2007) that require multiple iterative coordinative actions between agencies, officials and citizens (Rego, 2001; De Marchi, 2007).

The challenge of implementation suggests that existing policy and guidance for early warning cannot fulfil its role if it is treated as a knowledge

prescriptive instrument. Instead, it has to be understood as a process that builds principles for action for communities of practice, creating a 'space of meaning' with theories for action, social change and instruments for implementation (SLIM, 2004). Because each operational context is unique, stakeholders who aim to implement a policy or strategy have to learn their way into this implementation, often with a considerable need for innovation. This places implementation of recommended actions in a 'community of practice', a group of stakeholders who are interacting regularly in a certain manner and with a certain set of values, assumptions and actions (Wenger, 1998).

The approach outlined by the US-IOTWS guide for Coastal Community Resilience (CCR) (US-IOTWS, 2007) can be used to illustrate this

TABLE 1 Resilience elements and desired outcomes (US-IOTWS, 2007)

- | |
|---|
| A. <i>Governance</i> : Leadership, legal framework and institutions provide enabling conditions for resilience through community involvement with government |
| B. <i>Society and economy</i> : Communities are engaged in diverse and environmentally sustainable livelihoods resistant to hazards |
| C. <i>Coastal resource management</i> : Active management of coastal resources sustains environmental services and livelihoods and reduces risks from coastal hazards |
| D. <i>Land use and structural design</i> : Effective land use and structural design that complement environmental, economic and community goals and reduce risks from hazards |
| E. <i>Risk knowledge</i> : Leadership and community members are aware of hazards and risk information is utilized when making decisions |
| F. <i>Warning and evacuation</i> : The community is capable of receiving notifications and alerts of coastal hazards, warning at-risk populations and individuals acting on the alert |
| G. <i>Emergency response</i> : Mechanisms and networks are established and maintained to respond quickly to coastal disasters and address emergency needs at the community level |
| H. <i>Disaster recovery</i> : Plans are in place prior to hazard events that accelerate disaster recovery, engage communities in the recovery process, and minimize negative environmental, social and economic impacts |

point. The framework, developed in a series of workshops with government agencies, non-governmental organizations (NGOs) and individuals, comprises eight elements essential for CCR (Table 1). These elements of resilience incorporate long-term planning and implementation, hazard event-oriented resilience elements and governance, which provide the enabling framework for resilience in all other elements. Risk knowledge is similarly a cross-cutting requirement within each resilience element (US-IOTWS, 2007).

In the CCR, each resilience element is assessed with reference to a benchmark that represents the desired conditions against which the resilience status of a coastal community is evaluated (US-IOTWS, 2007, pp. 3–4). The resilience of the community is evaluated by using selected rating systems to rank the assessment results against these benchmarks, to position the current situation of the community and to suggest plans and means for action.

When investigating policy and guidance for EWS development as a process in which knowledge is jointly constructed by the stakeholders involved, three dimensions can be discerned: cognitive, normative and procedural (SLIM, 2004). These can be expressed in the language of the CCR framework as follows (Figure 1):

1. *Normative dimension*: The identification of the resilience benchmark implies an implicit theory of social change through which to determine what qualities and levels are to be considered desirable for each element.
2. *Cognitive dimension*: The rating of current levels of resilience against the desired and the creation of plans for action depends on the cognitive styles of those involved.
3. *Procedural dimension*: The development and application of means and instruments to move from the current level of resilience

