Understanding Tsunami Hazard Knowledge and Preparedness: Before and After the 2010 Tsunami in Mentawai (Indonesia)

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A Thesis

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"Rejoice in hope; patient in tribulation; continuing instant in prayer" Romans 12:12 (KJV)

I humbly proclaim "Jesus is my Saviour and Strength"

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Statement of Authentication

I certify that the work in this thesis has not been previously submitted for a degree nor has it been submitted as part of requirements for a degree except as fully acknowledged within the text.

I also certify that this thesis has been written by me. Any help that I have received in my research and the preparation of this draft itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

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1. Accepted conference paper with the title “Individual and Household Tsunami Preparedness Measures in Mentawai, West Sumatra, Indonesia” at The 21st NZASIA International Conference 2015 University of Canterbury, 29 Nov to 1 Dec 2015.
2. Accepted conference paper with the title “Potential coping capacities to avoid tsunamis in Mentawai” at the 6th International Symposium on Earth-hazard and Disaster Mitigation (ISEDM) 2016, Bandung (Indonesia), 11 – 12 October 2016.
3. Journal Article (in progress) with the title “The Internalization of Tsunami Hazard Knowledge and Its Implications for Tsunami Preparedness at the Community Level in the Mentawai Islands (Indonesia)”

Abbreviation	Description
Bappeda	*Badan Perencanaan Pembangunan Daerah* (Provincial or District Agency for Development Planning).
BMKG	*Badan Meteorology, Klimatologi and Geofisika* (National Agency for Meteorological, Climatological, and Geophysical Affairs).
BNPB	*Badan Nasional Penanggulangan Bencana* (National Agency for Disaster Management).
BPBD	*Badan Penanggulangan Bencana Daerah* (Provincial or District Agency for Disaster Management).
BPS	*Badan Pusat Statistik* (Center for Statistical Affairs)
LIPI	*Lembaga Ilmu Pengetahuan Indonesia* (The Indonesian Academy of Sciences).
ITB	*Institut Teknologi Bandung* (Bandung Institute of Technology).
IFCR	International Federation of Red Cross and Red Crescent Societies.
Pemda	*Pemerintah Daerah* (Provincial, District or City Government).
Perda	*Peraturan Daerah* (Provincial or District Regulation).
Satlinmas	Satuan Perlindungan Masyarakat, is a group of the local community members that have been trained to take care of any impacts of potential earthquakes and any potential tsunamis caused by an earthquake, in particular at night-time in one *dusun.*
UNESCO	United Nations Educational, Scientific, and Cultural Organization.
UNISDR	United Nations International Strategy for Disaster Reduction.
UNDP	United Nations Development Programme.
WHO	World Health Organization.

Abstract

This thesis is about the people from the Mentawai Islands (in Indonesia) in the context of disaster risk reduction. It results from a curiosity to deeply explore the tsunami hazard knowledge existing before the 2010 Mentawai tsunami occurred, and current tsunami preparedness. It also provides theoretical frameworks and key research concepts in relation to the issues. In order to understand the picture of Mentawai in the past and the present, the thesis also includes how the tsunami vulnerability progression has been formed. The progression presents from the era of solitary lives of the people, the era of destroying the traditional beliefs and tools, and up to the current era when the people live in unsafe locations. In order to obtain a full picture of the topics, a qualitative case study was designed with the consideration of how to plot and to show a number of illuminating facts.

The people's reflections and perspectives on their tsunami hazard knowledge before the 2010 tsunami occurred and devastated the islands, and their current tsunami preparedness, were examined. There were a number of substantial facts showing how the research participants captured, shared, and internalized explicit knowledge on tsunami hazards into their tacit knowledge. These processes occurred with little support from the district government and local non-government organizations, and were further impacted by their low socio-economic and educational status. The processes of the knowledge internalization were obviously influenced by their traditional beliefs and personal perceptions. Thus, the implications of the internalization were also different when it came to anticipating tsunami waves. Subsequently, the 2010 tsunami also brought different impacts to the participants. In the context of current measures, tsunami preparedness is applied differently at various levels, even though the people have experienced the 2010 tsunami. At the individual level, the participants mostly ignore their own preparedness, although some of the participants have specific personal efficacy and protective behaviour to avoid tsunami waves. At the household level, some would most likely leave their household members to save themselves, while others would try to help their family members. At the sub-village (*dusun*) level, the people tend to abandon the evacuation processes. Meanwhile, at the district level, although some important documents exist for the district government to follow, tsunami preparedness measures are less prioritized.

The last parts of the study are how the local community of Mentawai can increase their capacity to encounter potential tsunamis. In the absence of modern technologies, the community has a number of traditional strategies to anticipate hazards and various opportunities to reduce their vulnerability. Developing coping capacity is essential for the people through implementing community early warning systems. These systems will provide risk knowledge, strategies to monitor the surroundings, understandable warning communication, and qualified response capability in the event of a tsunami. For the longer term, the leaders and the community need to work hand in hand to create an adaptive mechanism for living in Mentawai. This will be achieved by utilizing and reutilizing their traditional tools and strategies, and taking any opportunity to improve their livelihoods, and consequently, their coping and adaptive capacities to deal with tsunamis.

Abstrak

Tesis ini berkaitan orang-orang yang berada di Kepulauan Mentawai (Indonesia) terhadap pengurangan risiko bencana. Tesis ini diawali dari keingin-tahuan untuk melihat secara mendalam pengetahuan terhadap tsunami sebelum terjadinya tsunami di tahun 2010 di sekitar Mentawai dan usaha kesiapsiagaan terhadap tsunami saat ini. Di dalam tesis ini terdapat bagian yang menjabarkan tentang kerangka teori dan beberapa kunci pokok pemikiran yang digunakan dalam penelitian ini. Untuk mendapatkan gambaran yang lebih jelas terhadap Mentawai baik di masa lalu maupun saat ini, tesis ini juga menyajikan perkembangan kerentanan terhadap tsunami. Perkembangan tersebut disampaikan dari masa penduduk setempat mulai mengenal orang-orang di luar Mentawai sewaktu mereka hidup aman dan tenteram di dalam hutan, masa penghancuran kepercayaan tradisi, hingga masa saat ini dimana kebanyakan dari anggota masyarakat hidup di tempat yang tidak aman terhadap tsunami. Untuk mendapatkan gambaran yang menyeluruh terhadap topik di atas, maka dipandang perlu mendisain penelitian ini dengan studi kasus secara kualitatif untuk mendapatkan beberapa fakta yang nyata di dalam masyarakat.

Di dalam tesis ini, terdapat beberapa pemikiran dan persepsi yang ditemukan di dalam masyarakat Mentawai tentang tsunami dari beberapa peserta penelitian. Pemikiran dan persepsi tersebut merupakan gambaran sebelum terjadinya tsunami 2010 yang merusak kepulauan tersebut. Beberapa hal yang sangat penting didapat adalah bagaimana peserta penelitian menangkap, membagikan dan menginternalisasikan pengetahuan terhadap ancaman tsunami yang telah secara terbuka disampaikan menjadi pengetahuan yang terpendem di dalam diri peserta tersebut. Proses tersebut dipengaruhi oleh terbatasnya peran pemerintah daerah, lembaga swadaya masyarakat maupun rendahnya tingkat pendidikan dan sosio-ekonomi masyarajak tersebut. Dalam proses internalisasi tersebut, sangat jelas terlihat adanya pengaruh kepercayaan yang lama dan persepsi pribadi. Sehingga, hal tersebut menimbulkan dampak yang berbeda terhadap peserta penelitian tersebut ketika tsunami 2010 terjadi.

Sedangkan dalam hal usaha peningkatankesiapsiagaan terhadap tsunami saat ini, tesis ini menyajikan beberapa usaha yang rendah, walaupun penduduk tersebut telah mengalami tsunami 2010. Pada tingkat individu, terlihat bahwa kebanyakan dari peserta penelitian

cenderung mengangap kesiapsiagaan tersebut kurang penting. Walau demikian, beberapa dari mereka telah memiliki kemampuan khusus dan perilaku yang protektif untuk menghindari tsunami di masa yang akan datang. Pada tingkat rumah tangga, beberapa peserta lebih cenderung menyerahkan usaha kesiapsiagaan terhadap anggota keluarga yang lain. Sebagian lagi akan berusaha menolong yang lainnya bila terjadi tsunami. Pada tinkat dusun (masyarakat), peserta cenderung mengabaikan beberapa proses dalam evakuasi. Terakhir, pada tingkat kabupaten, usaha kesiapsiagaan terhadap tsunami mendapat prioritas yang tidak penting walaupun beberapa dokumen penting untuk pengembangan kesiapsiagaan telah tersedia.

PART 1: INTRODUCTION AND CONTEXT

CHAPTER 1

Introduction

"The important thing is not to stop questioning. Curiosity has its own reason for existing" (Albert Einstein).

1.1. Background and overview of research

This thesis contributes to the field of disaster risk reduction, with a particular focus on tsunami preparedness measures in the Mentawai Islands (West Sumatra, Indonesia). The intended outcome of this research is to develop new useful insights into how the individuals, households, local community, and local government in the Mentawai Islands (Mentawai) respond to the threats of tsunami hazards. For this purpose, two main topics have been explored to develop this thesis. Firstly, the way individuals' knowledge of tsunami hazards was related to their efforts to prevent and prepare for the 2010 Mentawai Tsunami (the tsunami) is examined. This topic addresses how the local community of Mentawai captured, shared, created, and applied knowledge to protect their lives from the tsunami. Secondly, how current tsunami preparedness measures are formed within the community of Mentawai is also explored. These explorations show some actions by the individuals, households, local community, and district government in Mentawai in developing and enhancing their efforts to be prepared for potential tsunamis. To conduct the research, a qualitative case study to collect data and analyze the field data has been employed. The data analyses are based on a cross-cultural and institutional framework of knowledge management and multi-level approach to preparedness.

My interest in this subject arose when I worked for the *Badan Nasional Penanggulangan Bencana* (*BNPB*=the National Agency for Disaster Management) on the community empowerment program from 2008 to 2012. During my assignment, I attended some meetings to discuss how the district governments in Indonesia could revitalize the local wisdom within their communities to avoid disasters. One piece of local knowledge was *Arat Sabulungan* (a traditional belief and practice) from Mentawai. With its inherent values and principles, it was believed that *Arat Sabulungan* practices could afford protection against disasters to the community in Mentawai. However, when a tsunami occurred in Mentawai

in 2010, many people perished which caused several questions to arise such as to why and how it was that *Arat Sabulungan* did not work at that time. Initially, I intended to focus on *Arat Sabulungan* in relation to a cultural adaptation to tsunami; however, it became apparent that *Arat Sabulungan* would be part of the solution to the problem.

This study has brought me new understanding and insights about Mentawai. During the study, some references, research interviews, and observations have provided me with numerous facts about the existing desires of the local community in Mentawai to be safe from a potential tsunami. My exposure to the theoretical and practical aspects of knowledge management and disaster preparedness measures has strengthened my capability to understand the principles of problem progressions and their potential solutions. As a government officer in the BNPB, this understanding is essential for me in developing the right decisions or guidelines for a particular community in Indonesia in the future. In the last part of this thesis, I also propose some practical programs on how the community could mainstream tsunami preparedness measures into their daily lives. Also, I have recommended in the thesis to the district government of Mentawai ways to develop a number of technical guidelines and policies to strengthen community efforts towards safety from tsunami waves in the future.

1.2. Rationale of the research

Various studies of Mentawai have brought much knowledge and understanding to the world and many seismic and paleo-tsunami studies have been carried out over recent years. The scholars have mapped the old and current locations of earthquakes in the Mentawai Segment where the islands lie. They have also provided the information that Mentawai is very prone to tsunamis and potentially bigger earthquakes may occur that can generate significant tsunamis BMKG (2012); (Natawidjaja, 2007; Natawidjaja et al., 2006; Newman, Hayes, Wei, & Convers, 2011; Philibosian et al., 2014; Philibosian, Sieh, Natawidjaja, Hong-Wei, et al., 2012). Through these studies, the scholars have realized that the islands have been hit by tsunami hazards in the past and they will occur in the future.

Also, many social studies exist. These studies are mainly related to how the indigenous people in Mentawai moved from the jungles to the coasts (Delfi & Weintré, 2014; Schefold, 1988; Sihombing, 1979; Spark, 1991; Tulius, 2012a). The people mainly moved during the

1970-1980s when the Central Government of Indonesia applied a new program to introduce education and health services to the indigenous communities. Many external and internal factors forced them to leave their old ways of living in the jungles and find relatively new means of living on the coast. At the same time, the movements have made them vulnerable to tsunami hazards. They were never informed about any potential tsunami hazards, and they never knew that devastating tsunamis existed. No oral stories indicate that the indigenous people of Mentawai experienced tsunami hazards in the old days (Tulius, 2012a) so, consequently, it appears that the people of Mentawai never experienced tsunamis before the 2010 tsunami (the tsunami).

The tsunami was generated by an earthquake (Mw7.9) on 25 October 2010. The earthquake originated in the subduction zone near the Mentawai Islands and triggered tsunami waves that reached the islands about seven to ten minutes after the quake. The run-ups of the tsunami waves were about 9 metres and inundated up to about one kilometre inland (BNPB, 2011; Lay et al., 2011; Newman et al., 2011). The earthquake destroyed 1,262 houses and public facilities while the tsunami took 509 lives. The event created a number of socio-economic problems and financial losses for the people. Over 11,000 displaced people lived in temporary shelters in the jungles and about 1,800 students did not have access to education. From the damage loss assessment, the events caused financial losses of IDR 348.92 billion (equal to NZD 48.4 million in 2010) (BNPB, 2011).

Before the tsunami, several tsunamis also occurred in other parts of Indonesia. They were the Indian Ocean Tsunami (2004), the Nias Island Tsunami (2005) and the Pagandaran Tsunami (2006). These occurrences resulted in intensive news on the national television channels, newspapers, radios, and other media. However, the news seemingly never reached many of the people in Mentawai. There are several reasons why this might have been the case. Firstly, most of the people had no access to TV. Secondly, some the local NGOs tried to work after the tsunamis hit Aceh (Aceh Darussalam Province) and Nias (North Sumatra Province), but they found it difficult to continue their programs. The NGOs found it difficult to access and reach the people who lived in very remote areas and consequently, the situation forced them to make high-cost programs. Lastly, socio-economic status also influenced whether the people either received or did not receive the news.

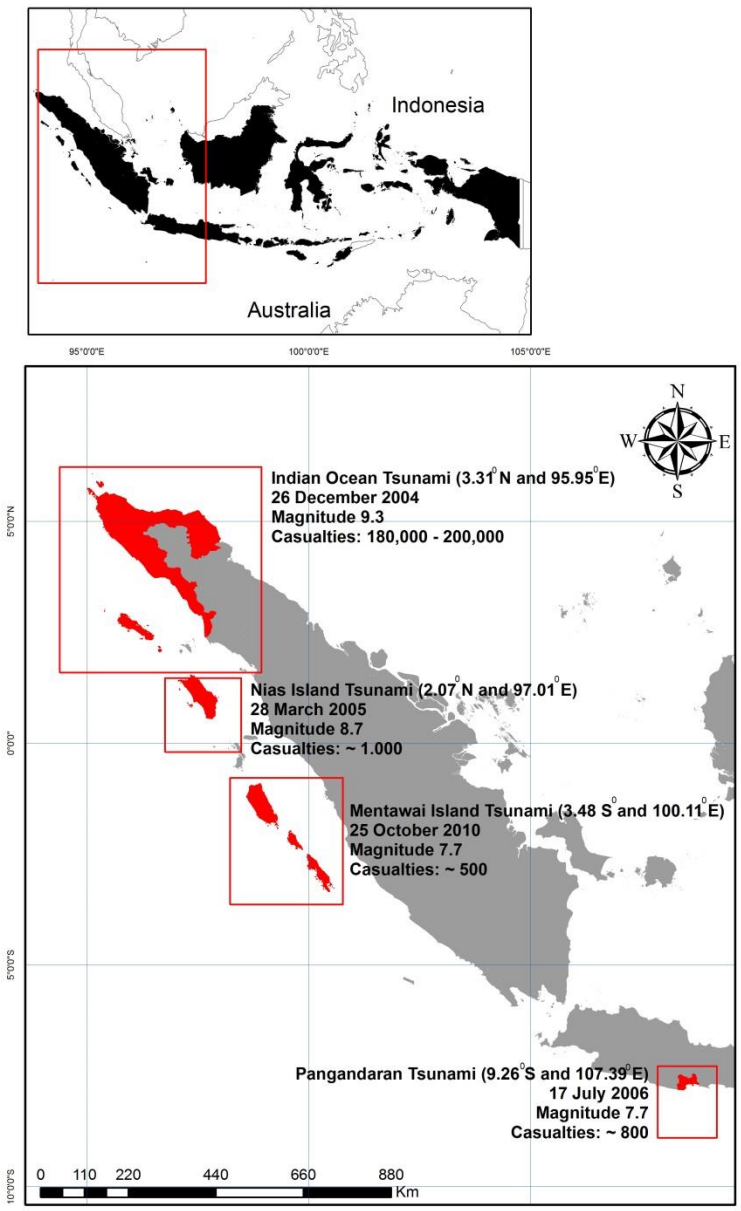

Figure 1. 1
Several tsunami occurrences in Indonesia for the last two decades
Sources: Satake (2014), Natawidjaja (2007) and Mori et al. (2007)

Therefore, as some seismic scholars warn, the people of Mentawai are still vulnerable to any potential tsunamis, despite their previous tsunami experience. The resettlement of all individuals from the coastal areas seems to be impossible as it would create other social problems and the relocation efforts would consume many resources both public and political. For example, the district government of Mentawai has very limited human and financial resources (BPS Mentawai, 2012; Kementerian Dalam Negeri, 2011). It is considered that the provision of advanced technologies to anticipate potential tsunamis is important.

However, such techniques also require skilful people and secure financial commitments. On the other hand, to provide individually experienced personnel in Mentawai is challenging because the Mentawai Islands are very remote and have limited public facilities. The local people also have limited capacity for operating complicated technologies. On the other hand, after they have experienced a tsunami, it is important to know how they would build any current protection from future potential tsunami waves. Understanding the local contexts is essential to provide valuable recommendations. These potential recommendations will be integrated with the existing traditional knowledge, cultures, and mechanisms to increase their capacity to carry out tsunami preparedness measures.

1.3. Overview of disaster preparedness in Indonesia

After Indonesia experienced several massive disasters in the last decade, such as the 2004 Indian Ocean Tsunami and the 2006 Yogyakarta Earthquake, the Indonesian Government passed the Act No. 24 of 2007 on Disaster Management. Since the enactment of the Act, Indonesia has altered two central tenets on how to manage disasters. Firstly, the Government focused more on preventive measures rather than reactive measures. This has brought many positive changes in disaster management in Indonesia. One goal of the Act is to provide protection for the people from disaster hazards by ensuring the implementation of disaster management measures in planned, integrated, coordinated, and comprehensive ways. The Act emphasizes integrated measures of emergency management, encompassing prevention and mitigation, preparedness, response, and recovery. The Act also mandates that the government at each level shall develop a disaster risk assessment and plan. This document becomes necessary in national or local development planning (BNPB, 2013a).

Secondly, the shifting of government- to governance-driven programs has provided conducive environments for various participants to partake in different kinds of programs in disaster management. To achieve the above goal, for example, the substantial involvement of governments (central, provincial, and district/municipality), communities, and private sectors are necessary for the planning, implementation, and evaluations of the programs. Similarly, Simarmata and Suryandaru (2011) argue that since 2008, more non-state participants have been involved in particular disaster risk reduction and preparedness compared to previous periods, including community-based organizations, private businesses, academia, and civil society.

The Act has also included a national system for disaster management that consists of five components: the legislation, organization, budgeting, strategic plans, and annual programs. Since then, there have been significant changes in how the Government develops its policies, public programs, or partnerships. Under the Act, BNPB is established as the leading national agency that organizes the above system. It coordinates the planning and implementation processes of the integrated national programs that consist of before, during and after the emergency. According to Simarmata and Suryandaru (2011), BNPB was established to meet the needs of a national agency, which can provide regulations, guidance, and policies for disaster management efforts both nationally and locally in the context of decentralized governance.

At the national level, BNPB also has the responsibility of maintaining and strengthening relationships with various ministries and other non-ministry agencies when implementing disaster risk management. At provincial, district or municipality level, BNPB takes part in establishing BPBD (Provincial or District Agency on Disaster Management) and in formulating the *Peraturan Daerah* (*Perda* = the Provincial, District, or Municipality Regulations) on disaster management. Since 2008, BNPB has supported 34 provinces and at least 450 districts/cities in issuing a *Perda* on disaster management. The *Perda* are used as the legal documents to establish public programs for disaster risk reduction and preparedness, emergencies, and rehabilitation after them. Furthermore, BNPB has also facilitated the establishment and development of 43 thematic risk reduction platforms as the forum to disseminate disaster risk reduction (DRR) awareness, to promote DRR mainstreams on local developments, and to share experiences and information among their members. Moreover, the Government has integrated DRR as part of sustainable national developments, where previously such developments were never considered (BNPB, 2015).

The Act also obliges the governments to develop and to integrate disaster management programs into the applicative programs. According to Maarif (2012), BNPB has created three main programs namely: before disaster programs, during disaster programs, and post-disaster programs (Figure 1.2).

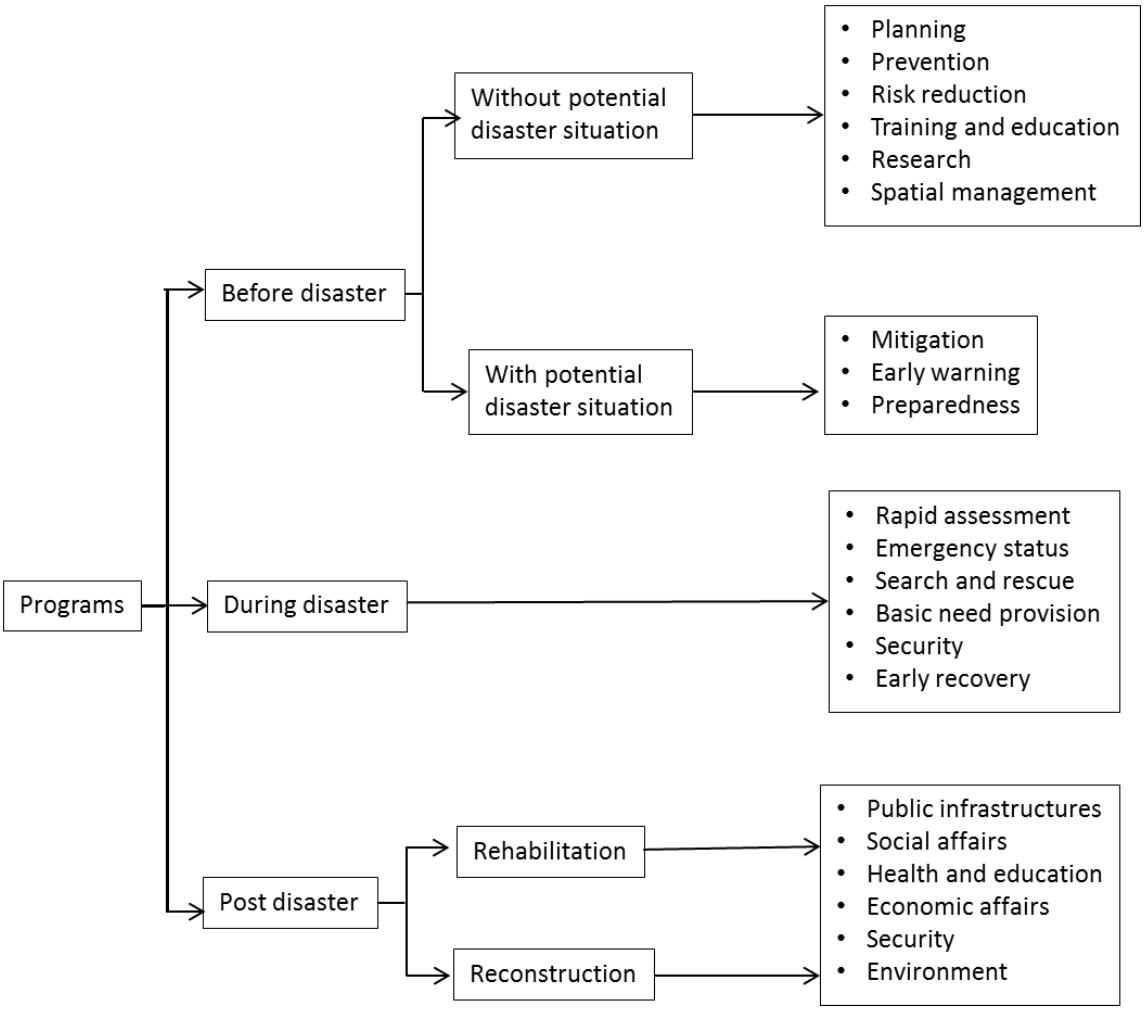

Figure 1. 2
Annual programs on disaster management in Indonesia
Source: Maarif (2012)

Figure 1.2 shows that the before disaster program consists of two programs based on the situation with or without potential catastrophes. With potential disasters, the program consists of mitigation and preparedness measures.

Following the 2004 Indian Ocean Tsunami that created a lot of deaths and destruction, Indonesia has started to develop an Indonesia Tsunami Early Warning System (Ina-TEWS) since 2005 with the involvement of 16 ministries. In 2008, Ina-TEWS was established and involved district and municipal governments in the system. Ina-TEWS is a comprehensive system to collect all information from seismic monitoring system to detect earthquakes and tsunamis. It also seeks to increase institutional capacities through research and pilot projects. Furthermore, it creates guidelines, policies, protocols and regulations in order to

mitigate tsunami risk and increase the capacity of Indonesian people to anticipate potential tsunamis (BMKG, 2012).

Ina-TEWS consists of three elements that are interrelated with each other i.e. Monitoring System, National Capacity Development and Mitigation and Emergency Response, as Figure 1.3 below shows.

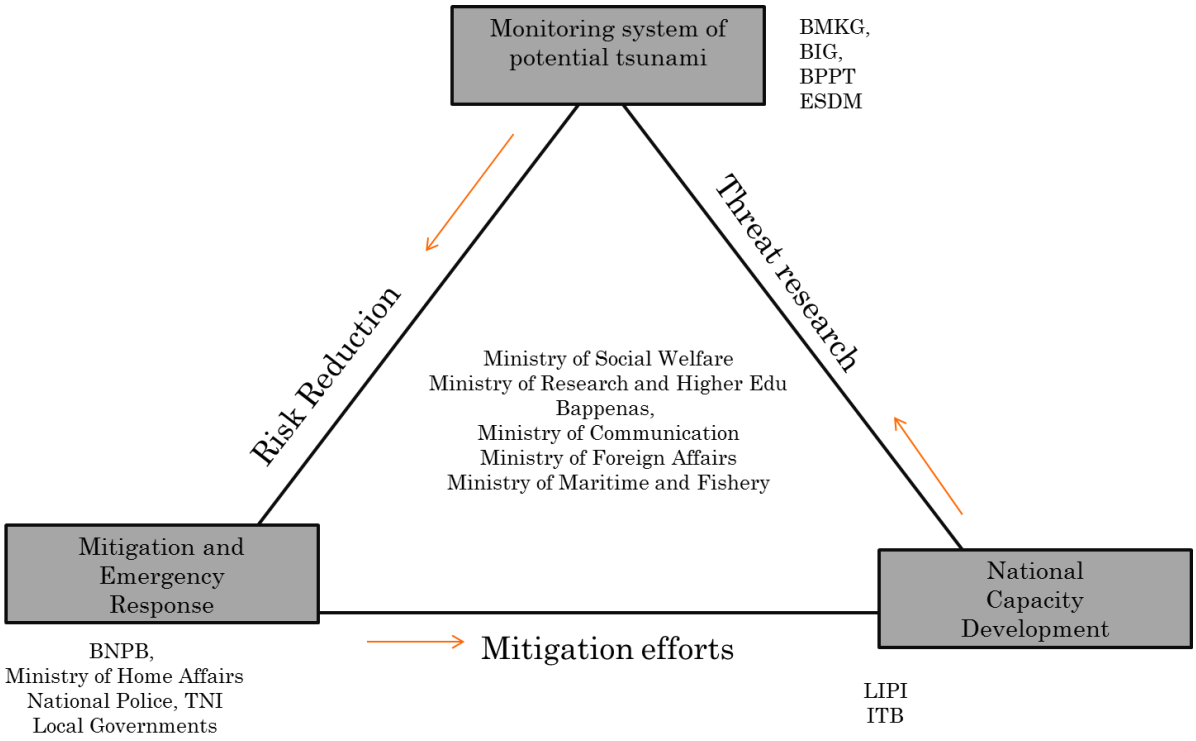

Figure 1. 3

The Ina-TEWS consists of Monitoring System, National Capavity Development and Mitigation and Emergency Response involve 15 Ministerial and National Institutions and Local Government to conduct an end-to-end tsunami preparedness in Indonesia

Adapted from BMKG (2012)

There are two main levels of Ina-TEWS, i.e. upstream and downstream. For the upstream level, the above elements work together to provide several aspects of tsunami-related information and to make sure the Indonesian people stay away from the tsunamis. First, the Monitoring System mostly focuses on earthquake detection along with analysis and dissemination of potential tsunamis. With supports from BIG, BMKG is responsible for the provisions of tidal gauges and a global positioning system, while BPPT uses deep-ocean

assessment and reporting of tsunamis (DART) to collect quality deep-water data during a tsunami (BMKG, 2012). Secondly, the National Development Capacity focuses on research related to physical and social aspects of tsunamis. ITB and LIPI work together to provide inputs for decision making institutions. ITB and LIPI also implement a number of pilot projects at the local level or community level in order to provide better understanding of model interventions. Lastly, the element of Mitigation and Emergency Response is coordinated by BNPB and focuses on two aspects: mitigation efforts and relief efforts in the event of a tsunami. Since these mitigation efforts are at the upstream level, BNPB focuses on how to develop a number of general guidelines and protocols, public policies and regulations. In any potential tsunami, BNPB is also responsible for conveying the tsunami warning to the relevant local government as well as ensuring the local government officers have sufficient knowledge and capacity to implement a series of tsunami preparedness programs at the local level (BMKG, 2012).

To make all efforts work at the upstream level work, a municipal or district government needs to implement applicative programs, known as the downstream level. At this level, it is important to develop a people-centered early warning to make vulnerable people become capable, resilient and able to protect themselves. The district/municipal government, through its local agency (BPBD), is required to increase risk knowledge through increasing capacity of the local community. BPBD also ensures easy access for the people to conduct evacuation processes and to provide reliable warnings. BPBD is also required to ensure timely and technically accurate responses of the community in any potential tsunami (BMKG, 2012). As cited from UNIDSR (2006), BMKG (2012) states that the above requirements will “enable individuals, communities and organizations threatened by a hazard to prepare and to act appropriately and in sufficient time to reduce the possibility of harm or loss”.

Recently, the Indonesian Government implemented a decentralized authority and district/city autonomy based on Act 22 of 1999 on Local Governments, and Act 25 of 1999 on Financial State Distribution. It means that the Central Government’s authorizations are mainly delegated to the local governments, also known as a delegation of authority. Disaster management is also included in the delegation of power to the local governments. With this, the local governments should consider all efforts to handle disasters including

prevention, mitigation and preparedness efforts (BNPB, 2008). In fact, at the district level, disaster management programs often have less priority.

1.4. Statement of problems

As mentioned above, the tsunami EWS in Indonesia consists of two sectors namely: upstream and downstream. At the downstream sector, the district/city government has the most responsibility for following up tsunami warnings and disseminating them to the community (BMKG, 2012). The district/city government is the only authority to claim and announce the evacuation procedures that are put into practice. Following the announcement, the district/city government should also provide guidance and instructions to evacuate the potentially affected people (BMKG, 2012). However, the District Government of Mentawai finds it difficult to receive the tsunami warnings from the upstream sector either from the government institutions or TV and radio channels. Several reasons may be found for the tsunami warnings being either delayed or never received. The placement of the buoy and tide gauges in the Mentawai sea requires high density in number. Currently, there are only four gauges placed in this vast sea (Yue et al., 2014). Also, although an office for the emergency centre (OEC) exists 24 hours a day and seven days a week, the electricity is often down every day (BNPB, 2012). Indeed, the OEC may have a power generator, but gasoline is not always easy to find in Mentawai. Similarly, the tsunami warnings through TV and radio channels also require electricity which is not available all day. So, there will be potential times that OEC may not receive the signals from the upstream sector, and the community cannot access the TV channels because of the unavailability of electricity.

