



## **Disaster Risk Reduction and Tsunami Early Warning Systems in Thailand: a case study on Krabi Province**

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## LIST OF ABBREVIATIONS AND ACRONYMS

ADPC	Asian Disaster Preparedness Center
CBDRM	Community-Based Disaster Risk Management
CBDRR	Community-Based Disaster Risk Reduction
CBO	Community-Based Organisation
CHARM	Coastal Habitats and Resources Management
CSO	Civil Society Organisation
DART	Deep Ocean Assessment and Reporting of Tsunami
DDPM	Department of Disaster Prevention and Mitigation
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
EGAT	Electricity Generating Authority of Thailand
EMS	Emergency Medical Service
EWS	Early Warning System
GIN	Government Information Network
GIS	Geographic Information System
GTS	Global Telecommunication System
GTZ/IS	GTZ International Services (Deutsche Gesellschaft für Technische Zusammenarbeit)
HDRTN	Hydrographic Department of the Royal Thai Navy
HFA	Hyogo Framework for Action 2005-2015

ICG	Intergovernmental Coordination Group
ICG/IOTWS	Intergovernmental Coordination Group Indian Ocean Tsunami Warning System
ICT	Information and Communication Technology
IFRC	International Federation of Red Cross and Red Crescent Societies
IOC	Intergovernmental Oceanographic Commission
IOTWS	Indian Ocean Tsunami Warning System
IUCN	The World Conservation Union
JICA	Japan International Cooperation Agency
JMA	Japan Meteorological Agency
MOA	Memorandum of Agreement
NCDC	National Civil Defence Committee
NDWC	National Disaster Warning Centre
NGO	Non-Government Organisation
NOAA	National Oceanic and Atmospheric Administration (United States)
OpenCARE	Open Exchange for Collaborative Activities in Response to Emergency
OTOS	One Tambon One Search and Rescue Team
PAO	Provincial Administration Organisation (Krabi)
PPEW	Platform for the Promotion of Early Warning
PTWC	Pacific Tsunami Warning Center
RTG	Royal Thai Government
Raks Thai	Raks Thai Foundation
SAN	Save the Andaman Network
SDF	Sustainable Development Fund
SEI	Stockholm Environment Institute
SOP	Standard Operating Procedure
TAO	Tambon Administrative Organisation
TAT	Tourism Authority of Thailand
TICA	Thailand International Development Cooperation Agency
TMD	Thai Meteorological Department
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific, and Cultural Organisation
UNESCO/IOC	United Nations Educational, Scientific, and Cultural Organisation, Intergovernmental Oceanographic Commission
UN/ISDR	United Nations International Strategy for Disaster Reduction
USAID	United States Agency for International Development
US-IOTWS	United States Indian Ocean Tsunami Warning System Programme
VHF	Very High Frequency
WCDR	World Conference on Disaster Reduction
WMO	World Meteorological Organisation

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collaboration between multiple partners in the Indian Ocean Region. The main collaborating partners were SEI, Macquarie University, Sydney, the Asian Disaster Preparedness Center (ADPC) and the Raks Thai Foundation (Raks Thai). The UNDP Regional Centre for Asia and the Pacific provided valuable feedback and advice in the planning stages of the project. Matthew Chadwick reviewed the final report and Delia Paul coordinated all input towards finalising and producing the report.

## EXECUTIVE SUMMARY

In this report we explore progress made in disaster risk reduction (DRR) and early warning system (EWS) development in Thailand since the 2004 Indian Ocean Tsunami. National efforts to develop an EWS in Thailand are undertaken in the context of the establishment of the Indian Ocean Tsunami Warning System (IOTWS) initiated at the World Conference for Disaster Reduction in 2005 under the leadership of the United Nations Education Scientific and Cultural Organisation Intergovernmental Oceanographic Commission (UNESCO/IOC).

Consultations with regional stakeholders undertaken by the Stockholm Environment Institute (SEI) and partners in 2008 indicated that despite the actions taken so far, there was, amongst policy makers and practitioners at both the international and regional levels, a widespread sense of a lack of implementation on the mainstreaming of DRR as promoted under the Hyogo Framework for Action (HFA). A particular challenge identified was the importance of addressing the so-called ‘last mile’, defined here as the interface between the national EWS and communities at risk. ‘Last-mile’ approaches aim to empower vulnerable communities through community-driven initiatives as part of ‘people-centred’ approaches to EWS development.

Based on a study of Krabi Province, one of the provinces in Thailand worst affected by the 2004 tsunami, the research reviews progress made in strengthening the institutions and policies guiding DRR and EWS development, and in implementing guidance and policies for reducing community vulnerability to tsunamis at the national and sub-national levels.

In order to elicit the views and experiences of different actors engaged in early warning and community-based disaster risk management (CBDRM) in developing national EWS and strengthening linkages with community-based initiatives, SEI, in collaboration with Macquarie University, the Asian Disaster Preparedness Center (ADPC) and Raks Thai Foundation (Raks Thai) undertook a series of stakeholder consultations in Krabi Province in July 2008. This participatory assessment provided a platform for stakeholders to improve their understanding of the challenges and enabling conditions for different actors to implement recommendations and guidance, aimed at strengthening the technology community linkages of EWS. Between April and July 2009, SEI and Raks Thai conducted a series of community-level activities in the tourism community of Phi Phi Island, Aow Nang Sub-district, Mueng

District in Krabi Province, to verify and substantiate the findings from the 2008 stakeholder consultations, and to raise awareness of the importance of integrating community-based disaster preparedness and early warning at the local level.

The discussion of stakeholder insights is based on the four key elements of the Platform for the Promotion of Early Warning (PPEW) framework for ‘people-centred’ early warning systems, namely: risk knowledge; monitoring and warning services; dissemination and communication; and response capacity:

- In terms of **risk knowledge**, the insights indicate that there are considerable constraints leading to a discrepancy in risk knowledge not only between national and sub-national levels but also between the risk knowledge at national and sub-national levels and that of the local communities. This is due in part to a lack of sub-national DRM planning, coordination and policy integration, and a lack of community-specific guidance that takes into account culture and gender issues in the implementation of DRM policies. We recommend a stronger emphasis on support that facilitates the consideration of these challenges in policy implementation at the local level and the ‘fine-tuning’ of policies and guidance to take into account local contexts, culture, and traditional and indigenous knowledge and practices.
- The challenges in **monitoring and warning services** exist due to fragmented ownership of warning tower construction and maintenance. Recommendations here include the establishment of clearer definitions of all roles and responsibilities for the construction and maintenance of warning towers and the improvement of accountability of building and maintenance contractors.
- The main concerns regarding the **effectiveness of dissemination and communication** of early warnings include non-functioning warning towers, inappropriate evacuation routes and safe places, and poor signage. Key recommendations to address these challenges include the establishment of monitoring and maintenance systems for EWS infrastructure; the application of alternative dissemination methods based on low-tech and easily available technologies; the construction of additional shelters and the improvement of

existing shelters and safe places; the inspection and updating of escape routes and signs; and in tourism destinations, the improvement of foreign language skills amongst tourism business staff to enhance the safety of international tourists.

- For **response capability**, the main challenges are related to a lack of shared awareness, purpose and functioning of the EWS. This is linked to different priorities at the local level, a low degree of transparency in the development and maintenance of the system, distrust in government actors and the EWS, and limited staff and financial capacities at the provincial and local governance levels. Key recommendations include the framing of CBDRM and EWS in innovative ways that also address other priorities such as livelihood improvement and overall development planning; the creation of novel funding mechanisms that are more easily accessible to communities; and improved coordination and linkages between the government, NGO and private sectors and communities.

Overall, the project findings indicate that despite significant progress made in creating an enabling environment for promoting early warning approaches and in facilitating improved governance at national and sub-national levels, in many cases the current policy and institutional environment fails to provide the conditions necessary for the effective implementation of the ‘last mile’ and the mainstreaming of DRR approaches.

There are considerable issues and constraints within the four inter-related elements of EWS that hinder the effectiveness of DRR and EWS in Thailand. While there has been progress in the elements of risk knowledge, and monitoring and warning services, challenges still exist in all elements but particularly in the dissemination and communication of knowledge, technology and response capacity at the local level.

# 1 INTRODUCTION

## 1.1 BACKGROUND AND CONTEXT

Following the 2004 tsunami, the development of the Indian Ocean Tsunami Warning System (IOTWS) was initiated at the World Conference for Disaster Reduction in 2005 under the leadership of the United Nations Education Scientific and Cultural Organisation Intergovernmental Oceanographic Commission (UNESCO/IOC). The Hyogo Framework for Action (HFA), adopted in Kobe in 2005, stresses 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’.*

A core message from the Kobe Conference in 2005 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 HFA thus emphasises the urgency of promoting community participation in DRR, policies, networking, and strategic management of volunteer resources, roles and responsibilities, calling for multi-stakeholder partnerships as a crucial mechanism (UN/ISDR, 2005).

Consultations undertaken by Stockholm Environment Institute (SEI) and partners in 2008 with regional stakeholders including the United Nations International Strategy for Disaster Reduction (UN/ISDR), the United Nations Development Programme (UNDP) Regional Centre for Asia and the Pacific, and the Asian Disaster Preparedness Center (ADPC) indicated that despite the actions taken so far, there is amongst policy makers as well as practitioners at international and regional levels a widespread sense of a lack of implementation of the mainstreaming of DRR as promoted under the HFA.

SEI, in collaboration with Macquarie University, ADPC and Raks Thai Foundation (Raks Thai) undertook a series of stakeholder consultations in Thailand, Sri Lanka and Indonesia throughout 2008 and 2009 to elicit the experiences of the different actors engaged in early warning and community-based disaster risk reduction (CBDRR) activities in developing national

early warning systems (EWS) and strengthening linkages with community-based initiatives.

The assessment provided a platform for stakeholders to share in the creation of an improved understanding of the challenges and enabling conditions for different actors to implement recommendations and guidance aimed at strengthening technology community linkages of EWS (the so-called ‘last mile’). 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 understanding of actors in the entire warning chain.

As part of the participatory multi-stakeholder assessment of ‘last mile’ implementation experiences, the project included an Online Dialogue on Early Warning (Paul *et al.*, 2009). Other project components entailed a review of the literature on efforts to promote DRR and early warning by strengthening institutions and policies at international, regional, national and sub-national levels; a detailed case study of community disaster preparedness and early warning in Krabi Province; and a number of contributions to meetings, workshops, conferences and initiatives aimed at identifying lessons learned throughout the Indian Ocean region and sharing these experiences amongst IOTWS member countries and globally.

For a more detailed description of the background and context of this report, please refer to Appendix 1 and 2. Approaches and methods are described in more detail in Thomalla *et al.*, (2009).

## 1.2 DISASTER PREPAREDNESS AND EARLY WARNING IN KRABI PROVINCE

Between April and July 2009, SEI and Raks Thai jointly conducted a case study in the tourism community of Phi Phi Island, Aow Nang Sub-district, Mueng District in Krabi Province, to verify and substantiate the findings from the stakeholder consultations undertaken in Krabi Province in July 2008, and to raise awareness of the importance of integrating community-based disaster preparedness and early warning at the local level through a series of community level activities.

Phi Phi Island is located 42 kilometres from the mainland of Krabi Province and covers an area of 10.25 square metres. Phi Phi Don is the only inhabited island of the six that form part of the Hat Nopparatthra-

**Table 1: Agencies, organisations and communities in Krabi Province, Thailand, that participated in the stakeholder assessment.**

---

Department of Disaster Prevention and Mitigation (DDPM)
Krabi Provincial Administration Division of Public Works
Krabi Provincial Administration Organisation (PAO)
Raks Thai Foundation (Raks Thai)
Thai Red Cross
Save the Andaman Network (SAN)
Monitoring, Control and Surveillance (MCS) fisheries network
Emergency Medical Service (EMS)
One Tambon One Search and Rescue Team (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

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Mu Koh Phi Phi National Park (Loulalalen *et al.*, 2007). The island is a key tourist spot of Krabi Province and generates USD 113 million per annum in revenue, with 60 per cent of this coming from foreign tourists. This accounts for nearly 23 per cent of Krabi Province’s annual tourism revenue (Department of Public Works and Town and Country Planning, 2005). In order to identify opportunities to strengthen collaboration between different stakeholders, and to promote and implement disaster preparedness and tsunami early warning, it is important to understand the policy framework and the roles and responsibilities of the relevant government agencies and non-government organisations (NGOs) for DRR.

The objectives of this project were to:

- review the institutional and policy framework for DRR and EWS development in Thailand;
- examine the division of roles and responsibilities between government agencies and NGOs involved in EWS development at all levels;
- identify progress made in building capacity to increase disaster preparedness;

- summarise insights on how stakeholder interactions on early warning and disaster preparedness at the provincial and district levels can be improved;
- identify gaps and entry points for interventions to increase community disaster preparedness in collaboration with multiple stakeholders including the Tambon Administrative Organisation (TAO), concerned government agencies and tourism entrepreneurs; and
- share good practices and lesson learned on linking community-based disaster preparedness initiatives and early warning.