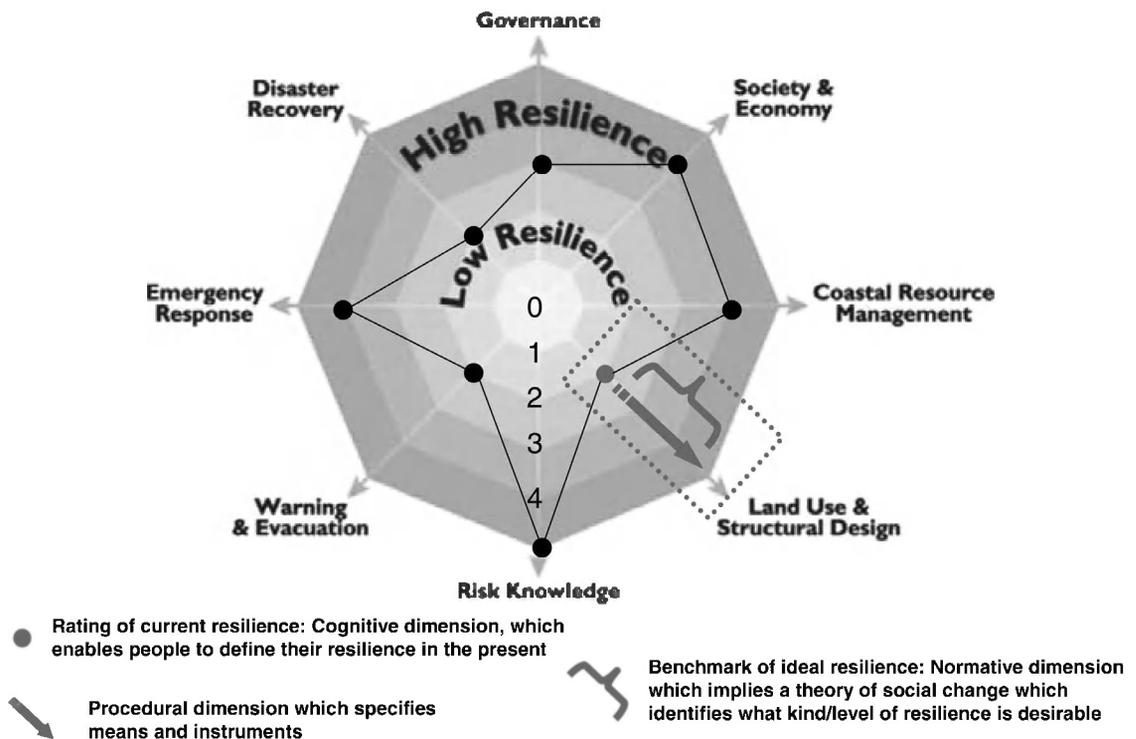


FIGURE 1 Role of normative, cognitive and procedural dimensions of EWS policy, exemplified with the CCR framework
 Source: US-IOTWS, 2007.

towards the desired one are embedded in a process of interaction between stakeholders.

2.2. Stakeholder consultations of last mile implementation experiences

A participatory assessment was conducted in 2008 to provide a platform for stakeholders to jointly create an improved understanding of the challenges and enabling conditions for different actors to implement recommendations and guidance to strengthen technology – community linkages of EWSs (the ‘last mile’). In June 2008, organizations from the region were invited to participate in the assessment through email communication. SEI, in collaboration with ADPC and Raks Thai Foundation (RTF), undertook a series of stakeholder consultations in Thailand, Sri Lanka and Indonesia between July and December 2008. Consultations were held with government agencies involved in disaster management, coastal resource management and community development at different administrative levels, international and national NGOs and community-based organizations (CBOs), and communities at risk from tsunamis and other coastal hazards (Table 2) in order to elicit factors at the national, provincial and district level that contribute to or limit the effective implementation of early warning. This reflects many of the same stakeholder groups that participated in the CCR framework development, and also more local groups and communities.

The following questions guided the research process:

- What is the state of understanding of EWS community linkages (‘last mile’)?
- Why are identified issues for the last mile not being addressed?
- Which conditions enable/hinder stakeholders to implement recommendations in practice?
- Which learning process are organizations going through to be able to implement policy and practice recommendations?

TABLE 2 Participating agencies, organizations and communities in selected case studies in Sri Lanka, Thailand and Indonesia

Sri Lanka

- Disaster Management Centre (DMC), Ministry of Disaster Management & Human Rights
- Ministry of Fisheries and Aquatic Resources
- Coastal Conservation Department (CCD)
- Department of Meteorology
- Sri Lanka Red Cross (SLRC)
- UNDP Disaster Management Program
- IUCN – The World Conservation Union, Sri Lanka Country Office
- Practical Action
- LIRNE Asia
- Sewalanka Foundation
- Mawella village of Hambantota District

Krabi Province, Thailand

- Thai Department of Disaster Prevention and Mitigation
- Krabi Provincial Administration Division of Public Works
- Krabi Provincial Administration Organization (PAO)
- Raks Thai Foundation
- Thai Red Cross
- Save the Andaman Network (SAN)
- Monitoring, Control and Surveillance (MCS) fisheries network
- Emergency Service (EMS)
- One Tambon One Security (OTOS)
- CBDRM committee, village Ban Klong Prasong
- CBDRM committee, village Ban ThaKlong
- CBDRM committee, village Ban Thalane
- Rescue Team for marine accident management, Koh Punyee
- CBDRM committee, village Ban Nam Khem