Moreover, even if the government (through BPBD) receives the warnings, it still has the problem of disseminating the warnings to the community. The geographic conditions of the islands create enormous challenges. Mentawai consists of four bigger islands, namely Siberut, Sipora, North and South Pagai Islands and 95 inlets (BPS Mentawai, 2012). Although the people mainly live on the bigger islands, some also live in the inlets and most individuals who live on the larger islands also live in very remote areas, in which accessibility is lacking. Unfortunately, potential tsunami waves in Mentawai can reach these areas in less than ten minutes (BNPB, 2013a). Therefore, it seems that the above standard procedure of tsunami EWS may not be applicable in Mentawai.

To save the local community of Mentawai from potential tsunami waves in the future, it is important to find a better way to disseminate tsunami warnings. It is considered that the local community has existing or traditional methods and strategies and potential opportunities to create, develop, or strengthen tsunami preparedness measures. Therefore, this study will explore that potential, so that in the future the people can use the tsunami hazard knowledge and preparedness measures for their safety.

1.5. Research questions

The primary aim of this thesis is to provide new insights of social and cultural aspects into preparedness measures in Mentawai. For this aim, I have designed two main research questions followed by several sub-questions.

1. *How was the tsunami hazard knowledge formed among the local community of Mentawai before the 2010 Mentawai Tsunami?*

From this question, the following questions are asked in order to explore the influence of such knowledge:

a. *Did the local people hear or know about tsunamis?*
b. *If they did, how was the knowledge captured and shared within the community?*
c. *How did the knowledge internalize within the community?*
d. *What did they know about tsunamis?*
e. *Was this knowledge useful to reduce the impacts of the 2010 tsunami preparedness*?

2. *How is the current tsunami preparedness formed in Mentawai?*

Some sub-questions dealing with the above questions are:

a. How do individuals and households prepare for potential tsunamis?
b. How does the local community at the dusun *level actively participate in tsunami preparedness?*
c. What relevant provision has the local government made for tsunami preparedness?

1.6. Thesis statements and contributions

The study has required proper preparation of a substantial thesis to present the findings of the research. The development has provided sufficient opportunity to include the broad framework of disaster risk reduction and the field research in the thesis. To accomplish the whole thesis, adequate and qualified supervisions have been obtained to ensure ability, persistence, vision, and guidance on a range of academic matters. As a result, the

supervisions have contributed to my intellectual independence and increased my capacity to undertake other challenges in the future.

It is acknowledged that the study has involved many pieces of research drawn from other studies. During the investigation process, I have also participated in a sustained, rigorous, and systematic manner to the relevant body of knowledge through some literature reviews. This method has provided a significant contribution to my experience and understanding and the application of knowledge. The insightful analyses, alternative ideas, literature, methods, and other people's work have been used in this thesis as building blocks, complementary additions, and re-framings.

From this study, a number of original contributions to knowledge are identified which can become a bridge to new knowledge about Mentawai. They can also provide a clearer understanding of tsunami hazard knowledge and current tsunami preparedness in Mentawai. Moreover, they also offer the reader an opportunity to review and rethink the written research findings in the thesis. Similarly, the opportunity also provides a chance for others to carry out further research into a new area of knowledge or to find a new angle from my understanding of what has been found. The principal contributions of the thesis are:

a) A realistic model of the vulnerability progression of tsunami hazards has been utilized to analyze the root causes and dynamic pressures that cause the local community of Mentawai to live in the hazardous coastal areas. This model has brought a new understanding of how past practices create huge problems for the future if no actions are taken to minimize or prevent the hazards in Mentawai.
b) A set of benchmark methodologies has also been utilized to capture the tsunami hazard knowledge and tsunami preparedness measures of the research participants. Among various kinds of qualitative methodology, a case study has augmented and enriched other methods. With the geographic, demographic, and infrastructure challenges, this approach has shown its reliability and function in collecting and exploring the field data in the future.
c) A particular knowledge management approach has been introduced to analyze tacit and explicit knowledge on tsunami hazards. This model has brought new understanding of how the knowledge has been transmitted, captured, and shared

among a “unique” group of people in Mentawai. More importantly, this also brought to our understanding how the knowledge was useful in avoiding the tsunami in 2010.

d) A multi-level approach model for tsunami preparedness has also been used to analyze the field research findings. This model has allowed an understanding of how the individuals, household members, community members and district government officers have participated in increasing their safety from tsunami hazards.

e) Based on the research findings and reference reviews, some specific actions have been proposed to enhance the capacity of the individuals, household members, community, and local leaders in anticipating and avoiding tsunami hazards in the future. The proposed actions have taken in to account their cultures, traditions, existing strategies, and opportunities, not only to increase their anticipation of the tsunami but also to improve their livelihoods.

1.7. Research limitation and delimitation

Although I have carefully considered the methods that were employed in this research, a number of limitations that I could not control might be found within the study. These limitations may decrease the validity to some degree; however, the research results are still applicable since the integrity of the study still remains. Some limitations are identified as follows:

1. As the heads of *dusun* were the gatekeepers in this research where purposive sampling was employed; they might have appointed the research participants as the best ones to express their opinions among others in their *dusun*. To avoid potential biases of the participants, as the criteria, I encouraged the head of *dusun* not to appoint the weakest or the strongest among the suitable participants. As Bryman (2008) warns, qualitative researchers should not choose participants who are the weakest or the strongest among the population. By considering the most talkative and the least talkative persons among the population, we can avoid potential bias in participants and increase the generalizability (Bryman, 2008). However, it is also important to note that this kind of bias is not easy to avoid.
2. Although the research participants expressed their opinions and ideas in Bahasa, several terms or words were spoken in the Mentawai dialect. Likewise, the participants might have also slightly misunderstood the questions that I raised in Bahasa. Indeed, I

brought with me someone who could translate the dialect and words into Bahasa, but that person might have expressed things differently or slightly differently.

3. It was considered that reaching a number of *dusun* in Mentawai was very challenging. The dirt roads, jungles, sea water, and weather were the main obstacles to accessing the *dusun* and the islands. It was thought necessary to have at least equal numbers of participants from each island; however, because of the time limitations and the above challenges, I had no chance to interview candidate participants from the Siberut islands.
4. The field research was conducted in the middle of 2014. As one of the research questions was about the tsunami hazard knowledge before the 2010 tsunami, the participants might have expressed their experiences, feelings, opinions, and perceptions differently or slightly differently from the actual conditions. This would influence the findings. In order that the participants were aware of this specific issue, I always emphasized my questions by starting each one with "before the 2010 tsunami".
5. As the ethical considerations required the participants' signature on the Consent Form, to some extent this could not be applied. Since the research needed to be carried out, however, I always requested that the participants provide me with oral consent prior to the interviews.

It was also considered that a number of delimitations were identified that might be under my control. The delimitations of this study are as follows:

1. It was a privilege for me to choose Mentawai as the research location as this location is very prone to tsunami hazards. In addition, the qualitative case study that provided me with numerous facts and evidence is important to increase the tsunami awareness and preparedness of the people in Mentawai.
2. In order to achieve the aim of the study, I had determined specific characteristics of the participants. I had also recruited the participants from certain *dusun* by adhering to the characteristics.

2.1. Structure and organization of the thesis

This thesis consists of three parts and eight chapters. Each part is linked as shown in Figure 1.4. The first part is the introduction and context and consists of Chapters 1 to 4. It demonstrates the framework of the research. Chapter 1 introduces the context of the problems by addressing and describing the research's background and rationales and setting

out the insights, which this thesis will contribute. Chapter 2 reviews the theoretical foundations of disaster preparedness and some key concepts of the research. Chapter 3 addresses the study of the theory of how the vulnerability in a community develops and provides an example of the vulnerability progression toward tsunami hazards in Mentawai. Lastly, Chapter 4 explains the methodology of the research on how the approaches and analytical framework are employed during the research.

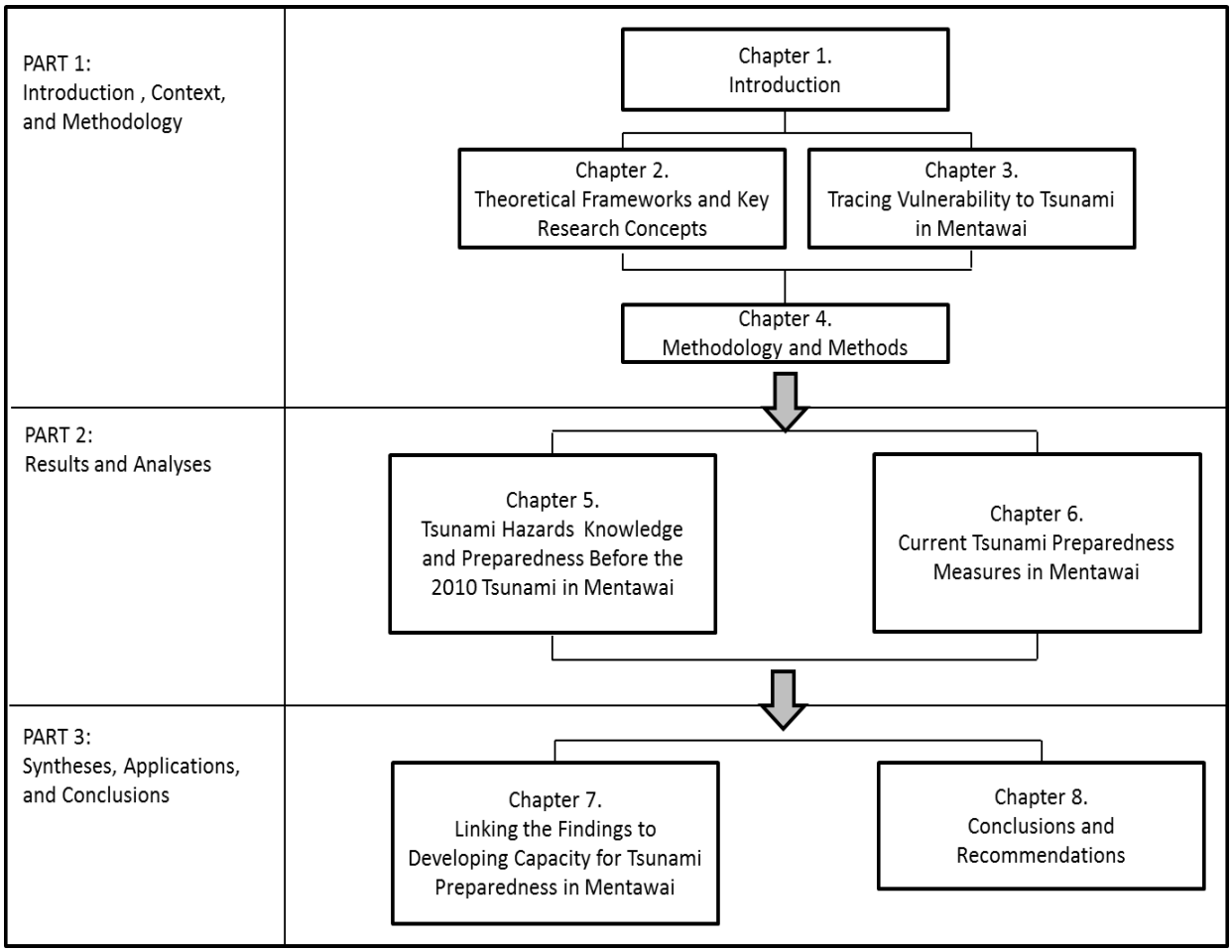

Figure 1. 4
The structure of the thesis

The second part contains the results and analyses of two topics that correspond to the two research questions. Respectively both are presented in Chapter 5 and Chapter 6. Chapter 5 explores the research participants' hazard knowledge and, by using knowledge management, the chapter shows how the knowledge is captured, shared, created, and applied to tsunami preparedness. Chapter 6 explores how the individual/household, the community from the *dusun*, and the local government implement tsunami preparedness

measures. It also shows some problems and potential solutions to enhance tsunami preparedness in Mentawai.

The third part is about synthesizing the lessons learned and consists of Chapter 7 and Chapter 8. Chapter 7 addresses how the facts from the field study and vulnerability progression are used to develop the local community's capacity in tsunami preparedness. Based on the field findings, this chapter looks at the enhancement of coping and adaptive mechanisms to solve the vulnerability to tsunami hazards in Mentawai. Chapter 8 extracts some conclusions from the study and suggests how the findings apply to other communities, in particular those in the remote, isolated islands in Indonesia

CHAPTER 2
Theoretical Frameworks and Key Research Concepts

"A concern for risk, and with it a motivation to improve disaster mitigation and preparedness, has tended to fall between the cracks of the conceptual framework that has driven development co-operation and humanitarian assistance" Christoplos, Mitchell, and Liljelund (2001, p. 185)

2.0. Introduction

Literary histories show that disasters have occurred over thousands of years; however scientific investigations of disasters, in particular from social standpoints, are just currently occurring. It is claimed by Dynes (2000) that the first scientist who had a social comprehension of disasters was Rousseau. His standpoint was based on the 1755 Lisbon earthquake of Mw 8.9 which created a tsunami wave 15 m high in the city of Lisbon (Baptista, Heitor, Miranda, Miranda, & Mendes-Victor, 1998). The earthquake killed about 1,000 people and this number rose to 10,000 due to the tsunami (Simoes, Afihado, & Mendes-Victor, 1992; Zitellini, Chierici, Sartori, & Torelli, 1999). Rousseau claimed that because most of the people had evacuated after the initial tremors, the aftershocks that ruined whole buildings did not greatly affect the dense population (Dynes, 2000). Urbanization in Lisbon had created a high vulnerability to earthquakes. He then discussed that the population growth should have been reflected in the planning and development processes to avoid disasters (de Almedia, 2008). Lastly, he pointed out that the societal and cultural norms should have been part of the solutions to manage the disasters (Dynes, 2000). In brief, Rousseau's viewpoint on the Lisbon Earthquake was the first step to place social perspectives on the disaster risk management framework.

The development of social insights into disasters is important nowadays. As this study is designed to produce new social insights, this chapter focuses more on the social aspects of disasters and will show the theoretical framework and the conceptualization of disaster preparedness for the thesis.

Section 2.1. Discusses how disaster risk framework is important to be analyzed.

Section 2.2. Discusses four phases of disaster management framework

Section 2.3. Links disaster preparedness with hazard knowledge.

Section 2.4. Explains disaster preparedness in the context of a local community at the household, community and local government levels.

Section 2.5. Describes how to promote disaster preparedness through a collaboration with the local NGOs, private business, mass media and using social media.

Section 2.6. Explains the theoretical concepts to achieve resilience.

Section 2.7. Concludes the chapter.

2.1. Disaster Risk Framework

Disaster risk is the probability of devastating effects of hazards on vulnerable people, their property and environments. UNISDR (2009, pp. 9-10) defines risk as "the potential disaster losses, in lives, health status, livelihoods, assets and services, which could occur in a particular community or a society over some specified future time period". It can also be understood that risk exists or is created within social systems as a result of the interaction of people with nature and their environment. Moreover, framing disaster risk has provided significant decreases of casualties and damages in quantity and quality through the development of disaster mitigation and preparedness (Christoplos et al., 2001). In addition, this emphasizes that capacity is also available within the people to cope with the risk. This capacity is considered to the sum of abilities of people, organizations and systems that exist such as the available efficacies, protective behaviors, and possessions to handle disasters (UNISDR, 2009). Therefore, discussing disaster risks involves the aspects of hazards, capacity, vulnerability and exposure.

The relationship of disaster risk with hazard, vulnerability and exposure can be drawn as below:

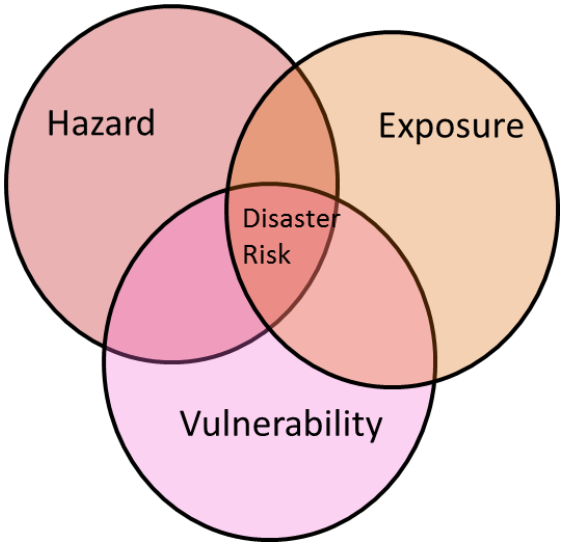

Figure 2 1
The intersection of hazard, exposure, vulnerability
from Reese and Schmidt (2008) cited from Power (2013).

Figure 2.1 indicates that disaster risk results from an intersection of hazard, exposure and vulnerability. This means that growing exposure and delays in reducing vulnerability or delay in developing capacity will increase the possibility, likelihood and consequence of a potential disaster.

2.1.1. Hazards

Disasters risk increases as a result of one or more events that trigger disruptions, known as hazard(s). WHO (2002, p. 3) defines hazard as "a natural or human-made event that threatens to adversely affect human life, property or activity to the extent of causing a disaster". Similarly, Makoka and Kaplan (2005) argue that a hazard is an event that potentially creates deaths, wounds, physical impairment, social and economic interruption, or environmental ruin. Also, a hazard is a hazardous event or circumstance which may potentially create deaths, injuries, or decrease health status. It can also damage human property, ruin livelihoods, worsen public services, and bring socio-economic and environmental disruptions (UNISDR, 2009).

The above definitions show that hazards are potential perils or interruptions to human life, property and infrastructure, livelihood, and environment. Therefore, it is vitally important to be aware of the existence of hazards within communities. All sectors such as individuals, communities, governments, and private business need to be aware of and anticipate the

hazards in their surroundings. This awareness allows the people to be entirely involved and enlightened as to how they may be affected by an emergency (Kapucu & Ozerdem, 2013). Through public education, adequate and effective preparedness measures may make people avoid the impacts of the existence of certain hazards. Or, the people may be able to create high levels of adjustment to harmonize the existence of the hazard (Perry & Lindell, 2007). For this purpose, the people are required to have hazard knowledge of adjustment adaptation and implementation.

Hazards can be human-induced or natural in origin. Table 2.1 indicates several kinds of hazard categories.

Table 2 1
Hazard categories

No	Hazard categories	Hazard
1	Geological	Earthquakes Volcanoes Landslides.
2	Meteorological	Windstorms Temperature extremes Lightings Droughts.
3	Hydrological	Floods Debris flows.
4	Oceanic	Erosion Tsunamis.
5	Biological	Outbreaks of communicable diseases Wildfires
6	Extra-terrestrial	Comets
7	Technological	Hazardous materials Industrial failures Fires

Source: Abbott (2014); McGuire, Mason, and Kilburn (2002); and Wisner, Gaillard, and Kelman (2012b)

Many people have tried to envisage hazards, since they believe that hazards are cyclical events. However, Hyndman and Hyndman (2009) point out that even the most periodic hazards are mostly not really cyclical, due to numerous irregularities that control the

behavior of hazards. Furthermore, historical records of hazards can only improve probable estimates as recurrence intervals. From these intervals, people may forecast when a hazard may happen (Hyndman & Hyndman, 2009).

Hazards can arise in all-time scales. They may last for a few moments, hours, days, a span of years or decades (Gregg & Houghton, 2006; Simon, 2012). Furthermore, they can be single, sequential or combined. Each hazard has certain characteristics, based on its position, strength, magnitude, possibility, length, and regularity (Gregg & Houghton, 2006; Niekerk, 2011; Simon, 2012). Because of different characteristics, according to Gregg and Houghton (2006), it becomes imperative to understand the precursory period and response time of a hazard. Therefore, the precursory period and response time provide substantial implications for a detailed planning and implementation of public programs such as preparedness measures.

As indicated above, precursory periods and response times are different for each hazard. Some hazards have a precursory period and response time which are very short so that people hardly have any time to conduct certain protective behaviors. However, some other hazards have very long precursory periods and response times. In this case, people may have time to carry out proper and adequate prevention and mitigation efforts. Gregg and Houghton (2006) give an example that earthquakes may have only a few seconds' precursory period, or even none at all. Similarly, their response time may last a few seconds. Other examples are river floods and droughts. Both hazards may have long precursory periods and response times. According to Alexander (1999), a river flood has an average of precursory period of 15 hours; therefore, those who may be affected can prepare for and react to the hazard for a longer period.

2.1.2. Vulnerability to hazards

Another aspect of disaster risk is vulnerability to hazards. Vulnerability is the particular characteristics and circumstances that exist within a group of people or within a special system that contribute to making the people or the system susceptible to a destructive hazard (UNISDR, 2009). Moreover, Cardona (2004, p. 37) defines vulnerability as an internal risk element within a certain community or system that creates an unprotected condition for the community or system from a hazard. It also corresponds to the inherent proneness

of the people or system to be affected or susceptible to impairment (Cardona, 2004). According to A. Singh, Hossain, Foresman, and Cheatle (2003), scholars have used vulnerability in numerous ways. Firstly, vulnerability was focused on physical structures, socio-economic circumstances, and accessible resources. Later on, vulnerability was also used to explore the linkages of hazards to demographic and geographic conditions (A. Singh et al., 2003). Recently, vulnerability has been used to describe the association of certain people with risks, hazards, climate change, and food safety. Currently, vulnerability has become a wide range of academic disciplines and practical intentions. However, the utilization of vulnerability to illustrate a phenomenon often concludes with the concerns of root causes and dynamic pressures of the phenomenon as these will subsequently cause the people to have fragile livelihoods and live in unsafe locations (Wisner, Blaikie, Cannon, & Davis, 2004; Wisner, Gaillard, & Kelman, 2012a).

2.1.3. Exposure to hazards

Other aspect to increase disaster risk is hazard exposure (exposure). Exposure is one important component that may affect our lives. Exposure refers to the various elements of people, such as livelihoods and belongings, that are found in a particular location where hazard events may exist (Cardona et al., 2012). Moreover, Lavell et al. (2012) define that an exposure can be employed to designate the existence of people with their livelihoods and daily activities in a place where their existence might be jeopardized by physical events. Thus, exposure can occur when the people, economic resources, infrastructures and cultures are situated in areas exposed to perilous hazards. However, Cardona et al. (2012) argue that, although exposure is essentially important to consider, it is not sufficient to determine disaster risk. People are possibly exposed to a hazard but they may not be vulnerable; however, people who are vulnerable to a disaster are necessarily exposed to the hazard.

Hazard exposure arises from people's habitation in the area where they may be involved in a particular category of hazards that jeopardize their sustainable existence or belongings (Lindell et al, 2007). UNESCO (2011b) gives an example of some people who are simply exposed to a combination of hazards such as tsunamis. Coastal areas are frequently exceedingly densely inhabited and developed as domestic, profit-making, industrial and delivery centres (UNESCO, 2011b). These developments are often driven by regimes with

improper and inadequate planning which can escalate the exposure to a tsunami hazard when the sea water is affected by a massive power such as an earthquake. As a consequence, those who reside in these shoreline zones are potentially more exposed to tsunamis because of improper utilization of coastal areas.

2.1.4. Capacity

The last aspect of disaster risk is capacity. Capacity is the deployment of powers, characteristics, and capital that exist within communities or institutions to reach established objectives (Lavell et al., 2012; UNISDR, 2009). Here, capacity includes the strengths and characteristics of institutions, societies, and personalities that can be accessed and used in relation to the presence of a hazard. In order to increase capacity, the above access and usage require the involvement of socio-economic, psychological, cultural and natural resources. Moreover, capacity contains accessibility to and usage of information and governance to reduce vulnerability. Therefore, capacity is also known as the subsidiary mechanisms for the people at risk. The mechanism can be obtained by the proper utilizations of structures, organizations, social coping abilities, awareness, protective behaviors, and characteristics. These elements are linked to social relations, governance, and management.

Capacity is related to short and longer terms; therefore, it is divided into two categories: a coping capacity and an adaptive capacity. Fletcher et al. (2013) and (UNISDR, 2007b) argue that coping capacity is the momentary response to decrease the effects of a traumatic occasion, or an adverse condition. This allows the competency of people, institutions, personal efficacies, and possessions to encounter and manage unexpected settings and emergencies. While Smit and Wandel (2006) argue that adaptive capacity is a response to manage and minimize the risk from recurring situations into a longer term solution by using community ability.

In relation to lessen disaster risk, capacity is important to develop. Capacity reduces vulnerability and moves the exposure away from hazards (see Figure 2.2).

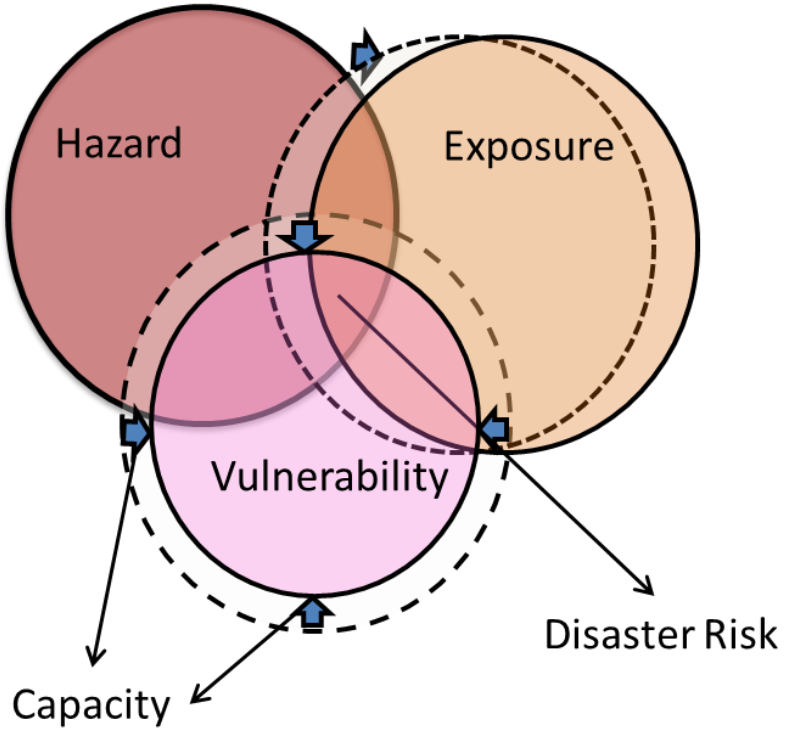

Figure 2 2
The reduction of disaster risk
The reduction from the intersection of hazard, exposure, and vulnerability by decreasing vulnerability and developing capacity and by removing the people, livelihoods, and poverty from the exposure to a hazard

2.2. Disaster management framework

Seemingly, disasters always lurk in human lives. According to Fritz (1961) a disaster is "an event concentrated in time and space, in which a society or one of its subdivisions undergoes physical harm and social disruption, such that all or some essential functions of the society or subdivision are impaired" (p.655). WHO (2002) also provides a definition of a disaster as an event disturbing a normal circumstance and causing a level of distress that surpasses the ability of the affected people to adjust. Similarly, UNISDR (2009) defines a disaster as a severe interruption within a community affecting people, their physical, economic, or natural destruction. This interruption is also considered to create serious devastation which exceeds the people's capability to solve these problems by using their strategies. Furthermore, Gregg and Houghton (2006) link disasters to the inability of local communities to deal with their adverse influences and which require external assistance.

It is generally accepted that disasters are the source of numerous casualties and which throw the human socio-economic system into crisis, and generate extensive and costly

damage. As disasters often require external assistance, there is a clear need to elicit more attention from relief donors. Nevertheless, no single measurement can capture the full scope of a disaster: neither the number of people killed or affected, nor the impacts on livelihoods or properties. However, a number of experts have tried to quantify the impact of a disaster. Foster (1976) and Burton, Kates, and White (1993) quantified disasters with a threshold of a death toll of at least 100 deaths, or economic losses reaching at least $ 1 million. However, this kind of quantification is not workable since many elements are involved in the occurrence of a disaster. Later, Alexander (1997) suggested that the determination of a disaster should consider the death toll, the economic values of destruction and the adverse results on the social and environmental fabrics. But again, because of this complexity there are no simple measurements to determine a disaster.

The above definitions of disasters also imply that disasters often occur from suddenly overwhelming and unexpected events; therefore disasters are related to before, during and after the events. From this view, experts argue that there is a cycle of measures as a disaster management to handle the problems. The measures are from latency through prevention and mitigation, preparedness, response and recovery (Alexander, 2002; Godschalk, 2007; Lindell, Prater, & Perry, 2007; B. D. Phillips & Neal, 2007). It can be said that disaster management is about all measures which may be implemented before, during and after an emergency. The measures have come from different approaches to different aspects of disaster management which vary from traditional approaches to recent sophisticated disaster risk management approaches. In fact, disaster management is linked to a number of disciplines, contexts, cultures, and practices (Bhandari, Malakar, & Murphy, 2010).

Normally, scholars and disaster-related institutions divide disaster management into four phases as shown in Figure 2.3. Ideally, the first phase, prevention and mitigation, comprises all actions designed to eliminate disaster risk to the people and their possessions and environment in the future. There are a number of broad actions that can be conducted under this phase: the establishment of legal and programmatic frameworks and systems at national, provincial, and district levels. These elements of governance will share common characteristics, while they also reflect the contexts and implementation particularities in the local contexts (Velasquez, Bonapace, & Srivastava, 2012). Furthermore, it is also important to conduct a series of risk assessments and risk prevention and mitigation (Alexander, 2002;

Godschalk, 2007; Khan & Khan, 2008; Lindell & Perry, 2007; B. D. Phillips & Neal, 2007). As scientific bases, these measures are useful prior to developing specific action plans from public policies (BNPB, 2012).