The work was framed using the Platform for the Promotion of Early Warning (PPEW) framework for people-centred early warning systems. According to the PPEW:

*‘the objective of people-centered early warning systems is to empower individuals and communities threatened by hazards to act in sufficient time and in an appropriate manner to reduce the possibility of personal injury, loss of life and damage to property and the environment’* (UN/ISDR PPEW, 2006, p. 2).

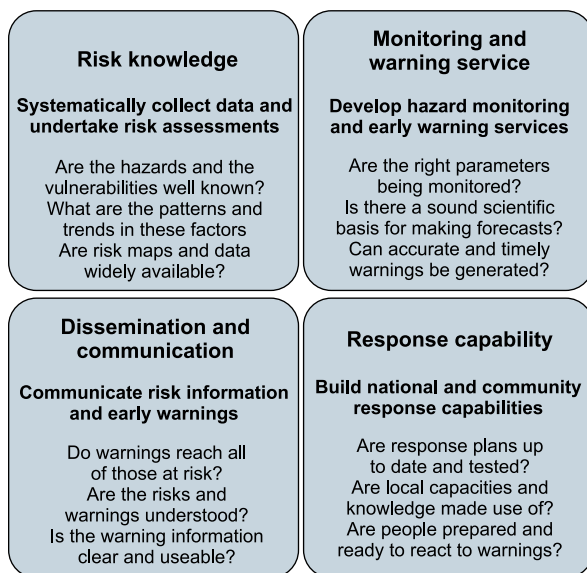
The PPEW distinguishes between the following four cross-cutting key elements of ‘people-centred’ EWS and suggests that a complete and effective early warning system comprises these four inter-related elements, spanning knowledge of hazards and vulnerabilities through to preparedness and capacity to respond (UN/ISDR PPEW, 2006). The elements and their respective aims are described as follows:

- **Risk knowledge:** The aim of this element is to establish a systematic, standardised process to collect, assess and share data, maps and trends on hazards and vulnerabilities. This includes the establishment of organisational arrangements, the identification of hazards, the assessment of risks, and the accessible storage of information.
- **Monitoring and warning service:** The aim of this element is to establish an effective hazard monitoring and warning service with a sound scientific and technological basis. This includes the establishment of institutional mechanisms, the development of monitoring systems, and the establishment of forecasting and warning systems.

- **Dissemination and communication:** The aim of this element is to develop communication and dissemination systems to ensure people and communities are warned in advance of impending natural hazard events, and facilitate national and regional coordination and information exchange. This includes the fact that organisational and decision-making processes are institutionalised, effective communication systems and equipment are installed, and warning messages are recognised and understood.
- **Response capability:** The aim of this element is to strengthen the ability of communities to respond to natural disasters through enhanced education of natural hazard risks, community participation and disaster preparedness. This includes the fact that warnings are respected, disaster preparedness and response plans are established, community response capacity is strengthened, and public awareness and education is enhanced.

The activities and outcomes of this case study include a review of DRR and EWS development in Thailand; a series of provincial level stakeholder workshops on DRR and early warning on Phi Phi Island in which lessons learned were identified jointly and shared; a handbook for community-based disaster risk management (CBDRM) entitled ‘Preparedness for Disaster’ (Raks Thai and SEI, 2009); and a number of outreach and communication materials aimed at increasing disaster awareness and preparedness amongst the participating disaster risk management (DRM) committees, community members, local government agencies and tourism stakeholders. By building directly on the development of the Disaster Emergency Prevention and Mitigation Plan for Phi Phi Island initiated in 2008, this project was able to provide policy recommendations for integrating CBDRM into the plan.

These elements can be seen as integral building blocks of an EWS with a clear set of activities that interact with the next element through effective communication channels (Figure 1.).



**Figure 1: Key elements of people-centered early warning systems** (UN/ISDR PPEW, 2006)

## 2 DRR AND EWS DEVELOPMENT IN THAILAND AFTER THE 2004 TSUNAMI

### 2.1 THE IMPACTS OF THE 2004 TSUNAMI ON THAILAND

The impacts of the 2004 tsunami were most severe on the Andaman Coast devastating the provinces of Phang-Nga, Krabi, Phuket, Trang, Satun, and Ranong. Severely affected areas included Khao Lak and Phi Phi Islands (DDPM, 2008a). The tsunami left Thailand with over 8,300 Thais and foreign tourists dead or missing, and with over 9,500 houses, as well as other buildings, roads, bridges and physical infrastructure, damaged or destroyed (Steering Committee of the Tsunami Global Lessons Learned Project, 2009). Phang-Nga Province was the hardest hit, with the devastated area covering six districts, and 69 villages with 19,509 people affected. In Krabi Province, 15,812 people were affected (DDPM, 2008a). As the tsunami struck some of Thailand's prime tourist areas, a large number of the dead and injured were foreign tourists. In Krabi Province, Phi Phi Island was the worst damaged, and, in particular, the main tourist areas of Ton Sai Bay and Loh Dalum Bay (The Office of Krabi Provincial Governor, 2007). When the tsunami struck there were 8,000 - 10,000 people on Phi Phi Island. At least 2,000 people were presumed dead (750 bodies found, a further 1,300 people missing.) (Pongponrat et.al, 2009; Sirichanna, 2006; Mureau, 2005).

About 20 per cent of coral reefs were adversely affected by the tsunami and approximately 10 per cent of sea grass beds were damaged. However, damage to mangrove forests was considerably less than that in other countries, with less than 1 per cent affected. Seawater intrusion affected about 30,000 hectares of land including vegetation cover (Srinivas, undated). The contamination of well water in Phang-Nga Province was significant with 187 out of 530 wells unsafe to drink from due to coliform bacterial contamination (UNEP, 2005a). Four sea turtle conservation projects were significantly affected including the breeding/conservation centre at Tap Lamu Naval Base (Phang-Nga Province) which lost around 2,000 turtles (UNEP, 2005a).

Total damage was assessed at around USD 508 million, while losses were estimated at USD 1,690 million; a total of USD 2,198 million or around 1.4 per cent of GDP. The impact on the affected provinces

was severe, and assessed as being equivalent to one half of the combined gross provincial product (GPP) (Nidhiprabha, 2007). In Phuket, damages and losses equalled 90 per cent of GPP, with 70 per cent in Krabi and Phang-Nga (Nidhiprabha, 2007). Loss of livelihood was particularly severe in fishing (with 30,000 people affected) and tourism industries (with 120,000 people affected) (UN Thailand, 2008). In Phang-Nga the fishing industry losses amounted to USD 22,830,462, while the total fishing industry losses for the six provinces was USD 43,873,447, including 7,500 fishing boats (DDPM, 2008a; UN Thailand, 2008). Over 50 per cent of all tourism industry losses occurred in Phuket (ADPC, 2005). The new luxurious resort area of Khao Lak (Phang-Nga) was completely devastated by waves that exceeded 10 metres in height (Edwards and Wang, 2005). Livestock losses amounted to USD 341,515 and agriculture to USD 61,466 (UN Thailand, 2008).

#### Hazard profile

According to the Department of Disaster Prevention and Mitigation (Research and International Cooperation Bureau, 2006), Thailand is considered a non-disaster prone country as there have been no catastrophic natural disasters such as volcanic eruptions or earthquakes. Notwithstanding this classification, Thailand experiences occasional large-scale natural disasters particularly water-related hazards such as riverine floods, urban inundation, tropical storms and droughts (Research and International Cooperation Bureau, 2006; Jacquelyn, 2006).

Geographically, Thailand is divided into four regions; the North, the Central or the Chao Phraya River Basin, the Northeast and the South or the Southern Peninsula. The northern region terrain is mountainous and prone to water-related hazards such as flash floods, landslides and debris flow. The arid north-eastern region frequently experiences flash floods and inundations during the rainy season, as well as severe droughts and cold spells during the summer and cool season. The central region, the vast fertile land, often referred to as the country's 'Rice Bowl', frequently encounters riverine floods and urban inundation during the rainy season. The southern region is hilly along the west coast with a low-lying coastal plain along the east coast. In this part of Thailand flash floods, mudslides, tropical storms and forest fires occur occasionally (Jacquelyn, 2006).

**Table 2: Event intensity, vulnerability, coping capacity and risk of Thailand to different hazards (Source: Research and International Cooperation Bureau, 2006)**

Type of Hazard	Intensity Level	Vulnerability Level	Managing Competency Level	Risk Level
Flood	High	Moderate	Moderate	High
Tropical Cyclone	High	High	Moderate	Moderate
Earthquake	Low	Low	Poor	Moderate
Land slide	Moderate	Low	Poor	Moderate
Drought	High	Moderate	Moderate	Moderate
Fire	High	Moderate	Moderate	Moderate
Explosives	High	Moderate	Poor	High
Accident	High	Moderate	Poor	High
Human Epidemics	Low	Low	Moderate	Low
Agricultural Pests and Diseases	Moderate	Low	Poor	Moderate
Social Unrest	Low	Low	Poor	Moderate
Influx of Refugees	Moderate	Low	Moderate	Moderate

The Research and International Cooperation Bureau (2006) ranks floods, accidents and explosives as high level risks; tropical cyclones, droughts, fires, landslides, earthquakes, social unrest, and agricultural pests and diseases as moderate risks; and human epidemics as

low level risks. According to the Tsunami Prevention and Mitigation Plan (2008 – 2012), 509 villages in the six Andaman provinces are located within tsunami hazard areas (DDPM, 2008b).

**Table 3: Number of villages in the six Andaman provinces located in tsunami hazard area<sup>1</sup>**

Provinces	Hazard Areas			Magnitude of impact			
	District	Tambon	Village	Level 1	Level 2	Level 3	Level 4
1. Ranong	3	11	45	1	7	12	25
2. Phang-Nga	7	22	106	12	31	21	42
3. Phuket	3	13	69	-	34	14	21
4. Krabi	5	19	113	-	3	37	73
5. Trang	5	21	102	-	-	6	96
6. Satun	4	16	74	-	-	4	70
<b>Total</b>	<b>27</b>	<b>102</b>	<b>509</b>	<b>13</b>	<b>75</b>	<b>94</b>	<b>327</b>

<sup>1</sup> Note: The magnitude of the tsunami impact is determined by Shuto's intensity scale which ranks wave heights compared to the highest wave recorded in areas affected by the 2004 tsunami. Level 4 is the highest level of destruction with a wave height of more than 10m; level 1 is the lowest impact level with a wave height of 2m (DDPM, 2008b).

## 2.2 INSTITUTIONAL ARRANGEMENTS AND POLICIES FOR DRM AND EARLY WARNING

The institutional and policy framework for DRM in Thailand involves a wide range of institutions at the national, provincial and local levels (IRC and Tetra Tech, 2007). The 1979 Civil Defence Act and the 2002 Civil Defence Plan form the legal basis of the DRM framework, which classifies disasters as natural and man-made disasters, disasters resulting from air raids during wartime, and disasters resulting from sabotage or terrorist attacks. Prior to the 2004 tsunami, DRM activities relating to man-made and natural hazards were guided under the Disaster and Fire Disaster Prevention Act, which was coordinated and enforced by the Department of Disaster Prevention and Mitigation (DDPM) and the Ministry of the Interior.

The National Civil Defence Committee (NCDC) was formed under the 1979 Civil Defence Act as Thailand’s strategic policy-making body for all activities relevant to civil defence and DRM (Figure 2). It is chaired by the Minister of the Interior and comprises 17 representatives

from various ministries including the Ministry of Health, the Ministry of Transportation, the Ministry of Information and Communication Technology, the Ministry of Agriculture and Cooperatives, and the Ministry of Natural Resource and Environment (IRC and Tetra Tech, 2007; DDPM, 2009). It performs all DRM functions at the national level, including the formulation of the Civil Defence Master Plan, the evaluation of implementation, and the organisation of annual or periodical training.