Indonesia

Padang

- PUSDALOPS (Provincial 24/7 Emergency Operations Centre)
- Komunitas Siaga Tsunami (KOGAMI)
- Centre for Disaster Studies, Andalas University
- BAPPEDA (Municipal Government Planning Board for Padang)
- Municipal Government

Banda Aceh

- IFRC
- German Red Cross
- American Red Cross
- Irish Red Cross

Continued

TABLE 2 Continued

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- GTZ Aceh Rehabilitation and Reconstruction Programme
 - BRR (Agency for Rehabilitation and Reconstruction for Aceh and Nias)
 - Sea Defence Consultants
 - Tsunami and Disaster Mitigation Research Centre (TDMRC)
- Jakarta*
- UNDP Crisis Prevention and Recovery Unit (CPRU)
 - Indonesian Red Cross (Palang Merah Indonesia – PMI), Aceh Darussalam Chapter
 - Indonesian Institute of Sciences (Lembaga Ilmu Pengetahuan Indonesia – LIPI)
 - GTZ International Services
 - Badan Nasional Penanggulangan Bencana (BNPB)
 - Badan Meteorologi dan Geofisika (BMG), ASEAN Earthquake Information Centre, Earthquake Engineering and Tsunami Division
 - State Ministry of Research and Technology (RISTEK)
 - Information Centre for Research on Natural Disasters (PIRBA)
 - UNESCO Indonesia, Jakarta Tsunami Early Warning Centre (JTIC)
 - BGR
 - UNDP
 - GITEWS Early Warning & Mitigation Centre
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To understand how organizations seek to implement policy in their specific operational context, the consultations were guided by a methodology of investigating innovation histories (Douthwaite and Ashby, 2005). This tool enables people who have been involved in a learning process to record and reflect on how this learning took place. An adapted version of the policy life cycle of Parsons (1995, cf. Lindahl, 2008) was used as a dialogical tool in discussions with stakeholders to explore the guidance and policy related to the ‘last mile’. Case studies for detailed analysis were identified and selected based on the following criteria:

- The selected cases were highly exposed to coastal hazards.
- There was a dominant sense among decision makers of the urgency in establishing an EWS.

- The actors and initiatives placed a significant emphasis on issues relating to early warning and disaster preparedness.
- The selected cases addressed multiple hazards.
- The selected cases represented operations at different scales and/or different organizational entry points for the project team.
- The selected cases exhibited different levels of hazard awareness and different levels of previous disaster preparedness experiences.

3. Key findings

In this section, we discuss the evidence from the stakeholder consultations, substantiated with secondary data, in terms of the normative, cognitive and procedural challenges associated with EWS implementation. Three selected CCR elements and benchmarks are used as points of departure for this discussion, namely the two cross-cutting elements governance and risk knowledge, and one that focuses on the concrete aspects of warning (Table 3). Each section below therefore starts with a discussion of the normative challenges associated with the often very diverse views on what, for each stakeholder, comprise desirable qualities of resilience.

3.1. Governance

3.1.1. Normative: Trajectories of social change

Disasters can affect everyone and the HFA describes them as ‘everybody’s business’. They unite stakeholders despite other diverging interests. However, EWS plans and actions have a bearing on and are themselves affected by longer trajectories of social change. The implementation of EWSs after the 2004 tsunami has taken place in a contested legal environment. For example, in Banda Aceh, Indonesia, the peace process and the tremendous scale of the reconstruction efforts shape the understanding of EWSs. The tsunami has also led to decimation in government capacity. In Sri Lanka the contested coastal buffer zone policy has led to conflict and increasing disparities between social groups. The

TABLE 3 Summary of current challenges in EWS implementation organized according to selected resilience elements from the CCR framework and the three dimensions of EWS policy/guidance