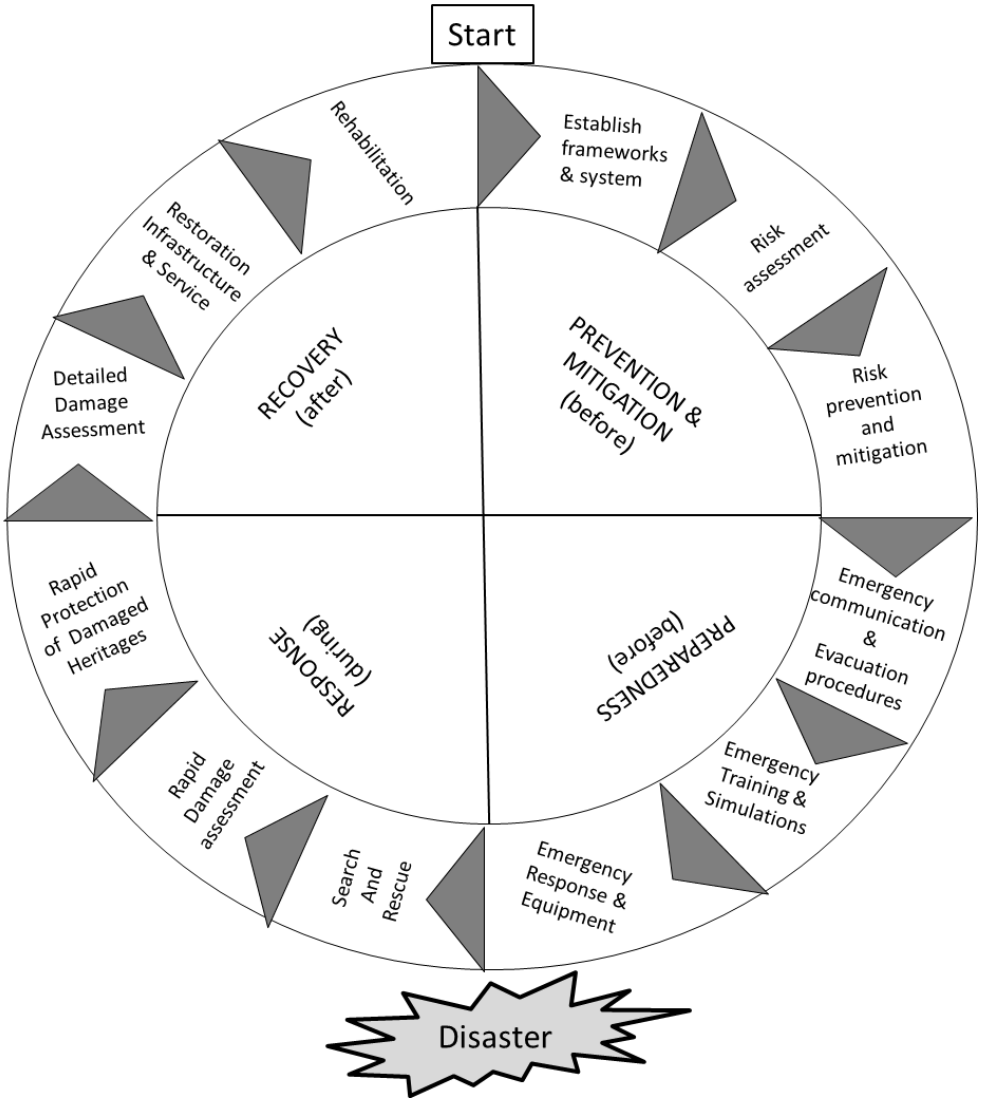

Figure 2 3
Disaster Management Cycle
Source: Adapted from Alexander (2002); Godschalk (2007) and Lindell and Perry (2007)

The second phase, preparedness, is about actions taken to decrease the impact of forecasted or imminent disasters. The actions are related to truthful knowledge of a hazard, adequate responses and external assistance (Alexander, 2002; Godschalk, 2007; Lindell & Perry, 2007; B. D. Phillips & Neal, 2007). There are also a number of broad actions needed such as providing emergency warning communication, evacuation procedures, training and simulation activities, and emergency response and equipment. The third phase, response, is

related to emergency deeds which focus on saving and safeguarding human lives throughout an emergency period and a short-term aftermath (Alexander, 2002; Godschalk, 2007; Lindell & Perry, 2007; B. D. Phillips & Neal, 2007). The effectiveness of response actions reflects the adequacy of prevention and mitigation and especially preparedness efforts. During this phase, search and rescue are vital to save the affected people. This will be followed by conducting rapid damage assessments and protections of property. Lastly, recovery is the actions taken after a disaster to repair destruction, reinstate public services, and rebuild public infrastructures. This phase consists of important damage assessments, treatments and rehabilitation which affect actions. These actions will affect mitigation, preparedness and response phases in the future (Alexander, 2002; Godschalk, 2007; Khan & Khan, 2008; Lindell & Perry, 2007; B. D. Phillips & Neal, 2007). From this last phase, we can start again to the first phase and go on.

2.3. Developing preparedness measures through hazard knowledge

Although scholars have conducted research on both the physical and social science aspects of disasters and disaster risk, yet people and governments still find it difficult to handle disasters, to reduce risk, and to implement preparedness measures. Recognizing the difficulties, it is important to involve the at risk people as a part of developing strategies to deal with disasters. It is thought that the people might have existing or traditional methods and strategies to cope with their own difficulties. In addition, they might have various opportunities to be involved in or participate in every effort to reduce the difficulties or risk. As such, the people are, alongside the relevant stakeholders including the government, scientists and civil society, different sources of knowledge (Hyndman & Hyndman, 2009; Mercer, 2012).

As actionable information, knowledge is acquired through education and experiences. Mercer (2012) argues that experience may include an internally embedded awareness of a particular situation. Or, knowledge can be acquired from exposure to, for instance, education and trainings (Gelkopf, Ryan, Cotton, & Berger, 2008; Mercer, 2012; Smith & Woodworth, 2012). Such knowledge is known as explicit knowledge. Both types of knowledge have been widely known and used as resources in various approaches. However, Polanyi (1958), as cited by Mercer (2012) divided knowledge into local (inside) and outside knowledge that also consists of tacit and explicit knowledge.

Outside knowledge has made considerable progress in the area of disaster prevention, mitigation and preparedness. This knowledge about tsunami mitigation measures, for example, tends to concentrate on public facilities enhancement such as building massive sea walls or providing modern technologies. The high-tech solution is based on scientific data and modelling that can be tried, tested, proven and utilized through methods (Mercer, 2012). Therefore, this kind of knowledge can be developed into other areas because it has evidently saved lives when disasters strike. However, in many cases this effort can also fail to provide accurate information, or even to protect lives because it relies on specific skills and complicated tools, or to encourage people to believe a risky coastline is safe. Hence, Wisner et al. (2004) warned that high-tech solutions often require skillful expertise in responding disaster risk.

Knowledge can also consist of traditional and indigenous knowledge which is acquired over generations. Dekens (2007) argues that this local knowledge is how indigenous or local people in a particular area view, interact, control, translate and respond to forceful differences in environments, resources and services that the people generate. However, Mercer (2012) claims that this local knowledge is often ignored by so-called 'expert knowledge'. Similarly, the knowledge is also often disregarded, deemed insufficient or even forgotten over time by the local people. Local knowledge stays influential and dynamic through examination and adjustment to ecological as well as demographical changes. Therefore, in the Hyogo Framework for Action (2005-2015) UNISDR (2007a) capturing and practicing traditional and indigenous knowledge in disaster preparedness measures are urged. Thus, local knowledge becomes an access point to promote local communities' involvement. This involvement requires support from local community resources and local institutions (Battista & Baas, 2004).

As disasters are related to interrelated human, social and cultural factors, local knowledge is needed to maximize the implementations of outside knowledge (Hiwasaki, Luna, Syamsidik, & Shaw, 2014). The integration of local and outside knowledge on hazards will assist communities to manage risks and how they realize their potential solutions. Moreover, the significance of hazard knowledge is necessary as parts of national and local strategies to develop policies on disaster preparedness measures. The integration of short- and long-term strategies is important to diminish or reduce the adverse implications, avoid the

further disadvantageous leverages of property, and quickly recover from disaster. Yet, it is very challenging to incorporate local knowledge into policy developments and their implementation.

2.4. Disaster preparedness in local contexts

As disasters have a local dimension, disaster preparedness should also begin at the local level. For example, households can conduct simple activities to support family members' safety and to protect their belongings. Different people and communities may have different approaches to building various disaster preparedness measures. However, basic knowledge and guidance are important to understand in order to survive or escape from the potential presence of a hazard. Consequently, the roles of individuals, households and local community members in creating, maintaining and supporting disaster preparedness measures become imperative.

2.3.1. Preparedness at the individual and household level

It is crucial for individuals and family members to be safe and well and to ensure this, the response to disaster preparedness becomes critical. Individuals may respond differently to an unexpected event that occurs within their own community, but they can also create a similarity in principle in developing preparedness. The above Figure 2.3 indicates that there is a need for necessary measures to be implemented at the individual and household level. Before the event of a disaster, individuals can increase their ability in a significant way so that they are able to cope when an emergency occurs. They are also able to rapidly recover from it, and to protect other household members and possessions from preventable loss. The first step in preparing for any disaster is to realize which hazards could strike. At this point, being aware of where they are and what supporting and obstructing factors are in their surroundings are also necessary (Gerdan, 2014). Individuals also need to know about warning systems such as what alarms sound like, what the alarms mean, and what actions should be taken when they are heard (UNISDR, 2006b). For particular hazards such as tsunamis, a quick decision is required to evacuate to a safer place, but for other hazards people may need to stay at home. Therefore, it is essential to maximize awareness and encourage participation of individuals in disaster preparedness measures to effect change at the household and community levels.

Risk perceptions have a significant influence on disaster preparedness. Wachinger and Renn (2010) claim that risk perception is influenced by several factors. These factors can be local and outside knowledge, familiarity, norms, perceptions, and feelings. These will stimulate how people think about and judge the magnitude and tolerability of risks. Perceptions may involve the process of gathering, choosing, or interpreting signals about the uncertain impacts of hazards. Donahue (2010) exemplifies how people's perceptions of risk vary depending on their location. His finding was that people who lived in coastal areas judged themselves and their properties as more at risk of disasters than people who lived inland.

Preparedness measures at the individual level are interlinked with the same measures at the household level. Family members tend to inform other home-members about important topics. At the household level, it is necessary to involve all family members including special needs people in disaster preparedness. A household may consist of one or more persons from the family or extended families that are co-residing in a single residential unit. There are paramount roles of households in conducting and maintaining effective disaster preparedness measures. Scheer et al. (2011) and Lin, Eluru, Waller, and Bhat (2009) emphasize that it is essential for all households to have household evacuation plans. This will significantly increase family members' ability to understand potential hazards in their surroundings and ensure that they are guided to safer places in time in the event of a disaster.

Furthermore, Johnston and Dudley (2009), UNESCO (2014), and Acker (2007) argue that regular household exercises are also imperative to ensure all family members, including special needs people understand where to go in the event of a disaster. During the exercises, family members need to be well informed to perform the necessary self-evacuation without being formally directed (UNHCR, 2014). Moreover, it is important to prepare equipment or facilities that households need during an emergency (Arlikatti, Peacock, Prater, Grover, & Gnana, 2010; E. Y. Y. Chan, Kim, Lin, Cheung, & Lee, 2014; DeBastiani & Strine, 2012; Harrington, 2007). Therefore, as a household is the smallest unit of the community, it has an important role to strengthen community participation.

However, we also need to identify a number of factors explaining why individuals and households pay less attention to preparedness. Kapucu (2008) warns that 75% of individuals

and households who generally feel prepared through the availability of an evacuation plan, actually never practise the plan. Individuals and households simply provide fewer items for emergency and build fewer preparedness measures as a daily mission and tend do more in response to a disaster. DeBastiani and Strine (2012) also identify several adverse factors contributing to disaster preparedness, namely: younger ages, insecure jobs, limited education, and certain people. Even household members or individuals that have had previous direct disaster experiences are significantly influenced by risk perceptions and their personal efficacy in defending themselves and their household members often remains low (E. Y. Y. Chan et al., 2014). Therefore, it is necessarily important to identify what obstacles exist within households in order to develop, maintain, and/or achieve effective and continuous individual and household preparedness measures.

2.3.2. Preparedness at the local community level

Communities have rights and responsibilities to participate in the protection of their lives and to create harmonious living within their society. To achieve these aims in terms of disaster preparedness, it is important to conduct a number of measures by involving the community. Oakley and Marsden (1987), as cited by Mathbor (2008), argue that community participation refers to a process of how people, households, and societies undertake accountability for their safety. They also improve their own capacity to increase their survival. Therefore, community participation is an influential way of encouraging people to carry out their agreed objectives and the execution of meaningful programs. (Mathbor, 2008).

Community participation will empower local communities to build preparedness measures. According to Letz (2006) and Sutton and Tierney (2006), community participation in disaster preparedness measures involves building awareness and educating local community members on life saving skills as well as creating and revitalizing local early warning systems. It also improves coping resources, protects property, and initiates early recovery activities (Letz, 2006; Sutton & Tierney, 2006). Furthermore, it strengthens community empowerment to control the decisions affecting their lives. Lastly, it increases the effectiveness and efficiency of preparedness measures (Mathbor, 2008).

Community participation builds the social dimensions of disaster preparedness. Local communities can see themselves through their cultural lens, particularly their local knowledge of hazards and accumulated experiences (Sutton & Tierney, 2006). Local knowledge may become a door to promote the local community's participation in aspects of disaster risk prevention and mitigation and preparedness. Considering local knowledge in the practice and context of disaster preparedness will also help local institutions to implement and improve programmatic planning and implementation (Dekens, 2007). Local knowledge can also improve programmatic acceptance, ownership, sustainability, and performance of local community members. This means cost-effectiveness in short- and long-term efforts may be easy to obtain. Moreover, from a social perspective, local knowledge may stimulate common trust, tolerance, and collective consideration from local people's sense of partnership and self-confidence (Dekens, 2007).

Moreover, Panjaitan (2012) argues that owing to the lack of resources from local governments, local communities should be empowered to become principal responders in disaster preparedness measures. Through the empowerment, local communities are encouraged to use their existing resources such as local skills to prevent and prepare for unexpected situations. In addition, local community members could also promote disaster preparedness measures for others to participate in. Empowerment of local communities is necessary to understand their exposure to hazards, disaster risks, and their prioritized actions (Delica-Willison & Gaillard, 2012). Local communities can participate in every action taken from the planning process to evaluation of the action.

Previous experience with hazardous events may intensify community risk perception and encourage the preparedness movements of communities (Lindell & Perry, 2000; Muttarak & Pothisiri, 2013). Although evidence shows that many communities pass their experience and knowledge from one generation to the next as an intergenerational knowledge, they tend to ignore both the knowledge and the essence of practising the knowledge. Thus, continued reminders can be important to help others to remember and to understand certain hazards. In addition, Muttarak and Pothisiri (2013) suggest that in a community with no recent hazard experiences, it is vital to give the people community memories of past events. The memories can be sustained through oral histories or disaster memorials. Disaster survivor records and spoken histories may form hazard awareness in other people. They may also

increase risk perceptions in order to encourage others, so that if preparedness measures are taken, people may be able to survive a disaster (McAdoo, Baumwoll, & Moore, 2008; Paton et al., 2008).

In relation to disaster preparedness measures, however, social vulnerability is important to consider at the community level. Communities of limited socio-economic status are a major determinant of the vulnerability to the efforts of preparedness (Dash, McCoy, & Herring, 2010; Usman, Olorunfemi, Awotayo, Tinde, & Usman, 2013). Certain demographic characteristics also often increase vulnerability to disaster. Peek (2010) argues that infants, under five year olds, special needs and older people are vulnerable to disasters and become challenges for preparedness measures. UNDP (2010) argues that in many cases, minority and indigenous people may not have the right to self-determination. Furthermore, they also may not be able to access their political rights, or socio-cultural and economic growth to protect themselves from disasters.

To be specific, gendered contexts are important in deliberating on preparedness measures. In many societies the disparities between men and women are wide and women tend to have less access to obtaining assets, skills, and social status. The imbalance will highlight the gendered nature of disaster impacts. Kottegoda (2007, p. 16) states “women, especially if they do not receive timely warnings, or other information about hazards and risks, or if their mobility is restricted, or otherwise affected by cultural and social constraints, are major casualties in disasters”. In addition, Mulilis (1999) argues that in certain cultures, women may be at more risk of being affected by a disaster than men. In many societies, women generally spend longer inside their house than men. In addition, women tend to appraise the risk of hazards and disasters as being more threatening and serious than men do (Mulilis, 1999). Moreover, protective behaviors between women and men are also different. Lastly, Alston (2015) found several ways that women are more likely to be vulnerable to disasters, such as limited access to early warning information, increased responsibility for their household, difficulty in accessing relief goods, and physical constraints (having long hair and clothing). Therefore, women tend to exhibit higher levels of preparedness measures, and in many cases are affected more than men.

It is important to link local communities to their local cultures. Understanding local culture is most suitable to implement disaster preparedness measures. Cultural perspectives may provide lessons on hazards and how to prevent and prepare for them. These lessons can be applied in other places and scholars such as Hewitt (2012) and Cannon, Schipper, Bankoff, and Kruger (2014) divide the main roles of culture in disaster preparedness measures into two. Firstly, culture may be an obstacle which increases vulnerability to hazards. In many cultures the exposure can be seen as a punishment from their gods or spirits rather than something to be prepared for, or certain hazards such as volcanic eruptions are perceived as social rather than natural events (Cannon et al., 2014). So, in order to prepare for it, the people could offer to do certain things for their gods. In many societies disasters are "acts of God" that could not have been avoided, foreseeable, or preventable. Furthermore, J. Lewis (2015) argues that cultures can often change and shift, become modified, grow, or are diminished over a longer period rather than temporarily, because cultures change when the mind-sets of the people change. Lastly, the changes in indigenous cultures tend to include adopting new or majority cultures in one country, and ignoring intergenerational native strategies in coping with certain problems could worsen their risk to disasters (A. Phillips, 2007). Therefore, cultures can be an obstacle to building disaster prevention and preparedness measures because of their own characteristics in particular societies, or the changes or modifications of the cultures.

The second role is that culture can have tangible and intangible heritages that play a role in reducing vulnerability (Cannon et al., 2014; Hewitt, 2012). Generally, tangible heritage can be classified as immovable and movable cultural products. They can be buildings and historic places, monuments, artifacts or music instruments. Meanwhile, intangible heritages are the practices, methods, knowledge, and skills which a local community and individuals identify as fragments of their culturally unique legacies (UNESCO, 2003). UNISDR (2015) ensures that cultural heritages (tangible and intangible) are an encouragement to be resilient that supports measures to lessen disaster risks. As a result, the heritages can be linked to traditional land usage, oral and local history, identity, traditional technologies, and other local knowledge systems. These can provide necessary information to both prevent the creation of new risks and reduce existing risks. Therefore, cultural heritages can contribute to local communities by increasing their disaster preparedness.

Understanding types of communities is important when it comes to disaster management measures. BNPB (2014) defines a community as a parochial or categorical group of individuals. Firstly, a parochial community refers to groups of people who live in one territory and which local governments have legally acknowledged, such as villages or districts. This community develops an approach of promoting the involvement of grassroots into disaster preparedness measures at the local level. For this, a series of efforts is required that includes community self-interpretation of hazards and disaster risk, reduction and monitoring and evaluation of their own performance in disaster preparedness (Paripurno, 2008). Furthermore, this community can also form a group of practitioners as a part of the community to have particular responsibility related to preparedness measures. This group, for example, can share knowledge and experience with other community members (Paripurno, 2008). According to Paripurno (2008) the development of such practitioner groups is often linked to customary and religious institutions.

Secondly, a categorical community can refer to a group of individuals with particular objectives, such as non-government organizations, or other institutions such as research, peer groups, and media. The community can conduct some efforts to strengthen disaster preparedness such as programmatic frameworks of evacuation procedures; awareness campaigns; capacity buildings; safe schools; and advocacies as seen in Figure 2.3. Now, it is common to find governments and NGOs as categorical communities that actively work on disaster preparedness for local communities as parochial communities. Therefore, the roles of local governments are important for the communities to be prepared.

2.3.3. Preparedness at the local government level

Undoubtedly, local governments have important roles in enhancing disaster preparedness measures as categorical communities. The main role of local governments in disaster preparedness is to ensure that all community members and their property are spared from disasters. In order to achieve this role, Lindell and Perry (2007) state that local governments can provide certain activities such as:

- Developing a number of standard operating procedures
- Conducting training at the individual, household, community and institutional team levels

- Conducting periodic drills and exercises to verify responses to warnings
- Conducting risk communication programs to promote necessary emergency preparedness
- Evaluating preparedness programs

The above roles will ensure local governments and local communities have disaster preparedness measures as routine or mainstream activities. The roles are also considered to reduce a dichotomy between the responsibility that local governments have for the future of their jurisdictions and specific before and after disaster planning functions.

Figure 2.3 indicates that disaster preparedness actions are not only programmatic affairs, but also legal and political affairs. Consequently, local government leaders should have strong leadership to build coordination with local parliaments. As Schoch-Spana, Franco, Nuzzo, and Usenza (2007) suggest, building a coordination mechanism through structured dialogues, joint problem-solving and collaborative actions is compulsory in order to build strong disaster preparedness. The involvement of the local parliament is necessarily important to design the legal frameworks and systems of disaster management in the region. Moreover, in many democratic countries such as Indonesia, the approval of parliament is required prior to the implementation of public programs, so that financial support may be prioritized to support the programs. Additionally, demonstrations of local governments' ability to manage disasters and disaster risks have to be made under changing sociopolitical circumstances (Jasanoff, 2009). Thus, in order to conduct a number of activities in local communities, it is a challenge to develop or change legitimacy for public reasons. Local communities, for example, progressively need more access to information on disaster risk, therefore local governments should expand their capacity to gain the required information with better equipment.

2.5. Promoting preparedness through collaboration

In order to conduct preparedness actions as mentioned in Figure 2.3, it is important to build strong collaboration. This measure can be gained from local, national and even international collaboration and partnership. Robust collaboration is a key element in emergency preparedness with those communities (Gerber & Robinson, 2009). Several entities are identified that are inclusively important to develop collaboration in disaster preparedness

measures such as NGOs, businesses, and media. They often provide technical expertise, resources and programmatic actions to develop, maintain and expand disaster preparedness.

2.4.1. Local non-government organizations (NGOs)

As categorical communities, NGOs are well positioned to develop capacities of parochial communities at the local level such as individuals and households and local communities. Thompson (2012) mentions that an NGO is an institution in which citizens organize themselves to achieve agreed goals to improve, regulate or even change society. Moreover, D. Lewis and Kanji (2009, pp. 9-10) define an NGO as:

> "either legal (focusing on the type of formal registration and status of organizations in different country contexts), economic (in terms of the source of the organization's resources) or functional (based on the types of activities it undertakes)".

Therefore, D. Lewis and Kanji (2009) conclude that an NGO has five key characteristics: formal as an institution, private due to its separation from a government (although many governments support NGOs), non-profit distributing, self-governing, and voluntary.

Local NGOs' roles can influence the implementations of disaster preparedness programs and the development of public policies and political will related to disaster preparedness. Benson, Twigg, and Myers (2001) argue that many local NGOs offer local communities opportunities to examine the nature of their vulnerability. They often incorporate appropriate disaster preparedness measures into the analyses through community participatory approaches. Moreover, local NGOs can provide specific technical expertise to local communities such as the technical aspects of hazard mapping, capacity buildings, and evacuation procedures. In order to develop public policies, accountability and political will, according to Thompson (2012), local NGOs also often have no doubts about working through advocacy activities with local government institutions, local parliaments, and local media. NGO activists often do advocacy, both for public policies and legal frameworks on disaster preparedness as mentioned in Figure 2.3.

Initiatives of disaster preparedness from local NGOs should be value-added programs to those of local governments. UNISDR (2006a) argues that initiatives should be part of the local government's strategic plan on disaster management. At the community level, local

NGOs may have strategic thinking on disaster preparedness. They can implement micro-level initiatives on disaster preparedness that may provide wider positive impacts on individuals and communities. Schoch-Spana et al. (2007) argue that these positive impacts are attainable only if constant discourse, collaboration, and engagement between local NGOs, local governments and community members are increased. Therefore, the roles of local NGOs become necessarily important to develop tsunami preparedness measures in one community.

However, it is also critical to consider that program interventions by NGOs are complementary. Farrington (1997) argues that, although having great intuitive appeal and reflecting widely commended values within communities, many NGOs find difficulties with financial sustainability. Many NGOs will forsake their target programs as well as their target communities if they find it difficult to support the programs. UNISDR (2014) also finds a challenge in how NGOs work in harmony with local governments. There needs to be further harmonization and synchronization of cross-sectoral public intervention policies among NGOs and local governments.

2.4.2. Private businesses

As Figure 2.3 also specifies, disaster management requires good collaboration with private businesses in implementing prevention and preparedness measures. The involvement of private businesses contributes to strengthening local disaster preparedness measures within communities as well as within their organizations (UNISDR, 2008). Although private businesses produce goods and provide services for profit, they can also place great emphasis on and allocate resources for disaster preparedness. Haddow and Bullock (2006) and Sutton and Tierney (2006) also note that the ultimate goal of private businesses to be involved in disaster planning is to ensure their business survives. Similarly, private businesses also desire to use resources to reduce the impacts of disasters by contributing to disaster preparedness measures (Zyck & Kent, 2014). Furthermore, it is important for private businesses to develop business continuity plans that encompass a variety of elements, including evacuation protocols, environmental security, and information technology security (FEMA, 2011). To ascertain business continuity, private businesses need resources to maintain the running of the companies. Therefore, private sectors must design

plans to allow business operations to continue under adverse conditions by implementing appropriate resilience strategies (Sutton & Tierney, 2006).

In addition, Niekerk, Ndlovu, and Chipangura (2015) argue that private businesses are also able to contribute to making communities safer. Communities gain benefits from businesses that set procedures and quality assurance to be implemented within the communities. They can also invest in a number of programs in community risk reduction efforts. Moreover, particular expertise from private businesses can help communities with external disaster risk assessments. Lastly, they can act as financial sources to support agreed community programs by providing funds and volunteers (Niekerk et al., 2015). A number of strategic business concepts from the private sectors may be involved in relation to preparedness measures. The concepts may be as private-public partnerships, corporate social responsibility, charity, sponsorship and philanthropy, which can support disaster preparedness at the business and community levels.

2.4.3. The media in disaster preparedness

In response to disasters or emergencies, local communities tend to use improvised or impromptu media to communicate the real situation to others. Media are combined communication channels or equipment used to store and deliver information or data. Media can be mass media such as electronic or printed media and the press and broadcast (radio and television), or as social media (text, images, audio and video). Nowadays, both are important sources of information on hazards and disasters for people.

Mass media have been inextricably entwined with disaster management measures including disaster preparedness. The electronic, printed and broadcast media reflect great public interest and concern and provide extensive coverage of disaster preparedness measures (Radford & Wisner, 2012). Iqbal, Ali, Khursheed, and Saleem (2014) believe that mass media can raise awareness about hazardous events and educate people about disaster warnings. Mass media can also disseminate details of hazards or disasters and their potential impacts including physical, economic, social, and psychosocial. Furthermore, mass media can provide information about the sources of disaster assistance, and coordinate with governments and emergency response organizations (Iqbal et al., 2014). Moreover, mass media can gather and transmit the right information about preparedness measures and

contribute to the control of discourse progression within communities. According to W. Zhang (2015) mass media can be a channel of discussions for a community to understand confusing information and at the same time strengthen communal cohesion for disaster preparedness measures. Lastly, Radford and Wisner (2012) state that the media play an important and decisive role in responding to the about-to-occur events with energetic and persuasive pressures on people. Therefore, it is important to include or consider mass media (local or national) as participants in disaster preparedness measures. However, disaster preparedness topics in the mass media are not always interesting for certain people. These people tend to be interested in disasters only after the disasters have occurred.

The presence of social media has changed the world, including the area of crisis management, considerably over recent years. Dewing (2012) argues that social media has numerous kinds of Internet-based and mobile services. These social media enable the people to share online interactions, participate in user-created content, and link virtual groups. J. C. Chan (2012) argues that with readily available social media, individuals and institutions are able to disseminate, obtain, and interpret information more proficiently. They have also improved collaboration between individuals within a community or an organization. Social media are also good sources for persons to produce and share their opinions or information (Edosomwan, Prakasan, Kouame, Watson, & Seymour, 2011). It may be more efficient and easier than writing and sending a letter, making a call or personally attending a meeting or an office.

According to Dewing (2012), several kinds of social media that exist today include social and status-update services. In pre-emergency and emergency situations; however, people mostly use and participate in social network sites and status update services. Social network sites allow individuals to share and discover information to and from their list of connections within a bounded system. Some popular examples of this are Facebook and Linkedln, while services (such as Twitter) enable users to update their status. Their status may relate to what they have just experienced (such as a disaster). Therefore, others can view this status and understand what has just happened (Dewing, 2012).

Social media are an important method of social interaction during pre-emergency and emergency situations (Howell & Taylor, 2012). In these situations, social media can be used to inform other people of the location and how to reduce the risk. Prevention of risk is the top priority and then making the people vigilant and taking the right decisions for their life safety are next (Coombs, 2010). It is also clear that users of social media may shift from users to participants to actively distribute information sharing. However, Howell and Taylor (2012) warn that it is necessarily critical to understand the dynamics of status-updates or information sharing and how to address the prevalence of right, trustable, proper information. Otherwise they could create panics and unnecessary actions by others.

To avoid untrustworthy information, it is important that local governments use mass media and social media to get messages or information out to their community members in pre-emergency and emergency situations. J. C. Chan (2012) suggests five characteristics of mass media in delivering their topic material to people, namely:

- *Collectivity* to connect people across geographic restrictions and time zones.
- *Connectivity* to connect users to other resources.
- *Completeness* to capture and keep the messages in a constant state to be viewed and shared;
- *Clarity* of content from those partaking to be mindful of every opinion;
- *Collaboration* on how information is gathered and feedback provided.

2.4.4. Regional and national partnership

Figure 2.3 also indicates that the importance of broader frameworks is applied into local contexts. Local disaster frameworks should be in line with regional (provincial) and national frameworks. A disaster regional or national framework is a set of guidelines developed by a provincial or central government and this framework can recognize present best practices that have been implemented in other areas. It can also be developed to describe certain procedures, roles, and accountabilities of certain persons with their unique task and responsibilities Baker and Cormier (2015) also outline necessary procedures of how the framework is operated. The framework requires the maintenance of an engaged partnership and creation of a tiered response among all levels to ensure all planned activities are well implemented. Moreover, the framework can demonstrate scalable and

flexible operational capabilities to anticipate emergencies. Lastly, it can show unity of action and preparedness to perform (Baker & Cormier, 2015).

The above framework can lead the responsible persons to perform quick responses if needed. It may also ascertain a comprehensive and efficient strategy to be implemented. In addition, the framework can be manifested in legislation, strategic plans, and regional or national disaster systems. Therefore, specific local strategy documents affirm that specific legislation, certain disaster programs and disaster preparedness systems are harmonized with the regional or national frameworks. Strong partnerships can be built among local, regional and national players to develop disaster preparedness. More importantly, when in the event of disasters, local and higher frameworks are not contradictory and can easily match with one another, it may take fewer efforts to adjust activities in emergency situations.

2.4.5. International collaborative agreements

It is important to establish strong collaborative networks among players of preparedness measures in advance. Collaborative networks and cooperative agreements are the efforts to reach goals by integrating a wide range of organizations and entities into their daily tasks on preparedness measures (A. Patton, 2007). In a situation where fewer resources are found, networks are required to integrate energy, insight and enthusiasm. The networks also have significant roles in assisting the affected communities or countries to distribute international assistance. (Varda, Forgette, Banks, & Contractor, 2009). However, they are also considered to have costs and challenges. The integration of policies, programs and operations among a variety of disaster preparedness related institutions requires a strong commitment and leadership. Meanwhile, the institutions might also have different priorities, insights or platforms to implement the polices, programs or operation on tsunami preparedness (McEntire & Dawson, 2007).

Indonesia, for example, performs cooperative agreements on emergency assistance through the Association of South East Asian Nations (ASEAN) and has ratified and adopted the ASEAN Agreement on Disaster Management and Emergency Response (AADMER). AADMER is the arrangement to deliver and offer operative mechanisms to attain a considerable decrease in disaster impacts of the ASEAN member countries. It also enables a mutual

response to any unexpected events with regional and international co-operation (ASEAN, 2014). AADMER entered into force on 24 December 2009. This document is a practical regional framework for collaboration, procedural support, and technical deployment to relieve the affected member states of ASEAN (ASEAN, 2014). Based on this, ASEAN has also established an ASEAN Coordinating Centre for Humanitarian Assistance on Disaster Management (AHA Centre) in 2011, in Jakarta, Indonesia. The AHA Centre aims to provide information and knowledge of disasters in the region. It is also intended to serve as the resource mobilization during an emergency among member countries. It also has a role as the means to certify emergency responses in quick and collective actions (ASEAN, 2011). In order to operate the Centre, ASEAN has developed a Standard Operational Procedure for Regional Standby Arrangements and Coordination of Joint Disaster Relief and Emergency Response Operations (SASOP); recruited and trained the ASEAN-Emergency Rapid Assessment Team (ERAT), and established a Disaster Emergency Logistic System for ASEAN (DELSA) in 2012 in Malaysia. Since being established, the AHA Centre has conducted a number of humanitarian missions in the region.

In short, the development of several networks and collaboration in a number of joint and mutual areas of cooperation at the bilateral and regional levels and with international and domestic NGOs has been acknowledged. Proper disaster preparedness may integrate collaborative mechanisms and networks into the frameworks. It may also accommodate different actors in cooperating based on agreed principles and objectives. Appropriate means and ways of disaster preparedness at the community level consequently enable the potential resources and capacities to be identified, recognized and utilized.