Under the 2002 Bureaucrat Reform Act, the NCDC, previously under the Civil Defence Division of the Department of Provincial Administration, became part of the DDPM at the Ministry of the Interior, while the DDPM replaced the former Civil Defence Division of the Department of Provincial Administration (Research and International Cooperation Bureau, 2006). DDPM staff were seconded from five government agencies including the Department of Rapid Rural Development; the Civil Defence Division; the Department of Provincial Administration; the National Safety Council of Thailand, the Office of the Permanent Secretary of the Prime Minister; the Department of Public Welfare;

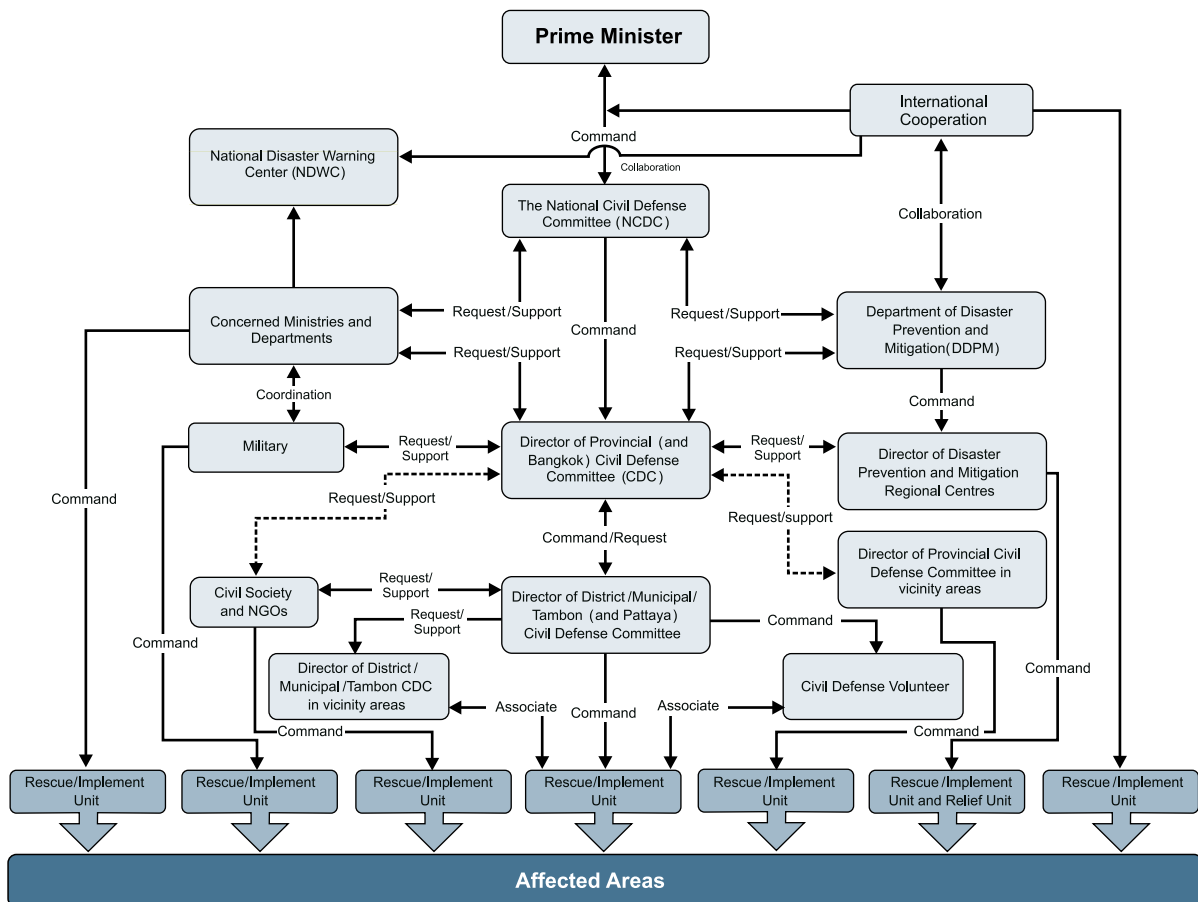


Figure 2: Legal structure of DRM in Thailand (DDPM, 2009)

and the Department of Community Development (DDPM, 2009).

In 2005, the National Civil Defence Plan replaced the previous plan. This serves as the master plan for all agencies concerned with DRM, and provides guidelines for the formulation of operational plans. The CBDRM was introduced through the Ninth National Economic and Social Development Plan (2002 – 2006), which places a high priority on enabling participatory processes between the government, the private sector, and the communities. The plan is complemented by ten Disaster Prevention and Mitigation sub-plans that include hazards relating to floods, accidents, explosives, tropical cyclones, droughts, fires, landslides, earthquakes, social unrest, agricultural pests and diseases, and human epidemics (Singbun *et al.*, 2008).

The 2007 Disaster Prevention and Mitigation (DPM) Act is the most important planning instrument aimed at strengthening DRM efforts in Thailand. Implementation of this Act is through the 2005 National Civil Defence Plan and the 2007 Tsunami Disaster Prevention and Mitigation Plan. These plans were established by the institutions responsible for disaster prevention and mitigation under the Ministry of the Interior, and the National Civil Defence Committee under the Office of the Prime Minister's Secretary in charge of pandemic diseases and natural disasters. The 2007 DPM Act gives the authority for DRM to the DDPM and the Civil Defence Committee at the national and provincial levels. This is an important change as the DDPM had previously functioned in only an advisory role to the provincial governments (Singbun *et al.*, 2008). Now, the newly established DDPM and the National Disaster Warning Centre (NDWC) have DRM as their sole responsibility, while various long-standing departments and technical agencies still have roles in the different phases of the disaster management cycle (IRC and Tetra Tech, 2007). The 2007 DPM Act also provides the legal guidelines for the operations of the DDPM and outlines the structure, policies and resources needed for DRM. DDPM plays a vital role in formulating policy and allocating different responsibilities to the provincial, district and sub-district levels, while the provincial governors are responsible for implementing DRM in their respective provinces.

Eighteen Regional Disaster Prevention and Mitigation Centres have been established to provide technical assistance and to collaborate closely with provincial governors on DRM issues, and, in particular, on large-scale disasters. These regional centres have to mobilise their own resources including personnel,

equipment and relief efforts to support the provincial governors and the provincial DDPM offices (Research and International Cooperation Bureau, 2006; DDPM, 2009). The regional centres oversee provincial, district, and sub-district level Civil Defence Committees under the command of the Provincial Governor, the District Deputy and the Tambon Head, respectively. These institutions and mechanisms are directly responsible for carrying out relief operations during and after a disaster, and for supporting disaster preparedness activities.

At the provincial level, the primary organisation for DRM is the Provincial Disaster Prevention and Mitigation Office (PDPMO) under the Provincial Governor's Office. The PDPMO's activities include the development of a Provincial Disaster Prevention and Mitigation Plan, the allocation of roles and responsibilities at each level, the organisation of drills, the testing of tools, the provision of training to local administrative organisations and the undertaking of evaluations. The provincial plans all specify CBDRM as an important activity to develop and support. The PDPMOs are composed of representatives from government agencies, private sectors, and Civil Society Organisations (CSOs). The Department of Local Administration instructs local government agencies to develop local disaster preparedness policy and action plans in collaboration with these stakeholders. The plans aim to integrate infrastructure and communication systems development, and capacity building for volunteer rescue and recovery operations, and must be linked to the Community Development Plan and the Provincial Disaster Prevention and Mitigation Plan. The PDPMOs have to mobilise all resources including personnel, equipment and relief efforts to support the provincial governors and the DDPM provincial offices (Research and International Cooperation Bureau, 2006; DDPM, 2009a). They also oversee provincial, district, and sub-district level Civil Defence Committees under the command of the Provincial Governor, the District Deputy and the Tambon Head, respectively. These institutions and mechanisms are directly responsible for carrying out disaster relief activities during and after emergencies, and taking precautionary measures before the occurrence of disaster.

District level authorities do not play a significant role in the DRM process in Thailand, where the main responsibility is allocated to the sub-district level, the Tambon Administration Organisations (TAO). The 2007 DPM Act and the National Disaster Plan specify that TAOs are the primary organisations responsible for both relief and community disaster prevention. While oversight and technical support is located at the

provincial level, the majority of DDPM DRM funding is allocated to TAOs, along with the decision-making authority on how to utilise these funds in accordance with Thailand's decentralised government structure.

The National Tsunami Prevention and Mitigation Strategy (2008 - 2012) created under the Tenth National Economic and Social Development Plan (2007 – 2011), and the 2005 National Civil Defence Plan framework and provide the policy framework for DRM in Thailand. This Strategy reflects a proactive approach, focusing on knowledge transfer, enhancing community understanding, early warning, safety area preparation, evacuation, and CBDRM. Ten tsunami prevention and mitigation principles are used as a framework for government agencies. The principles emphasise the importance of disaster prevention and multi-stakeholder participation, an integrated management approach, the creation of a management system that supports CBDRM, as well as the efficiency and accuracy of early warning and communication, the strengthening of human resource capacities and skills, the encouragement of the volunteer system, the enhancement of networks, and the importance of the lessons learned (DDPM, 2008b).

Six Disaster Prevention and Mitigation Academies (DPMA) have been established to conduct training in DRM for managers, practitioners, local government officers, and other actors located in the northern, central and southern regions in Thailand with the aim to enhance the understanding of DRM and to build the DRM capacities. The Ministry of Public Health and provincial hospitals are required to establish emergency rescue centres (Narenthorn Centre) that will train community volunteers to carry out evacuation and rescue procedures and apply First Aid, working closely with hospital casualty departments. The NDWC and the DDPM have prepared two plans for community evacuation in tsunami-affected areas, the Master Plan (2005) and the Tsunami Prevention and Mitigation Master Plan (2007). The NDWC is also currently preparing additional plans that address other natural and man-made hazards.

The Ministry of the Interior has instructed the DDPM to train at least 2 per cent of the population, or around 1.2 million volunteers, in disaster preparedness. This is implemented through the establishment of search and rescue teams, known as 'One Tambon One Search and Rescue Team' (OTOS) (see Box 1). Local government executives are required to attend a five-day training course in disaster prevention and mitigation, while civilian volunteers attend training in disaster prevention, CBDRM, and OTOS.

Various pilot CBDRM projects along the Andaman Coast were initiated in collaboration with the Japan International Cooperation Agency (JICA), the Princess Pa Friend in Need Foundation, the Thai Red Cross, Raks Thai Foundation, and GTZ/IS in Phuket Province, Bangnieng and Taplamu, and Krabi, Ranong and Phang-Nga Provinces (Singbun *et al.*, 2008), but these were often not coordinated.

This assessment indicates that DRM activities started in early 2005 through the formation of the Coordination Committee that aims to support tsunami-affected people and consists of a number of government agencies. NGOs, people networks and volunteer groups have also been undertaking activities to support the recovery of affected people and communities. Many of these actors have been working independently; many others have been cooperating with government agencies to support CBDRM or CBDRR in more than 20 communities. Various actors including government agencies at different levels, NGOs, international organisations and entrepreneurs with Corporate Social Responsibility (CSR) programmes have been working with coastal communities since 2007.

In the last three years, the NDWC has conducted a number of pilot projects aimed at preparing communities through school mechanisms by developing evacuation plans and practicing evacuation drills. In Krabi Province, these tasks have now been transferred to the Krabi Provincial Disaster Prevention and Mitigation Office, which collaborates with local government

#### **Box 1: One Tambon One Search and Rescue Team (OTOS)**

DDPM has incorporated various government agencies such as the Department of Local Administration, the Health Insurance Office, the Office of Health Promotion and Support Fund, and the Thai Red Cross, to achieve the following OTOS objectives: 1) to ensure the safety of life, and rapid and efficient search and rescue operations; 2) to establish efficient search and rescue teams at every province, district and tambon (sub-district) in the country; 3) to enhance the capacity and efficiency of search and rescue teams through technical training and drills; 4) to build up the self-confidence of search and rescue teams; and 5) to provide first aid treatment and rapid transfer to the appropriate medical establishment (Ratanakin, 2007).

agencies along the Andaman Coast to increase the disaster preparedness of coastal communities. The Krabi provincial government agencies include the Disaster Prevention and Mitigation Office, the Public Health Office, and several other organisations that have the mandate and resources to implement early warning, rescue and recovery. These agencies have established a number of services aimed at helping tourists during natural disasters and marine accidents. These include the Krabi Marine Rescue Unit, the Koh Lanta District of the 3rd Region Royal Navy, and the Tourist Rescue Centre of the Krabi Provincial Administration Organisation (PAO). Even though the activities of the different agencies are not yet formally integrated, they do cooperate. According to the 2007 Disaster Prevention and Mitigation Act, it is expected that the Disaster Prevention and Mitigation Office will coordinate the work of all related agencies in the future.

NGOs and CSOs have played an important role in the aftermath of the tsunami by strengthening community capacity in planning and implementing CBDRM and supporting cooperation among different sectors. NGOs have been involved in response and relief operations, and in preparedness activities (IRC and Tetra Tech, 2007). As part of the longer-term sustainable recovery and resilience building efforts, a number of international organisations, NGOs, CSOs, private sector actors, and government agencies, including World Vision, World Concern, Raks Thai, PDA, Sustainable Development Fund (SDF), Save the Andaman Network (SAN), Asia Foundation, the Thai Red Cross Society, the American Red Cross, the International Federation of Red Cross and Red Crescent Societies (IFRC) and UNDP, have been engaged in building resilience in affected areas through disaster preparedness and CBDRM activities, the establishment of revolving (savings) funds, the promotion of alternative livelihoods, support for skills improvement, and help with legal issues such as proof of nationality and land ownership.

Community leaders, community groups and community members have been encouraged by the Royal Thai Government (RTG) to join in the participatory process in cooperation with government agencies, NGOs, and private and public sector community networks to build information systems and to develop community preparedness plans for tsunamis and other natural hazards, as well as marine accidents.

In December 2004, Save the Andaman Network (SAN), a collaboration between NGOs and local

community-based organisations (CBOs), was established. The six core members of SAN are the Community Development Project (South), the Federation of Southern Fishermen, the Southern NGOs-Coordinating Committee on Rural Development (the Southern NGOs-CORD), the Community Organisations Development Institute (CODI), the Health Public Life Project (South), and the Friends of the Andaman Group. Forty-four other NGOs partners have been working with SAN in supporting the recovery of local communities in the six tsunami-affected provinces in the south of Thailand (Save Andaman Network, 2005).