Resilience element	Normative challenges	Cognitive challenges	Procedural challenges
<i>Governance:</i> Leadership, legal framework and institutions provide enabling conditions for resilience through community involvement with government	<ul style="list-style-type: none"> ■ EWS development can have bearing on and can be affected by socio-economic factors and trajectories of social change in society and communities 	<ul style="list-style-type: none"> ■ Sectoral fragmentation of sub-national DRM planning undermines integrating frameworks and collective actions ■ Lack of mechanisms for facilitating exchange of diverging stakeholder perspectives leads to duplication of efforts and lack of integration 	<ul style="list-style-type: none"> ■ Methodological polarization between top-down government approach to provide EW technology and bottom-up NGO approach that focuses on community-based disaster preparedness ■ Lack of mechanism for feeding back CBDRM lessons learnt to the formulation of policy and guidance
<i>Risk knowledge:</i> Leadership and community members are aware of hazards and risk information is utilized when making decisions	<ul style="list-style-type: none"> ■ The norms of stakeholder participation in generating risk knowledge are contested ■ Low trust in EWS providers undermines the confidence in risk knowledge 	<ul style="list-style-type: none"> ■ The prevailing political economy of knowledge in EWS development disqualifies competencies of many stakeholders ■ CBDRM guidance/policy promotes knowledge prescriptive and expert-based approaches 	<ul style="list-style-type: none"> ■ Risk knowledge for CBDRM is approached as prescriptive awareness programmes ■ EWSs introduce artefacts as systems of symbols that have to be internalized and/or constructed by users ■ Norms of stakeholder participation conflict with the knowledge prescriptive education programme
<i>Warning and evacuation:</i> The community is capable of receiving notifications and alerts of coastal hazards, warning at-risk populations and individuals acting on the alert	<ul style="list-style-type: none"> ■ De facto priorities of national and sub-national decision makers conflict with the stated goals of the regional EWS 	<ul style="list-style-type: none"> ■ Decentralization implies additional roles and responsibilities for provincial and district government authorities with limited or no additional financial and human resources ■ Tsunami EWSs dominate and a multi-hazard approach is rarely integrated 	<ul style="list-style-type: none"> ■ Despite considerable international funds for the development of national EWSs in the short term, there is a lack of sub-national funds available ■ Reliance on volunteerism and concerns over the long-term sustainability of newly created government institutions, such as research facilities and operational emergency centres

same communities that have been disadvantaged by this policy are now expected to participate in EWS development (Ingram et al., 2006). In Banda Aceh, a similar idea to create a coastal buffer, the so-called 'blue zone', was not enforced because of resistance from fishing communities and the absence of initiatives to support alternative livelihoods. High disaster impacts in Asia are frequently attributed to ineffective measures to address increasing vulnerabilities arising from population growth, poorly planned urbanization and other socio-economic factors. In Krabi Province, Thailand, land acquisition by private investors that are in alliances with influential people in villages and tambons in many cases push poor and marginalized people to areas exposed to hazards.

Due to the power associated with EWSs, that is, in mobilizing large numbers of citizens, the possession and sharing of knowledge can be highly politicized. In Padang, Indonesia, both the provincial and the district government have responsibility for disaster management. Development actors there experience an ongoing tension due to the struggle for authority between the two agencies arising from ambiguities in their respective mandates. In Sri Lanka, staff at the Disaster Management Center (DMC) described similar challenges of power sharing between government departments. In Krabi Province, provincial government officials raised concern that surveys conducted by the Department of Disaster Prevention and Mitigation after the 7 July 2008 drill were not shared with the provincial departments. Moench (2005) argued that the legitimacy of authority can be a dilemma when agencies fight for seizing mandates. Some argue that current policies relating to EWSs support existing power structures but increase social vulnerability when disaster risk management (DRM) is not integrated into wider development policies (Heijmans and Victoria, 2001).

3.1.2. Cognitive: Sectoral fragmentation and duplication of efforts

There is a continuing cognitive challenge in integrating community-based disaster risk

management (CBDRM) with sectoral policies, and in developing standard operating procedures (SOPs) at sub-national levels. Linking coastal zone management and disaster preparedness requires the development of new mental models and shared theoretical frameworks for action with new roles and responsibilities, for example, to ensure that resettlement does not occur in areas highly exposed to hazards or in areas important for food production. In many cases, CBDRM practitioners have to frame and repackage EWSs in innovative ways to address other priorities such as livelihoods improvement and overall development planning, particularly when working with large numbers of partners. In Krabi Province, this comprises alignment with restoration and expansion of mangrove ecosystems to increase food security and reduce hazard impacts. In Sri Lanka, there is an ambition to use the 2010 revision of the national coastal zone management plan to enable DRM activities to build on existing management structures and staff resources at the lowest levels of government through integrated coastal zone management and special area management planning.