2.6. Pathway to resilience

The disaster management cycle shown in Figure 2.3 has been discussed above. Conducting an adequate preparedness phase, along with the other phases, may create resilience. Resilience is the capability of a system within a community to have better handles with catastrophic events, to encounter change, and to master vital functions, structure, and identity (Longstaff, Armstrong, Perrin, Parker, & Hidek, 2010, p. 3). Resilience reflects direct implications of the unexpected event, response, recovery and re-building activities. It also presents a new circumstance to community members, in which the circumstance may differ in several essential means from the pre-event of an emergency (Paton, 2006a). Therefore,

resilience is a condition in which a community has a comprehensive and integrated action before and after a disaster.

Although its definitions seem simple, resilience to disaster is a complex phenomenon. Resilience can be reached when a community can attain all actions in Figure 2.3. Bruneau and Reinhorn (2006) conceptualize resilience into robustness, redundancy, resourcefulness, and rapidity as the four R properties. Robustness is the power of components or schemes to endure in a certain degree of pressure or demand without experiencing decline or deletion of functions. Redundancy demonstrates the substitutability of part of the element or the system. The substitution shows the capability to satisfy purposeful necessities when the interruption, decline, or deletion of a function occurs. Resourcefulness is a capacity to elaborate difficulties, set urgencies, and deploy capital when part of elements or systems are disrupted. It may be financial, physical, technical, informational, and social capital that are used to attain objectives. Lastly, rapidity is a capacity to use urgency to accomplish objectives in a timely manner during decline or deletion of functions and improving functionality to prevent potential interruption (Bruneau & Reinhorn, 2006).

The above properties need to be adopted in the context of operationalization. Bevc (2013) argues that the properties can be operationalized within organizations and communities through strengthening technical, organizational, societal, and economic systems. The integration of both frameworks provides strong commitments within communities and organizations. However, the integration of conceptualizing and operationalizing the concept of resilience requires capabilities, knowledge, and resources. Thus, the above resilience properties do not warrant escalating capacity in the short-term, but rather perseverance of system utilization for the longer term (Longstaff et al., 2010). Furthermore, Zukowski (2014) points out that the scope, type and impact of catastrophes also influence pathways to resilience. Although all actions in Figure 2.3 have been implemented in very proper and adequate concepts of the above properties; however, if a very massive, destructive, and intensive disaster occurs, the efforts seem to be insufficient. Therefore, the pathway to resilience is not easy to achieve and takes a long time. It involves multiple activities, interactions and relationships and requires complex systems at the organizational and community levels.

2.7. Conclusion

This chapter has discussed the theoretical framework for the study and has defined an understanding of disasters and hazards and their linkages to the social contexts. It also shows how disasters and hazards influence disaster management actions, in particular preparedness measures. As a critical phase to avoid disasters, there are several key concepts that have been considered to develop disaster preparedness measures. A clear understanding of hazard knowledge and integrating it into actions may be strategic to develop preparedness; the participation of individuals, households, local communities and governments is essential to develop preparedness measures; and building collaborations and partnerships is also a necessity. These actions will provide skills, resources and knowledge at the local levels. Lastly, although resilience to disaster is complex, comprehensive actions are required to increase capacities to face unexpected events.

As the above discussions have defined several terms of the key research concepts, the next chapter will mainly discuss how the local community of Mentawai becomes vulnerable to tsunami hazards. Their vulnerability is important to explore so that the readers of this thesis have a comprehensive understanding of the community with regard to tsunami hazards.

CHAPTER 3
Tracing Vulnerability to Tsunamis in Mentawai

> "It is necessary to move beyond looking at disasters as simply physical events and consider the social and economic factors that make people and their living conditions unsafe or secure to begin with. Fragile livelihoods are as important as fragile buildings in understanding vulnerability to environmental hazards" (Bolin & Stanford, 1998, p. 42).

3.0. Introduction

The Mentawai archipelago is situated in West Sumatra Province. It is about 150 km to the west offshore of Sumatra Island. Its width is about 600 km^2 and it is situated between $0^0$55'00" to $3^0$21'00" South and between $98^0$35'00" to $100^0$32'00" East. The topography of the islands is dominated by plains with hills. The lowland plain is between 0 – 50 m high (Bappeda, 2013). Later in this chapter, we can see how this situation contributes to the development of vulnerability to tsunami hazards for the local community of Mentawai.

This chapter explores the fundamental and significant techniques of how we frame an understanding of the way communities become vulnerable to disasters. It consists of six sections as follows.

Section 3.1. Discusses a number of challenges for people who live in coastal areas.

Section 3.2. Discusses vulnerability as a concept and a term.

Section 3.3. Demonstrates the root causes of vulnerability of the local community in Mentawai to tsunami hazards.

Section 3.4. Describes the dynamic pressures of the local community of Mentawai who are vulnerable to tsunami hazards.

Section 3.5. Explains a number of reasons why the local community of Mentawai live in the coastal area which is a location unsafe from tsunami hazards.

Section 3.6. Concludes the chapter.

3.1. Challenges in living in coastal settlements

Nowadays, coastal and marine ecosystems are among the most important and productive ecosystems for human society and provide a range of services. The utilization of coasts increased significantly during the 20th century and continues into the 21st century (Post et

al., 2007). As a result, human populations, settlements, and socioeconomic activities are growing rapidly on the coasts and Nicholls et al. (2007) projected that about 23 per cent people in this world live on coasts within <100 metres above sea level. Similarly, the World Bank (2015) reports that about 10 – 12 per cent of people all over the world have livelihoods related to fisheries and aquaculture. However, coastal zones encompass less than 15 per cent of the land surface and therefore, population densities in coastal zones are much higher than the average global density.

Despite the important roles of coastal and marine ecosystems, there is increasing evidence of high exposure to a variety of hazards in coastal zones. More importantly however, living in coastal settlements can put people's lives at risk from tsunamis. Many coastlines are geologically prone to disaster hazards that create tsunamis. Tsunamis, in particular local tsunamis, can reach coasts a few minutes after sea waters are affected by strong energies such as an earthquake. Therefore, according to Lauterjung, Muench, and Rudloff (2010), the most challenging problem for people who live in coastal areas is the avoidance of local tsunamis. However, it is a big challenge to produce reliable tsunami warnings that require sophisticated tools, technologies and skills. In addition, existing tsunami warnings are often intentionally vandalized from direct or indirect contact by fishing activities. UNESCO (2011a) states that this kind of vandalism has had a dramatic impact on the data delivery of tsunami early warning systems.

As a result, the above situations make those who live in coastal areas environmentally vulnerable. However, this vulnerability is not just a product of the present, but also from inherited past practices. According to Hilhorst and Bankoff (2004), a proper understanding of vulnerability is frequently blocked by the less than sufficient historical perspective of the contexts and roots of disasters. Therefore, vulnerability among coastal residents has become more complex, because it is interlocked with political powerlessness, isolation, income poverty and other aspects of social status.

3.2. Vulnerability: term and concept

As briefly defined in Chapter 2, vulnerability is a term and concept. As a term, it is tangibly simple, but it is also hard to quantify in practice. It exists around the people and relates to their livelihoods and assets (Bankoff, 2004; Cardona, 2004; Wisner et al., 2004).

Furthermore, it is associated with susceptibilities, instabilities and insufficiencies of the people to counter catastrophic events (Cardona et al., 2012). Therefore, in terms of tsunami preparedness, to reduce vulnerability is often connected to the physical development of giant sea walls, or the liability of the people living in coastal residence. In fact, as a concept, it is employed in numerous other contexts. It refers to the imbalances of political practice and power (Cannon, 2008; Oliver-Smith, 2002; Parkes, 2013), or the susceptibility of physical, economic, and social conditions (de Leon, 2006), or an integration of poor livelihood, poor natural resources and property (Wisner et al., 2004). Therefore, the above discussion shows a clear understanding that vulnerability is formed by many factors from within the community itself as well as from the place in which the community lives.

After a series of hazardous disasters worldwide, the United Nations International Strategy for Disaster Reduction (UNISDR) developed the Hyogo Framework for Action 2005-2015. Through their actions, UNISDR has recognized that preventive measures are more important than responsive measures in disaster management. Therefore, UNISDR has promoted the effective action of disaster risk reduction into sustainable development frameworks. These efforts include exceptional highlights, particularly on disaster preparedness in relation to vulnerability reduction. These efforts also embrace a habitual behavior of prevention in the area of natural disasters (UNISDR, 2005). Furthermore, UNISDR (2007b) defines vulnerability as the essences and conditions of certain people with their system and assets that make them susceptible. Therefore, it is imperative, by involving all sectors, to implement effective and integrated measures within a community to reduce vulnerability.

As for the term and concept, I will address the tracing of the vulnerability of the local community in Mentawai. To discuss this vulnerability, Wisner et al. (2012a) and Wisner et al. (2004) have developed a Pressure and Release (PAR) model which identifies three main factors that explore the progressions of vulnerability. These factors are root causes, dynamic pressures, and unsafe locations. The PAR model can also be applied to the situation in Mentawai with adaptation.

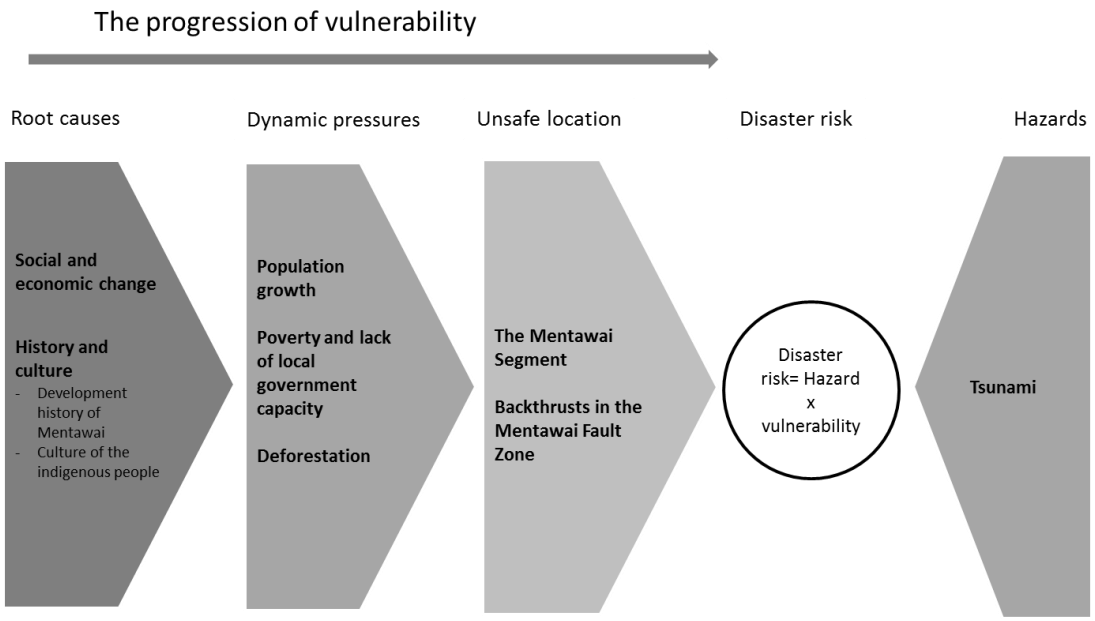

Figure 3. 1
Pressure and Release Model on the progression of vulnerability
Adapted from Wisner et al. (2004); Wisner et al. (2012a)

Figure 3.1 illustrates the PAR model which demonstrates the idea that social factors and processes cause the people to be vulnerable to certain hazards (Wisner et al., 2004). The progression of vulnerability has three different factors which link a series of progressions which make people live close to hazards. Heyse (2015) mentions that root causes will lead to dynamic pressures that in turn produce unsafe conditions that create vulnerability to disasters.

3.3. Root causes

Commonly, root cause is the major reason for the occurrence of a problem. It is used to describe the depth of the causal chain within complex systems. In terms of the concept of vulnerability, root causes are various underlying deep-rooted aspects that exist in communities. The root causes interrelate synergistically to shape and sustain vulnerability. Furthermore, root causes “nudge” a number of factors to create vulnerability. As a result, according to Wisner et al. (2012a), root causes are determined by an imbalance of social and economic structures, rapid changes of ideologies, and historical and cultural problems.

3.3.1. History and culture

a. Development history of Mentawai

Understanding the root causes of vulnerability requires a study of the historical and development changes among the indigenous Mentawai. Schefold (1988) and Spark (1991) have stated that these people have cultures going directly back to the Neolithic Age (the late Stone Age), when the people lived inland on the Mentawai Islands. It is believed that people from Southeast Asia migrated into Indonesia more than three thousand years ago and gradually settled in the various islands (Spark, 1991; Tulius, 2012b). Those who arrived in the isolated Mentawai Islands had less exposure to other parts of Indonesia. As a result, the traditions of the Neolithic Age are more intact in the Mentawai Islands than anywhere else in Indonesia. The people lived in small groups next to rivers and survived by hunting animals, gathering fruits from the forest and catching fish from the rivers (Tulius, 2012a).

Kennedy (1943) and Heine-Geldren cited in Loeb (1935) have classified the indigenous Mentawai people as having a very archaic and primitive culture. The people often carried out human headhunting raids (Schefold, 1988) and, in addition, they had “no true chiefs, laws, or government” (Loeb, 1935, p. 176) and were egalitarians (Schefold, 1991). Although some Hindu practices were found, such as the customs of chicken and pig sacrifices, the communal meal and the arts of divination, no Hindu influences have been found in their mythology. Furthermore, the indigenous Mentawai knew nothing about metal technology, paddy rice planting, and weaving arts (Schefold, 1991). Also, no customs of creating megalithic stones have been found among them. The people bartered their crops for metal axes with the Sumatra traders from about the 1800s (Schefold, 1991).

Loeb (1935) argued that the name “Mentawei” (now called as Mentawai) is derived from the native word for a man or male “si manteu”. The islands of Mentawai were firstly designated as one island under the name of Isle de la Fortune in a French atlas of 1692. Subsequently, a Dutch sea captain discovered “Si berut” (the Mouse) Island when his ship was wrecked there. Later, he also discovered another island “Si Pora” (Good Fortune). Subsequently, the people called these two islands Big Luck Island (Siberut) and Little Luck Island (Sipora). However, the first contact of the Mentawai people with Western people began when John Crisp, an employee of the English East India Company, ‘discovered’ the Mentawai people in Pagai in August 1792. He originally called the island ‘Poggy” Island.

Since then, these groups of people have called the islands the “Mentawei Islands”. Crisp then published a document dealing with the islands and mentioning that the people had a very different language from those of the mainland of Sumatra (Loeb, 1935; Rudito, 2013).

Later on, another Englishman, John Christie, made several visits to Pagai and started exporting timbers to the Dutch East Indies Resident in Sumatra in 1825 (Reeves, 1999). From 10 July 1864, the Dutch East Indies (the Dutch colonization state in Indonesia) officially brought the Mentawai Islands under Dutch sovereignty, under the Resident for the Pesisir Selatan-Painan area. H.A. Mess (the Assistant-Resident) once said that the people who inhabited the islands lived in the past and had no knowledge of God (Reeves, 1999). The Mentawai people were recognised as one of seven Sumatran tribal groups (Kennedy, 1943) and in 1893 the Dutch East Indies sent troops to Sipora in order to stop the plunder of trading vessels by the Mentawai people. However the colonial involvement in the islands was relatively small. The Dutch paid less attention to Mentawai due to geographical barriers, the total population was estimated to be below 10,000 and the inhabitants were considered primitive (Kennedy, 1943; Loeb, 1935; Reeves, 1999). Sihombing (1979) also mentioned that the social changes during the Dutch Administration were relatively small.

The first Christian missionary, August Lett (a German), took up residence in 1901, but he was killed 8 years later. In 1904 the Dutch East Indies started increasing its influence in the Islands by placing a permanent military post in Siberut to prevent further plunder of trading vessels (Persoon, 1987). The troops also banned the human headhunting raids (Schefold, 1988), but it was not easy to stop them, and the people headhunted monkeys or other wild animals in the forest instead (Tulius, 2012a). They continued to practise the traditional belief known as *Arat Sabulungan.*

In 1914, the missionaries started not only focusing on religious affairs, but also on medical treatment and hygiene, public education and carpentry skills in Sikakap, North Pagai (Sihombing, 1979). In 1915, the first Mentawai person converted from *Arat Sabulungan* to Christianity and this conversion extended to Sipora and Siberut in the following year. A mission station was eventually established in 1932 at Maeleppet (North Pagai). In addition, the developments of the above basic services were always next to the coasts for easy access for everyone. Furthermore, the timber concessions had aggressively widened in the North

and South Pagai Islands. As a result, the communities from both islands had major changes and moved to the coasts (Sihombing, 1979).

After Indonesian Independence in 1945, significant changes began to occur. The Central Government banned the practices of traditional belief in 1954 (Schefold, 1988), decreeing that the people should choose one of five official religions (Islam, Protestantism, Catholicism, Hinduism and Buddhism), under threat of police action. Following the decree, there was a series of meetings in several settlements in Mentawai in 1954 known as "The Three Religions Meeting" to discuss the traditional beliefs of the Mentawai people (*Arat Sabulungan*). The meetings were attended by a number of representatives from Islam, Protestantism and *Arat Sabulungan*. The meetings discussed the ban of *Arat Sabulungan* and the conversion to one of the five official religions (Delfi, 2012). As a result, the meetings issued the following two important instructions that influenced the community:

- *Sabulungan* belief will be abolished by force by the police officers
- In the three months (after the meeting), the local community of Mentawai should decide to choose either Protestantism or Islam. If the community has not chosen one of the two after three months, all traditional artefacts and tools that are used for the rituals of *Sabulungan*, will be burned by the police and they will be charged (Sihombing, 1979, pp. 10-11).

Three months later, the Government of Indonesia forced the local community to convert to either Islam or Protestantism after the Ali Sastroamijoyo Cabinet issued a decree (No. 167/PROMOSI/1954) that proscribed any practices of traditional beliefs or animism (Sihombing, 1970). Thus, by 1955, officially most of the people of Mentawai had converted to Islam, Protestantism, and even Catholicism (Sihombing, 1979). Furthermore, Schefold (1991) explains explicitly the efforts to make the "uncivilized" "more civilized"

> "...in Sukarno Era, the Mentawaians hardly corresponded to the image of the national Indonesian personality, and everything was undertaken to adapt them to it as soon as possible. In 1954 a decree was promulgated prohibiting their traditional religion, which was said to be heathen; all the inhabitants were given three months to decide whether they wanted to convert to Christianity or to Islam. Anyone who did not choose within this period was threatened with punishment by the police or by mission teachers, and his ritual equipment was burned... As the same time, external features such as glass-beaded jewellery, the long hair of the men, loincloths, tattoos and the custom of chiselling the incisors to a point were forbidden as mark of unIndonesian primitiveness" (p.22)

After the ban on the practice of traditional beliefs, the Central Government established a program known as *Pemukiman Kembali Masyakarat Terasing* (PKMT) or resettlement of isolated communities, during the 1970s-1980s (Erwin, 2007; Hernawati, 2007). G. A Persoon (2002) argues that the core of PKMT was the resettlement of the scattered communities into large villages within reach of government services and infrastructures. To achieve its goal, the Government gathered the Mentawai people who had lived as an inland community in the forests and relocated them on the coasts. There was no clear data that showed how many people were moved by this program; however, Goeltenboth and Timotius (1996) indicated that 30 % of the people in Siberut participated in the program. They also indicated that the numbers of people from the other islands who participated were higher than those from Siberut. The impacts of PKMT will be discussed in the following sections.

Therefore, it is clear that the recent development history of Mentawai has brought significant changes to the community of Mentawai and the arrival of Western people provided a massive chance to exploit the area of Mentawai. However, the missionary activities provided several basic services in the coastal areas and these stimulated the people to move their settlements there. The deforestation of a number of forestry industries also forced some parts of them to move to the coasts in both Pagai Islands. Furthermore, in the early era of independence, the Indonesian Government forced the "uncivilized" to leave their traditional animisms and to convert to one of the official religions. These factors were among other root causes that led to the dynamic pressures on the people in Mentawai to move from the forest to the coasts.

b. Settlement Changes of the Indigenous People of Mentawai

As mentioned in the above section, the indigenous Mentawai people had a belief in *arat sabulungan.* This animistic belief is that each thing has a "spirit" that exists either in the sky, sea, earth, or the jungle (Coronese, 1986; Mulhadi, 2008; Salmeno, 1994). The spirit can move and separate from its "host" and the separation can create death and imbalances such as damage, illnesses, or gales. The word *arat* means tradition, while *sabulungan* comes from the words *sa,* meaning a group of and *bulung,* meaning leaves. Therefore, *arat sabulungan* can be defined as "a system of knowledge, values, norms, and regimes in understanding and interpreting the environments that consist of the interaction patterns

among humans, animals, trees, soil, water and air and man-made things" (Mulhadi, 2008, p. 53). The indigenous Mentawai people always used particular leaves of trees and specific animals that were found in the jungles. Therefore, it was important for them to live in the middle of the jungle, so they could easily conduct their rituals. To practise *arat sabulungan*, one *uma* had one *sikerei* (shaman) as a cultural leader.

In addition, the indigenous Mentawai people lived in a *lalep* next to their communal house called an *uma*. A *lalep* consists of several individuals, namely father, mother, sons, daughters, and sometimes one or more widows (Tulius, 2012a), while an *uma* is surrounded by 5-10 *laleb* and about 30-80 individuals (Hernawati, 2007). The measurements and the number of people in each *uma* were relatively stable over a long period (G. A Persoon, 2002). Hernawati (2007) mentions that generally *uma* are surrounded by their gardens and trees. If possible they are also surrounded by several hills as a protection from other clans. Furthermore, u*ma* are next to a river for planting sago trees and taro, as well as for daily needs such as bathing (Figure 3.2).

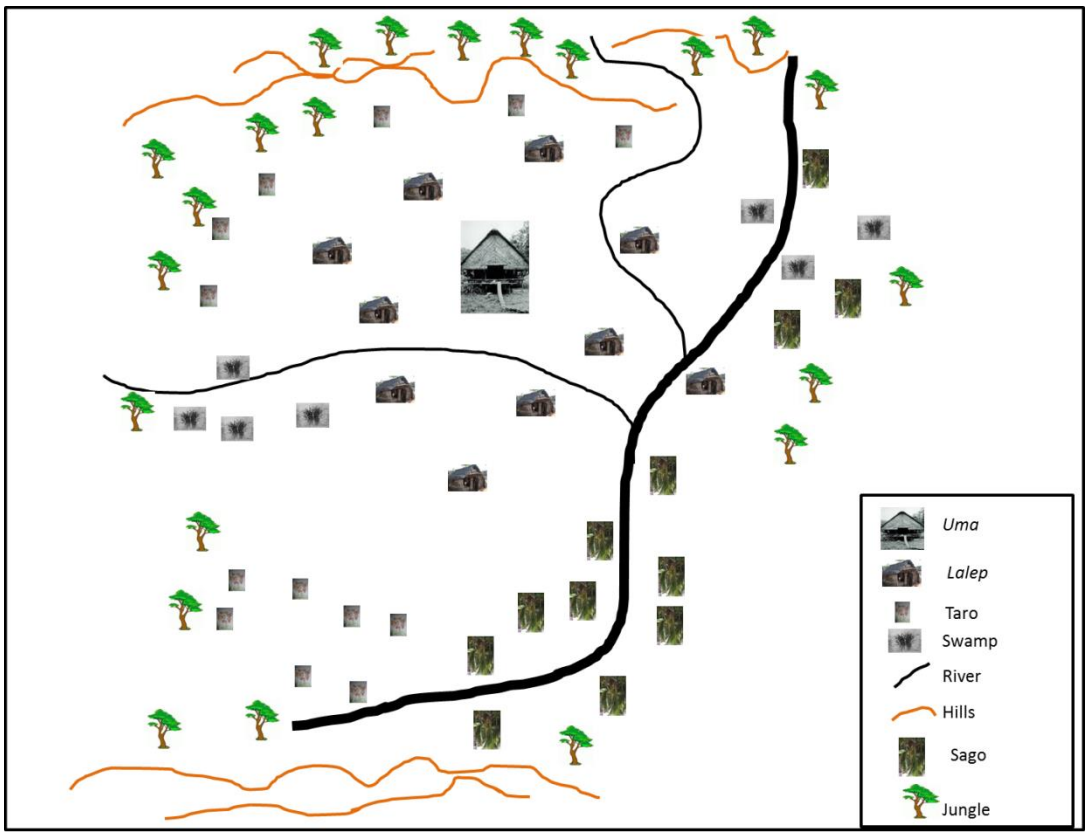

Figure 3. 2
A sketch of indigenous settlement
Adapted from Hernawati (2007).

The word *uma* is also related to the genealogical lineage of a particular clan (Delfi, 2013; Schefold, 1991). Interestingly, an *uma* is usually built from five different kinds of vegetation (*meranti* woods, rattan, bamboo, eaglewood, and palm leaves) (Figure 3.3). The main pillars of the *uma* are made from the *meranti* wood, known as the lord of earthquakes (*Teteu Ka Baga*). The people believed that the pillars would prevent the *uma's* collapse when earthquakes occurred. The pillars (*bakkat uma* or *riokuma*) should be protected in the same way as parents protect their children (Ponting, 2001). The pillars are the strongest parts of the *uma* and knotted to other parts.

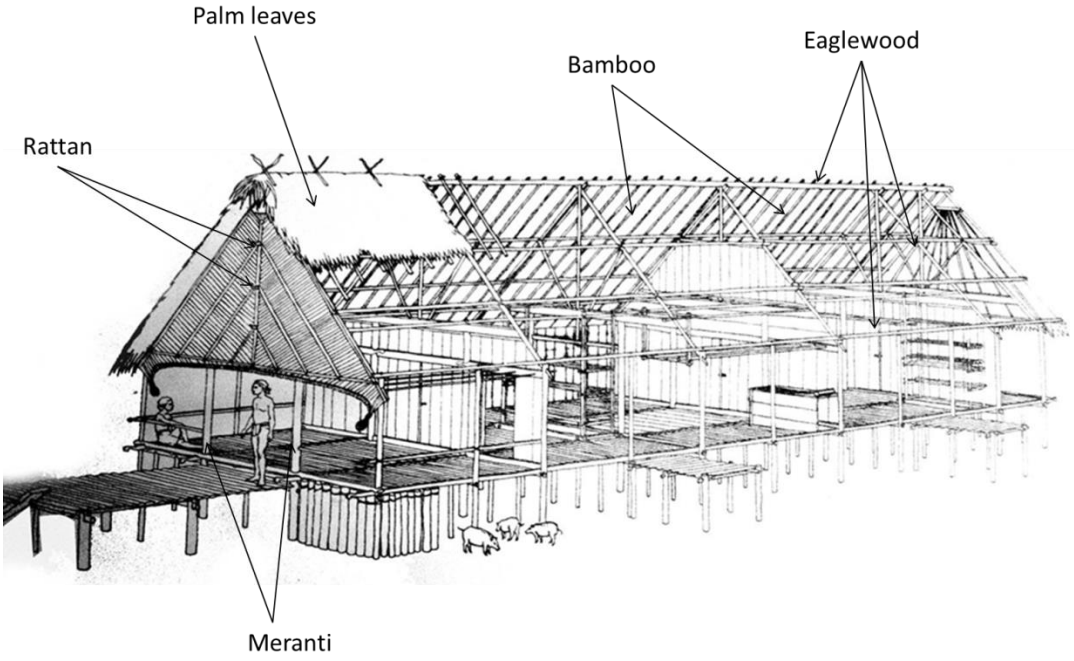

Figure 3. 3
This sketch shows how the indigenous Mentawai people built their traditional communal house, *uma* by using different kinds of woods.
Source: Coronese (1986), Delfi (2013) and Schefold (1991).

Figure 3. 4
This picture shows an original *uma* from Mentawai
Courtesy: The Tourism Agency of Mentawai, date unknown.

Now, most of the local communities have left this type of the traditional settlement and prefer living on the coasts. They live in towns or *dusun* next to the sea. As a result, the younger generation has been used to living on the coasts and has forgotten their traditional settlements and old ways of living. As the change in traditional settlements in Mentawai has brought the community to live on the coasts, therefore this has contributed to the dynamic pressures on the people in Mentawai to move from the forest to the coasts.

3.3.2. Social and economic changes

In a continuation of the changes in the traditional history and culture in Mentawai, several new social and economic systems have been introduced in systematic and comprehensive ways. Firstly, a new system was introduced through the PKMT. Although the PKMT played a critical role in creating a more equitable society and helping the community build wealth, this program has destroyed the existing traditional social and economic structures of the people in Mentawai. Originally, these structures were very simple. The people were all of the same status without leaders or a lower class such as slaves. As an *uma* was based on the same paternal line, loyalty to the other *uma* members was high. What one family (*lalep*) harvested from its crops, belonged to the *lalep* members; however, if other *lalep* members needed the crops, they had to share them. One *lalep* could not eat meat without sharing it with other *lalep* members (G. A Persoon, 2007; Schefold, 2007). Each *lalep* collected pigs

and chickens when the *uma* had *punen* (rituals) such as a special party or a wedding ceremony. They would also share the same amount of meat between *lalep*. This social and economic structure has disappeared. The PMKT grouped people without considering their original clans and the people in mixed community live independently in more individualistic ways and are suspicious of one another (Hernawati, 2007).

The PMKT also introduced the *dusun, rukun warga*, and *rukun tetangga* systems to which the local people were not accustomed. Moreover, new rules at the *dusun* and village administrative level were also implemented, whereas originally they had no true chiefs, laws or government (Loeb, 1935). A *dusun* is the smallest unit of the community that consists of several households/families living together in a particular area, while a village consists of several *dusun*. Since then, a *dusun* has been led by an appointed leader who is chosen by the members of the *dusun*. The leader is responsible to the community members and often is representative of the community. However, the newly mixed *dusun* people often have less respect for the *dusun* leaders, because they are of different origin or *uma* (Sihombing, 1979). Therefore, this makes it difficult to deliver any programs within the community.

In addition, the Government moved some families from Java to Sipora, North and South Pagai Islands (Figure 3.5). In order to rapidly assimilate the local people with this external migration, the Government also moved the local community of Mentawai, mixing them with the people from Java and placing them into a number of *dusun* along the coasts. The mixing was thought to be good for the local people and they learned from the migrants how to plant rice (Agustina, Hardi, & Yulia, 2014).

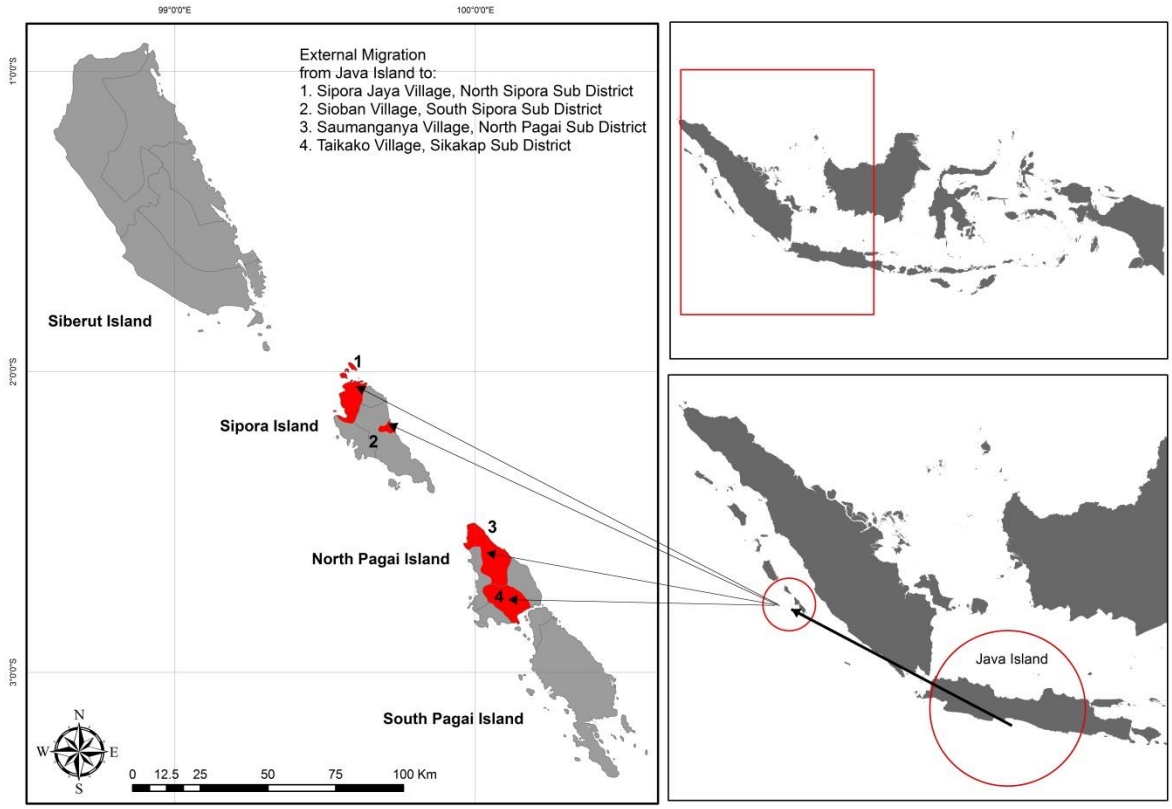

Figure 3. 5
In 1987 there were the Central Government conducted an external migration of a number of people from the Java Island to several villages into the Sipora, North and South Pagai Islands.
Source: Agustina et al. (2014)

In short, rapid changes in Mentawai have affected the social and economic structures. Previously, they lived as egalitarians without any particular ranking or status in the community, but the PMKT introduced government administration with the *dusun* and village regulations. The old social and economic structures where they shared crops and meat with other members of *uma* changed, with each individual household now having to survive more independently. These aspects also became root causes for the people to move to the coasts in Mentawai.