The Mirror Foundation, the Tsunami Volunteer Centre, and other NGOs with experience in organising volunteer programmes and undertaking DRM activities in Thailand, are currently working on the establishment of a Disaster Volunteer Centre to coordinate volunteer activities in response to all potential hazards. The lessons learned from the tsunami indicate that volunteers are crucial in preparing for and responding to disasters. It is envisaged that the planned Centre will enhance the efficiency of volunteer work (Thai NGOs Team, 2009) and help to fulfil DRM work with other NGOs, civil society, and government agencies in providing relief and recovery efforts in affected communities.

In Krabi Province, the Thai Red Cross Society, SDF, SAN, ActionAid and Raks Thai cooperate with technical organisations in arranging training for practitioners. For example, the Marine Rescue Unit (Koh Lanta District) has provided very high frequency (VHF) radio communication and marine rescue skills training, and the Narenthorn Centre (EMS), provincial and district hospitals and health centres have provided standard first aid and evacuation training. This training has highlighted the importance of CBDRM. After training, the practitioners are delegated to established CBDRM project pilot areas where they work closely with the communities and, with the cooperation of local government agencies and other NGOs, arrange training for community volunteers. Phi Phi Island has received support largely from 'Help International Phi Phi', also known as 'Hi-Phi Phi', a community-based initiative in which local Phi Phi Island people and foreigners running local businesses work together. 'Voluntourism' was very successful in the Island's recovery. More than 3,000 people from several different countries participated in the recovery work by helping with the clean up, repairing homes and giving grants to people affected by the tsunami (Pongponrat et al, 2009).

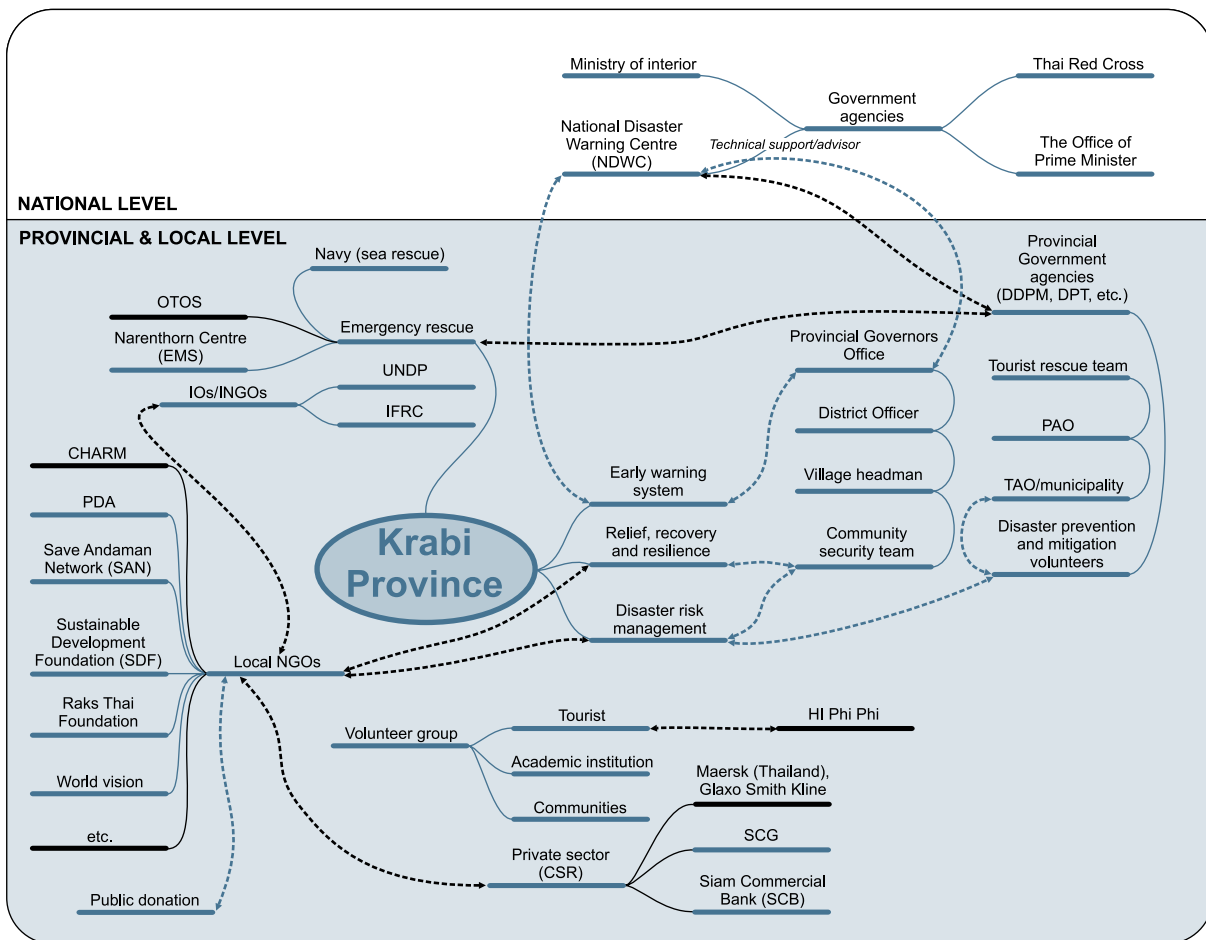


Figure 3. Mental map of Government and NGO actors in Krabi Province

### 2.3 ESTABLISHMENT OF AN EARLY WARNING SYSTEM FOR THAILAND

Prior to the tsunami, the Thai Meteorological Department (TMD) was responsible for providing weather forecasts and warnings for rain and floods, cold and dry weather events, storms and monsoons to farmers and fishermen countrywide. The Mineral Resources Department had the mandate for earthquake warning.

In 2005, the RTG first established a Committee for the development of an early warning system (EWS) and a few months later the NDWC was established. The Centre was later transferred from the Secretariat of the Prime Minister to the Ministry of Information and Communication Technology (ICT) and charged with the task of improving the disaster prevention and mitigation system. The NDWC building was

renovated, new equipment installed, and a national and international communication system established. The main responsibility of the NDWC is to detect earthquakes and to analyse seismic data to determine the possibility of tsunami generation before issuing notification messages to the public, the appropriate authorities and emergency services to evacuate people to safe places (Research and International Cooperation Bureau, 2006).

In November 2006, the Thailand International Development Cooperation Agency (TICA), the NDWC and the National Oceanic and Atmospheric Administration (NOAA) of the United States of America (USA) signed a series of agreements, including a Memorandum of Agreement (MOA) for a Technical Cooperation in Effective Tsunami System Analysis and Early Warning, a General Cooperation in Meteorology, Oceanography and Hydrology and for the Deployment of the Tsunami Detection System in the Indian Ocean, and a Deep Ocean Assessment and Reporting of Tsunami DART II buoys in the Indian

Ocean. The MOA will remain in force for five years from 2006 – 2011 (NDWC, 2006).

The U.S. Ministry of Commerce donated a DART II buoy to the TMD after the tsunami. In December 2006, the NDWC in collaboration with the NOAA and the Southeast Asian Fisheries and Development Center (SEAFDEC) successfully deployed the first DART Buoy in the Indian Ocean. In its first phase, the DART Buoy operation system will be carried out through the National Data Buoy Center at NOAA in Maryland, USA which will disseminate information through the Global Telecommunications System (GTS) of the World Meteorological Organisation (WMO) to the TMD before sending information to the NDWC. The NOAA will provide capacity building for the NDWC and relevant government agencies in operating the DART System until it can be operated independently.

According to the Director of the Division of Early Warning and Public Relations of the NDWC (Gp. Capt. Sarun Tappasut, pers. Comm., 2009), the information from the buoy has changed the standard operating procedure (SOP) of the NDWC, which previously relied on only earthquake information but now includes DART buoy information. This helps to reduce the time necessary to analyse whether a tsunami has been generated and to respond to the tsunami situation in an effective and timely manner. The buoy has been working continually from its deployment at the end of 2006. The system has gone into tsunami mode five times, including the time of the response to the 8.5 magnitude earthquake in southern Sumatra, Indonesia, on 12 September 2007. The buoy data can also be provided to other agencies within Thailand and to other Indian Ocean countries through the website of the NOAA's National Data Buoy Center.

Ten government agencies are responsible for the development of the Thai EWS: the TMD; the Department of Mineral Resources; The Department of National Parks, Wildlife and Plant Conservation; the Department for Pollution Control; the Hydrographic Department of the Royal Thai Navy (HDRTN); the DDPM, the Department of Fisheries; the Royal Irrigation Department; the Department of Maritime Transport and Commerce; and the Electricity Generating Authority of Thailand (EGAT). Regional partners include the Pacific Disaster Center (PDC), Pacific Tsunami Warning Centre (PTWC), Japan Meteorological Cooperation Agency (JMA), the United States Geological Survey (USGS), the NOAA, the European - Mediterranean and Seismological Center (EMSC), the Indonesian Meteorological and Geological Agency (IMGA), the

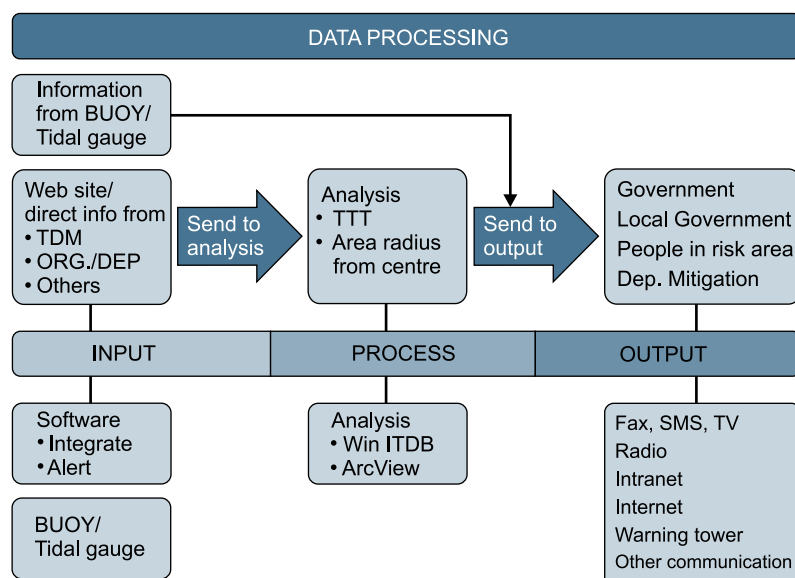
Malaysian Meteorological Service (KJC), and GTS of the WMO.

Supported by USAID, Thailand, together with Cambodia, China, Lao PDR, Myanmar, Philippines, and Vietnam agreed to cooperate in an end-to-end multi-hazard EWS arrangement in the Indian Ocean Region under the guidance and leadership of the UNESCO/IOC and the WMO (Luwin, 2008). The NDWC and the DDPM aim to enhance capacity and cooperation in Thailand on early warning and disaster management with other countries in the Indian and Pacific Oceans. The RTG, particularly the DDPM, has been supporting institutional capacity building for DRM and early warning through technical cooperation with ADPC, and training and study visits to Japan.

The Thai EWS is being developed in three phases: In the first phase, 76 warning towers were installed in the six tsunami-affected provinces. During the second phase, which will end in 2009, the system is being expanded to other vulnerable areas along the Gulf of Thailand and in other provinces. In the third phase, another 144 warning towers will be installed in other parts of Thailand, particularly in mountain areas that are vulnerable to other natural hazards such as flash floods and landslides.

Starting with EWS development for earthquake and tsunami hazards in 2005, the NDWC's activities expanded to include other hazards such floods, storms, landslides, chemical and toxic spills, and forest fires during 2006 – 2008. Then, the NDWC began to focus on drought, pollution, multi-hazard preparedness and awareness rising in 2007 - 2010. Most recently, between 2007 and 2011, the NDWC has started to target the establishment of a joint DRM network with other countries in the Indian and Pacific Oceans (Tappasut, 2009).

In addition to the establishment of the NDWC and the installation of warning towers, the analog observation equipment at the HDRTN and the TMD have also been upgraded in phases. Additional seismic stations are being established and communication links between the technical agencies and the NDWC are being improved (IRC and Tetra Tech, 2007). The NDWC controls the operation of the tsunami warning towers. The provincial governor is the official in charge of the decision to transmit warning signals to the towers (Tsunami Aid Watch, 2007). The Department of Water Resources in the Ministry of Natural Resources and Environment cooperates with the TMD to develop flash flood and sudden landslide warning systems in communities located on slopes and along waterways,



**Figure 4: NDWC warning process** (Source: Tappasut, 2009)

especially in the northern and southern regions of Thailand.

## 2.4 CHARACTERISTICS OF THE EARLY WARNING SYSTEM

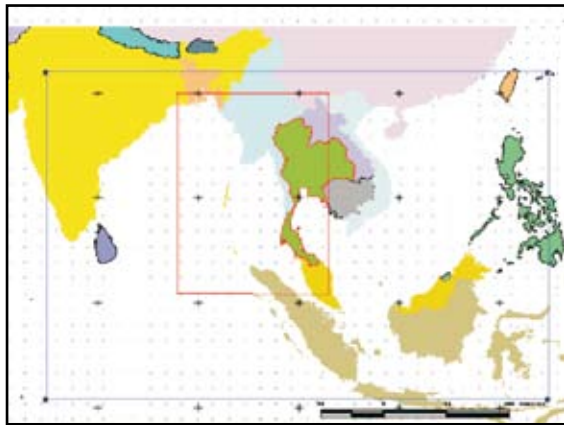
The EWS information network is linked to the ten government agencies mentioned above. Data on the intensity of seismic and wave activities are received and transmitted via the EWS established by the NDWC (Tourism Authority of Thailand, 2007). The NDWC receives information from these government agencies, from the DART buoys and from other international agencies, and then verifies and analyses the data. Since its deployment in the Indian Ocean, the DART II system has been working properly and has been sending wave data regularly. Initially, the data was sent to the National Data Buoy Center in the USA and then transferred to the NDWC via the internet. Now the data is transferred directly to the NDWC through GTS (Tatong et.al, 2008).