Divergences in what actors consider desirable benchmarks of institutional coordination and leadership can result in a duplication of efforts and lack of capacities and progress. However, parallel efforts can also be a manifestation of attempts to complement or improve existing initiatives. Some claim that what might be perceived as a duplication of efforts reflects a distribution of labour among government and NGOs (Shaw, 2006). Several NGOs in Sri Lanka regarded their DRM and EWS projects as contributions to government technical instalments, focusing on the strengths of NGOs, namely participatory engagement with communities. One example of this is the Hazinfo project (Evaluating Last Mile Hazard Information Dissemination) led by LIRNE Asia in Sri Lanka (LIRNE Asia, 2008). EWSs tend to evolve in a piecemeal fashion (Davis et al., 1998) and often ride on the back of political and financial windows of opportunity, aligned with past and ongoing initiatives by various stakeholders. For instance, in Sri Lanka,

the Disaster Management Act had been in the pipeline long before the 2004 tsunami, but was only officially launched in 2005. Similarly, in Indonesia, the Badan Meteorologi dan Geofisika described how it had attempted to gather support for developing a national EWS in 2003, but only after the 2004 tsunami did local government express full commitment.

3.1.3. Procedural: Polarized approaches and lack of feedback from practice

Normative divergence and cognitive fragmentation can lead to polarizations at the procedural level if mechanisms to create synergies are absent. This is seen most strongly in the tension between what is frequently described as a 'top-down government approach' to provide EW technology ('hardware') and a 'bottom-up NGO approach' that focuses on community-based disaster preparedness ('software'). This is linked to notions of NGOs being 'over-participatory', focusing too strongly on engagement with community organizations that lack legal status, and avoiding the governmental bureaucracy (see also Lukitasari, 2006). In Krabi Province, competition for donor support has undermined previously well-functioning relationships between NGOs. In Indonesia, donor funding has been largely allocated to high-profile programmes, many of which do not pay attention to the actual needs of communities.

Sub-national platforms for dialogue between government, NGOs and CBOs play a crucial role in enabling stakeholders to build operational relationships with communities of practice with other normative and cognitive standpoints. However, despite the growth of sub-national stakeholder networks, there are few adaptive mechanisms that enable feedback of lessons learnt for CBDRM from practice to policy. Many national and international workshops and conferences have been conducted but these events have been criticized for their focus on high-level policy goals, concepts and/or theories. NGOs voiced concerns that government representatives rarely stay on after their own presentations to

learn from the ensuing discussions or commit to represent their institutions in stakeholder meetings. Important implementation lessons thus tend to be only communicated to staff working at lower government levels who do not have the mandate to respond to the needs and do not have the capacity or authority to induce positive change within their organizations. Another challenge is the disconnect between expatriate staff, many of whom have limited knowledge of the local context, and national and sub-national stakeholders (see also ALNAP, 2003). Governments are also highly dependent on external consultants because of a lack of capacities to conduct risk assessments. Such concerns motivate criticisms that decisions are made without considering the needs of communities and that the form and procedures in dialogues relating to EWS development should be more critically scrutinized.

3.2. Risk knowledge

3.2.1. Normative: Contested mechanisms for stakeholder participation and distrust in risk information

The challenges associated with developing effective strategies for DRR have in recent years led to an increasing emphasis on participatory planning in humanitarian work with mainstreaming of community participation into international DRR policy and humanitarian standards (ALNAP, 2003; de Ville de Goyet and Morinière, 2006). The Indonesian Disaster Management Law No. 24 of 2007 provides the legal basis for the participation of government, NGOs, the private sector and communities. Many assessments, however, highlight that such participatory approaches to DRR are rarely taken (i.e. IEG, 2006). This is partly due to the fact that goals of community participation in EWS policy reflect contested norms regarding what constitutes good governance (see also Tingsanchali, 2005). Many researchers in the region remain unconvinced of the value of participatory methods, and DRR professionals are reluctant to

give up their integrity as 'experts' when the norms of 'people-centred' early warning have not yet been translated into institutional changes in research, agency and government organizations. While one Sri Lankan NGO observed that 'there is a huge gap between the military man and the community', other development professionals are of the opinion that military-controlled approaches to DRR are more efficient than participatory models.

Because they are excluded from national EWS planning decisions and processes, some individuals and communities disregard official warnings and instead take their own initiatives to warn and evacuate. These actions are guided by traditional knowledge of the hydro-meteorological changes (e.g. in the Indonesian Simeulue Islands) and employ TV, walkie-talkies and alternative speaker systems (see also TAW, 2007).