3.4. Dynamic pressures

Beside the above root causes, there were various aspects to contribute the people to move to the coasts, known as the dynamic pressures. As discussed, it is obvious that the indigenous Mentawai people have experienced profound changes in their history and culture and in social and economic aspects. Usman et al. (2013) define dynamic pressure as

an intermediary process which incurs negative effects for the people and subsequently the people live in unsafe conditions. Similarly, Wisner et al. (2004) believe that dynamic pressure distributes the root causes of vulnerability into particular forms of unsafe locations in relation to a hazard. Several elements are found as dynamic pressures in developing the vulnerability to tsunami hazards in Mentawai: population growth, poverty and lack of local government capacity, along with deforestation.

3.4.1. Population growth

Wisner, Bleakie, Cannon, and Davis (2003) and Philip and Rayhan (2004) argue that there is an indirect linkage between population growth and developing vulnerability to disaster. Generally rapid population growth will increase poverty among people; as a result poverty will create vulnerability. In many cases, rapid population growth will create economic and social implications with limited access to income and resources in the society. Consequently, the limitations can affect certain groups of the population, and increase the numbers of poor people. Today, the BPS Mentawai (2014b) have reported that population growth in Mentawai is high, about 2.3 per cent in 2013. There are several reasons for this growth: the headhunting ban, an inter-clan conflict ban, migrations and births (Tulius, 2012a). Additionally, BPS Mentawai (2012) reported that the population growth in Mentawai is different in the towns and in the remote areas. In the towns the population growth is mainly caused by migration from external and internal Mentawai, while in the remote areas, it is caused by births.

With a population growth of 1.39 per annum, the population in 2014 numbered 81,840 people of which the dependent age groups (1-14 years) are dominant (see Figure 3.6). These dependent groups are projected to remain the same, unless there is a significant effort to reduce the birth rate. This means that there are many basic needs such as food and education to be filled (Siahaan, 2004). In fact, 78.32 per cent of the workforce in Mentawai have mixed jobs (gardening, fishing, gathering crops from the jungles) (BPS Mentawai, 2012), but many earn insufficient money for their daily needs (Bakker, 2007; Reeves, 1999). These unmet needs can be a dynamic pressure in increasing the vulnerability of the people to tsunamis, since they try to do any jobs, including fishing.

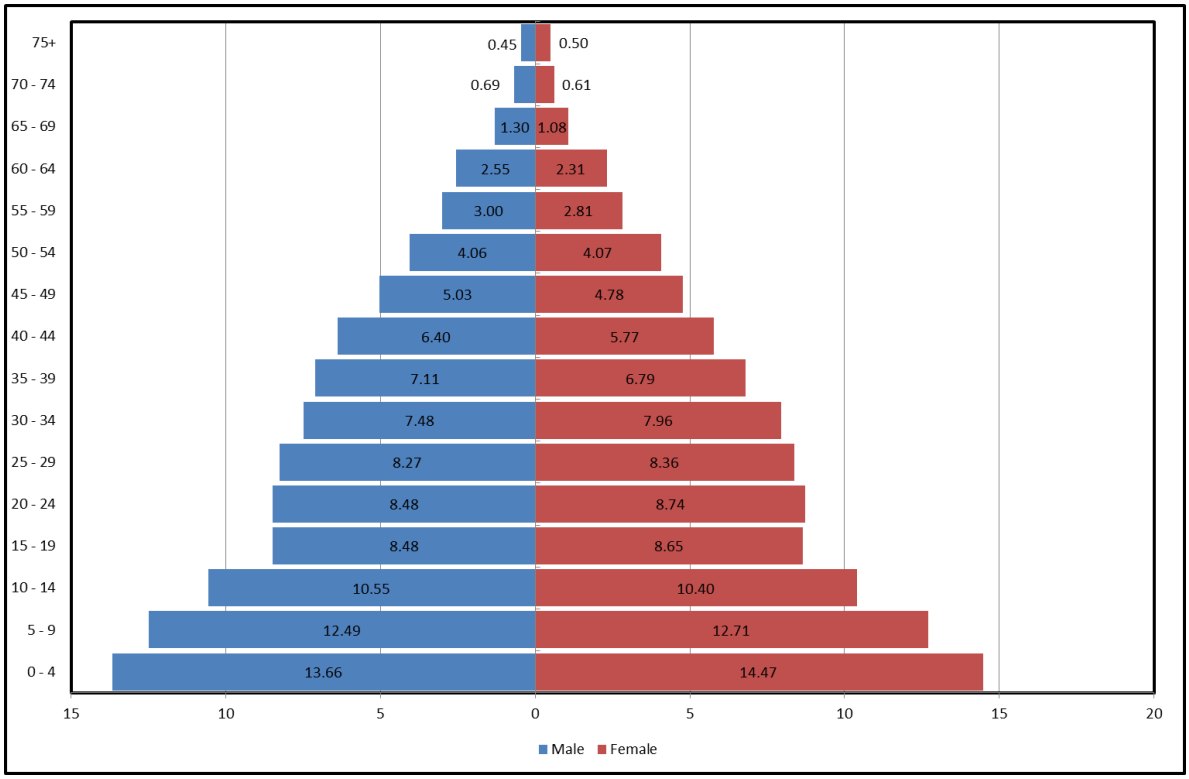

Figure 3. 6
The expansive pyramid of population growth in Mentawai, 2014
Source: BPS Mentawai (2014b)

3.4.2. Lack of local government capacity

In order to increase the welfare of the local community, local governments have powers and responsiblities in providing policies, regulations, development and services. Local governments also have to promote the social, economic, environmental and cultural well-being of communities. However, in many cases local governments fail or partly fail to perform their responsibilities to their local community. Even worse, governments often participate in making the community poorer. The poor performances increase poverty among the local community, thereby increasing their vulnerability to disasters.

In 1999, the Mentawai Islands became a new district after the enactment of Law No. 49 of 1999 on the Establishment of the Mentawai Islands District. This district was officially separated from its mother district, the Padang Pariaman District on Sumatra Island. Since then, the Mentawai District has managed the local community of Mentawai and is required to perform services in transparent, accountable, effective and democratic ways. However, several aspects indicate that the district government of Mentawai performs its tasks in a way that is inadequate for the welfare of the local community.

Firstly, in 2011 Kementerian Dalam Negeri (2011) evaluated certain performances for districts and municipalities in Indonesia and found that Mentawai was one of the ten worst in providing public services such as education and health. In Mentawai, providing easy access to education and health services could create further problems. The Government of Indonesia obliges all children to participate in compulsory education based on the 2003 Act 20 of the National Education System and on the Government's Regulation 47 of 2008 on Compulsory Education. In these legal documents, it is well formulated that each child in Indonesia should finish at least intermediate school as a minimum formal education requirement. The local community of Mentawai understands the essential meaning and purpose of formal education and there are 108 elementary schools and 19 intermediate schools in Mentawai (BPS Mentawai, 2012). However, about 90 per cent of the schools are located next to the coasts and in order for the children of Mentawai to get access to school, it is necessary for the adults to move and stay near the schools on the coasts.

The BPS Mentawai (2014a) have also reported that there are ten community health centres (*Puskesmas*) in Mentawai and all of them are located near the coasts. In addition to *Puskesmas*, the government also developed 14 community health sub-centres (*Puskesmas Pembantu*) in several *dusun*. Although the *Puskesmas Pembantu* are also found inland, Supporting Indigenous Futures (2012) reported that it is common to find these without medical staff. Moreover, often the *Puskesmas Pembantu* do not co-operate in providing medical services. However, because of the absence of the *sikerei* owing to the *Arat Sabulungan* ban and the rarity of particular trees for traditional treatments and rituals found inland owing to deforestation, the *Puskesmas* have forced the local community of Mentawai to move and live close to them. These are dynamic pressures stemming from the provision of local services to encourage people to live on the coasts, thus exposing them to vulnerable locations.

Secondly, private investments provide multiplier effects and positive impacts on the investor(s), the local people and the local government. Investments can be defined as every asset that is owned or controlled by the owner(s) and is committed to gaining or expecting to gain some positive rate of return. Therefore, it is important for a private investor to make rational investment decisions before investing. In order to attract investors to a particular area, the local government must ensure the environment is conducive to carrying out

business. Pambudhi et al. (2008) reported that there are a few potential sectors for private investment in Mentawai, namely: marine tourism, hotel development and the fishery industry. However, these are difficult to exploit because the local government has little capacity to create a conducive environment. The local government fails to provide sufficient gasoline and electricity and to build infrastructure such as roads and bridges (BPS Mentawai, 2014a).

In fact, during the field research, one of the interviewed researchers mentioned that there has been an increase in hotel investment in Mentawai for marine tourism. However, she said:

> "…[indeed there are] significant hotel developments [in Mentawai]. This indicates an economic increase [in Indonesia]. But, the workers [in this sector] are all from Sumatra [not from Mentawai]" (Researcher, No.05).

It may be assumed that a number of private investors have invested their assets in marine tourism and hotels. In addition, the investors also recruit workers from Sumatra who temporarily live in Mentawai. However, there has been no chance for the local people to be recruited as employees. It can thus also be assumed that no or few multiplier effects of the investments reach the local community even though the local government has the authority to request the investors to recruit a number of the local people to work for them. As a result, in the absence of the local government's requests for the local people to be recruited, this has become another dynamic pressure for people to remain in their current circumstances as poor people and living in unsafe locations on the coasts.

Thirdly, Wisner et al. (2003) urged that local communities should have easy access to markets to sell their local products. Otherwise, the local products will be less-valued and/or will require extra costs to sell. In Indonesia, the traditional markets are normally organized by local governments. Therefore, local governments have the authority to facilitate the local community to trade their local products in the traditional markets. In Mentawai there are six traditional markets that operate on only one or two days in a week. From my observations, however, they are not easily accessed by the local community. The markets mostly sell brought-in products rather than local ones. In fact, in two markets in Sikakap and Tuapejat that I observed, the people traded brought-in products, rather than the local

products such as bananas and taros (Figure 3.7). I also found that the local products were sold to incoming middlemen (from Padang) on the ferry. This indicates that the local community has less power to bargain over the prices of the products. As normal practice in Indonesia, middlemen buy at lower prices than in traditional markets. Therefore, the unavailability of government intervention in how the community trades their products is another factor keeping them in poverty.

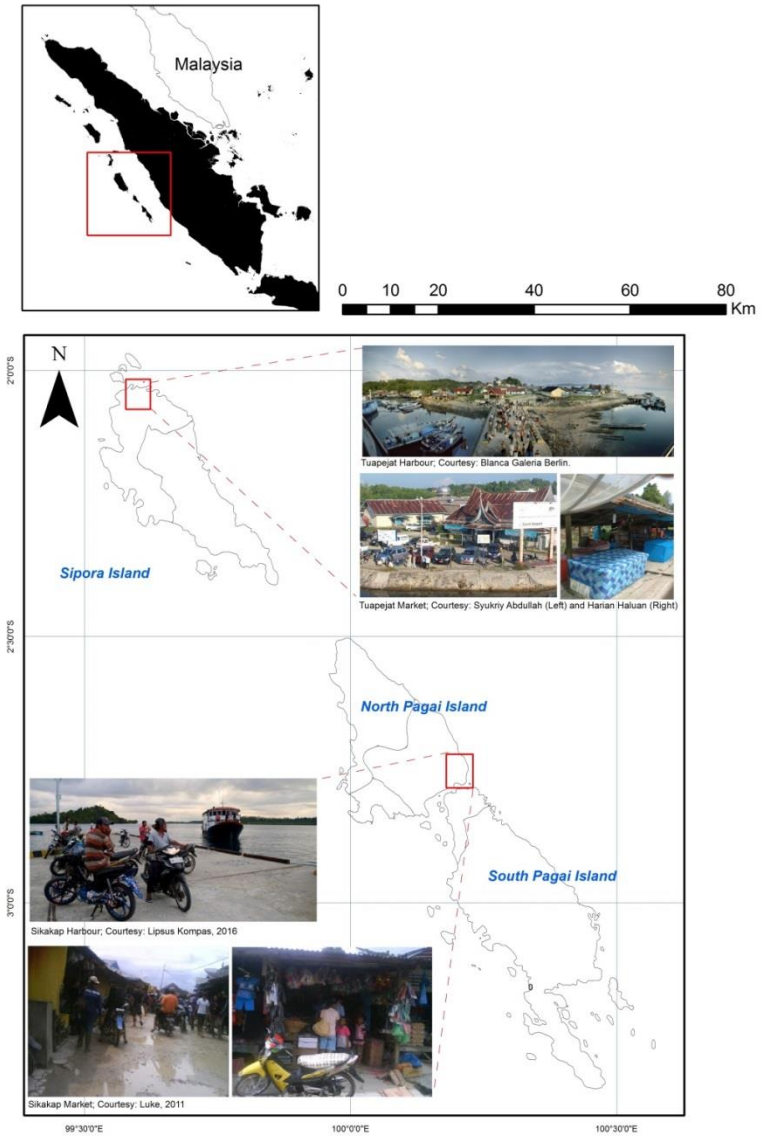

Figure 3. 7

In 2014 there was one one traditional market in Sipora island namely Tuapejat. Mainly the people from the island bought their daily needs from the market once in a week. The people mainly sold their local products directly to the harbour nearby. Similarly, in both South and North Pagai, in 2014 we found only one market in Sikakap. The people bought their daily need once a week. They also brought their local product to the Sikakap Harbour when the ferry from the Padang (Sumatra) anchored.

In conclusion, the district government of Mentawai seems to lack the capacity to provide for the welfare of the local community which remains in a poor condition. As a result, the people may struggle to meet their basic needs. In order to meet their children's education and their health needs, they live close to schools and *puskesmas* that are situated on the coasts. Despite the availability of a number of private investments in Mentawai, the local community receives no or few multiplier effects from the investments. The government has failed to make or has never requested the investors to recruit members of the local community. Lastly, it seems that the district government of Mentawai has never intervened in the trading of the local products. The government has the authority to ban the middlemen from operating in Mentawai and can encourage the local people to trade their products in the traditional markets at competitive prices. As a result, the lack of local government capacity to provide for the welfare for the people produces other dynamic pressures. These result in the people remaining in their current circumtances and living in poverty next to the coasts. Consequently, the poverty will create vulnerability to tsunami hazards for the local community of Mentawai.

3.4.3. Deforestation

Indonesia is one of the countries that is blessed with abundant natural resources. Indonesia is the country with largest extent of tropical jungle after Brazil (Barber, 2010). Based on its constitution, these forests are to be managed by the Central Government. Mr. Seoharto (the second president) ruled the country from 1968 to 2008 and called his regime the "New Order Era". This era was famous for its policy developments to exploit natural resources and under his centralised system, no-holds-barred exploitation reduced the forests considerably. The main reason for exploiting the forests was to boost the country's economy and, in order to run forest deforestation smoothly, the regime worked together with the Indonesian armed forces (Chidley & Marr, 2002). The Government intentionally cut millions of hectares of the forest every year, and destroyed much of it. Barber as cited by Chidley and Marr (2002) described it as follows:

> "From nearly nothing in 1966, the timber and forest products industry has with the state's active support grown into a highly concentrated, wealthy and well-connected political and economic actor dependent on cheap raw materials, used to high levels of profit and accustomed to passing on the environmental costs of unsustainable logging practices to local communities, the state and

> society at large. The industry is now a significant factor in forest policy-making and thus lessens the autonomy of the state to move in directions that might be more sustainable but would hurt the industry" (Chidley & Marr, 2002, p. 8)

Following the natural resource exploitation policy, the forest concessions in both Pagai Islands started in 1970, followed a couple of years later in Sipora Island (Hernawati, 2007). Now, we only find limited and permanent production forests in Pagai and Sipora. The forest concessions in Siberut started in 1982 through the Ministerial Circular Letter, *Surat Edaran Kementerian Pertanian* No.623/Kpts/Um/8/1982. According to Darmanto and Setyowati (2002) Siberut Island was divided into several forest functions as follows:

Table 3. 1
Distribution of the functions of forests in Mentawai, 2002

No	Functions of forests	Wide (ha)	Per cent
1	Conservation forest	132,900	32.95
2	Protected forest	3,500	0.87
3	Limited production forest	59,550	14.77
4	Permanent production forest	119,900	29.73
5	Convertible production forest	87,450	21.68
	Total	403,300	100

Source: Darmanto and Setyowati (2002)

Table 3.1 shows that about 44 per cent of the forest in Siberut was designated for conservation and protection and approximately 15 per cent is limited production forests. In the limited production forests, the local community of Mentawai is given a right to plant their crops among the trees. About 30 per cent belongs to the timber companies and about 21 per cent is convertible production forest. This kind of forest can be changed into permanent production forest.

Since the New Era Order started, the forest concessions in Mentawai have been extensively exploited. Consequently, many Mentawai people who lived in the forests have started moving to the coasts. No documents are available to indicate whether the indigenous people worked for the forestry industries. However, as they respected *tai kai leleu*, one of their gods that was believed to protect the trees (Rudito, 2013), it is considered that they would never work for the industries. They then started to have mixed jobs as mentioned

above. This deforestation became a dynamic pressure to channel the community towards unsafe locations vulnerable to tsunami hazards.

3.5. Unsafe locations

The above dynamic pressures work on the underlying root causes to push the people to live or keep living in unsafe locations. Wisner et al. (2004) argue that unsafe locations are distinctive circumstances in which vulnerability is stated in time and space in relation to a hazard. In Mentawai, there are several key elements that create these situations as explained below.

3.5.1. The Mentawai Segment

The Mentawai Islands are above the Mentawai Segment (Prawirodirdjo, McCaffrey, Chadwell, Bock, & Subarya, 2010) which is about 700 km long, between Batu Islands in the north west and Enggano Island in the south east. The Mentawai Islands are situated next to the Sunda Megathrust (Figure 3.8). Prawirodirdjo et al. (2010) described the Sunda Megathrust (Sunda Trench) as located in the Indian Ocean and forming the converging borderline between the Indian-Australian Plate and the Eurasian Plate. It is about 305 km from the coast of Sumatra and 2,600 km long. The Indian-Australian Plate moves towards to the Eurasian Plate about 5-6 cm/year (Ambikapathy et al., 2010; Briggs et al., 2006; Natawidjaja, 2007). This area, about 40 km from the plates' joint-point at the seafloor into the subduction zone, is generally elastic. However, beyond this area the convergence of the plates is weakened. Therefore, the motion becomes slow and creates a shrunk locked area (Natawidjaja, 2007; Weller et al., 2012). As a result, the continuing thrusts from the Indian-Australian Plates accumulate a high tension of potential energy that creates earthquakes.

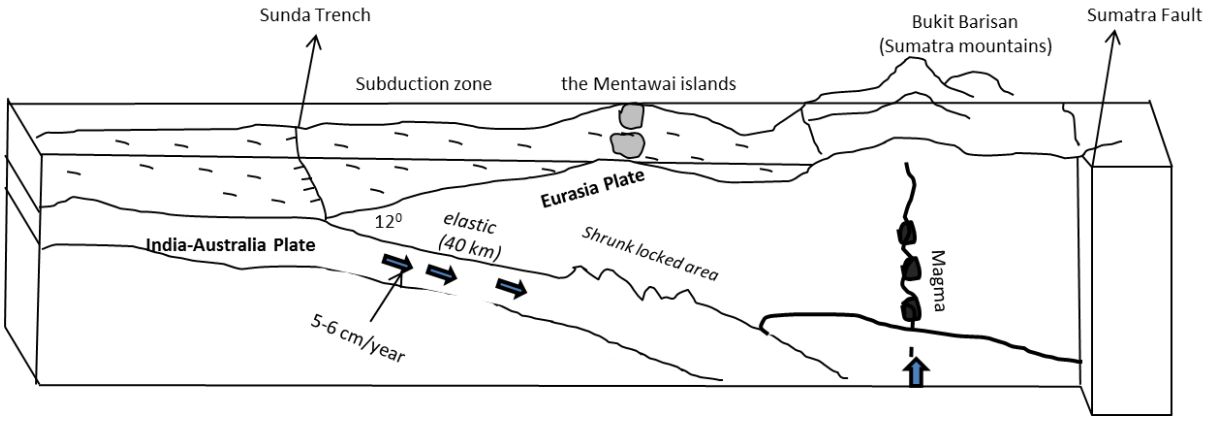

Figure 3. 8
An illustrative diagram shows the sources of earthquakes in the small islands (including the Mentawai Islands), west of Sumatra. The Megathrust area is about~ 50km depth and traps potential energy to create earthquakes. The plates are melted and become magma in about 150-200 km deep in the crust of the Earth. Magma will rise up and become volcanos. Source: adapted from Natawidjaja (2007).

In addition, paleo-seismic and paleo-tsunami studies in Mentawai produce interesting facts about the Segment. According to Philibosian et al. (2014) the Segment has a centurial cycle and a shorter-term supercycle (a series of ruptures). The Segment is also bounded by persistent barriers to major ruptures that could potentially produce a series of ruptures rather than one massive rupture (Sieh et al., 2008). Evidence has also been gathered through the coral micro-atoll records. These records are a good tool to know the change in the sea level after a vertical tectonic deformation has occurred. Philibosian, Sieh, Natawidjaja, Chiang, et al. (2012) reported that a large rupture between the Sunda Megathrust and the Mentawai Islands occurred in 1314. Their conclusions are drawn from the elevation and deaths of coral records that indicate a number of earthquakes had occurred in the past.

Furthermore, Ambikapathy et al. (2010); Borrero, Sieh, Chlieh, and Synolakis (2006); Briggs et al. (2006); and Natawidjaja (2007) mention that large events occur approximately every 200-240 years on the Segment. The repetitions of the uplifted coral on the Mentawai Segment show the seabed transfigurations that were produced in the 1797 and 1833 tsunamis. These tsunamis were triggered by a number of great earthquakes (Mw 8.3-8.7) in 1797 and (Mw 8.9) in 1833. The 1833 tremor started in southern Sumatra and cracked the Enggano Island in the south to Sipora Island (Collings et al., 2012). Both tsunamis hit the western coasts of Sumatra and were recorded in a number of memoirs of the Dutch residents (Natawidjaja, 2007).

Recently, earthquakes have taken place around the Mentawai Segment resulting in several ruptures within it. On 12 September 2007 and 13 September 2007, the Segment released its energy and created the earthquakes called the September 2007 Bengkulu Earthquake of respectively Mw 8.4 and Mw7.8 (Collings et al., 2012; Natawidjaja, 2007). The earthquakes in 1833(Mw > 8) and 1797 (Mw 8.5 – 9.2) occurred in the Mentawai Segment (Figure 3.9).

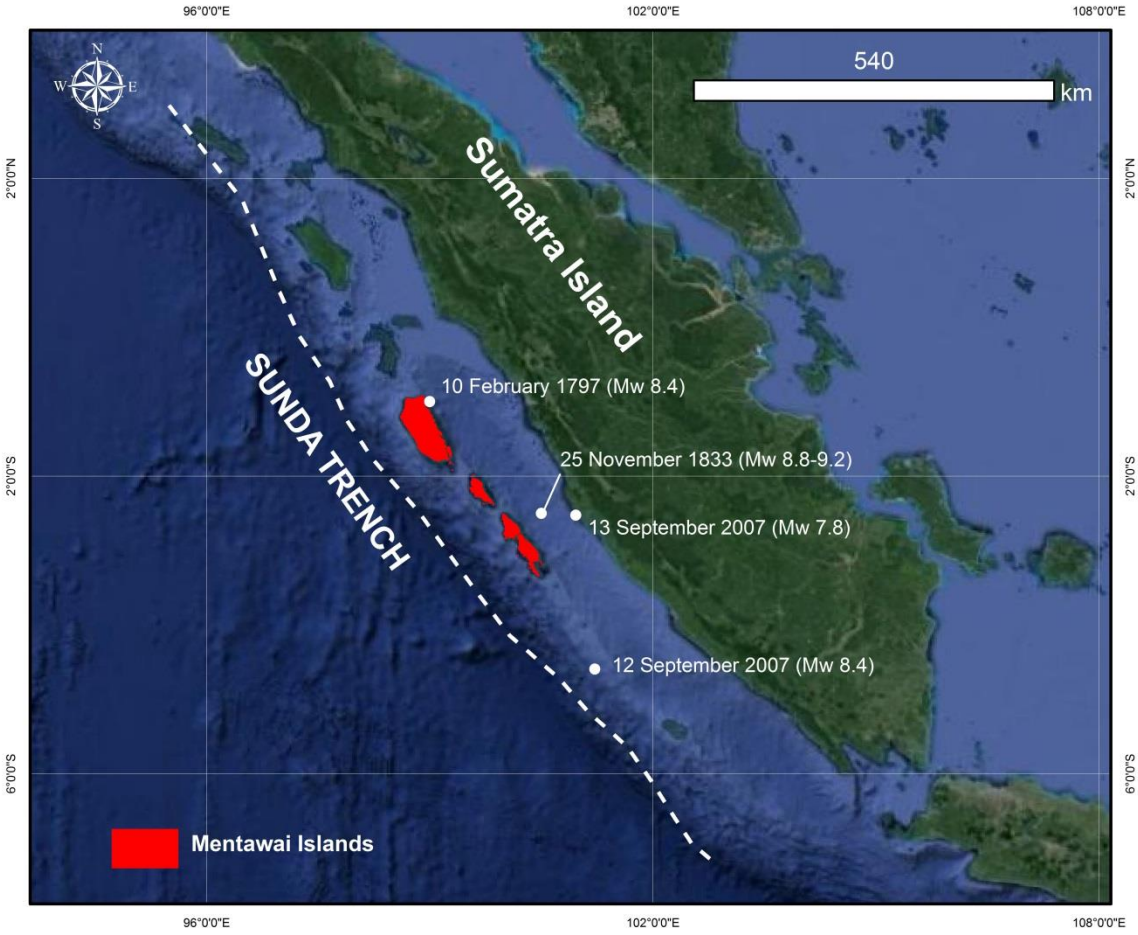

Figure 3. 9
Several major earthquakes that occurred in past and present time
Source: Collings et al. (2012) and Natawidjaja (2007)

According to Natawidjaja (2007) the affected area has about a slope 120 degrees to the east that created the motion to the west. This slope upheld the tsunami waves that were only less than 3 m in Bengkulu (Sumatra) and less than 1 m in Padang (Sumatra). Twelve hours after the above earthquake (13 September 2007), another earthquake occurred in the compound of the Mentawai Segment of Mw 7.8 (Natawidjaja, 2007). Experts agree that this earthquake was not an aftershock of the Bengkulu Earthquake because it was too big to be an aftershock. Normally, an aftershock earthquake is less than Mw 7.4. Natawidjaja (2007)

and Philibosian et al. (2014) believe that the energy released was less than one third of the total energy that had accumulated since 1797 and 1833.

The last big earthquake was on 25 October 2010 with the above kind of rupture taking place at 9:42 pm (local time) in the Mentawai Segment. The earthquake was known as the 2010 Mentawai Earthquake with a magnitude of Mw 7.8. The source duration of the earthquake was about 102 seconds and it occurred in a shallow megathrust area. According to L. Zhang, Liao, Jinggang, and Wang (2015), big quakes that are able to split the shallow area close to the Sunda Megathrust are relatively rare. However, when a large rupture occurs, it could be exceptionally tsunamigenic. This tsunamigenic type of earthquake is categorized by low rupture velocity which can trigger tsunami waves because it is responsible for converting oddly weak short-period seismic wave energy to long-period signal levels. This type of earthquake could produce waves bigger than those of other earthquakes with the same magnitude (L. Zhang et al., 2015).

According to Collings et al. (2012), the 2007 and 2010 events only released a portion of the seismic energy accumulated since 1797 and 1833, and the ruptures are only found at the southern part of the Mentawai Segment. This means that the amount of the energy still trapped is larger than that released. Therefore, scholars predict that in the near future a series of earthquakes will occur in the Mentawai Segment that could generate a series of tsunami hazards. BNPB (2013) also predicts that the potential earthquake(s) could be of Mw~9.3 and the tsunami waves will affect more than 1,000 people in Mentawai alone.

3.5.2. Backthrusts in the Mentawai Fault Zone (MFZ)

Mukti et al. (2012) found that the MFZ is situated along the borderline between the accretionary wedge and the mainland barrier. An accretionary wedge is the mass of sediments accreted at the edge of convergent boundary. This barrier shows curved ridges on the seabed towards the east. Underneath the ridges, there are overlapping high-angle backthrusts toward the Mentawai Islands in the innermost portion of the accretionary wedge. The backthrusts deform the Mentawai forearc basin sediments (Mukti et al., 2012) and are also called “secondary faults” because they are like braces on the main fault.

The strength of the continental backstop (from Sumatra) has a significant influence on the deformation pattern at the rear of the wedge if any energy stresses the backthrusts (Figure

3.10). Wiseman, Banerjee, Sieh, Bürgmann, and Natawidjaja (2011) found that the backthrusts are active and have a number of steeply-dipping seismic occurrences. These occurrences are positioned on the MFZ. On 10 April 2005, a large earthquake (Mw 6.7) occurred on the MFZ in the eastern strait between Siberut and Sipora (red dots). This was followed by two other earthquakes seven hours later with magnitudes of 6.5 and 6.1. These earthquakes triggered a tsunami of one metre high in the south east of Siberut. Furthermore, Wiseman et al. (2011) also found that a Mw 6.7 earthquake on 16 August 2009 occurred next to the locations of the 2005 earthquakes. This earthquake was also followed by a series of earthquakes over several days with magnitudes from 5-6 (blue dots).