After receiving the seismic information from the DART buoys and/or the national and international agencies, the NDWC undertakes an analysis, using a tsunami model on their mainframe computer, of the likelihood of the generation of a tsunami and which areas are likely to be affected. The model takes account of the magnitude of the earthquake and the bathymetry of the nearshore area in the generation of information for decision-making. After receiving

the seismic information, the NDWC assesses which of the three seismic awareness zones is likely to be affected (Figure 5). The hazard information is disseminated through the Government Information Network (GIN) which comprises the intranet (OpenCARE), the warning towers, telephone network channels e.g. SMS (capable of sending 5,000 messages/time), auto-fax (capable of sending 150 faxes at a time), call centres for a 1860 number, 280 radio stations and television (TV5). If an alarm is sounded through the warning towers, the messages are broadcast in five different languages including Thai, English, German, Chinese and Japanese<sup>2</sup>.

Short messages are also sent to community leaders, volunteers, health facilities and schools in remote areas where radio and television is inaccessible. In some areas, shortwave radio communication normally used for official purposes in government departments and local government offices as well as for amateur users like fishermen and volunteer networks, is also sometimes used as a supplementary device for warning and rescue missions in areas at risk or affected by earthquakes and tsunamis. Such

2 The intranet NDWC Open exchange for Corroborative Activities in Response to Emergency: (OpenCARE) is one of several information dissemination channels of the NDWC. OpenCARE has four different groups of target audiences: the general public, disaster management agencies, DDPM and related government agencies, and NDWC operating staff (Singbun et.al., 2008).



**Figure 5: Seismic awareness zones of Thailand tsunami preparedness**  
(Source: Tappasut, 2009)

initiatives are largely community driven and not properly coordinated.

When the NDWC was first established, the decision to issue a tsunami warning was based entirely on earthquake information. The existing data indicate that a tsunami can only be generated by earthquakes with a magnitude higher than 6.5. It was assumed that the magnitude of the tsunami is directly related to the magnitude of the earthquake. However, the near-shore bathymetry is also a key factor affecting the magnitude and hence potential impacts of the tsunami. Therefore, three different SOPs (Table 4) were developed that account for the potential differences in the tsunami impact levels based on these considerations. For example, an earthquake in Zone 1 (indicated in Figure 5 by the red box) represents a high tsunami potential for the six

**Table 4: SOP for tsunami warning of the NDWC** (Source: Tappasut, 2009)

**Zone 1: Red Box (3°N – 23°N and 88°E – 103°E)**

Magnitudes	Hypocenter	
	< 100 km	> 100 km
5.0 - 6.5 Richter	Do not generate tsunami Reporting	Do not generate tsunami Reporting
6.6 – 7.7 Richter	Potential to generate tsunami Watching (tracking more information)	Potential to generate tsunami Watching (tracking more information)
> 7.8 Richter	High tsunami potential Warning	Tsunami potential Watching (tracking more information)

**Zone 2: Blue Box (75°S – 25°N and 75°E – 125°E)**

Magnitudes	Hypocenter	
	< 100 km	> 100 km
5.7 - 7.0 Richter	Do not generate tsunami Reporting (tracking more information)	Do not generate tsunami Reporting
> 7.1 Richter	Potential to generate tsunami Watching (tracking more information)	Potential to generate tsunami Watching (tracking more information)
	If no tsunami occurs, then status changed to Warning	If a tsunami occurs, then status changed to Warning

**Zone 3: Other areas not included in the Red and Blue Boxes**

Magnitudes	Hypocenter	
	< 100 km	> 100 km
> 7.0 Richter	Have no impact on Thailand Reporting	Have no impact on Thailand Reporting

coastal Andaman provinces. This earthquake zone covers the seismically active Burma Micro-Plate in the Andaman Sea and the Sunda Micro-Plate in the Indian Ocean.

## 2.5 REMAINING CHALLENGES AND FUTURE SUSTAINABILITY OF THE THAI EARLY WARNING SYSTEM

As the TAOs are the government authorities directly overseeing village affairs, DDPM policy stipulates that TAOs are also responsible for supporting CBDRM processes. This is also specified in the plans prepared at the provincial level. However, the funding that DDPM allocates for local DRM processes is incorporated in the annual budget for TAOs without any clear guidance on how much should be spent on DRM or the spending modalities. As a result, DRM activities, including support to CBDRM as proposed under the provincial plans, receive very little priority amidst the many social and economic programmes under the TAOs' purview. Moreover, the decentralised government structure leaves provincial authorities with little leverage over TAOs to encourage a greater response in line with the provincial plan. A situation has now developed wherein DRM is largely decentralised with resources allocated at sub-district level without comprehensive guidance (both from policy and practice) on the effective allocation of such resources.

Participants in the 2007 National Conference on Community Disaster Risk Management (NCDRM)<sup>3</sup> highlighted the TAOs' responsibility to initiate planning, develop mechanisms for coordination and monitoring, and undertake resource mobilisation for CBDRM processes in villages under their purview. While several TAO representatives expressed

their willingness to better support CBDRM, there was a general consensus that the TAO support to communities was not in line with this responsibility, mainly due to the TAOs' lack of capacity and CBDRM experience.

A total of 103 warning towers have been installed in the six Andaman provinces, 79 by the NDWC and 24 by local administrative organisations in Krabi (20) and Ranong (4). In addition, the NDWC has also installed 48 warning towers in the northern provinces (17) and in other provinces along the Gulf of Thailand (31). These are not only intended for tsunamis but also for other hazards such as flash floods and landslides. The NDWC plans to install another 144 towers throughout other parts of Thailand (Tappasut, 2009).

In 2009, the RTG allocated USD 4.29 million and instructed the NDWC and the Ministry of Information and Communication Technology to install two new DART II buoys in the Andaman Sea to detect earthquakes in the Burma Micro-Plate and the Sunda Micro-Plate. From these sources, a tsunami would take only 15 minutes to reach Thailand's coast. With the new buoys, the NDWC will be able to alert communities in these vulnerable areas five minutes before the arrival of the tsunami. The RTG also allocated funds of USD 1.26 million to maintain the existing buoys and USD 2.51 million to improve or upgrade the 144 warning towers by enhancing the towers' capacity for two-way communication (Sirisukwattananon, 2009). Figure 6 shows the existing DART II buoy (marked by x) in the Indian Ocean. This buoy was donated by the U.S. Ministry of Commerce in November 2006. The letters A and B mark the proposed locations for the two new DART II buoys in the Andaman Sea.

The NDWC plans to develop a more accurate tsunami model and to apply GIS to EWS and DRM activities. This includes the development of a seismic operating system; the development of EWS for other water related hazards; the development of a model for EWS equipment, and the development of a model to simulate different early warning situations. The NDWC also plans to develop a disaster command and control system for crisis situations, and to use satellite images for early warning (Tappasut, 2009).

The NDWC, DDPM, the Tourism Authority of Thailand (TAT), and the Government Department of Public Relations aim to conduct a tsunami warning and evacuation drill in the six tsunami affected areas

3 The 2007 NCDRM was hosted by Raks Thai, and co-organised by Raks Thai, the Department of Disaster Prevention and Mitigation, Ministry of Interior; the Royal Thai Government's Coastal Habitats and Resources Management (CHARM) Project; the International Organization for Migration (IOM); the World Conservation Union (IUCN); the Office of Population and Technical Assistance (OPTA); the Save Andaman Network; Save the Children; the Sustainable Development Foundation; the Thai Red Cross; the United Nations Children's Fund (UNICEF); the United Nations World Food Programme (WFP); and the World Wide Fund for Nature (WWF).

once a year. In 2005, the first drill was undertaken in selected areas. In 2006, one drill was conducted in each of the affected districts, and in 2008, the drills covered all the tsunami-affected areas for the first time. The National Tsunami Drill on 21 August 2009 showed that a number of technical and non-technical problems still need to be overcome. For example,

in Ban Thoong-La-ong, one of the 15 coastal communities in which Raks Thai has been engaged in CBDRM projects, the main problems related to the communication of the warning, particularly the areal coverage of the loudspeakers and the reporting and feedback to the administration and coordinating centre.

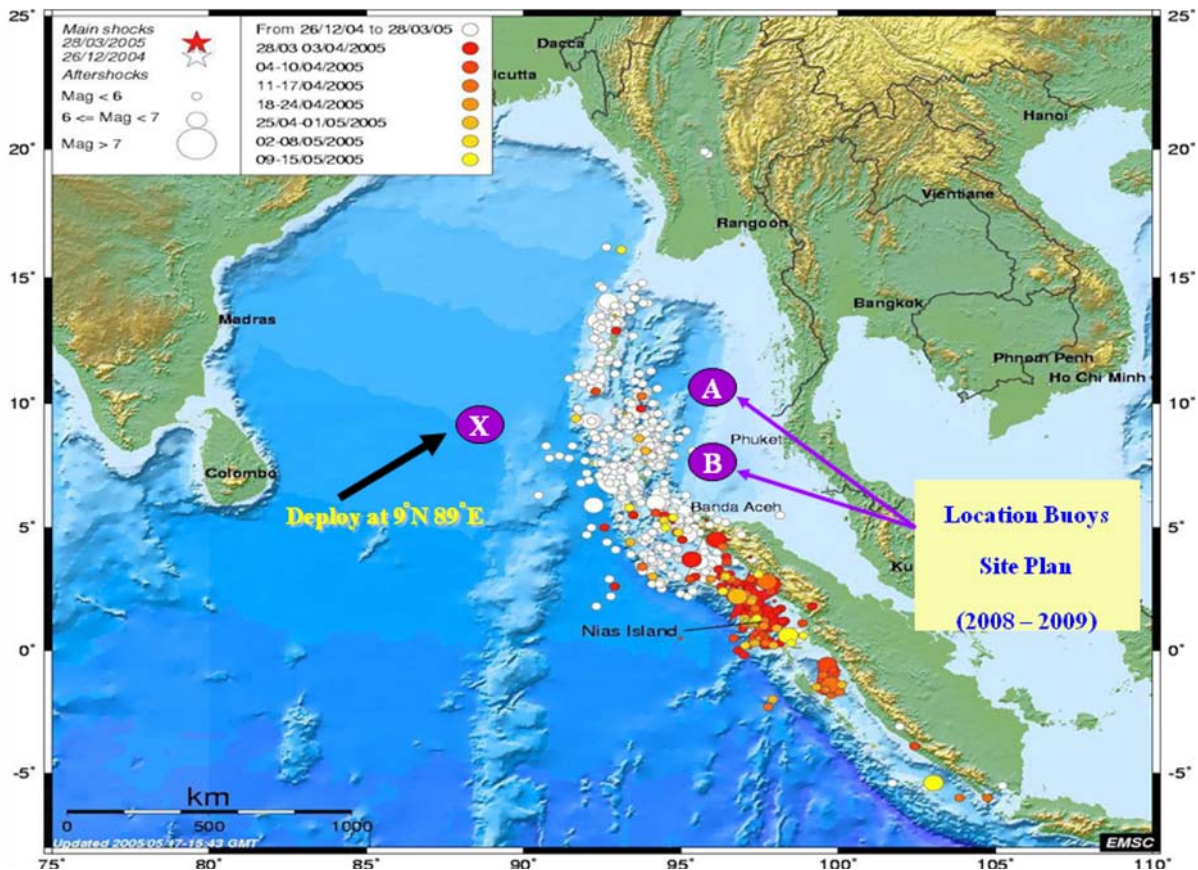


Figure 6. Proposed location of the two new buoys in the Indian Ocean (Source: Tappasut, 2009)

### 3 CHALLENGES TO DRR AND EWS DEVELOPMENT IN KRABI PROVINCE

In this section we examine the progress made in DRR and EWS development in Krabi Province since the 2004 tsunami. The discussion is framed using the key elements in the ‘people-centred early warning systems’ framework of: risk knowledge; monitoring and warning services; dissemination and communication and; response capacity (UN/ISDR PPEW, 2006). The PPEW suggests that a complete and effective early warning system comprises these four inter-related elements, spanning knowledge of hazards and vulnerabilities through to preparedness and capacity to respond (UN/ISDR PPEW, 2006). Best practice EWS have strong inter-linkages and effective communication channels between all four elements. In addition to the four elements, several cross-cutting issues are also critical to the development and sustainability of effective EWS. These include well-developed governance and institutional arrangements, the foundations upon which the four elements of early warning are built, strengthened and maintained, and a local ‘bottom-up’ approach to early warning, with the active participation of local communities which enables a multi-dimensional response. In this way, local communities, civic groups and traditional structures can contribute to DRR and to the strengthening of local capacities (UN/ISDR PPEW, 2006).