In some villages a lack of trust in the government is rooted in a general suspicion of government agencies because of rumours/evidence of fraud and corruption in post-tsunami compensation payments for lost and damaged items such as boats and fishing gear. This is further exacerbated where resource conflicts have created factions among local user groups. Such tensions are frequently not considered in the negotiation between international donor organizations and national and sub-national decision makers regarding ownership, roles and responsibilities between governments in the region, international donor agencies and UN agencies.

3.2.2. Cognitive: A prescriptive political economy of knowledge

Policy and guidance widely recognize that EWSs require a well-functioning communication system between the organizations comprising the warning chain. Three sets of actors are typically discerned: originators, intermediaries and disseminators or recipients of warning messages (Davis et al., 1998). The ICG/IOTWS Concept of Operations states that in end-to-end early warning 'information must flow from one end (detection) to the other (community response)

without interruption or ambiguity (Elliot, 2006, p. 5). The 'last mile' is here situated in the operational context of the recipients, where effective communication depends on the transfer of information from the national warning centre to the communities. This view on communication is rooted in a certain communication model, which by Lackoff and Johnsson (1980) has been termed the 'conduit' metaphor, that is, the assumption that communication comprises the 'conduit', or transfer, of objective information between two or more stakeholders.

When the EWS is designed by the same actors that are tasked with managing it in the warning situation, this communication model is extrapolated from the warning situation to the development of the EWS. The distinction between 'people with information' and 'people at risk' (US-IOTWS, 2007) creates a political economy of knowledge, which disqualifies the competencies of some stakeholders and promotes knowledge prescriptive and expert-based approaches. For instance, the distinction between 'risk management' and 'community participation' in many planning models might disconnect stakeholder involvement from knowledge generation. The attention paid to 'indigenous knowledge' in Krabi Province and in Indonesia is an example of an attempt to counter marginalization of local knowledge. However, this can be problematic if the validity of claims depends on judgements of what comprises 'intergenerational wisdom' or 'indigenouness'. Such judgements are often made by outsiders, for example, government representatives or development actors (see also Bankoff, 2001).

3.2.3. Procedural: Education and awareness raising

A consequence of prescriptive approaches to risk knowledge is to emphasize a one-way teaching model in public education and awareness programmes. Education and awareness raising is deeply engrained as a core element of most EWS frameworks (e.g. Perera, undated; CTEC, 2007). UN/ISDR states that a unanimous view has

emerged among humanitarian agencies 'that a better education and awareness of local communities on natural hazards could have contributed to reduce and mitigate the tragic human losses caused by these events' (UN/ISDR, 2007a, p. 11). Indeed, one of the most commonly encountered problem statements of government and NGO staff across the three case studies was that of 'lacking awareness' among communities.

However, EWS development introduces artefacts as systems of symbols that have to be internalized and/or constructed by users if they are to be meaningful. The prescription of what is considered relevant risk knowledge means that warning artefacts such as sign-posts and risk maps are in many cases not relevant in a particular location or for a particular end user. In Krabi Province, evacuation routes were determined by the national government based on the consultation of topographic maps without visual on-site inspection of the characteristics of the village and the surrounding area. Because of a lack of consultation with communities, suitable buildings that could be used as shelters, such as temples and schools, were not considered. In one coastal community, the villagers did not trust the safety of the designated safe area and therefore evacuated to the neighbouring village instead during drills. In another location, a sign pointing to a safe site had been erected, but the shelter was never constructed due to a lack of funds. Another concern was that evacuation signs were only in English. One village rescue team set up additional signs in Thai that advised people to evacuate to the local school and mosque. Similarly, the Sri Lankan Disaster Management Act was criticized by a number of NGOs for lacking appreciation of how local factors such as population density and cultural factors such as religion might affect the effectiveness of SOPs.

Very few documents aimed at guiding EWS development entail critical attention to the degree and nature of stakeholder involvement in the project cycle. In a DRM project cycle used by some organizations in Krabi Province, the evaluation phase is placed immediately before project closure and basic participatory

monitoring and evaluation principles are not incorporated. While the HFA recognizes that indicators for quantifying and measuring progress for DRR must be meaningful and credible to a range of stakeholders, it provides no guidance as to how stakeholder participation might take place in order to develop and agree on context-specific indicators (UN/ISDR, 2008).