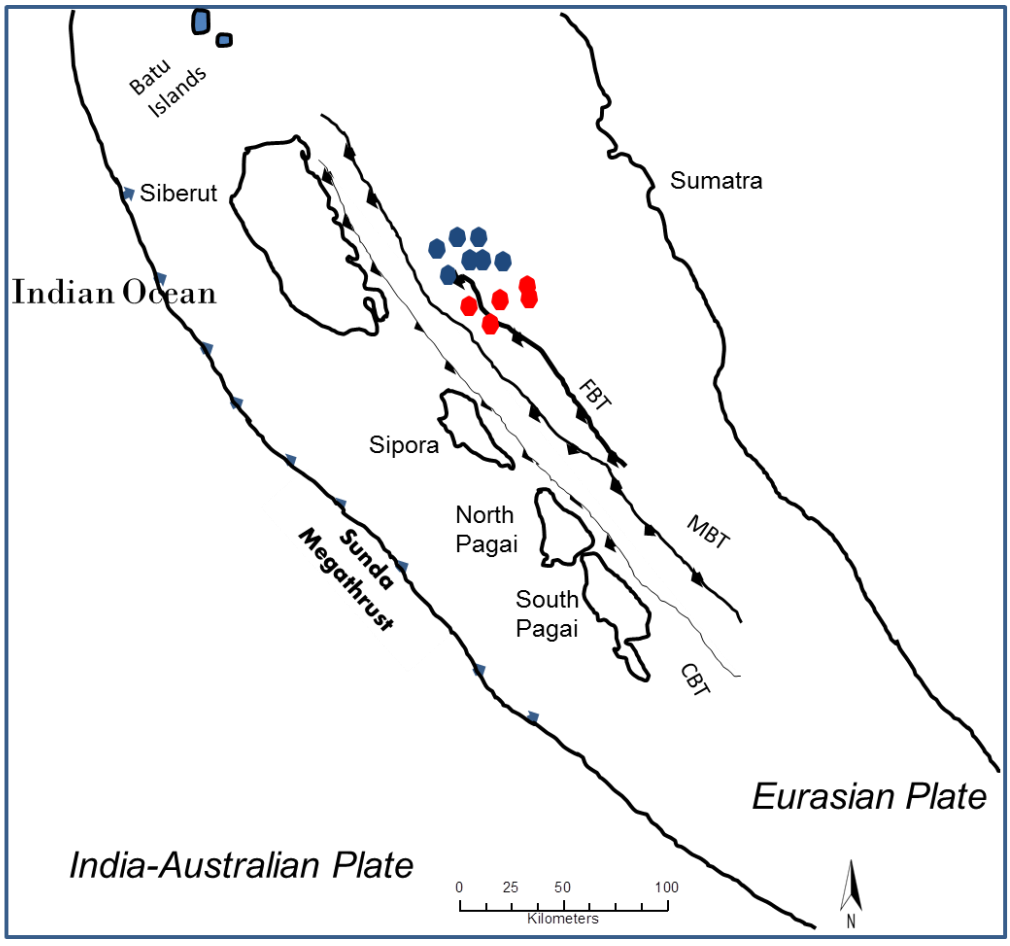

Figure 3. 10
This illustrative figure shows backthrusts created earthquakes
in the Mentawai Basin in 2005 and 2009
Source: S. C. Singh et al. (2010); Wiseman et al. (2011).

In addition, S. C. Singh et al. (2010) found that there are three kinds of backthrust traces on the MFZ, namely coastal backthrust (CBT), main backthrust (MBT), and frontal backthrust (FBT). The FBT interfaces the continental plate and is fitted to the relocated earthquakes at

a depth shallower than 30 km. As a result, earthquakes could cause the features of the accretionary wedges to erode. Wiseman et al. (2011) found that the 2007 Bengkulu earthquakes ruptured a number of one-metre slip features on the wedges in the areas of the earthquake centres. Therefore, Natawidjaja et al. (2006) predict any interventions from the backthrusts to the wedges could create undersea landslides. These landslides can create strong local tsunamis in the future. Furthermore, Natawidjaja et al. (2006) also found that no broken sections on the MFZ have been found for at least 200 years. This means that submarine landslides could potentially occur at any time. These landslides could also be triggered by the direct intervention of earthquake activities from the Sunda Megathrust (Mukti et al., 2012). If mass wasting occurs near the brinks of the MFZ, submarine landslides occur that may trigger tsunami in the Mentawai Islands.

The above discussion shows that the Mentwai Islands are prone to being hit by tsunamis since their location is situated on the Mentawai Segment and next to the Mentawai Fault Zone. However, there are several natural barriers that could lessen tsunami impacts such as coral reefs, mangroves, and coastal dunes.

3.5.3. Mangroves as natural barriers

Accumulating scientific evidence shows that mangroves are important to human communities and can protect vulnerable coastlines and populations from destructive waves. Giesen, Wulffraat, Zieren, and Scholten (2007) define mangroves as a group of woody vegetation grown in marine and brackish environments. The growth of this vegetation is mainly influenced by the tidal zone which allows the vegetation to have numerous tangled roots that appear to be standing upright above the water. Growing evidence shows that mangroves become a crucial pathway to tsunami resilience in coastal areas (Adger, Hughes, Folke, Carpenter, & Rockstro, 2005). Mangroves are also important in limiting the exposure level of tsunamis on people. Coasts with dense mangroves are better protected from tsunamis. According to Harada and Imamura, as cited in Forbes and Broadhead (2007) a coastline vegetation 200 metres in width can decrease 80 per cent of the hydraulic force from a tsunami. Furthermore, Utomo, as cited in Diposaptono and Budiman (2008), argues that a mangrove forest with a 3000 trees/ha and 5-m in height can reduce 52 per cent of a tsunami's height, 38 per cent its energy and about 14 – 22 per cent of its run-up.

According to Ghufran (2012), there are five factors necessary for optimum growth of mangrove vegetation: less frequent and less intense sea waves, high salinity of water, particular kinds of substrata, muddy river flows in estuaries, and lots of sunshine. Pemda Mentawai (2010) reports that there are 25 species of mangroves in the coastal areas of the Mentawai Islands. *Rhizophora nucronata* is the main species found in Sipora and other smaller islands where the coasts have deep mud and another species and *Rhizophora apiculate* is mostly found in Siberut where there are more rivers.

Furthermore, the Pemda Mentawai also reports that the average density of mangroves is about 473 trees per ha with an average height of 13.15 m and an average diameter of 14.80 cm. It is also said that the average density of seedlings is 2905 per ha. The seedlings cannot grow very well because there is no thick mud on the coasts. Moreover, the average diameter of the trees is about 40 cm and the average height is about 25 m (Pemda Mentawai, 2010). As a comparison, these averages are very much lower than those in the Sembilan National Park in South Sumatra which has one quarter of Indonesia's remaining mangroves (Adger et al., 2005) with up to 2.490 trees per ha and 2.328 seedlings per ha (Nurlia, Siahaan, & Lukman, 2013).

According to Anwar and Gunawan (2006), the soil type beneath the water bays in Mentawai is saline young soil. This type has less clay, is more alkaline, and has less organic content. On the other hand, the rivers in Mentawai are relatively short, so the flows bring less mud and natural fertilizers. These natural factors have less influence on the thickness and growth of the mangrove vegetation.

Figure 3. 11
The coast on the *Dusun* Betumonga (Sipora) has no mangroves on the shoreline.
In fact, the *dusun* people live about 100 metres from the shoreline
Source: Personal documentation taken during the field study

Figure 3. 12
The coast on the ex *Dusun* Lakkau (South Pagai) has few mangroves,
because its clay is mainly covered by dead corals.
This settlement was abandoned by the community after the devastating 2010 tsunami.
Source: Personal documentation taken during the field study

Figure 3. 13
Mangroves are also found on the coast of the *Dusun* Limu (South Pagai).
The settlement is about 150 metres from the coast
Source: Personal documentation taken during the field study

Pemda Mentawai (2010) claims that generally 70 per cent of the mangroves are still in a good condition. However, Yayasan Minang Bahari (2009) reported that several human activities have devastated the mangroves in Mentawai. Firstly, members of the local community exploit the mangroves for their daily needs by cutting and drying them for their cooking fires. Secondly, it is also found that the level of coastal erosion in certain areas is very high due to human activities such as logging. After cutting the trees from the forests, the forest concession companies often push the logged trees to the closest sea waters before they are shipped. These activities damage the mangroves and no tree seedlings grow. Thirdly, the over exploitation of the corals causes the sediment loads to lessen which can create vegetation removal. Many of the community members of Mentawai use the dead corals as the foundations and walls of their houses, instead of using river sand and stones (Yayasan Minang Bahari, 2009). In fact, no river sand and stones are found naturally in Mentawai.

In conclusion, the shrinkage in the density and number of the mangroves in Mentawai is influenced by several factors such as human activities and natural conditions. The local community and the private companies are responsible for reducing and destroying the mangroves in significant ways. While the soil type beneath the bay waters is saline young soil, the estuaries in Mentawai are relatively poor in mud and natural fertilizers that

influence the growth of the trees. This shrinkage creates less power to withstand energy and run-up tsunami waves, because the buffer zones between the ocean and the land are wider.

3.6. Conclusion

Based on the Progression of Vulnerability Model above, we found there are a number of factors which make the local community of Mentawai vulnerable to tsunami hazards. The root causes of the vulnerability originated in the contacts by Western people with the indigenous Mentawai early in the 19th century. After Indonesian independence, the root causes became more prominent when the Government of Indonesia banned the traditional belief practices. In line with the ban, the Government started a new program (PKMT) that resettled the indigenous people and introduced new ways of living which caused a number of dynamic pressures, channeling the vulnerability of the local community. These pressures exist as the results of the population growth, poverty, the lack of capacity of the local government, and deforestation and have created fragile livelihoods and unsafe conditions for the local community of Mentawai.

The local community tends to live in the coastal zones where they can carry out fishing. In fact, the Mentawai Islands are situated in the Mentawai Segment where the Indian-Australian Plate subducts into the Eurasian Plate. This subduction zone often creates earthquakes that could trigger tsunamis. The islands are also next to the Mentawai Fault Zone that could deform and create tsunamis. Besides, the mangroves are found only in certain particular places to protect all the coasts from tsunami waves. Moreover, the human, social, and political resources in Mentawai are limited to support the welfare of the local community. Therefore, the local community of Mentawai has become vulnerable to tsunami hazards.

In order to understand how this vulnerability will be juxtaposed with the local community of Mentawai, it is important to design a research study. Therefore, the next chapter will discuss which research methodology will be suitable to explore the research questions as mentioned on Chapter 1. It will also explain how the methods will be employed to collect and analyze the field data.

CHAPTER 4
Methodology and Methods

"Qualitative studies are tools used in understanding and describing the world of human experience" (Myers, 2000, p. 1).

4.0. Introduction

As explained in Chapter 1, this thesis explores the tsunami hazards knowledge and current tsunami preparedness in Mentawai. The context of the tsunami preparedness has been described in Chapter 2, while the reasons that Mentawai is vulnerable to tsunami hazards have also discussed in Chapter 3. This chapter now outlines the research methodology and methods that have been utilized to collect and analyze the data for the thesis. There are eight sections in this chapter.

Section 4.1. Indicates the rationale of why a qualitative and case study is suitable for the research.

Section 4.2. Explores a number of methods and procedures that are designed to gather the data and how the designs are employed in the field work.

Section 4.3. Explains my position in collecting and analyzing the data, and in writing the thesis.

Section 4.4. Describes how the data collection process in the field works.

Section 4.5. Explains how the data triangulations, through interviews and observations, are gathered.

Section 4.6. Shows the data analysis processes that are conducted from the transcribed verbatim interviews through to presentations of the findings.

Section 4.7. Demonstrates the implementations of the ethical considerations of the research.

Section 4.8. Summarizes the chapter through a concluding remark.

4.1. Research design and its specific context

As mentioned in the previous chapter, the aim of this study is to provide new insights from the explorations of tsunami hazard knowledge and preparedness measures in Mentawai. For this purpose, it is important to link the explorations by analyzing the social, cultural, economic, political, and environmental objects or practices within the community. This has allowed me to explore these features in a natural setting without any manipulation of the

people's behaviours. In order to achieve this, I designed this study as a qualitative research. Qualitative research is commonly considered interpretative research that uses many kinds of methodological approaches to explore and explain social relations and reality. According to Winchester and Rofe (2016), it is also associated with revealing human environments and human experiences with many conceptual frameworks. More specifically, Pawson and DeLyser (2016) argue that only qualitative research can capture the human realities of anxiety, frustration, and loss of security that lie behind statistical figures. Lastly, Adams, Khan, Raeside, and White (2014, p. 26) state that it "employs methods of data collection and analyses that are non-quantitative, aims towards the exploration of social relations, and describes reality as experienced by the respondents".

Qualitative research takes various approaches in exploring social phenomena. One of these is a case study method. Stake (2008) argues that a case study identifies and explores a specific case as "a 'functioning specific' or a 'bounded system'" (p. 199). Moreover, Schramm (1971) argues that a case study has the essence to try to highlight for a decision or even a set of decisions, why the decisions are taken, how the decisions are implemented and what results are expected. Also, J. Baxter (2016) states that it explores in-depth nuances, contextual influences, and explanations of a phenomenon. Based on the above definitions, I conducted a qualitative research program for the following reasons.

Firstly, I focused on investigating one particular community: the local community of Mentawai. This community consists of the indigenous people of Mentawai and out-coming people who have lived in Mentawai from Sumatra and other parts of Indonesia. This mixed community is unique since the indigenous people have experienced significant changes over the decades, while the out-coming people have reinforced changes amongst the indigenous people by bringing formal education, health services, and modernized influences. As discussed also in the previous chapter, the indigenous people of Mentawai lived in the jungles as fruit gardeners and hunters, but external influences forced them to move to the coastal areas and become fishermen and gardeners (Erwin, 2007; Hernawati, 2007; Schefold, 1988; Sihombing, 1979). However, because of their origins, the indigenous people had limited access to tsunami hazard knowledge, even though the islands are prone to tsunamis (Ambikapathy et al., 2010; Borrero et al., 2006; Natawidjaja, 2007; Prawirodirdjo et al., 2010). Similarly, the out-coming people were also vulnerable to tsunamis. They mostly

gathered and built some small towns in the coastal areas because here they could easily access economic resources such as buying the fish and crops from the indigenous people, while the indigenous tend to live in the *dusun*. Because of the poor infrastructure and accessibilities to information such as tsunami knowledge, the out-coming people also had little knowledge about tsunami hazards. This is in line with what Liamputtong (2013) mentions that a case is a unique aspect of whatever object or event is under scrutiny. Moreover, the object of qualitative research can be an individual, a group of people, an institution, or a community. As Yin (2014) expands and contributes to Schramm's definition, a case study is about "cases of 'decisions' as the major focus of a case study includes 'individuals,' 'organizations,' 'processes,' 'programs,' 'neighbourhoods,' 'institutions,' and even 'events'" (p.15)., Therefore, a qualitative case study was a suitable method to scrutinize the unique community of Mentawai.

Secondly, I aimed to make the findings generalizable and replicable across the whole community of Mentawai. However, this required me to analyze the study findings in a comprehensive way. Generalizability and replicability are essential components of a case study in order to understand the phenomena. These findings can potentially contribute valuable knowledge to the community and build new insights about the whole community. Yin (2014) and J. Baxter (2016) agree that the findings of a case study are generalizable and replicable across populations. This process is based on assumptions that representative samples (participants) are not too dissimilar from the whole population (Myers, 2000). Therefore, in order to make generalizability and replicability of the findings across the community of Mentawai, I also accommodated the secondary statistical data from the district level.

Thirdly, I expected to provide some previously unconsidered and surprising facts from the very limited knowledge that currently exists about hazards knowledge and preparedness in Mentawai. It also enabled me to provide a number of new insights on how a local community forms their own prevention and preparedness measures for potential tsunamis, what were the problems they faced and what potential solutions could be developed. From my observations, only one Masters Student has conducted social research related to tsunami knowledge in a particular village: Saibi Samukop village, in Siberut Island. This research aimed to develop a better understanding of how past and contemporary

construction of knowledge of earthquake and tsunami risks was achieved (Rafliana, 2015). Comparatively, my study covered three different islands of Mentawai, in which the participants originated from 19 *dusun* in nine villages from South and North Pagai and Sipora Islands. As Gerring (2007) states that a case study may show a "lightbulb moment" , it is believed that this study may provide some unexpected facts from the local community of Mentawai regarding knowledge of tsunami hazards and tsunami prevention and preparedness measures. The findings may provide clear "lights" of phenomena within the community.

Lastly, I provide potential public policies related to the issues at the community and district levels on tsunami preparedness in Mentawai. Through my "how" research questions, I anticipated an in-depth description of contemporary real-life situations regarding the topics. Yin (2014) mentions that a case study is a suitable approach to explore the implementation of a "program". A public education program on tsunamis had been implemented in the local community of Mentawai previously. Through this current study, we can see how far that program has been implemented. The findings will provide a number of inputs to develop future public policies. As an employee in BNPB, I will have a good understanding and knowledge of what happens at the community level. Schramm (1971) argues that a case study can be a good method to provide constructive inputs for policy and decision makers, rather than to scientists. Therefore, in the future I could propose a reform or review of the existing tsunami preparedness measures at the community and district levels in Mentawai.

4.2. Method and procedure designs

After discussing the suitability of a qualitative case study for this research, this section will outline appropriate methods and procedures. A case study depends on numerous sources of facts and data collection methods and procedures (Iacono, Brown, & Holtham, 2009). According to Thomas and Bryan (2011), there are three main methods used to collect the data in a case study. Firstly, it is common to collect words as the main data by interviewing individual(s) or group(s) of people. Secondly, it is important to use words, images, and/or numbers from questionnaires, observations, and image-based methods. Lastly, numbers can be used to collect data by measuring and testing objects, reviewing official statistics and other numerical data (Thomas & Bryan, 2011). The data collection methods were conducted using the first two methods, i.e. interviews and observations. Nevertheless, in order to have

a clear understanding of the context, I also used a number of data triangulations to corroborate the evidence from the interviews and observations as well as the data from secondary sources.

It is appropriate to collect data for qualitative research from participant(s) in natural settings, i.e. in their “real life” environments in order to have more accuracy in reflecting "real life" behaviors, rather than “contrived or manipulated” behaviours (Liamputtong, 2013). Therefore, participant interviews always take place in community settings, in locations that researchers identify as having relevance to their research questions. In order to gather the data, it is important to select the research participants by undertaking a number of participant recruitment processes.

4.2.1. Selection criteria

In order to explore the social phenomena of this case study, I determined certain characteristics of the participants. I formulated the participants’ characteristics, according to my need to achieve the aims of the study. Generally, the characteristics were adult males or females over 18 years old who lived in the Mentawai District. The potential candidates could be the indigenous people or the out-coming people who have lived in Mentawai before the 2010 tsunami. The key characteristics of the participants were as follows:

- having experience of the 2010 Mentawai Tsunami, or/and
- living on the coast of the Mentawai islands during the research.

In qualitative research, the determination of research participants can be conducted according to the needs of the researcher(s). This method is called purposive sampling. Because I have determined the aim of this study as mentioned in Chapter One, I used purposive sampling to identify the above characteristics of the candidate participants. According to Creswell (2013), Etikan, Musa, and Alkassim (2016), and Longhurst (2010), purposive sampling is a non-random tool to carefully select available participants in order to provide insightful information or experience. Researchers can select their participants based on their needs and set out to find the participants who can and are willing to provide the information (Creswell, 2013; Etikan et al., 2016; Longhurst, 2010). Therefore, purposive sampling is important in ensuring that researchers are able to use effectively limited

resources as well as to determine information-rich participants to reach the aims of the study.

I considered that the above characteristics would be able to provide me with the rich data I required for the depth of analysis needed and for the development of my thesis as a whole. Although the number of research participants was limited, I designed the research to allow for generalizability and replicability of the findings across the community of Mentawai. Bryman (2008) argues that purposive sampling allows picking homogeneous cases to decrease disparity. Therefore, I could recruit a homogeneous group of participants in order to be able to generalize the findings to the wider community of Mentawai through this purposive sampling.

Additionally, purposive sampling also allowed me to obtain assistance from people known as gatekeepers in order to reach the candidate participants. According to Creswell (2013), purposive sampling enables the researchers to access gatekeepers. Gatekeepers are the persons who can provide the candidate participants to researchers. Furthermore, gatekeepers can create participants' confidence to contribute to research. Therefore, the purposive sampling allowed me to have assistance from the gatekeepers to access to the research participants and to build the participants' confidence to partake in this research.

For this purpose, I built up layers of contact persons, because I originally knew little about Mentawai. The layers were obtained by asking the research participants to show a potential *dusun* to which to go. This method is known as the snowball method. According to Parfitt (2005), a snowball method will build-up layers of contacts for interviews by asking a participant to show another potential participant. Furthermore, Atkinson and Flint (2001) argue that snowball sampling is often used as a response to overcome the problems associated with sampling concealed populations. In many cases, these populations can be the victims of discrimination, or isolated people who are difficult for researchers to access. But for the sake of this research, these populations were the 2010 Mentawai tsunami victims who might have moved to the middle of forests. In addition to this method, research participants are involved in the research process by referring other people who have the same characteristics of the research interest (Biernacki & Waldorf, 1981; Mack, Woodsong, MacQueen, Guest, & Namey, 2011). This will increase the credibility of the research.

Therefore, in order to increase the credibility of my research, I have used the snowball methods to build-up the layers of the contact persons in order to attain the particular data required from particular groups; in this case, the victims of the 2010 tsunami are considered as the concealed population.

Figure 4. 1
A summary of the methodology that are employed in this study

Figure 4.1 indicates the summary of the methods for this study. Firstly, I chose a qualitative research method in order to explore the social relations about the tsunami preparedness in Mentawai. I designed a case study to deeply explore the social phenomena from its context within the local community of Mentawai. In order to find the data, I selected a purposive sampling to achieve the intended aim of the study. Through the purposive sampling, I also intended to obtain the data from the victims of the 2010 tsunami in Mentawai by building up the layers of the people contacts. This method is known as snowball method.

As a snowball method has been employed to this study, gender and age of the participants were less significant by comparison. This method allowed a head of *dusun* as a gatekeeper to choose a candidate participant. This would also influence the decision of the gatekeepers whether or not to choose new out-coming people into the community. As the result, it was not possible to compare the findings by age, gender or when they started to live in Mentawai.

4.2.2. Recruitment process

Once the selection criteria were setup, the above methods were applied in the field. I decided to start the research interviews in North Pagai, then South Pagai, and lastly Sipora Islands. I visited Sikakap Town in North Pagai first. After my arrival, I contacted a person who worked at the Sub-District Authority of Sikakap who provided me with a list of villages and *dusun* to choose potential research sites from (as purposive sampling). From there, I then went to several *dusun* in North Pagai to carry out the investigations. After interviewing in North Pagai, I continued with participants in South Pagai. Because accommodation was only available in Sikakap, I stayed there. From the islands, I continued on to Sipora. Because no direct ferries were available from Pagai to Sipora, I had to go back to Padang, and the next morning I went to Sipora. Mostly I hired a motorcycle to reach the target participants.

I went to Makuket Dusun, Matobe Village (North Pagai Island) about 10 km from Sikakap, to recruit the first participant . The selection of this *dusun* was based on the suggestion of the contact person from the Sub-District Authority of Sikakap as, according to him, these people had been involved in the community-based program for tsunami preparedness. Firstly, I saw the head of Makuket Dusun (as the gatekeeper) to inform him of my purpose. The head of the *dusun* then appointed one of the *dusun* members who was suitable to participate in the research. I believed that one participant from each *dusun* would be sufficient to gain the data. After meeting with the potential participant, all the interview procedures were employed as discussed after this section.

After finishing the interview, I asked the participant to identify the next *dusun* where I could interview, thus enacting the snowball method. The first participant named Berkat Baru Dusun in Sikakap as the second *dusun* that I needed to go to, to recruit another participant. In short, this process was applied to the rest of the participants in the South Pagai Island, North Pagai, and Sipora Islands.

It is important to mention that when I saw the heads of *dusun* often they were at their work (in the garden or on the coast), at home, or at *kedai kopi* (traditional coffee/tea kiosks). So, they often designated someone else (who was qualified to be a participant) nearby to be interviewed. I generally found no particular difficulties in meeting the participants.

In brief, the way I obtained the participants was in accordance with what the cited scholars suggested. I wanted the participants to provide the data that I needed through purposive sampling by requesting that the heads of *dusun* as the gatekeepers appoint the participants (Creswell, 2013; Etikan et al., 2016; Longhurst, 2010). To find certain victims of the 2010 tsunami (can be considered as the concealed population), other participants showed me the next *dusun* to go to, demonstrating the snowball method in action (Atkinson & Flint, 2001; Mack et al., 2011; Parfitt, 2005). Therefore, I believe that these methods allowed me to gather credible research data.

4.2.3. Semi-structured interviews

Generally speaking, the main forms of qualitative interviews fall into the following categories: unstructured, structured, and semi-structured interviews. I used the semi-structured interview to collect the field data. The reasons that I chose this were as follows. Firstly, a semi-structured interview was suitable for my research as it enabled me to provide a list of the issues to be freely explored. As semi-structured interviews require some degree of predetermined order (Dunn, 2016), I had prepared several questions prior to the interviews. Secondly, since this kind of interview maintains flexibility (Creswell, 2013; Dunn, 2016), I could also add some questions from the valuable findings from the previous interviews and observations. Furthermore, Creswell (2013) argues that this allows participants to discuss general topics at the beginning, and then switch to the main topic. Moreover, it can allow for further opportunities for the participants to elaborate on any new line of inquiries (Waliman, 2005). Lastly, R. Edwards and Holland (2013) explain that it enables one to have an interactional dialogue between the researcher and the participant, within a fluid and flexible structure.

4.3. My position

Because of the involvement of social interactions, it is important to avoid researcher subjectivity in qualitative research. Therefore, the objectivity of researchers becomes an important issue. According to Dowling (2016), objectivity has two components: the personal involvement of the investigator and the participants; and the independence of researchers from the object of the research. Similarly, Iacono et al. (2009) argue that subjectivity can arise from two sources. One is that subjectivity may be driven by the influence of researchers leading participants' behaviors to what the researchers intend. The other is that

subjectivity may arise through the impact of the researcher's own beliefs (Iacono et al., 2009). It is, therefore, important to note that researchers are required to have integrity in conducting their research.

In order to maintain my integrity, I conducted several activities. Although objectivity is an ultimate prerequisite, and interpretations should avoid subjectivity (Stake, 2008), certain efforts can reduce subjectivity. Firstly, I recorded all the interviews and wrote them in transcriptions. As part of the data analyses, I read the transcriptions many times until I established the real meanings in each of the interviews. Secondly, I conducted a number of triangulation activities such as observing several objects and activities. Shenton (2004) argues that the role of triangulation can reduce the effect of subjectivity. In following chapters, I also discuss the facts from the observations to corroborate the evidence. In addition, I enrich the field findings with secondary data and other literature. MacCoun (1998) warns that researchers should be wary about jumping too quickly to conclusions to avoid subjectivity. Although objectivity is often considered elusive (McNeill & Chapman, 2005) and hard to capture (Denzin & Lincoln, 2005; Flyvbjerg, 2011), the above activities should decrease my subjectivity to the data.

It is also important to mention that while I was in the field, I often obtained privileged status by being from a Batak tribe. Historically, since 1932, many priests of Batak origins have become missionaries in Mentawai (Sihombing, 1979), and many Batak people have lived and mingled within the local community. This made it easy for me to associate with the community members at the first stage. Although some of them hesitated when receiving my objectives to interview them, they mostly welcomed me and received my offer to be a candidate and participant of the research. In addition, I brought with me a local person who could understand the situation in Mentawai. This person was chosen by the officer from the Sub-District Office in Sikakap.

During the research process, I also maintained my role as a critical advocate of tsunami prevention and preparedness measures and tools to develop community resilience to tsunami-induced disasters. As an ex-middle manager in BNPB, I tended to support every preparedness measure at the individual, household, community, and district levels. However, I continued to maintain myself in a "critical" position right through the

development of the measures. Therefore, I could identify both positive and negative aspects from the field by using academic approaches and literature, and hence, avoid biased conclusions. In addition, the research process required me to maintain certain interactions with the local community members. It is advised by Yin (2011) that researchers refer themselves as "insiders", "locals", or those who sympathise with the participants' living conditions. Therefore, at some stage, I put myself in the position of one who sympathised with the participants' living conditions; that is, of being threatened by potential tsunami hazards. However, I also put myself in a critical role in order to maintain my objectivity as an "outsider" so as to ensure the quality of the research findings.

4.4. Data collection

Qualitative case study may require in-depth interviews to gather the data. In order to do the interviews, it is important to carry out certain processes to have good interviews.

4.4.1. In-depth interview processes

A face-to-face individual in-depth interview is suitable to collect primary data for a qualitative case study. Dunn (2016) suggests that the face-to-face interview is a procedure to collect the data through spoken conversations or expressions of ideas or beliefs from one person or a group of people. Below are several reasons why I chose the interviews. First and foremost, as mentioned above, I intended to investigate a certain topic, which is the tsunami preparedness in Mentawai. This specific topic could be covered typically in the interview sessions. As Hesse-Biber and Leavy (2011) argue, in-depth interviews are issues oriented to yield the exploratory data from the perspective of selected research participants.

Secondly, I also intended to explore a particular experience of the 2010 tsunami in Mentawai from the perspective of the tsunami victims. The in-depth interviews were useful to dig up the experiences and the particular knowledge of how they escaped from the tsunami waves. Hesse-Biber and Leavy (2011) and Winchester and Rofe (2016) argue that in-depth interviews in qualitative research can reveal people's thoughts, ideas, memories, behaviours, and motivation. The interviews are useful to access exclusive knowledge or practices from marginalized or special groups of people.

Lastly, the in-depth interviews enabled me to obtain the data from the participants because I could interview them in their familiar surroundings such as at home, at the garden, or at the kiosk. The interviews also enabled me to tape all the conversations with the participants' permission. Scholars such as Hesse-Biber and Leavy (2011), Opdenaker (2006) and Waliman (2005) also support my reasons. An in-depth interview yields exploratory data under an investigation that is not linked to particular settings (Hesse-Biber & Leavy, 2011; Waliman, 2005), and can be taped (Opdenaker, 2006).

It is important for researchers to consider all processes of the interviews from beginning to end. As Legard, Keegan, and Ward (2003) suggest, researchers should be aware of the interview processes from the arrival, introduction to the research, the beginning, during, and ending and after the interview. During the field research, I normally greeted the potential participants by saying "*Halo, apa kabar?"* (Hello, how are you?). I then introduced my field assistant and myself. After saying a few words about my purpose and explaining that I got his/her name from the head of *dusun*, I often let my assistant talk more in the local dialect or local language to make the potential participants less worried or suspicious. This also put them at ease, helped them relax, and built their trust. After they had a clear understanding of my purpose, I respectfully requested them to become one of my research participants. At this stage, no potential participants showed that they were unhappy or forced against their will to participate in the research. I then requested them in polite way to step away a little to have some privacy.

In the next step, I tried to introduce my purpose in more depth. I also made sure to explain that they could withdraw and not answer the questions if they felt uncomfortable. I also mentioned that all questions would be in Bahasa. However, if they could not speak in Bahasa, or inserted the local dialect into their conversations, that would be fine. I told them that I would directly ask my research assistant to translate it if I found any difficulties with understanding the interviews. I also spoke briefly about my questions on the interview. After having a clear idea that they had no objection to participating, I then handed the Information Sheet for the research. I encouraged participants to read it first, and waited for their response. However, in many cases, I read the Sheet clearly and slowly for them, because they did not want to read it. I suspected several reasons why they were reluctant to

read. They might be reluctant to read a long three-page document, seldom read, and/or had some difficulties in reading and understanding what they read.

After they understood what they or I read, I then asked them to sign a Consent Form. Mostly, they did not want to sign the Form. The main reason was they were suspicious of 'something' such as some kind of hidden agenda behind this form that might have repercussions in the future. They genuinely intended to participate in the research, yet felt uncomfortable signing a document they possibly didn't really understand or trust, even after providing their participation. The other reason was they were working on the coastal areas or in their garden when I asked for the interviews. However, they usually agreed to be interviewed by giving oral consent. In this stage, two candidates objected to the interview and did not want to give their oral consent. I then asked the head of *dusun* to appoint someone else to participate. The same process was applied and after they gave their consent, I also asked their permission to put the audio tape recorder on to record the interview. They all agreed to taping the interviews.

As suggested by Englander (2012), a preliminary meeting is a chance for researchers and research participants to build a trusted relationship. This also will allow participants to briefly understand research procedures. After obtaining their consent, I still held myself back from not asking the core questions of the interview. As a native of Sumatra, I followed the best code of conduct when dealing with Indonesians from Sumatra. Indeed, in order to interview the participants in an effective and respectful way, and as is a common habit in Indonesia, the first thing I did was to familiarize myself as "a guest" with each participant. During the "familiarization" activities, I started "chit-chats" about general issues such as talking about their family members, about eating habits, etc. Alternatively, when they were at their work I asked them about their garden or the fish catch. It took about three to five minutes. This also enabled me to have more chance to prompt or encourage the participants for any more interesting information.