The four elements of the framework are used as the main headings for this discussion to illustrate the current challenges and constraints to DRR, EWS and CBDRM in Krabi Province.

#### 3.1 RISK KNOWLEDGE

In Krabi Province, there are considerable constraints that lead to a discrepancy not only between national and sub-national levels but also between the risk knowledge at national and sub-national levels and that of the local communities. This is due in part to a lack of sub-national DRM planning, coordination and policy integration as well as a lack of community-specific guidance that also takes into account culture and gender issues for the implementation of DRM policies.

##### **Generic and ambiguous DRM policies and guidance**

Adapting generic policy guidance to Krabi Province is a challenge. In Ban Nam Khem, for example, guidance was perceived as too complicated while in Koh Panyee, generic evacuation procedures, provided by

the Provincial Office of the Department for Mitigation and Preparedness, did not consider the specific conditions of an island village location. The guidance given on traffic management during evacuations does not apply to Koh Panyee as there are no vehicles on the island. A revision of the guidelines was necessary to consider evacuation procedures undertaken by foot or by boat. Changing tidal conditions also needed to be considered.

Compounding the problem of generic manuals is the fact that local government agencies frequently lack the human and technical capacity to implement policies and guidelines in the context of their daily work because sufficient information and resources are not available at this level. Hence, guidance is not always available to local government agencies, communities and hotels.

Because of the challenges in adapting generic concepts derived from international expert knowledge and standards to the local context, some agencies and organisations have developed their own manuals based on lessons learned from their own projects and operations. For example, Raks Thai is in the process of developing a revised manual (originally from the Southern Thailand Tsunami Affected Areas Rehabilitation and Strengthening programme) based on experience in practice - not only from its own programme but also taking into account the experiences and learning from other DRM practitioners. This is an important step in the internal capture and reflection on the lessons of what works and why.

In Krabi Province, a network has been established between Raks Thai, SAN, SDF, the DDPM, and the Thai Red Cross. This has enabled organisations to draw on support from such a platform to develop their own guidelines, manuals and strategies to implement policy goals in context. In Krabi, this included the adaptation of guidelines from the DDPM into an improved manual for local stakeholders.

##### **Integration of Indigenous knowledge**

In Krabi Province, specific initiatives are taken to integrate indigenous knowledge and practices into DRM planning. However, this can be problematic if the validity of claims comes to depend only on judgements of what comprises ‘intergenerational wisdom’, or ‘indigenesness’, particularly if such judgements are made only by outsiders, e.g. government officials or

development workers. The argument by Thomalla *et al.*, (2006) that a multi-community dialogue and learning process is needed to link the disaster risk reduction, climate change adaptation, environmental management and poverty reduction research communities and to co-design applicable frameworks can here be widened in terms of the scale of the dialogue to include practitioners in general.

### Sharing of lessons learned

The many regional and national level workshops and meetings have provided a considerable amount of information on DRM and EWS. The lessons learned, both for Krabi Province and nationally, indicate the challenges in reaching the local community. While the sharing at national level is important and relevant, it rarely reaches the people involved in implementation. While there are many opportunities for stakeholders to discuss lessons learned and to reflect on the implementation challenges, considerable constraints exist for these occasions to be realised as spaces for reflection and feedback to revise policy and guidance.

One problem that has been noted is a tendency for government officials to be present only for their own presentations, and then to leave the workshop before the general discussion. This means that important insights and lessons tend to be communicated to the staff working at lower government levels and who are not always able to place them in the context of larger scale processes and policies.

Cultural differences in how to engage in deliberation and critique were highlighted as a key factor for the lack of critical reflection. From interactions with agencies experienced in regional DRM, it was found that public debates on disaster prevention have their own dynamics in Thailand, where they are often shaped by the unique cultural realities and governance patterns. In Thailand, this means that people are not inclined to voice open criticism in meetings. This was demonstrated in the recent DRR and EWS policies-practice dialogues. The role of gender is also important as women often have less opportunity to participate in DRR activities, and the realities of women are therefore represented inadequately in the prevailing risk knowledge. Such knowledge is particularly crucial in the many cases when EWS rely predominantly on the adaptation of existing low-tech community alert systems and social networks with neighbouring communities.

### Sub-national DRM planning, coordination and policy integration

National level disaster preparedness planning has been considerably improved since the 2004 tsunami through

new policy frameworks and a restructuring of the roles and responsibilities of different government agencies for DRM and EWS. However, the Thai institutional and policy environment is very complex. According to a representative of the Krabi PAO, there are too many government departments and too many different policies.

There is a lack of integration in CBDRM, EWS, and DRM and in coordination between the departments responsible for these different issues. Hence, the sharing of information is subject to political battles at various government levels and the communities' decision to engage in DRM depends strongly on local politics and priorities. In Krabi Province, for example, provincial government officials raised concern that surveys organised by the DDPM after the 7 July 2008 drill were sent directly to the national government and were not shared with the provincial departments, even though it is the provincial department that meets with working groups involved in the drills to discuss the experience, including evacuation routes and villagers' understanding of the warning system.

Different actors have different approaches to implementing 'the last mile' and for engaging with other stakeholders. This reflects an ongoing debate on the role, control and ownership between state and non-state actors, nested within ongoing decentralisation and governance reforms. For example, Raks Thai uses a bottom-up approach, engaging first with the communities and then with the relevant government agencies. The Thai Red Cross, on the other hand uses a top-down approach, beginning a new project by first signing a Memorandum of Understanding (MOU) with relevant government agencies and conducting monthly meetings with the provincial governor. Raks Thai describes a feeling of having had a large amount of 'dialogue' already with government and other stakeholders, but that the problem is to move beyond the dialogue to action.

### Risk Knowledge Recommendations

- There needs to be a shift of emphasis from international and national policy making to greater support for policy implementation at local levels. Greater government support is required from higher levels of government, including those representatives working at national and provincial levels, to oversee and strengthen local governance and to support long-term EWS and DRR strategies. Sufficient funding, for example, is needed to flow to the feedback stages of conferences and workshops and to reach those tasked with implementation.

- Policies and guidance need to be ‘fine-tuned’ taking into account the local context, traditions, culture, and indigenous knowledge and practice. Policies and guidance for EWS need to be tailored to meet the needs of every group in all vulnerable communities. They must recognise that different groups have different vulnerabilities according to culture, gender or other characteristics that influence their capacity to effectively prepare for, prevent and respond to disasters. Women and men often play different roles in society and have different access to information in disaster situations. In addition, the elderly, disabled and socio-economically disadvantaged generally tend to be more vulnerable.
- The DDPM needs to play a key coordinating role to lead and link up all different stakeholders to enhance the CBDRM network with other CBDRM communities. When joint reflection upon experience can be linked to joint activities this can be a major mechanism for improving CBDRM activities and sharing recommendations and lessons learned.

### 3.2 MONITORING AND WARNING SERVICES

According to the PPEW (2006), warning services for different hazards should be coordinated where possible to gain the benefit of shared institutional, procedural and communication networks. Economies of scale, sustainability and efficiency can be enhanced if systems and operational activities are established and maintained within a multipurpose framework that considers all hazards and end user needs. Multi-hazard systems also help the public better understand the range of risks they face and reinforce desired preparedness actions and warning response behaviours.

Monitoring and warning systems have been implemented throughout Krabi Province. 12 warning towers were installed by the NDWC under the central government budget in vulnerable areas, in particular, the main tourist destinations of Ao Nang beach, Nopparattara beach, Klong Muang beach, Phi Phi Islands and Lanta Island (Table 5).

**Table 5: Tsunami warning tower locations in Krabi Province**

(Source: The Office of Krabi Provincial Governor, 2007)

Location	Sub-District (Tambon)	District
1. Baan Koh Kwang	Nong Talay	Muang
2. Klong Muang Public Health Centre	Nong Talay	Muang
3. Nopparattara Beach	Ao Nang	Muang
4. Nopparattara Beach	Ao Nang	Muang
5. Ao Nang Beach	Ao Nang	Muang
6. Lam Nang	Ao Nang	Muang
7. Baan Koh Phi Phi	Ao Nang	Muang
8. Lam Po	Sai Thai	Muang
9. Baan Klong Tor	Sri Boya Island	Nua Klong
10. Baan Tinglai	Sri Boya Island	Nua Klong
11. Baan Tinglai School	Saladarn	Koh Lunta
12. Baan Saladarn Community School	Saladarn	Koh Lunta

Krabi Province includes 154 islands in the Andaman Sea and has a coastline of 160 km. Despite the fact that only 13 of these islands are inhabited, the 12 warning towers installed by NDWC do not provide cover for all the inhabited coastal areas. To address this situation, the Krabi Governor has allocated approximately USD 1 million from the provincial budget to install a further 20 warning towers (Figure 7). The presence of the EWS has made community members feel safer. Warnings are broadcast over the loudspeakers in five languages, with additional alerts being broadcast via, radio, television and SMS (the latter being a free service people can subscribe to) (Calgaro, *et al.*, 2009). Furthermore, in July 2009, the DDPM Office in Krabi Province received USD 0.57 million, allocated to the budget of the provincial governor, from the Office of the Prime Minister to solve the signal connecting problem of 20 dysfunctional warning towers.

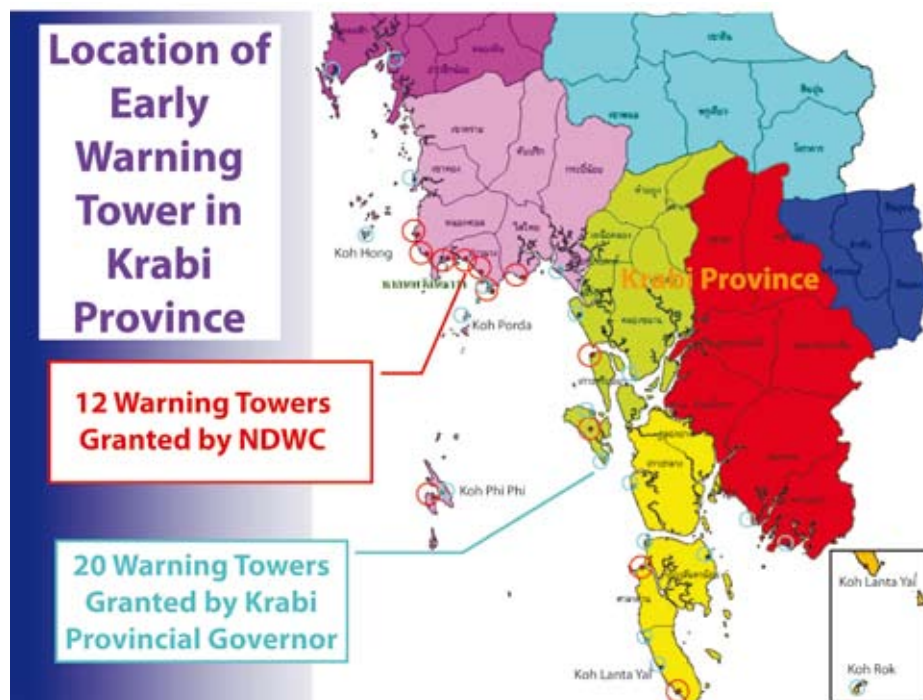
Fragmented ownership of warning tower construction and maintenance

Problems with warning tower signal linkage in Krabi Province stem from a lack of funds and fragmented ownership of tower construction and maintenance. While the EWS is tested daily by sending a signal to the towers via satellite and with repairmen being

dispatched within 24 hours to repair faulty towers (USAID and DTRAC, 2007), the RTG has not made any plans for regular inspection and maintenance of the towers. Building and maintenance contractors are perceived as not being accountable and there is a lack of information about the maintenance schedule.

Indeed, a tower in Ban Tha Klong is not linked to the EWS because of a lack of funds. There are also some instances where the government has been informed of technical failure and a technician has been sent, however the towers are still not working. Further, most of the 20 newly installed towers have no signal linkage with the NDWC.

On Phi Phi Island, the two early warning towers (one in Ton Sai Bay and the other in Loh Dalum Bay) are incompatible and rely on different technologies. This is due to one being established by the NDWC and the other by the Provincial Governor. Thus, fragmented ownership is a problem. There appears to be a lack of coordination between the national and provincial government and thus there is a lack of a clear understanding of who holds the mandate for issuing, constructing and then maintaining the warning towers.



**Figure 7. Location and Type of Tsunami Warning Towers in Krabi Province**

(Source: The Office of Krabi Provincial Governor, 2007)

The rationale of focusing on the construction of warning towers has been questioned by several informants (e.g. UNDP) as more cost effective and reliable warning channels, such as TV, radio, telephones, mobile phones, and walkie-talkies exist. Some end-users, who find themselves excluded from EWS planning processes, disregard official warnings and rely on self-maintained EWS instead. For example, the Ban Tha Klong community has disregarded the warning towers and reverted to TV and walkie-talkie systems instead. In Koh Panyee, the Rescue Committee set up an alternative speaker system supported by Raks Thai. Further, a lack of trust in the EWS has led local people and tourists to rely on their traditional knowledge and experience to observe changes in the sea-level (Tsunami Aid Watch, 2007; Calgaro *et al.*, 2009).