3.3. Warning and evacuation

3.3.1. Normative: Reconciling EWSs and DRM with other priorities

In many countries in the Indian Ocean region, national-level disaster preparedness planning has been considerably improved following the 2004 tsunami through new policy frameworks and a restructuring of the roles and responsibilities of different government agencies for DRM and early warning (Tsunami Global Lessons Learned Project, 2009). In Sri Lanka, the Disaster Management Act changed the legal environment for DRM and a restructuring of the government is currently ongoing with more power being transferred to the DMC. But despite the increased importance given to disaster preparedness at the national level, decision makers at provincial, district and village level have to reconcile new demands for disaster preparedness placed on them with a range of other priorities. The value sets, willingness and priorities of local administrators to a large degree determine to what extent EWS and DRM policies and strategies are implemented. This is particularly so in decentralized governance systems such as in Indonesia, where ultimate fiscal and managerial responsibilities lie with the district and provincial governments.

There are different perceptions of the role of DRM in relation to other sectors. For example, in Krabi Province, fisheries and tourism are the two most important economic sectors and the provincial government sees the demonstration of DRM activities as important to instil confidence in the tourism sector. In Indonesia, we came across the opposite; some local government authorities resist the implementation of disaster

preparedness activities driven by the national government because of concerns of the negative image this might shed on tourism destinations. Similarly, in the communities, the value of CBDRM as a tool for community empowerment depends on the priorities and commitment of local stakeholders to engage in risk reduction activities. Both vary markedly between communities, even in those that were severely affected by the 2004 tsunami. In Krabi Province, the DRM Committee of Ban Tha Klong village developed an EWS for sea-based transport, which contributes to income generation through fishery and trade. Of the 84 households, 60 depend directly on fishery and most others are connected by family ties.

3.3.2. Cognitive: Taking a multi-hazard perspective

There is consensus among policy makers, practitioners and researchers that EWSs should address multiple hazards because such systems enable the integration of hazard information sharing in the context of broader societal development by linking preparedness and response to different kinds of hazards, including hydro-meteorological hazards, as well as for instance biological hazards and hazards to food security (see also Minamiguchi, 2005). The Hyogo Declaration stresses the importance of '[...] integrated, multi-hazard, and multi-sectoral approaches [...] to build resilience to disasters (UN/ISDR, 2005, p. 2) and the G8 Response to the Indian Ocean Disaster pledged that 'early warning systems should cover as many hazards as possible, not just tsunamis [...] (G8, 2005).

However, there is little evidence in the countries investigated that national EWSs currently being developed consider any other hazards than tsunamis. The US-IOTWS, which includes Thailand and Sri Lanka, aimed to apply a multi-hazard approach that simultaneously addresses tsunamis as well as other coastal hazards such as cyclones, sea swells, floods and earthquakes (www.iotws.org). However, in the transition workshop the lack of a multi-hazard

focus was identified as a major gap (US-IOTWS, 2008). The Indonesian Tsunami Warning System, currently being developed through the German–Indonesian Cooperation for a Tsunami Early Warning System (GITEWS), focuses on tsunamis, earthquakes and volcanic hazards (www.gitews.org). Some representatives from government agencies informed us that they aim to build a multi-hazard system in the longer term, but other stakeholders voiced doubt as to whether this will be accomplished.

Because of the diversity of needs and priorities at the local level, it is important to frame proposed interventions for early warning and DRM in contexts that are relevant in addressing local priorities and building partnerships between different actors. Addressing multiple priorities within an integrated framework will also improve the coordination between different actors. This is particularly so when EWS development as a political and social activity has to be bought into by government representatives as well as community leaders. The Thai Red Cross and the RTF both learnt that DRM activities must be planned with local decision makers such as the village headman to ensure that response plans and EWS activities are properly sanctioned to get buy-in from villagers.

While there is considerable potential for integrating DRM in the environmental domain, there are to date few efforts to integrate DRM into development planning processes in order to reduce disaster risks in the recovery process and to improve livelihoods. The World Conservation Unit in Sri Lanka highlighted the potential to integrate DRM objectives when performing environmental impact assessments. Some actors have started to link DRM with natural resource management. This provides an incentive for communities to engage in DRM and ensures local ownership (see also Sudmeier-Rieux et al., 2006).