After some general talk with the participants, I began the interviews through key themes of my research questions. Each key theme question was followed by the next questions from my list or by probing the participants' opinions. I actively explored the ideas, thoughts, and perceptions. Many times my assistant also actively translated several local words. At this

moment, two interviews were discontinued because I saw their emotional expressions on their faces had changed. This was potentially caused by the questions that I raised reminding them of the 2010 tsunami so I, therefore, stopped the interviews and nullified all information that they had given. I then asked the research participant to name one *dusun* person for me to interview.

Before ending the interview, I indicated that the interview was about to finish. At this stage, I allowed the participants to raise any questions related to myself and my study or any issues related to the interview questions. Mostly, they asked me about my study or my family, and I always responded to all the questions.

To end the interview, I handed participants the Debriefing Sheet Form to read, but often I read it for them. I then switched the audio tape recorder off. I offered my thanks for their participation. I often stayed a little longer to discuss general topics before I left.

Generally, the main core of the interview took approximately 60 minutes. But, since I needed some time before and after the interview, I occasionally needed longer. The interview was conducted once with each participant and was not repeated for participant checking. According to Dunn (2016), participant checking may be needed for the research participants to vet or authorize the interview for some qualitative research. Here, after the interviews were transcribed, the transcripts were given back to the participants for further comments and/or corrections. However, I did not do this participant checking process. There were several reasons for this. Firstly and mainly, the participant checking could cause the participants to become embarrassed, perplexed, or to hesitate. They could feel confusion about the research I was doing. Similarly, they could feel a sense of hesitancy for what they had said. In fact, generally, it is not polite to reflect what someone has said in Indonesia.

Secondly, as I witnessed prior to the interviews, the participants were reluctant to read the Consent Form and the Information Sheet. I then assumed that they would be reluctant to read the transcript. Indeed, mostly the number of pages of each transcript is more than the Information Sheet. Lastly, I had limited time and effort to do participant checking. Geographically, the location of each participant was very far away and not easy to access. In fact, I completed the transcripts after I came back to UC.

4.4.2. Recruited research participants

The code, sexes, ages and locations of the research participants are shown on Table 4.1. Twenty participants took part in the research and they lived in 19 *dusun* from nine villages in Mentawai. Among the participants, there were 11 males. I considered that 20 participants would provide me with sufficient data for the study.

Table 4. 1
The code, sexes, ages and locations of the research participants,
Mentawai District, West Sumatra

No	Name Code	Sex	Age (years old)	Dusun	Village	Island
1	Community Member No.01	Male	39	Berkat Baru	Sikakap	North Pagai
2	Community Member No.02	Female	50	Berkat	Sikakap	North Pagai
3	Community Member No.04	Male	41	Passibuat	Taikako	North Pagai
4	Community Member No.05	Female	35	Makuket	Matobe	North Pagai
5	Community Member No.07	Female	40	Sabeugunggung	Betumonga	North Pagai
6	Community Member No.09	Male	53	Sabiret	Malakopa	South Pagai
7	Community Member No.11	Male	54	Eruparaboat	Malakopa	South Pagai
8	Community Member No.12	Male	60	Munte Kecil	Malakopa	South Pagai
9	Community Member No.13	Female	41	Parourogat	Malakopa	South Pagai
10	Community Member No.14	Male	39	Belaraksok	Malakopa	South Pagai
11	Community Member No.15	Female	42	Lakkau	Bulasat	South Pagai
12	Community Member No.16	Male	28	Tuapeijat	Tuapeijat	Sipora
13	Community Member No.17	Male	31	Gobik	Bosua	Sipora
14	Community Member No.18	Male	49	Basua Utara	Bosua	Sipora
15	Community Member No.19	Female	45	Nemnem Leleu Utara	Nemnem Leleu	Sipora
16	Community Member No.03	Male	39	Seay Baru	Sikakap	North Pagai
17	Community Member No.06	Female	50	Passibuat	Taikako	North Pagai
18	Community Member No.08	Male	41	Taikako	Taikako	North Pagai
19	Community Member No.10	Female	35	Sikakap Tengah	Sikakap	South Pagai
20	Community Member No.20	Female	40	Sagitsi Utara	Nemnem Leleu	Sipora

As Bradshaw and Stratford (2010) and J. Baxter (2016) argue, in a qualitative case study, it is important to highlight the depth of understanding and contextualized understanding of the cases. Moreover, J. Baxter (2016) suggests that in order to obtain the contextualized understanding of a qualitative case study, it is important to involve multiple sub-units of

cases (e.g. newspaper, policies) into the study. This argument suggests that no particular number of samples adequately is needed to participate as long as the context of the research is fulfilled. Therefore, I believe that the number of the participants in this study was sufficient and adequate to emphasize the context of the study, because from them the contexts of the research were sufficient to answer the research questions.

Below is the map where I interviewed the research participants. From a total of 20 participants, seven participants were from South Pagai, eight from North Pagai, and five from Sipora (Figure 4.2).

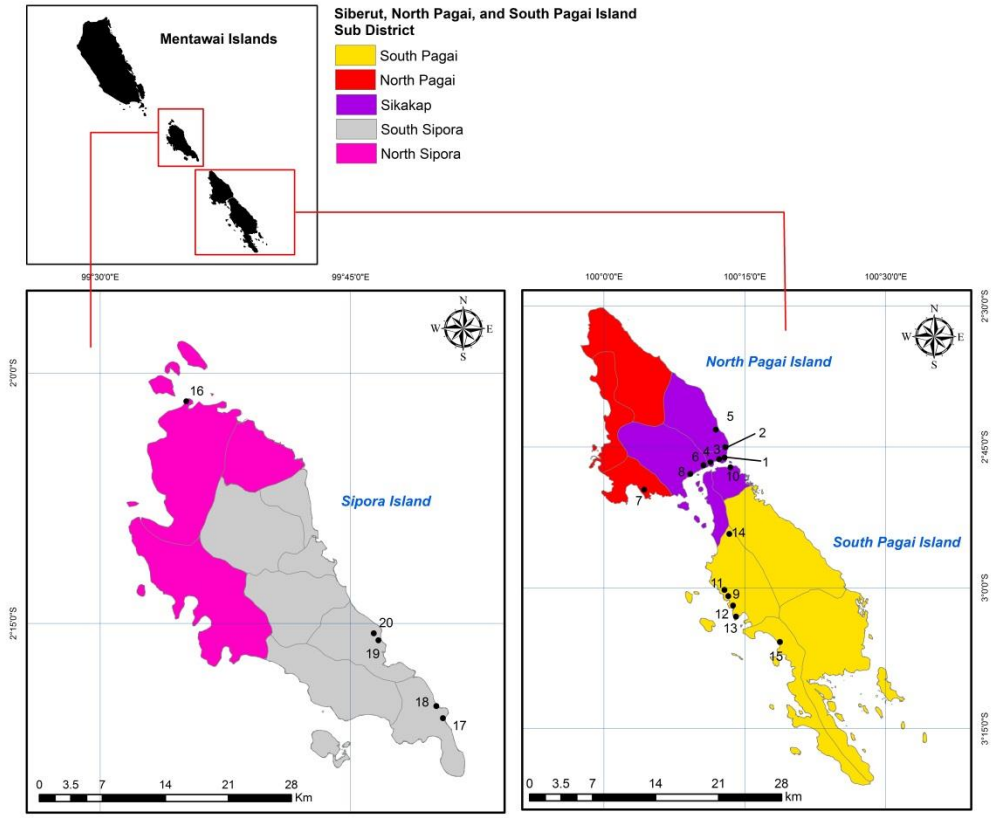

Figure 4. 2
The participants came from several *dusun* in the islands of Sipora, North and South Pagai. Each number refers to the Name Code column from Table 4.1.

To enrich the findings, I will also include statistical data and exclusive reportage of the 2010 Mentawai Tsunami in the thesis. In addition, to strengthen the credibility of the research and to avoid subjectivity, I also conducted a number of interviews with "non-community member participants" and a number of observations to corroborate the findings. This process is known as data triangulation.

4.5. Data triangulation

I found that the data from the community member participants were voluminous and rich. However, it was important to integrate this data with data from other resources. This method is called data triangulation. Data triangulation can strengthen a study by using several kinds of methods or data (Lichtman, 2006). Often, qualitative researchers use a triangulation method to avoid researchers' subjectivity. The term "triangulation" has multiple meanings in the social sciences. It can refer to the use of a combination of methods of investigation, data resources, or a process of data verification (Ayoub, Wallace, & Zepeda-Millan, 2014). The main idea behind triangulation is to enrich the field data by utilizing multiple methods, data resources, theories, and/or observations. Therefore, researchers can better explain and overcome limits and subjectivity. More importantly, data triangulations corroborate facts from various sources to provide enlightenment on a theme or perspective (Creswell, 2013). It is also said that data triangulations are processes to repeat data collection and to critically assess what is being said by the research participants (Stake, 2008). When investigators discover facts that substantiate research themes from other sources of data, the triangulated methods can provide findings that are more objective. As briefly mentioned above, I also conducted data triangulations to avoid my subjectivity on the data through the interviews of the non-community member participants and through some observations.

4.5.1. Triangulation through non-community member participation

Triangulation can be conducted by interviewing some external research participants i.e. stakeholders or experts who can be substantial and reliable for data triangulation. They can provide more data to strengthen or even to counter the findings from the research (Ayoub et al., 2014). Therefore, I employed this argument in my research. I identified some external research participants and interviewed them. These were selected from:

- local government officers of the Mentawai District
- local NGOs that had ever and/or still worked for the local community of Mentawai
- social researcher(s)/lecturer(s)
- geodetic researcher(s)/lecturer(s)

In order to recruit them, I conducted several steps. To begin with, I submitted the letter from BNPB with the supporting documents to the institutions. After several days (roughly

three days after the submission), the institutions would appoint one of their staff to be interviewed. Nevertheless, in order to shorten the time, I often went directly to the institutions one day after submitting the letter. In many cases, this method worked very well and I could interview them earlier. I suspected this privilege was because 1) I enclosed enough supporting documents, and 2) besides being a student, I am a government officer too.

Table 4.2 indicates the non-community member participants. There were three officers from the local government of Mentawai, three activists from local NGOs, and seven researchers or lecturers from the University Andalas (Padang, West Sumatra) , BPPT (Jakarta), LIPI (Jakarta) and ITB (Bandung, West Java).

Table 4. 2
The codes and institutions of the non-community member participants

No	Name Code	Institution	Place
1	Government Officer, No. 01	Kantor Bupati, Local Government of Mentawai	Sipora Island
2	Government Officer, No. 02	Bappeda, Local Government of Mentawai	Sipora Island
3	Government Officer, No. 03	BPBD, Local Government of Mentawai	Sipora Island
4	NGO Activist, No. 01	Center for Disaster Risk Management & Community Development Studies (CDRM & CDS)	North Pagai Island
5	NGO Activist, No. 02	SurfAid	Padang, West Sumatra
6	NGO Activist, No. 03	Yayasan Cipta Fondasi Komunitas	North Pagai Island
7	Researcher, No. 01	Andalas University	Padang, West Sumatra
8	Researcher, No. 02	Andalas University	Padang, West Sumatra
9	Researcher, No. 03	The National Agency for the Assessment and Application of Technology (BPPT)	Jakarta
10	Researcher, No. 04	the Indonesian Academy of the Sciences	Jakarta
11	Researcher, No. 05	the Indonesian Academy of the Sciences	Jakarta
12	Researcher, No. 06	Bandung Tecnology Institute (ITB)	Banding, West Java
13	Researcher, No. 07	Bandung Tecnology Institute (ITB)	Banding, West Java

I believed that the above participants enriched the data that I had obtained from some of the community members in Mentawai. Their expertise and experience of working with, for, and about Mentawai provided clear understanding of the research topics.

4.5.2. Triangulation through observations

It is also important to provide complementary evidence to the field research through observations. Kearns (2016) argues that observation is an in-depth interpretation of a particular social-temporal context of interest through a direct experience. For the purpose

of this study, I undertook a structured observation of a number of important features. According to Thomas and Bryan (2011), structured observation is where an observer only watches for particular kinds of events, behaviour or situations. Because of no interventions or questions during the observations, this method allows the observer to make their own assumptions of the observed event, behaviour or situation that can contribute to primary data collection (Yin, 2014). Firstly, I had a chance to observe the *dusun* people from Passibut in Taikako Village, North Pagai Island conducting an earthquake and tsunami simulation. The data can be obtained by observing individuals' activities in one community (Creswell, 2013; Remenyi, 2012; Thomas & Bryan, 2011). During the simulation, I recorded the event from what I heard on the voice recorder and noted some important parts. This voice record was then typed into the transcription as part of the study. To make the observation more complete, I also took some notes and photographed pictures for the specific scenes of the simulations.

Secondly, I observed and made some notes regarding the conditions of the evacuation routes and evacuation signage from several *dusun*. I also took some photographed pictures as evidence. Lastly, I observed the billboards for tsunami preparedness campaigns. As the billboards were placed at several strategic points such as the traditional market, sea harbour, and roads, I noted the text and pictorial messages on the billboards. The above observations were proper, because the data can be obtained by looking at physical objects and environments (Creswell, 2013; Remenyi, 2012; Thomas & Bryan, 2011). Later on, I raised a number of questions based on the observations with some of the research participants and non-community member participants.

To do the observations, I watched and took the field notes from a distance without direct involvement with activity or people. I also took some photographs to show evidence. Noting what the observations were about and taking some pictures of the observations are good ways to avoid missing some details during the observation (Liamputtong, 2013; Remenyi, 2012). Therefore, the results from the observations can be integrated together to promote a greater understanding of the cases (Creswell, 2013; Yin, 2014).

4.6. Analysing data

It is important to note that analysing text and other forms of data is challenging for qualitative researchers because the data is voluminous and rich. As M. Q. Patton (1980) explains:

> "The data generated by qualitative methods are voluminous. I have found no way of preparing students for the sheer massive volumes of information with which they will find themselves confronted when data collection has ended" (p.297).

As a novice in qualitative research design, I realized that the data I had gathered from the field were voluminous, diverse, and complicated. I needed a model as a guide to analyse the data. From the many models of analysing qualitative research data, I found that the Data Analysis Spiral Model (See Figure 4.2) was a suitable guidance to analyse the data that I had collected. This model , originally developed by Creswell (2013) has a systematic procedure from data management to data visualization of research findings. From the texts or images gathered from the field study, the steps of the procedures are: to conduct data managing; reading and memoing; coding and interpreting and lastly representing and visualizing.

From the analysis of my field data, I used the above steps. It is important to mention that the steps of data managing, reading and memoing, and coding and interpreting were conducted in Bahasa. The reasons were firstly it was easier to proceed with the steps, because I am an Indonesian native, secondly, to avoid unnecessary translations since not all the data would be used, and lastly to capture the real meanings of the data. However, for representing and visualizing the data, I presented the findings in English.

4.6.1. Data managing

After finishing the field data collection, I firstly transcribed verbatim each tape of the interviews into narrative forms and saved them as soft copy document files on my desktop at the UC. All pictures taken from the field were also moved into the computer. In order to manage my data, I organized the files and pictures according to the island where the participants lived as the main organisational units.

4.6.2. Reading and memoing

I read each file several times until I obtained the sense of the interview. I also marked and noted some interesting parts of the interviews. I found it convenient to write the memos

into Microsoft Word. The memos were about exploring the possible viewpoints and connections from the readings across the files. As Charmaz (2006) and Clarke (2005) mention, no best approach can produce good memoing and researchers can use pen and paper, a computer program, or a voice recorder. These processes helped me to feel more immersed in the interviews.

4.6.3. Coding and interpreting the data

The next step was to code the data from the transcribed files. The substantial data were coded according to the sub-research questions. I manually coded the data with codes such as 'RS1Sub1', and 'RS2Sub3'. RS1Sub1 meant that the data were suitable to place under Research Question No. 1 and the Sub-Research Question No. 1. RS2Sub3 meant the data were suitable to put under Research Question No. 2 and the Sub-Research Question No. 3. The codes made it easier for me to interpret in the future. The codes also reduced potential contention regarding the interpretations of the data and reduced the volume of the data. As Creswell (2013) states, the process of coding is "winnowing" the data where researchers should sort only important information.

I completed the coding process with the assistance of a computer using a simple word-processing package (Microsoft Word). Miles and Huberman (1994) and Weitzman and Miles (1995) advise that researchers do not use any software beyond a word processor, otherwise there will be a number of obstacles in analysing the data. However, Weitzman and Miles (1995) also mention that the coding process is ultimately determined by the researchers because there is no ideal method to do the coding process. I agreed with Weitzman and Miles (1995) and decided not to use any particular software for analysis. The main reason was I would need some time to learn and familiarise myself with any form of data analysis software until well into the coding process. I therefore manually coded the themes and patterns into Microsoft Word. Gorden (1998) suggests that the coding process can be made by labelling the certain text data into different numbers, colours, or geometric shapes. I then numbered the data because it was more convenient to use numbers than the other codes explained earlier. Mainly, I focused the coding process on the answers of the research questions.

The next step was to interpret the findings into broader meaning based on hunches, insights, and intuition. I connected the findings to a number of academic references, triangulated data, or existing data such as from the Statistical Agency of Mentawai. Similarly, Creswell (2013) argues that researchers might link their interpretations to broader research literature. In many cases, I also provided my personal views to enrich the interpretations. Mostly, my personal views were inserted into the quotes of the participants. There are several reasons why I inserted my personal views into the findings: 1) to connect the statements of the participants to my questions; 2) to determine the appropriate meanings of the participants' statements; 3) to probe the statements.

4.6.4. Representing the data

The last step is representing the data. For this step, I will present the data through written means. Pawson and DeLyser (2016) argue that the presentations of the data should embrace robust thinking, good preparation, and apparent structure with basic academic fundamentals. Therefore, I will represent the findings in mainly Chapter 5 and Chapter 6.

As Stiles (1993) suggests, qualitative research seeks knowledge that extends and increases the tenet of human presence rather than prediction and control. Therefore the conclusions and products of qualitative research may be better judged for their implementations and has "a little-used epistemological space between that of received-view science and that of history and biography" (Stiles, 1993, p. 598). From this argument, it is not critical to represent the data or findings on maps because the participants did not represent particular *dusun* as the research will be applied into whole *dusun* in Mentawai. However, in order that thesis readers can identify where the participants are from, I have constantly put the Name Code of the participants at the end of the interviews. The readers can refer each code to Table 4.1 "The code, sexes, ages and locations of the research participants, Mentawai District, West Sumatra" and to Figure 4.2 "The participants came from several *dusun* in the islands of Sipora, North and South Pagai. Each number refers to the Name Code column from Table 4.1.".

To briefly summarize the data analysis processes, they are shown below in Figure 4.3.

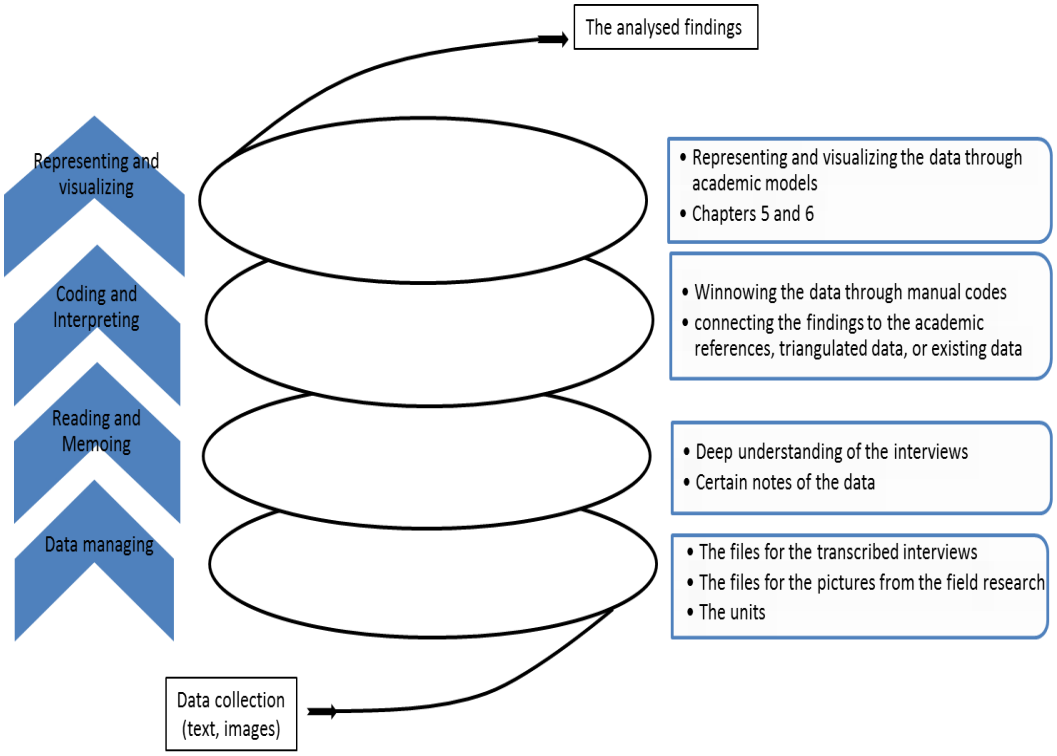

Figure 4. 3
The data analysis spiral from Creswell (2013) that has been employed into the research

The above figure indicates several steps that I have conducted in analysing the data. Firstly, I managed the transcribed data into soft files and units and to have clear understanding of the data, I read and memoed the data into certain notes. I then coded the data in accordance with the suitable sub-research questions. Lastly, I will present the data as the findings in the next chapters.

4.7. Ethics for the research

An ethical consideration is critical as a substructure of a research. It also becomes the research process for qualitative research. Therefore, before, during and after the data collection it is important to adhere to the ethics.

4.7.1. Human ethics committee

Following research proposal approval in 2013, ethics approval was obtained on 7 February 2014 from the University of Canterbury Human Ethics Committee with ref No: HEC 2013/164 (Appendix 4.1). Ethical requirements concerning confidential, anonymous, protecting actions from discomfort has been highlighted. The research participants were given printed and voiced explanations regarding the study.

4.7.2. Ethical considerations

A number of ethical considerations arose during the field research. Before the interviews, candidate participants were informed about the nature of the research and the intended use of the findings. They were also informed that the interviews would be audio-recorded. Their consent was important to be obtained after I had read the Information Sheet and explained it clearly. They were also assured of the confidentiality of their personal particulars and the information they would provide. As mentioned in the previous section, a number of the participants could only provide their consent orally. Before the interviews, I always introduced myself and explained my position and purpose of visit. Ethics was also considered in the observation process in Passibuat *Dusun*, in Taikako Village, North Pagai. The consent of the local community members of the *dusun* was also obtained orally after a clear explanation of their roles in the research.

The ethical consideration of research participants is also important after the interview. The data with identifying information that has been collected from the field study is securely stored in an organized fashion with the possibility of retrieval using my desktop in the Department of Geography, UC. The desktop is protected with a secure password known only to me. All data generated are backed up daily as protection from loss from hardware failures, fire, theft, etc. into the personnel UC email account that only I myself can access.

Lastly, during the data analysis, I also adhered to the ethical considerations by concealing the participants' names with their initials, as seen in Table 4.1 and Table 4.2. Therefore, on the report, the readers will only see 'Community Member', 'Researcher', 'NGO activist' and 'Government Officer' followed by two digit numbers. I believe that this will ensure that the participants' identities are concealed.

4.8. Conclusion

In order to conduct this study in the Mentawai islands, I have designed a qualitative case study with a number of scientific rationales. This study was also designed with a purposive sampling and a snowball method in order to gather the specific data to achieve the intended aim. My position as a researcher was also clearly addressed, as objectivity is ultimately needed to avoid subjectivity in qualitative research. This study had also allowed me to collect the data through face-to-face in-depth interviews. However, in order to avoid subjectivity of the evidence from the participants, triangulation methods were implemented

through the inclusion of interviews from various sources of participants, direct observations, and archival photographed pictures. This also allowed me to analyse the data with a systematic approach by using the Data Analysis Spiral. Lastly, the ethical considerations were adhered to in the field research.

This chapter is the last chapter of Part 1. This part has discussed a number of rationales to conduct this study and formulated a specific research questions to lead the direction of the study. It has also discussed a number of key frameworks and concepts which would employed in the study. In addition, this part has also explored how the local community becomes vulnerable to tsunami hazards by tracing a number of factors of rooted causes, dynamic pressures and living in an unsafe location. Lastly, this part has discussed the design of the study to collect and analyse the data.

The next part will be Part 2 which mainly presents the research findings. The research findings will be analysed and presented by juxtaposing a number of academic views and references in order to make the findings reliable, objective, transparent, and academic.

PART 2: RESULTS AND ANALYSES

CHAPTER 5

Tsunami Hazard Knowledge and Preparedness in Mentawai before the 2010 Tsunami

> "We, the Team Nine feel like bringing a death message, but the scientific findings must be delivered [to the public] so that we get prepared to face the disaster" (Wahyu Triyoso, 12 October 2010, the Daily Singgalang)

5.0. Introduction

Having discussed in the previous part about the rationales, context, and methodology of this study, now Part 2 contains exploration of the results and analyses of the research findings. It consists of Chapter 5 and Chapter 6 that analyse and present the study results. Generally, Chapter 5 presents the results and analyses of how tsunami hazard and preparedness knowledge was explicitly exposed to the research participants before the 2010 Mentawai Tsunami (the Tsunami) occurred. While Chapter 6 demonstrates how the preparedness measures are applied in the community of Mentawai.

Chapter 5 will give one characterisation of the specific context of knowledge management on tsunami preparedness in Mentawai. Its main proposition is to understand how the local community of Mentawai prepared for the potential tsunami hazard after the explicit knowledge was delivered to them. The field study findings elaborate and identify the community's knowledge from pre- and during the 2010 Mentawai Tsunami (the tsunami). There are six sections in this chapter, as follows:

Section 5.1. Defines hazard knowledge into knowledge.

Section 5.2. Demonstrates how knowledge management is used to analyze the field research findings.

Section 5.3. Explains a number of the macro factors that influenced the tsunami hazards knowledge in Mentawai.

Section 5.4. Identifies knowledge providers within the community of Mentawai to transfer the tsunami hazards knowledge.

Section 5.5. Explains how the tsunami hazards knowledge is shared.

Section 5.6. Discusses how tsunami hazard knowledge is internalized by the local community of Mentawai

Section 5.7. Briefly concludes an exclusive reportage on the earthquake and tsunami

Section 5.8 Concludes the chapter.

5.1. Defining hazard knowledge

Experts have defined numerous definitions of knowledge. Jashapara (2011) defines knowledge simply as an actionable information. However, this definition implies making better decisions and providing an effective input within an organization or community. Therefore, knowledge becomes more complex than this simplistic notion. Mohanty, Panda, Karelia, and Issar (2006, p. 1) also define knowledge as "the fact or condition of knowing something with a considerable degree of familiarity through experience, association, or contact". In addition, Davenport and Prusak (2000, p. 5), define knowledge as "a fluid mix of framed experience, values, contextual information, and expert insight that provide a framework for evaluating and incorporating new experiences and information. It originates and is applied in the minds of knowers."

In disaster preparedness, understanding disaster hazard knowledge becomes important. Alam (2016) argues that the improvement of hazard knowledge may create an increase in risk perception and preparedness. It also enables us to explore innovative means by which communities at risk can become more involved in developing appropriate risk reduction strategies and opportunities (Turnbull, Sterrett, & Hilleboe, 2013). Through hazard knowledge, it is considered that the inclusion of individuals and community members in disaster preparedness activities may increase. This knowledge can be applied as the basis of disaster mitigation and preparedness measures (Pathirage, Seneviratne, Amaratunga, & Haigh, 2015). In terms of practices and contexts of disaster preparedness, the knowledge can improve the planning and implementation processes, and program acceptance, ownership, and sustainability. It can also increase commitment and effort in conducting disaster preparedness measures from various kinds of people.

5.2. Knowledge management on tsunami preparedness

Since Knowledge Management (KM) was introduced in 1990s, KM has gained increasing importance in a business strategy. However, Iverson and McPhee (2002) argue that there is no consensus among scholars on the best way to implement KM or even to define it. Furthermore, Roberts (2010) argues that applying KM in a community context becomes more attractive and challenging. Community is much broader than a team or project groups

established for a specific purpose. It is also ill-equipped to manage heterogeneous community members. But scholars have distinguished two basic approaches to KM: information based known also as an object and people based, known also as a process.

As an object, KM concentrates more on high technology solutions that could ignore tacit knowledge because it removes social context. Moreover, it can be seized, deposited, and reused by using a technological solution. It also more focuses more on "the right knowledge, in the right place, at the right time" (Seneviratne, Baldry, & Pathirage, 2010, p. 380). Whereas "the right knowledge" for some people may be different from that for others. Consequently, information-based KM pays significant attention to the implementation of repositories to capture, store, control, manage and reuse structured phenomena (Chatti, 2012; Iverson & McPhee, 2002).

On the other hand, as a process approach, KM stresses the importance of the individuals in working within KM processes and acknowledges the inputs from them. It is also inherently tied to social and contextual phenomena (Iverson & McPhee, 2002) and (Chatti, 2012). It is also supported by Ribeiro (2013) that this approach enables community members to foresee their problems so that they can respond to any potential change in the problems. Furthermore, this approach is also applied and adapted according to community members' experiences. Meanwhile, manuals and operational standards are not always sufficient during emergency situations, KM is useful where several senses are to be utilized simultaneously, when skilful behaviour is involved, or when understanding social relationships is crucial (Lundvall, 2000). Lastly, KM with a process approach enables the clarifying of the importance of interactional and informational views of making knowledge more effective.

In order to integrate both types of KM, Chatti (2012) defines that knowledge management is a concept that enables the turning of information into actionable knowledge through effortless measures. Subsequently, the knowledge can turned into a usable form to be applied for human benefits. The definition elaborates some processes that are involved such as skilfulness, invention, expansion, dissemination, transfer, sharing, and application. Therefore, it is important to consider that KM is systematised in a holistic and relational framework.

KM has pivotal roles in confirming the people can access trustful and accurate tsunami information. The accessibility to information in KM is ensured through an effective process of lesson learning (Seneviratne et al., 2010). For the purposes of analysing my field study, this chapter builds on these sights of the process approach knowledge management. Mohannak and Hutchings (2007) have designed a cross-cultural and institutional framework of knowledge management with three dimensions. The first dimension is at the macro level where the application of knowledge management is influenced by several factors in a community. These include the institutions and the socio-economic and educational conditions of the community. The second dimension is the availability of knowledge providers within the community. It is also considered that the providers have the ability to transfer new knowledge. Lastly, how the community responds to the new knowledge that that been transferred is also included.

5.3. Macro level of knowledge management on tsunami hazards

As briefly drawn above by Mohannak and Hutchings (2007) a district pattern of a social system consists of public and private institutions, political, economic, and social and educational factors. These factors are related to public and community institutions in particular social-cultural contexts. Based on the field study that was conducted in Mentawai, below are the significant findings that were related to the knowledge transfer about tsunami preparedness measures.

5.3.1. Public and non-governmental institutions

Decisive and clear decisions by government authorities protect their community members from unexpected tsunamis. Effective institutional policies are critically important to influence public programs on tsunami hazards and preparedness for the community (Seneviratne et al., 2010). However, it was shown from the field research that the district government of Mentawai had implemented few efforts to support the knowledge transfers o tsunami hazards and preparedness before 2010. The participants provided some reasons why the district government paid low attention to implementing public programs at the *dusun* level. One of the reasons was the difficulty in accessing the remote areas.

> "...But indeed [I have to acknowledge] this area is too difficult [to get access to]. [The islands are] far away from one another. So, it is too difficult to manage it. [Still] some people [stay] in the jungles or on the tips of the

> islands where [the people] are just difficult to reach. The local government ['s capacity] is also limited..." (Community Member No. 3)
>
> "...[J]ust if the government [officers] often visited us in the villages to see [our condition], the local community would have the spirit [to do everything]. [They] do not [need to] care only for the people in the towns. But we who stay in the village [remote areas] also need care" (Community Member No. 06).