### Monitoring and Warning Services Recommendations

- Clear definitions of all roles and responsibilities for the construction and maintenance of warning towers between all levels of government are needed. Building and maintenance contractors must be made accountable and a maintenance schedule put in place.
- Communities need to feel confident that the warning signals are working properly. There has been a suggestion that the Thai National Anthem could be played as a test warning. This could help allay feelings of distrust in the system. However, this needs to be supported by the NDWC because of the costs involved.
- All NDWA and provincial disaster warning towers need to be linked up. This will increase the local communities' confidence and trust in EWS. In addition, there needs to be signal linkage between warning towers and the tourism sector (hotels/resorts/restaurants) to enhance tourist confidence in Thailand as a safe tourist destination.
- The Krabi Province warning towers are not only intended for tsunamis but also for other hazards such as flash floods and landslides. The warning services for different hazards need to be coordinated where possible to gain the benefit of shared institutional, procedural and communication networks.

### 3.3 DISSEMINATION AND COMMUNICATION

There are serious concerns regarding the effectiveness of the EWS in Krabi Province. The main challenges and constraints to the dissemination and communication of the EWS include unreliable warning towers, inappropriate safe places and inadequate signage.

#### Unreliable warning towers

Many of the warning towers in Krabi Province are considered unreliable. Of the six Krabi communities the Thai Red Cross is working in, only one has a warning tower that is operational. There are also instances of damage through lightning, for example, at Ban Thalane, theft and vandalism (see also Calgaro *et al.*, 2009).

#### Positioning and areal coverage

There are examples of warning towers being poorly positioned and having poor areal coverage. For example, a warning tower in Ban Tha Klong is located on the other side of the estuary. In Ban Nam Khem, the Krabi Provincial Administration Division of Public Works and the CBDRM committee have confirmed that the warning tower covers only a small radius of approximately 300m which means that communities near the coast cannot hear or understand the warnings during strong winds. Similarly, during a visit to Phi Phi Island by SEI and Raks Thai (May - July 2009), it was observed that the warning sirens and announcements were not clearly audible on all parts of the island, particularly the far-eastern end of Ton Sai Bay, where the Phi Phi Island School is located, and the north end of Bang Niang Beach (see also Calgaro *et al.*, 2009). In some areas, the warning siren was also found to be disturbed by noise pollution from bars, restaurants, boat engines and construction sites.

#### Accidental triggering of alarms and failures to warn

There are many instances of warning alarms sounding by accident or tests not sounding at all. The confidence of local residents and tourists in EWS has suffered as a consequence. For example, in Koh Pu Village a signal alarm kept sounding causing distress to the villagers. In Ban Klong Prasong, villages resorted to 'cutting the wire' to silence a tower that kept sounding. Similarly, on Phi Phi Island two false alarms from the tsunami warning tower frightened people and led to panic evacuations that resulted in injury and lawsuits against the government. A growing distrust in the EWS was demonstrated in September 2007 following an earthquake off the Sumatran Coast. News of the threat and the issuance of tsunami warnings in neighbouring



**Figure 8. The topography of Phi Phi Island** (Source: SEI and Raks Thai, 2009)

countries came via international news channels causing many locals to run to high ground for safety (Montague, 2007). No news or reassurance was issued from the NDWC, causing much uncertainty and fear (Calgaro *et al.*, 2009).

#### Limited access to risk information

The lack of awareness of coastal hazards and vulnerabilities limits a community's capacity to address hazard risk (US-IOTWS, 2007). Prior to 2004, coastal communities such as Phi Phi Island were not fully aware of the risk posed by a tsunami and information about the risk was scarce. One reason for this is that potential risks in tourism destinations are often played down for marketing purposes (Calgaro *et al.*, 2009). The potentially negative consequences of these risks to tourist flows are considered too great to warrant timely warnings (Cassedy, 1991; Drabek, 1995). Accordingly, tourism communities such as Phi Phi Island were completely unprepared for the 2004 tsunami. Phi Phi Island, particularly the main tourist areas, suffered the most damage in Krabi Province. Due to the island's topography dense tourism infrastructure is located on the narrow sand isthmus between the twin bays of Ton Sai and Loh Dalum (see Figure 8). The island was struck twice by tsunami waves creating an inescapable death trap. 750 people were killed and over 1,300 people are still missing (Ioualalen *et al.*, 2007; Sirichanna, 2006; Mureau, 2005).

#### Inappropriate safe places

Communities in Krabi Province have voiced concern over the inappropriateness of designated evacuation routes and safe places, and the inadequacy of signage that has been erected following the 2004 tsunami.

According to the CBDRM Committee, the evacuation routes in Ban Nam Khem identified by the national government are simply based on topographic maps without visual on-site inspection of the characteristics of the villages and their surrounding areas. Because of a lack of consultation with communities, suitable buildings that could serve as potential shelters, such as temples and schools, were not considered as safe areas.

Because the topography in Ban Nam Khem is flat and low-lying, higher ground can be quite some distance away. However, this has not been taken into consideration when designing the evacuation routes. Likewise, in Ban Thalane where people have to travel 3km to the hills, a government designated safe place was thought to be too low and too flat. Consequently, not trusting the safety of this designated evacuation site, the inhabitants of one village evacuated to the neighbouring village during recent drills.

In Ban Klong Prasong, a lack of government support has left the community frustrated. The community school was identified as a potential safe site for evacuation and a proposal was made to build a second floor to make it suitable as a shelter. However, a petition to the local government to finance the construction costs never received a response. Similarly, the school on Phi Phi Island needs support for a new building which can be used as a shelter from tsunamis in the future.

#### Confusing and misleading signage

There are many examples in Krabi Province of poor evacuation routes and signs. Signs are often misleading, obstructed, or barely visible and marked evacuation distances are often unclear. In Ban Nam Khem for example, some route signs pointed in



**Figure 9: An example of an incorrect evacuation route sign** (Source: SEI and Raks Thai, 2009)

the wrong direction (see Figure 9). Villagers also explained that a sign pointing to a safe site had been erected but that the shelter was never constructed due to a lack of funds. Another concern in Ban Nam Khem was that the signs were only in English.

Ban Naam Khem is an example of a community that has initiated and engaged in CBDRM activities to improve the dissemination and communication of EWS. A village rescue team, with support from Raks Thai, set up additional signs in Thai language. Furthermore, because of inadequate government signage the rescue team along with Raks Thai produced their own signs with directions and distances to safe places, such as the school and temple. They have also produced maps identifying locations of secondary hazards such as gas tanks. Future plans of the village rescue team include expanding their efforts to neighbouring villages as well as forming an inter-village CBO network.

On Phi Phi Island, we found many examples where tsunami escape signboards are obscured or hidden by buildings making it difficult for people to see them (Figure 10). Also, the escape route painted on the street of Phi Phi Island has either faded or has entirely disappeared (Figure 11). There are concerns on the island about how to handle a disaster in the narrow and congested street full of carts, bicycles and pedestrians. Another concern is that the popular leisure spot, Lo Da Lum, where tourists participate in activities such as swimming, sunbathing and rowing boats, is quite far away from the tsunami escape route.

#### **Recommendations for dissemination and communication**

- To continuously improve dissemination and communication of information to the public the national government needs to establish monitoring and maintenance systems and undertake regular drills to strengthen disaster preparedness in the community. The successful execution of a robust monitoring and maintenance strategy requires additional financial and technical support for the local authorities responsible.
- The dissemination of up-to-date knowledge on possible risks and appropriate responses is imperative. There needs to be an emphasis on public relations and increased communication channels at the community level. Information could be circulated through a local disaster-preparedness centre or committee. Other dissemination methods including direct-line EWS to hotels, resorts and restaurants; local radio links to temples and mosques, and community announcement points could be utilised (Calgaro *et al.*, 2009).
- Additional funding is required to complete the construction of safe places in designated areas. Community cooperation is required to locate appropriate safe places and onsite inspections are essential for all designated sites.
- To improve evacuation signage it is essential that regular monitoring takes place and that information is correct and updated. This includes repairing,



**Figure 10: Obstructed evacuation signage on Phi Phi Island** (Source: SEI and Raks Thai, 2009)



**Figure 11: Faded escape route signage on Phi Phi Island** (Source: SEI and Raks Thai, 2009)

correcting and updating existing escape routes and sign boards. Evacuation route signs need to be clearly seen and not obscured from view, arrow signage on the street needs to be made visible and incorrect escape direction needs to be corrected.

- Escape routes that shorten distances and allow for faster escape need to be developed. For example, a new route in front of Lo Da Lum Bay on Phi Phi Island would enable people to escape faster.
- Public relations material such as maps and escape routes need to be developed to provide knowledge for entrepreneurs, employees and the general populace, including tourists. This material then needs to be appropriately disseminated throughout the region. Phi Phi Tourist Business Association in collaboration with Raks Thai and SEI has developed a large scale map for Phi Phi Island

that displays escape routes and safe areas (see Appendix 3).

- Improved foreign language skills of small beach activity operators would enable them to better assist and instruct tourists in emergency situations, thereby creating a safer environment. To increase accessibility, language courses could be run through existing local organisations but financial backing would be needed from government sources (Calgaro *et al.* 2009).

### 3.4 RESPONSE CAPABILITY

The main constraints and challenges in the response capability element of the PPEW framework are related to a lack of shared awareness about the functioning of the EWS. This is linked to a low degree of transparency

in the development and maintenance of the system and a widespread distrust in the EWS. The lack of government support including limited staff and financial capacities affects all elements of the people-centred framework and is hence difficult to address as a separate concern. However, distrust in EWS particularly affects the community response capacity.

### **Integrating DRM with livelihoods**

At the provincial governance level DRM efforts are strongly linked to the reduction of risks associated with livelihood activities relating to fisheries, marine transport and tourism. In Krabi Province, this has comprised an alignment with the restoration and expansion of mangrove ecosystems aimed at increasing food security and reducing the impacts of hazards. In Ban Tha Klong, it has been demonstrated that participation and ownership of DRM by the local community is the key to success. The village DRM committee found a way to develop EWS for sea-based transport which directly improves the safety and effectiveness of income generation through fishery and trade. Sixty of the 84 households depend directly on fishery and most of the other households are indirectly dependent on fishing through family relationships.

Local risk perceptions and livelihoods are the driving forces for engaging in community preparedness. Raks Thai initially engaged with communities in Ban Thalane and Koh Panyee with a focus on livelihoods and then extended its activities to DRM. In Ban Thalane, we were told that the community would not have initiated CBDRM activities without the initiation and support from Raks Thai.

In Krabi, there has also been a move to create more accessible funding sources for communities. Innovative ways of addressing DRM financing have recently emerged in the form of micro-credit arrangements. The establishment of Revolving Loan Funds provide a major entry point for the Raks Thai Foundation into EWS and DRM projects with community groups. Similarly, UNDP provides small grants to communities to engage in mangrove planting activities enlisting the support of local youth groups. Furthermore, schemes like the Swedish Micro-Credit Foundation's initiative used on Phi Phi Island can help provide alternate financial credit options (see Calgaro *et al.*, 2009).

### **Limited resource availability for DRR and CBDRM activities at provincial and local government levels**

One of the most common problem statements from government and NGO representatives in Krabi Province, and across Thailand was that of a lack of

awareness and knowledge of disaster preparedness amongst communities.

Key challenges in the 'last mile' implementation are particularly to do with limited resources for DRM activities at provincial and local government levels. Without adequate public awareness and knowledge of disaster preparedness procedures, early warning technology is useless. Increased awareness and preparedness do more than promote safety; together they instil community and investment confidence in livelihood resilience (Calgaro *et al.*, 2009).

### **Lack of appropriate training**

Information on warning procedures and disaster preparedness training for communities is limited. Evacuation drills and disaster preparedness training are infrequent due to restricted localised financial constraints (Calgaro *et al.*, 2009). A further constraint for delivering effective disaster-preparedness training in destination host communities is the timing of such activities. For example, during evacuation drills on Phi Phi Island, many businesses sent only two or three staff to attend the drill as they did not want to close their businesses entirely during the drill process. Unfortunately, this means that the knowledge and practical experience obtained during the drill was limited to only those who participated in the practice.

### **Lack of financial and staff capacity for (CB) DRM**

According to the Thai Provincial Disaster Preparedness and Mitigation Office, many authorities and non-government actors experience a shortage of funds at sub-national levels. As a result of funding problems, provincial government lacks staff capacity to manage the DRM tasks placed upon it by the DDPM. On the other hand, the DDPM noted that private actors and local governments are not engaging enough in CBDRM and that this is an obstacle in the implementation and monitoring of DRM activities at the local level. Lack of staff, equipment and financial resources at the local government level were also reasons given by the Krabi Provincial Administration Division of Public Works for poor implementation of DRM activities. Apart from training and basic support for volunteers, communities experience severe difficulties in securing funding for other CBDRM activities. According to the Krabi Provincial Disaster Preparedness and Mitigation Office, there is a bias of funding for CBDRM towards communities that have been severely affected by the tsunami and that other communities do not receive much funding. Progress in preparing DRM and emergency plans hence varies substantially between provinces, districts and municipalities.

### **Dependence on volunteerism and loss of institutional memory**

As a consequence of the lack of resources including staff, CBDRM relies heavily on volunteerism. The high turnover of volunteers and the need to continuously recruit and train new ones puts considerable strain on organisations. Many NGOs such as SAN and the Thai Red Cross have very limited staff and resource capacities.