3.3.3. Procedural: Creating sustainable mechanisms for DRM funding

Despite considerable international funds for the development of national EWSs in the region,

there are many concerns regarding the distribution of funding for early warning and disaster preparedness activities. While many sub-national authorities and non-government actors experience a shortage of funds, strict rules about the use of the significant volume of donations from the international community mean that a large proportion remains unspent almost 5 years after the tsunami. Some organizations lack the capacity to absorb the large amount of funding they received through donations. Also, some donors are not aware of the budgeting procedures in local government agencies (Lukitasari, 2006; ADPC, 2006) and some local government officials are reluctant to provide funds dedicated to CBDRM (Managbanag, 2006).

As a consequence of the lack of resources at the local level, CBDRM relies heavily on volunteerism. The Sri Lankan Red Cross has 100,000 trained volunteers; many of these are pupils recruited in schools. In some villages in Krabi Province, only those who have acted as volunteers are eligible for village elections. However, despite incentives such as health care, skills training and improved social status, and the dedication of volunteers, many stakeholders voiced concerns about the longer-term sustainability of disaster preparedness efforts because even volunteers require basic financial support for operational logistics such as transport, food and compensation for the loss of income. In all three countries, the lack of funds to pay or at least compensate volunteers for their time is a cause of low staff retention rates. The high turnover of volunteers and the need to continuously recruit and train new people throughout project implementation puts a considerable strain on an organization's capacities. Frustration over the lack of resources also relates to the inability of committees and volunteers to act and to induce positive change in their communities. Because many of the volunteers have full-time occupations and no compensation is provided for their time, they may not participate in important meetings. In the Philippines, limited local level funds for the implementation of national disaster preparedness policies means that village Disaster

Coordinating Councils/Committees are essentially 'shell' organizations that are not functional in emergency response (Heijmans and Victoria, 2001).

Innovative ways of addressing DRM financing have recently emerged in the form of micro-credit arrangements. In Krabi Province, the establishment of revolving loan funds provides a major entry point for the RTF into EWS and DRM projects with community groups. In Sri Lanka, many community groups that are engaged in NGO and government programmes were originally formed to administer economic activities such as micro-credit schemes or loan funds. In Vietnam, Development Workshop France provides short-term affordable loans to reduce household vulnerability by strengthening house construction (Chantry, 2006). Improved financing mechanisms are important in making DRR more effective (e.g. Southasiadisasters.net, 2005). In Sri Lanka, LIRNE Asia and Sarvodaya developed a new funding model to ensure the retention of staff. In the IOTWS, such community-based micro-financing mechanisms have not received much attention and many of the NGOs supporting such activities play only a minor role in EWS development.

4. Conclusions

The insights obtained from this multi-stakeholder participatory assessment suggest that the critical perspective on the 'last mile' espoused in the HFA and other EWS policy and deliberations is not sufficiently translated into action in the policy implementation process. This represents a major barrier to the development of effective EWSs in the region. There is hence an urgent need to ensure that the emphasis on people-centred warning systems introduced with the HFA does not remain semantics, as is currently perceived by many practitioners.

The evidence presented in this paper illustrates that practitioners operate in contexts shaped by multiple stakeholder agendas and navigate diverse needs and priorities. However, policy recommendations and guidance tend to focus

predominantly on the procedural dimension of EWS development. More attention needs to be paid to the cognitive and normative challenges in positioning EWSs in the wider trajectories of social change in societies and communities at risk. Better platforms for knowledge sharing need to be established to enable stakeholders to collectively negotiate these challenges, to improve the integration of early warning with other priorities such as livelihoods improvement, natural resource management and community development, and to provide opportunities for critical reflection of 'on-the-ground' experiences and lessons learnt. Such mechanisms will require that local actors, such as district and municipal government representatives, community leaders and NGO field staff, become more strongly involved in the improvement of national policy objectives and action plans, for instance addressing the need for more sustainable funding mechanisms. However, the normative nature of stakeholder and community participation must be better integrated with existing governance cultures.

We have presented an application of the CCR framework to better appreciate the complexity of the policy implementation process. The original framework does not visually indicate the cross-cutting nature of governance and risk knowledge, but the above analysis highlights cross-cutting issues through the dynamic feedback from and to other elements. In addition to the three dimensions considered here, future work could address more specifically the feedbacks between all resilience elements and explore how unexpected events such as large-scale disasters affect the self-organizing capacities of societies at risk.

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