Institutional memory is frequently lost through the high turnover of staff. For example, the Thai Red Cross has a staff rotation policy under which only locals are hired for longer-term appointments; international staff are moved every 6 - 12 months and are therefore not part of the entire project implementation time.

On Phi Phi Island, a concern is that frequent changes of school personnel (community volunteer workers and supporting agencies) will undermine awareness and continuity, and result in the loss of knowledge and practices that are not recorded.

The lack of resources also causes frustration amongst volunteers about their inability to act and to initiate positive changes in their communities. For example, the Koh Panyee Rescue Team were provided with training and uniforms under the OTOS programme but there are no funds available for the volunteers to conduct disaster preparedness activities. On Phi Phi Island, the CBDRM activities are often interrupted because a high proportion of community members are migrants, thus making it difficult to find/retain volunteers. Here too, the frequent change of staff and the associated loss of institutional memory, together with a lack of public relations, impede information updating.

Another challenge lies in the lack of authority of the volunteers. For 'cultural reasons' many young people acting as volunteers do not feel comfortable telling older people what to do and many older people do not take them seriously. Also, because many of the volunteers have full-time occupations and no compensation is provided for their time, they may not participate in important meetings.

### **Lack of support/action by government resulting in distrust in EWS**

Effective governance is a cross-cutting issue that is critical to the development and sustainability of effective EWS. A lack of government support affects all sectors of the people-centred framework and is hence difficult to address as a separate concern. However distrust in EWS affects the community response capacity in particular. There are many examples of communities

facing a lack of support from all levels of government for (CB) DRM activities.

In Ban Nam Khem, the CBDRM committee commented that they felt compelled to develop their own Tsunami Preparedness and Response Plan because the government was not taking any responsibility.

In Ban Thalane, committee members described a complete absence of government presence in the village regarding EWS activities.

In some villages, there is a widespread distrust and suspicion of the government because of negative experiences with corruption issues relating to post-tsunami compensation payments for lost or damaged boats and fishing gear. In such instances government officials are reluctant to engage with these communities for fear of retribution.

On Phi Phi Island, the disinterest and the resultant disconnection between the community and their government representatives have left the community with few political avenues for voicing concerns and resolving issues. The community's trust in the TAO's ability to bring about positive change has been eroded by ineffectual meetings and unfulfilled promises, and so has dissuaded further community participation. Corruption and an abuse of power by local elites further exacerbate policy and planning success leaving the communities frustrated and disillusioned with the sincerity and effectiveness of governance structures. The continuance of such practices has created mistrust and apathy among the community with regard to the government's intentions, their agenda and their capacity to represent the best interests of the whole community instead of particular factions (Calgaro *et al.*, 2009).

### **Recommendations for Response Capability**

A local, 'bottom-up' approach to early warning, with the active participation of local communities, enables a multi-dimensional response to problems and needs. In this way, local communities, civic groups and traditional structures can contribute to the reduction of vulnerability and to the strengthening of local capacities (PPEW, 2006). However, such local action must be appropriately supported by higher levels of government through necessary funding and policy adaptation.

- CBDRM and EWS development need to be framed in innovative ways to address other priorities such as livelihood improvement and overall development planning. This will also help to address concerns of enthusiasm waning in the absence of disasters in the longer-term.
- Improved financing mechanisms are important in making DRR more effective. Indeed, innovative ways of addressing DRM financing have recently emerged in the form of micro-credit arrangements. In Krabi Province, UNDP provides small grants to communities to engage in mangrove planting activities enlisting the support of local youth groups. The establishment of Revolving Loan Funds provides a major entry point for Raks Thai into EWS and DRM projects with community groups. Similarly, schemes like the Swedish Micro-Credit Foundation's initiative in Phi Phi Island provide alternate financial credit options that have flexible terms and repayment options (Calgaro *et al.*, 2009).
- Disaster preparedness training and evacuation drills need to be run in the low tourist seasons to enable the participation of smaller operators and all employees (Calgaro *et al.*, 2009).
- Communities and businesses need to work more closely together to manage and preserve natural resources because these are important for tourism as well as DRM.
- There needs to be more time overlap of NGO staff in order to retain institutional memory, and to monitor and evaluate good practices, and lessons learned.
- DDPM and related government agencies need to develop better mechanisms to improve awareness and CBDRM capacity in all communities vulnerable to hazards. DDPM should encourage and enable all communities to be involved in the CBDRM learning process.
- Local government authorities need to outline their policies and plans more clearly, support communities to implement CBDRM, and help to coordinate linkages between government and community sectors. Likewise, communities need to cooperate more closely with local governments.
- Provincial Administration Organisations (PAOs) should support local communities in formulating projects and planning through TAOs. Policies and work plans need to be introduced through provincial disaster prevention and mitigation committees and CBDRM promoted in close cooperation with local government as well as private and public sectors.
- TAOs because they work closely with communities are key stakeholders to encourage DRM within communities. The annual DDPM budget does not cover all vulnerable communities for drill exercises, however, TAOs can allocate their annual budget to cooperate with DDPM and help support CBDRM activities such as purchasing training and rescue equipment like VHF radio communication. DPM and related agencies including NGOs should facilitate the activities of the TAOs, particularly in areas highly vulnerable to multi-hazards, in order to prepare the DRM plan.
- Village leaders and TAOs need to cooperate more closely. It is important to involve the village leader when planning DRM activities because the decision by communities to engage in DRM depends strongly on local politics and priorities.

## 4 CONCLUSIONS

This report reviewed the progress made in strengthening the institutions and policies guiding DRM and EWS development in Thailand. It analysed the efficacy of implementing guidance and policies for reducing community vulnerability to tsunamis at the national and sub-national levels with a focus on Krabi Province. The observations and recommendations provided in the previous sections relating to the four elements of people-centred EWS provide the basis for several broader conclusions.

The review indicates that since the 2004 tsunami, Thailand has made considerable progress in creating an enabling environment for promoting early warning approaches and in facilitating improved governance at national and sub-national levels. There is also an increasing awareness amongst decision-makers and practitioners of the importance of addressing the ‘last mile’.

However, the work also shows that despite the tremendous efforts to improve tsunami disaster preparedness, the current policy and institutional environment in many cases fails to provide the conditions necessary for an effective implementation of the ‘last mile’ and to mainstream DRR as promoted under the HFA. Many of the institutional and policy changes have yet to be translated into concrete actions or are facing considerable implementation challenges.

The PPEW’s people-centred EWS framework, used as the basis of our analysis, ranges from knowledge of hazards and vulnerabilities through to preparedness and capacity to respond. The findings from Krabi Province reveal that there are considerable issues and constraints within the four inter-related elements that hinder the effectiveness of DRM and EWS in Thailand. While there has been progress in the elements of risk knowledge, and monitoring and warning services, challenges still exist in all elements but particularly in the dissemination and communication of knowledge and technology, and response capacity at the local level.

In Krabi Province, limited human and financial resources for provincial and local government; a lack of knowledge, experience and skills relating to DRM; a lack of sub-national planning, coordination and policy integration processes; a lack of appropriate capacity-building resources; and limited engagement and ownership by local government, are the main obstacles to building an effective and sustainable

approach to CBDRM and early warning. As a result of these challenges, the ‘last mile’ is currently one of the weakest links in the national EWS and effectively excludes many of those living in communities at risk from the system.

With regard to capacity building, a clear approach with set milestones and quality benchmarks, and solid process documentation is essential to identify and record good practices and lessons learned. For example, there are currently no appropriate or comprehensive capacity building materials in the Thai language to support communities in undertaking DRM processes; culturally appropriate tools to support CDBRM have not been yet developed, and limited process documentation exists describing the approach and lessons observed in past and ongoing activities. There is hence an urgent need to review, consolidate, document, share and apply the wealth of field experience built up in CBDRM over the last five years. Furthermore, although there are several CBDRM initiatives implemented in the tsunami-affected provinces in Thailand, these initiatives are not linked and there has not yet been an effort to consolidate and reflect on the learning from these initiatives.

Well-developed governance and institutional arrangements are critical to the development and sustainability of effective DRR and EWS (PPEW, 2006). Strong leadership and effective institutions provide the enabling governance, socio-economic, and cultural conditions required for building resilience in coastal communities (US-IOTWS, 2007). Accordingly, mutually accountable partnerships between all levels of government, NGOs and communities need to be developed and strengthened to alleviate social exclusion, mistrust and frustration and enable meaningful and informed participation in decision-making processes and future DRR and EWS development.

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## APPENDIX 1. SEI'S STRATEGY TO SUPPORT THE SUSTAINABLE RECOVERY AND RESILIENCE BUILDING IN THE TSUNAMI AFFECTED REGION (SEI'S TSUNAMI PROGRAMME)

**F**ocusing on Thailand, Sri Lanka and Indonesia, the overall objective of this programme is to support the region's recovery from the tsunami by generating knowledge and building capacity with key regional partners in the areas of vulnerability assessment, sustainable livelihoods, and resilience building. The programme consists of five integrated projects that aim to build long term resilience to coastal hazards

among vulnerable communities through knowledge generation (field- and desk-studies, assessments, policy and institutional analyses); synthesis of research and studies; identification of lessons learned; facilitation of policy dialogues; and applied interventions.

For more information about SEI's Tsunami Programme, please visit: <http://sei-international.org>.

### **The SEI Tsunami Programme.**

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#### Tsunami vulnerability assessment: for immediate and longer-term sustainable recovery

This project aims to produce a synthesis of regional vulnerability analysis, as well as local vulnerability and capacity assessments to inform the longer term recovery and reconstruction of the region, to help target assistance programmes, and to ensure that new vulnerabilities to future shocks and stresses are not created as a result of the reconstruction process.

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#### Early warning and community preparedness: strengthening the technology–community interface

This project aims to ensure that the establishment of an Indian Ocean EWS that addresses the link between technology and communities, by promoting community preparedness and resilience, across a range of hazards.

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#### Public administration, coastal zone disaster preparedness and vulnerability

Through the process of identifying key lessons from disaster responses, this project aims to facilitate a dialogue on better institutional structures, policies, and management plans for dealing with disasters in general, and, specifically, for managing resources in coastal areas.

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#### Sustaining coastal communities – aiding livelihood recovery

This project aims to support the sustainable recovery of those in key coastal industries, such as the informal tourism sector, through an integrated study of the factors underlying their vulnerability and inhibiting their recovery.

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#### Sustainable water and sanitation for household/community systems

This project aims to support the water and sanitation needs of remote and poor communities affected by the tsunami through a focus on sustainable water supply, well rehabilitation, and the promotion of improved rainwater harvesting techniques, and ecological sanitation.

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## APPENDIX 2. EARLY WARNING AND COMMUNITY PREPAREDNESS: STRENGTHENING THE TECHNOLOGY–COMMUNITY INTERFACE

The overall aim of this project was to explore the links between technology and communities in the development of national early warning systems (EWS) in the Indian Ocean Region. The project departed from the recognised challenges associated with implementing policy/guidance for EWS on the ‘last mile’, and explored how community resilience can be more effectively supported through EWS development.

After the 2004 tsunami, the Intergovernmental Oceanographic Commission (IOC) of the United Nations Education Scientific and Cultural Organisation (UNESCO) received a mandate from the international community to coordinate the establishment of the Indian Ocean Tsunami Warning System (IOTWS) at the World Conference on Disaster Reduction (WCDR) in 2005 (UN/ISDR, 2005). This coincided with the adoption of the Hyogo Framework for Action 2005 - 2015 (HFA) which is based on the insights of a review of global progress made in disaster risk reduction (DRR) under the Yokohama Strategy between 1994 - 2004. The HFA highlights early warning as one of the major elements of DRR that could both save lives and help protect livelihoods, and also protect national development gains (UN/ISDR, 2005). It recognises early warning as an effective tool to reduce vulnerabilities and to improve preparedness and response to natural hazards. The HFA stresses that 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’ (UN/ISDR, 2005, p. 2). 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 HFA thus emphasises the urgency of promoting community participation in DRR, policies, networking, and strategic management of volunteer resources, roles and responsibilities through multi-stakeholder and cross-sectoral partnerships (UN/ISDR, 2005).

In hazard EWS the term ‘last mile’ or ‘last kilometre’ is frequently 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, pers. comm., 2008). The term ‘last mile’ has been criticised 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, EWS should be developed using a bottom-up approach that prioritises 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 EWS that address all stages of early warning, from hazard detection and warning to community-level response (US-IOTWS, 2007a).

Notwithstanding the diversity of definitions, the notion of the ‘last mile’ has been increasingly popularised in the Indian Ocean during the tsunami EWS development (Vidiarina, pers comm., 2008). As a notion it is understood and interpreted differently by different actors (Jegillos, pers. comm., 2008). For example, LIRNEasia 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 (LIRNEasia, 2008). The United States Indian Ocean Tsunami Warning System (US-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, 2007a). 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. It is thus not relevant to seek a comprehensive 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 EWS in the Indian Ocean Region and the current challenges associated with improving this link.

For a detailed description of the rationale and methodology please refer to Thomalla *et al.*, (2009).



Map of Phi Phi Island displaying evacuation routes and safe areas (Raks Thai and SEI, 2009)

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