As my experience of collecting the data, often I had ride the motorcycle for over 1.5 hours (about 15 km) to reach one *dusun* from another. The dirt roads were very bad to ride on, in particular after heavy rains (Figure 5.1 and Figure 5.2).

Figure 5. 1
One of many muddy points in the road from Sikakap to Taikako (North Pagai Island)
Source: Personal documentation taken during the field study

Figure 5. 2
One of many muddy points in the road from Tuapejat to Bosua (Sipora Island)
Source: Personal documentation taken during the field study

From the district government perspective, another reason was the government was complacent about the fact that the indigenous people of Mentawai had no experience of tsunamis.

> "No literature and no oral stories about it [tsunami occurred in Mentawai]. ... [T]he government saw no need for necessary actions ..." (Government Officer, No. 03).

In fact, in 1797 and 1833 there were two earthquakes that generated the tsunamis that reached and devastated Sumatra. It is understandable that there are no oral stories about tsunamis among the indigenous people of Mentawai because at the time they lived in the jungles and experienced no effects from the tsunamis. However, the 1833 tsunami was noted by a number of Dutch residents in Padang (West Sumatra) (Natawidjaja, 2007). Natawidjaja (2007) believes that the same tsunami also devastated the Mentawai islands.

It is important to involve the governance system in order to strengthen knowledge management in transferring tsunami hazard knowledge to the community. As the district of Mentawai is led by a local government leader known as *Bupati*, I found a single document was issued as a public policy to strengthen public education on tsunami hazards. Normally, an official document that is signed by a *bupati* can be effective to implement a public

program. The heads of villages and dusun will take necessary actions as the document instructs. As the district consists of 266 *dusun* from 43 villages, the heads could have been powerful people to support the programs before the tsunami.

In the rarity of the district government implementing the tsunami education in the community , the roles of the local NGOs are important for the community. Many participants acknowledged the existence of the NGOs in Mentawai to provide public education on tsunami hazards. However, no reliable data indicated when and how many NGOs started working on the transfer of explicit knowledge of tsunamis in Mentawai. Two participants mentioned that Surfaid International initiated efforts in 2004 right after the 2004 Indian Ocean Tsunami. It is also stated on its website that Surfaid International is a non-commercial benevolent agency. It focuses on improvement through such means as the self-reliance of isolated people through surfing. This organization was legally registered in New Zealand and founded by Steve Hathaway and Phil Dreifuss and worked for tsunami education in 2004 in the western islands of Sumatra including Mentawai (Surfaid, 2015). One of the participants mentioned:

> "Surfaid [International] came to Mentawai because when some Australians [in fact, they are New Zealanders] surfed in the Mentawai beaches they saw a lot of the children's graves. They then knew it that the children died of malaria. Finally, they [Surfaid International] started working on health [in Mentawai]. After they saw the Aceh Tsunami, and they realized that Mentawai is prone to tsunami, they also work for [a knowledge transfer on] tsunami." (Researcher No. 4).

The NGOs also found a number of difficulties in implementing the program. The main reason was that accessibility to *dusun* was very poor. Using small boats (*tronton*) to go from one place to another was possible; however, it cost, in many cases, three times as much as using motorcycles. In addition, the gasoline price was commonly found to be three times higher than that in Sumatra. Therefore, the lack of public transportation and roads made the implementation of the program very expensive.

> "[You can] imagine trying to visit a very difficult area to get access to. Because of almost no access to Mentawai [dusun], the people [NGOs] spent [a lot of] money on transportation fares more than on the programs. This made us seldom go to the same dusun more than a couple of times" (NGO Activist, No. 02).

The data from the district government indicates that in 2010 only 7 per cent of the total length of the roads was in a good condition. This had surely negatively affected NGOs' implementation of their programs.

Briefly, we can see that before the 2010 tsunami the district government of Mentawai and the local NGOs faced difficulty in implementing their public education programs, especially for tsunami education. The reasons were the inaccessibility of the dusun and the false complacency of the government about the tsunami occurrences in the past.

5.3.2. Social and educational factors

One of the common social factors used to explain a condition of a community is poverty. Poverty has many dimensions and manifestations but is always related to the underlying structural inequities and inherent advantages that come from less access to public goods and other resources (Philip & Rayhan, 2004). Furthermore, Martine and Guzman (2002) state that poverty takes place as the result of historical processes from resource losses. In addition, Darmanto and Setyowati (2002) argue that besides geographically, Mentawai is also socially marginalised. BPS Mentawai (2012) reported in 2011 that the North Siberut and South Siberut Sub Districts had high percentages of poor households in the coastline areas in the Mentawai District, consecutively 28.60 % and 25.71 %. These households had incomes below IDR 600.000 per month (Kamal, 2013). The above income was equal to USD 64.84 (based on the assumption of the economic macro from the Central Government 2011, USD 1= IRD 9,250). In other words, there were many households that had incomes of less than USD 2 a day, where the minimum income of a household should have been USD 3.80 daily in the Mentawai District (Kamal, 2013). This condition could worsen knowledge transfer efforts to the community since the community is focused more on their work rather than caring for their own safety.

The education level of a community will also influence the knowledge transfer. Morin, Coster, Paris, Flohic, and Lavigne (2008) argue that enhancing education is a key to developing tsunami preparedness among coastal people. From the research findings, the NGO activists had tried to explain the tsunami hazards in a simple way. Although the NGOs had no adequate tools which could assist them to address the occurrence of earthquakes and tsunamis, they used simple, daily tools from the dusun, for example, a bucket or tub

filled with some water. When the water became calm, they used one of their fingers to ripple the water's surface. The finger symbolized an earthquake and the small induced-waves were the symbolized waves of tsunamis. However, they often found some unexpected responses from the community.

> "My own experience when I was working for my previous job in one NGO…… after I explained [how the occurrence of tsunamis was], a sudden voice sounded mentioning '[if] the Lord's hand touches the sea, [it] will create big waves'. [After I heard it] I felt like [crying]…" (NGO activist, No. 01)

The low level of education could be associated with the level of knowledge acceptance in in related to tsunamis hazards by the local community of Mentawai.

In views of the simple ways of the local community' thoughts and inadequate educational tools, the NGO participants assumed that what they explained to the community could have made some misunderstandings. A concept of how wide earth was, for instance, was beyond off their thoughts. Moreover, a phenomenon of how different plates of the earth collided could be a nonsense for them.

> "Ever one of participants said 'how come the soil grounds move and fight each other'. So, [it just is too] difficult to explain it" (NGO activist, No. 03)

Therefore, the participants concluded even the people that had been reached out; most of them might still not understand what tsunamis were. Even more they could have had misunderstanding and created new myths related to tsunamis.

It is necessary to increase a community's level of education for children as well as community members. As reported by the BPS Mentawai (2012) in Table 5.2, there was a big gap between urban (97.16%) and rural (85.2%) in the number of people over five years old who can read Latin letters. The table also indicates that there were big differences in the percentages of males and females who could read Latin letters in these areas. Surprisingly, over 40 per cent of the population who lived in urban areas also could read Arabic letters, and 13 per cent other letters. Moreover, the illiteracy rate in Mentawai was high (13.27%). The difference in the illiteracy rate between urban (2.84%) and rural (14.31) was very significant at more than 9 %. However, in urban areas the illiteracy difference between male

(5.45%) and female (0%) was also significant. Conversely, the illiteracy rate in rural areas for females was much higher (17.07%) than for males (11.82%).

Table 5. 1
Percentage of population over 5 years old able to read
Latin, Arabic and other letters
By sex in Mentawai, 2012

Settlement / Sex	Able to read			Unable to read
	Latin letters	Arabic letters	Others	
Urban				
Male	94.55	40.14	16.2	5.45
Female	100	42.82	10.52	0
Sub-Total	*97.16*	*41.42*	*13.46*	*2.84*
Rural				
Male	87.38	2.62	0.38	11.82
Female	82.79	2.34	0	17.07
Sub-Total	*85.2*	*2.49*	*0.2*	*14.31*
Total	**86.29**	**6.03**	**1.4**	**13.27**

Source: BPS Mentawai (2012)

Furthermore, the NGO participants explained that many of the local community members reluctantly participated in any meetings of the tsunami education programs. They found it difficult to create any detailed plans. They just worked rather than to try to find their own problems and solutions.

> "They chose to work rather than gaining much useful information to their own safety. I was also pessimistic with the attitude that they had showed at the time. Low [level of] education, difficult economy and low participation had influenced to what we had delivered for them"(NGO Activist, No. 01)

Lastly, according to one of the participants, those who had participated in the NGO programs often only passively listened. They would have received whatever had been explained or conducted and not try further actions. It was hard to develop some advanced actions for their own solutions to their own problems. The participant indicated that the local community had hoped that the NGOs and the government would do all that was needed.

The above findings indicate that social and education factors also affected the ability of the local community of Mentawai to understand the explained tsunami hazards. Low education status and other commitments meant the education efforts were unmet.

5.3.3. Economic factors

Low economic factors hinder explicit knowledge being transferred to and shared with the community. As the field study reveals, the NGOs stated that the local community preferred working rather than capturing explicit knowledge of tsunami preparedness. One of the research participants from an NGO states some reasons why it is difficult to transfer the knowledge to the local community of Mentawai.

> "They are difficult to push. They have had less motivation to do things, except working in their gardens or the sea. Only that [working] is their life" (NGO Activist No. 03).

The above interview indicated that their low economic status was a big challenge for the knowledge providers to transfer knowledge of tsunami hazards and preparedness. Pathirage et al. (2015) also reported that low economic status worsens the implementation of disaster preparedness program in a community. In order to see an integrated assessment of one community, we can use a comparative measure of life expectancy, literacy and education, and standard of living through the Human Development Index (HDI). Figure 5.3 below compares HDI from Mentawai to other districts in West Sumatra.

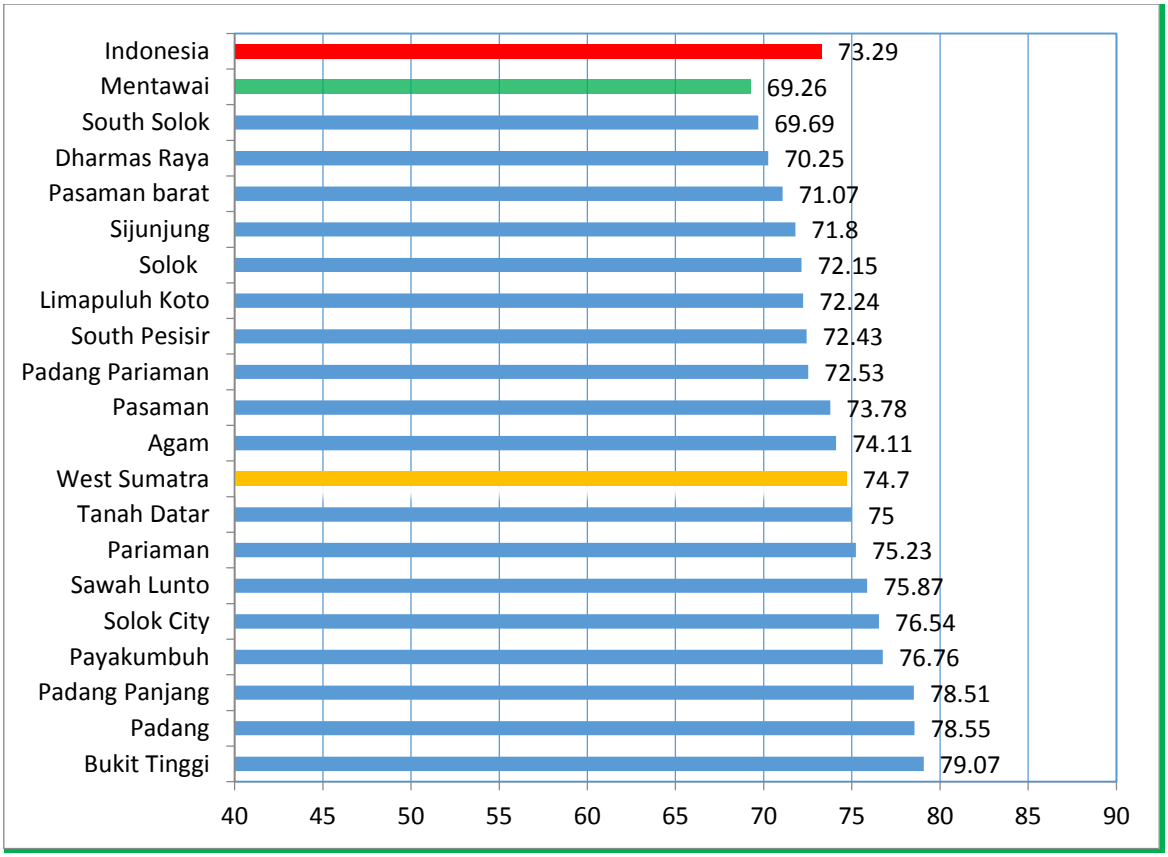

Figure 5. 3
The Human Development Index by District in West Sumatra, 2012
Source: the Kementerian Kesehatan (2013), Depkes (2014)

In 2012, the HDI score from Mentawai was only 69.26 meaning it was the lowest amongst the districts in the West Sumatra Province, and far below Bukit Tinggi (79.07), the highest in the province. The HDI of Mentawai was not only below the average in West Sumatra (74.7) but also the national (73.29) (Depkes, 2014; Kementerian Kesehatan, 2013). From this, it can be concluded that in 2012 Mentawai still had the lowest index among the districts in the same province. Owing to the unavailability of the same data, we can draw a similar conclusion that before the tsunami, the HDI from Mentawai was also below the average of West Sumatra Province. It can therefore be taken that that there have been no significant changes before and after 2010 in the community.

In conclusion, the macro level of knowledge management was influenced by the district government of Mentawai and a number of local NGOs, social and educational conditions, and the economic status of the local people in Mentawai. The local government and NGOs had tried to implement the tsunami education programs to the people; however, the demographical and geographical conditions meant the programs were more or less unmet.

The people also found it difficult to understand the tsunami hazard concept, although the NGOs had tried to explain it in a simple way. This may be related to their low educational status. In addition, the people also gave little attention to the programs. Lastly, their low economic status ensured the people had other priorities rather than making the programs succeed.

5.4. Micro level of knowledge management on tsunami hazards

In order to transfer knowledge, it is important to have knowledge providers. Knowledge providers are responsible to explicitly transfer knowledge in order for the knowledge to become an asset for a community (Mohannak & Hutchings, 2007). The providers can also train some community members as cadres to share the knowledge to other community members. However, these tasks may become challenging when the providers have different backgrounds or ethics from a community. Or it will also be more difficult when the providers regard themselves as different or, even worse, higher than community members (Mohannak & Hutchings, 2007).

From the research, several knowledge providers were also found in Mentawai. They were the NGO activists and the district government officers that implemented the tsunami education programs. Some research participants argued that the knowledge providers had transferred knowledge mainly about what earthquakes are, how tsunamis occur, how they prepared themselves for tsunamis and who and what should be saved in the event of a tsunami. However, one of the participants from the researchers criticized the unclear knowledge materials that had been transferred to the community. It is also said that because of the uncertainty of tsunami occurrences in terms of time and place, the knowledge providers had never informed the local community when and where potential tsunamis would hit the Mentawai District. This might have created misunderstandings in the local community, which thought that tsunamis always occurred during daytime and never at night time.

> "… [A]ceh occurred in the morning, Pangandaran [the 2006 Pangandaran tsunami] occurred in the afternoon, and [we] never said [to the local community that tsunamis] could occur at night. So, [it was] always recorded in their memories of the real events and what [the NGO and the government] communicated…." (Researcher No. 05).

In transferring explicit knowledge to the community, the knowledge providers should work together with the community members. As this study research revealed that the knowledge providers had a series of meetings with the *dusun* people. During the meetings, the providers had explicitly transferred the above knowledge. However, most of the participants claimed that the meetings with the government and NGOs were very rare but useful to increase or to add their knowledge.

The participants from NGOs also agreed with these claims. Several NGOs had intervened in a few areas of the local community, even though they had faced difficulties with access to the areas due to their being no proper public transportation and roads available. This difficult access made it very expensive to implement some programs. It was also mentioned that at the time only a few NGOs worked on tsunami programs.

The study also reveals that the local community preferred to be assisted and facilitated by NGOs rather than the district government. However, to some extent, the NGOs also needed to restrain themselves and transfer the knowledge to the community in a sensitive way.

> "I prefer it if NGOs come to us. They are more patient. They also take care of us. They sometimes stay with us for one week and sleep in one or two homes here. If the government [officers] come, it is only for a short time. Never sleep here. [They] come in the morning, go back in the afternoon" (Community Member No. 12).

> "Sometimes NGOs help us, too. They explain many innovations. For example, we know now how to plant chillies. However, we [I] cannot [use my time] fully [on it] and [the chillies] are only planted in the plastic [polybags]. But [so] sometimes, it just bothers us. NGOs that come here seem like to force me to plant chillies, corns or whatever. [As you know] to plant them is very tiring…." (Community Member No. 04).

Besides the local government and NGOs, some other channels were identified such as mass media and newcomers. As mentioned in Chapter Two, the media influence our daily lives. Media are channels of communication that transmit information in a number of modes or forms to large numbers of people. They can be as windows into society and reflect phenomena in society (Subiakto, 2001). TV is an audio-visual medium that has a wide out-reach to communities. It has penetrative power that can influence attitudes, perspectives, life styles, orientations, and motivations of communities. Generally, TV is informative, educational, and recreational. By watching TV, people can see or know the outside. To

comprehend the roles of TV in informing the people, the study revealed that the 2004 Indian Ocean Tsunami on TV provided the deepest impact on their knowledge about tsunamis. Apparently, the roles of TV especially for some males were unused before the tsunami occurred.

> "When the Aceh tsunami [the 2004 Indian Ocean Tsunami] hit. It was very big [waves]. I had not seen anything like that before. I also just heard the word 'tsunami' [for the first time]. I had never heard that before" (Community Member No. 02).

Surprisingly though, some participants said that the local adult males seldom watched television programs including news programs or educational programs. The reasons were that very few families had television sets and they had chosen other activities instead. They also preferred to do other activities rather than watching TV because they claimed at the time watching TV was the females' and children's business.

> "I seldom watch [TV programs]. It is very common here; watching is for adult females and children. They say the TV dramas are very entertaining. These kinds of programs are not for us [adult male business]" (Community Member No. 16).

> "The [female] people do not like to watch news programs, but only dramas" (Community Member No. 07).

Radio is also important to inform a community about a disaster. Radio is one of the most effective platforms, especially in pre-disaster situations in sharing knowledge in a tsunami prone community. Radio enables listeners and broadcaster(s) to communicate in an interactive way, but only one participant mentioned knowing about tsunamis from radio programs. There were three radio stations in Sipora and one in North Pagai. They also mentioned that very few local people could access the radio because the electricity was limited and the dry cell batteries were relatively expensive for them.

Another way to raise public awareness or to increase public knowledge on tsunamis preparedness is through newspapers. As a serial publication, newspapers encompass news on current special and general events (Bucher, Büffel, & Wollscheid, 2005). They can be used to distribute knowledge to communities. The field study revealed that only one participant who stayed in Tuapejat (where information access is relatively easier) reported knowing about tsunamis preparedness from the newspaper(s). As I observed, the national,

provincial or local papers were not easy to obtain but are available in Tuapejat (the district capital) and Sikakap (the biggest towns in North and South Pagai). It is also important to note that the newspapers are available to the community the day after the scheduled ferry arrival from Padang City. Meanwhile, the local community has little access to some online local portals.

From the NGOs' perspective, in order to obtain tsunami hazard knowledge, the local community preferred watching educational films to other kinds of educational media. Moreover, the NGOs argued it would be more effective and efficient to use compatible tools in Mentawai. Owing to its difficult access, they suggested bringing a laptop, LCD, CD and a screen to disseminate the information. This finding was consistent with Yayasan Minang Bahari (2006) findings where the local community preferred these media as an effective way to share the coral reef information in Siberut. However, the NGO participants also had concerns about the limited electricity available. It was also said that colourful leaflets with pictures were useful for them.

> "…[T]hey don't like reading. In fact, we still found many of them could not read at all. Thus, don't expect too much that they will read your messages" (NGO Activist No. 03).

Additionally, it is also thought that some habits of the community could hinder the knowledge acceptance. It was confirmed by one of researchers that when the 2010 Mentawai earthquake shook, some of the local community just ignored the potential harm. They just paid no attention to it and continued watching a drama program on one of the TV stations, while another station had announced a warning about a potential tsunami in the Mentawai region.

> "[Many people] watched TV together in one house; [almost] half of the *dusun* people watched a TV drama. Watching it made [them] forgets [about potential tsunamis]" (Researcher No. 02).

In fact, the Minister of Communication and Information (the Republic of Indonesia) had formulated a ministerial regulation No. 20 of 2006 on Tsunami or Other Disaster Early Warning through Broadcast Institutions in Indonesia. This regulation clearly states "Public, private, community and pay broadcast institutions in Indonesia shall broadcast potential disaster information as a STOP PRESS". Furthermore, this regulation also mentions, "The

STOP PRESS shall be broadcasted through stopping temporarily the existing program by sounding a high tone alarm of 1 kHz for 30 seconds and simultaneously presenting a static text with full screen." In another document, *Information Guide: Tsunami Early Warning for Broadcast in Indonesia,* says the static text should contain the earthquake information, namely magnitude, location, depth, and potential tsunami. However, when the 2010 Mentawai earthquake shook, only one (Metro TV) among many national TV stations informed the public of the earthquake possibly because they were just ignorant. In fact, however, this TV station only informed it with a running text, not with a STOP PRESS. Metro TV is more focused on news (Sudibyo, 2004) and the local community of Mentawai might not be interested in watching this station. The community mostly watch other TV (RCTI and SCTV) stations that aired dramas.

Lastly, knowledge providers to the community are not always official. The providers can be other persons who bring the knowledge on tsunami preparedness to community members. As a community is bound by particular conditions of geography (such sea and islands) (Suharto, 2006), for some participants, newcomers working in Mentawai become a good source of tsunami information. The newcomers who mostly work as traders, fishermen or workers for forest concession companies seemed to know about the potential tsunamis in Mentawai. As I observed during my departures and arrivals to Sikakap and Tua Pejat, most passengers in the ferry were the Minang people who originally came from Sumatra. I noticed this from their local dialect.

> "[The] people who came to work here always said that tsunamis and tsunami threats would potentially hit Mentawai" (Community Member No. 17)

It can be concluded that knowledge creation on tsunamis preparedness for some of the local community of Mentawai before the Tsunami was transferred and created by the mass media, some individuals from NGOs and local government offices, and also the new comers. However, the providers faced difficulty in their tasks due to their own limitations to transfer the knowledge, as well as the local community' limitations in absorbing the knowledge.

5.5. Community level of KM on tsunami preparedness

It is considered that after knowledge providers transfer knowledge, knowledge receivers are also important to understand what the knowledge is about. In this study context, knowledge receivers were the *dusun* people who had been transferred the tsunami hazard knowledge and preparedness. Dalkir (2011) points out some processes of how the community captures and creates knowledge by identifying and codifying the existing inside and outside knowledge. After this phase, the community will select suitable knowledge in relation to its culture and share the new knowledge among the members. Once they have decided on the right knowledge they accept it and use it.

5.5.1 Capturing explicit tsunami hazard knowledge

Knowledge capture at the community level emphasizes how individuals gather information and build a new knowledge. Therefore, community members will interact with other members or groups in the community. The members can capture knowledge from media, books and peers (Wiig, 1993); however, this kind of knowledge is more explicit and it is also important to make tacit knowledge explicit by documenting or creating directories to foster knowledge sharing (Dalkir, 2011).

The field study revealed what the participants had captured from the knowledge providers. In the context of knowledge management, knowledge that is explicitly delivered is known as explicit knowledge. Explicit knowledge is a knowledge that is tangibly captured. This knowledge can be in the forms of words, audio-visuals, or pictures and is related to the ability to disseminate, to reproduce, to access and to re-apply amongst individuals and groups. It also needs creativity to change knowledge from invisible knowledge to visible knowledge by using systematic transformation methods (Huang, Wei, & Chang, 2007). So, explicit knowledge can be captured from individuals, experiences, mass media or materials such as book or leaflets or electronic devices.

From the interviews of some research participants in Mentawai, the tsunami hazards knowledge had explicitly transferred from TV programs.

> "When the Aceh tsunami hit. It was very big [news] in TV. I had not seen anything like that before. I also just heard the word 'tsunami'. I had never heard that before" (Community Member No. 02).

As explicit knowledge may be in a written form, it can be delivered through special procedures to perform a given activity (Sanchez, 2004). Related to the explicit knowledge of tsunami hazards and preparedness in Mentawai, the field research indicates that such knowledge was found in a public elementary school in Sikakap through several sessions of training and simulations. The knowledge providers used articulated information, drawings, tools, and procedures to explicitly deliver the information on tsunami hazards and preparedness.

> "The children have [several times] got training in the school. ..,[S]o when an earthquake occurs, the children [have been mentioned] not to be panic" (Community Member, No. 02).

For the *dusun* people, the knowledge providers from NGOs and the district government had transferred explicitly tsunami hazard knowledge and preparedness.

5.5.2. Sharing the knowledge

After knowledge has been captured, community members need to share the knowledge with other members. In order to do this, the members are needed to provide some training on what and how to share the knowledge on tsunamis preparedness (Dalkir, 2011). The field research also disclosed that some NGO activists had recruited some in the local community, known as cadres in order to share the knowledge before the tsunami with other community members. The NGOs trained the cadres and provided some information materials. However, according to participants from the NGOs, there were many people who could not be reached because of the lack of capable persons, geographical and demographical conditions and financial support. Even so, they also claimed that the quality of the knowledge on tsunamis preparedness was still low because the cadres could absorb and deliver only basic information.

5.5.3. Internalizing the knowledge

Currently, the most dominant concepts of knowledge are the notions of 'explicit and 'tacit knowledge (Awad & Ghaziri, 2007; Dalkir, 2011; Jashapara, 2011; Nonaka & von Krogh, 2009; Tsoukas, 2005). As briefly mentioned above, commonly, explicit knowledge is the knowledge that a knower owns and that is able to be articulated and distributed to others. It can be modified and transmitted in various forms such as words, pictures, audio-visuals (Dalkir, 2011). This knowledge is related to the ability to disseminate, to reproduce, to

access and to re-apply amongst individuals and groups. However, despite it being formed or articulated in a particular format, knowledge is never completely explicit.

Tacit knowledge is the knowledge that is not easily expressed in words, text, or drawings. It is inside the head of the knower as their property and they find it difficult to externalize it to other persons. Tacit knowledge includes non-verbal experiences and non-expressional actions. According to Lundvall (2000)and Kumar and Chakrabarti (2015), tacit knowledge can be linked to intuition, emotions, beliefs, values, perceptions, and feelings (the cognitive dimensions) and know-how, know-why, experiences, and hard-to-pin-skills (the technical dimensions). Tacit knowledge is also related to the ability to adapt and to deal with new and exceptional situations. Furthermore, tacit knowledge may be more valuable when being more difficult to articulate. It is also observable because it includes non-verbal experiences and unexpressed actions. It also requires the beginning to the end of processes of knowledge (Bechina & Ribiere, 2012). In some cases, tacit knowledge has its roots in complexity and in variation in quality.

The study found that mostly the research participants had heard the first time about tsunamis after the 2004 Indian Ocean Tsunami had been widely and explicitly televised. However, a few of them never heard or knew about tsunami until they experienced the 2010 Mentawai Tsunami. The participants indicated that they heard about tsunamis mainly through the television broadcasts, followed by the activities of the local NGO activists and district government officers. The following interview shows that tsunami hazard knowledge became explicit from TV news.

> "Before that [the 2004 Indian Ocean Tsunami] we here had never heard from TV about it. [I] never thought that there was such a thing. [It was] impossible that the seawater [waves] was so high all of a sudden and came on to the land for hundreds of metres. I never thought that before. However, it was a fact, [and then] we thought that one day it might come to Mentawai. The Aceh tsunami… [I] think that tsunamis might come down here into Mentawai or Padang. So, at the time there were [a lot of] rumours [those tsunamis] would hit the Mentawai [Islands]" (Community Member, No. 17).

The above interview indicates that the participant understood that the Mentawai islands could be devastated by tsunami hazards triggered by earthquakes. The people have often experienced earthquakes due to the islands' position next to the active subduction zone

(Natawidjaja, 2007; Philibosian et al., 2014; Prawirodirdjo et al., 2010). When they lived in the interior, they believed that earthquakes (teteu -known also as grandfather or grandmother) always brought many blessings to the people's lives (Delfi, 2013, 2014). However, after they had been exposed explicitly the tsunamic devastation, they became perplexed. They never knew how such devastation could occur as it was in such contrast to what their traditional beliefs led them to expect.

> "The Mentawai people had no traumatic [experiences of earthquakes]. They welcomed any earthquakes by saying 'hopefully, this shock will bring blessings [to them]'. Indeed [they received] many [blessings]. [Durian trees produced] a lot of durians. But now [what we believed was just contrary to today's reality]…." (Community Member, No. 18).

> "Their belief said '*teteu* is your grandmother but also mainly your grandfather'. [And] this grandfather could twist [from his sleeping]. Therefore, that is an earthquake. [As believed] a grandfather would never harm his grandchildren. If a grandfather comes, grandchildren should be silent and do nothing" (Researcher, No. 1).

In fact, Delfi (2013) found that in Mentawai the old traditions always related that the relationship between the people and nature would be harmonious as long as they conducted their traditional-belief practices, *Arat Sabulungan.* This animistic belief is that each thing has a "spirit" that exists either in the sky, sea, earth, or the jungle (Coronese, 1986; Mulhadi, 2008; Salmeno, 1994). It is a social system of knowledge, values, norms, and regimes to understand the environments that involve in the interaction shapes among humans, animals, trees, soil, water and air and man-made things (Mulhadi, 2008). The indigenous people always used particular leaves of trees and specific animals that were found in the jungles. Therefore, it was important for them to live in the middle of the jungle, so they could easily conduct their rituals.

As discussed, explicit knowledge can be delivered through many forms including practical procedures (Sanchez, 2004). With regard to the explicit knowledge on tsunami preparedness in Mentawai, the findings also indicated that such knowledge had been delivered to public elementary schools through several tsunami simulations. Simulations, as practical procedures, may significantly contribute to this process and enhance individuals skills and thereby create tacit knowledge (Nonaka & Konno, 1998). The findings revealed that the children in schools had been explicitly exposed to tsunami hazard knowledge. It

also indicated that the children were advised not to panic when an earthquake occurred. Further investigations showed that several local NGO activists had worked in several elementary schools in Mentawai. The activists had presented regular activities to inform the students and teachers about tsunami hazards.

We can see that before the 2010 tsunami some of the people in Mentawai had special skills that might help them escape from the tsunami waves. The people had internalized the tsunami hazard knowledge by integrating their existing skills in order to escape from potential tsunamis in the future. These findings reflect what Nonaka and Konno (1998) discussed in that the internalization process creates a new concept of how to do something and of how to apply this to a new strategy. Therefore, a new strategy to escape from tsunami hazards can result from the integration of new concepts with existing skills.

The internalization of knowledge conversion is related to the process how explicit knowledge becomes tacit knowledge within the individual(s). According to Nonaka and Konno (1998), there are two dimensions of internalization processes. Firstly, explicit knowledge needs to be actualized in actions and practices. This process requires explicit knowledge as concepts to be actualized as strategies, tactics, innovations, improvements, or intuitions. From the field research, one participant climbed a coconut tree when the tsunami occurred as he had tacit knowledge regarding the tsunami. The other showed their tacit knowledge.

> "...The wave was so high and I was taken by the water somewhere [I did not realize anymore]. There was some wood which hit me and I stayed with it for hours..."(Community Member No. 14).

Secondly, explicit knowledge is embodied by using simulations or experiments to create learning by doing processes. This process entails new methods or concepts to be learned in virtual situations (Nonaka & Konno, 1998). This is when an individual internalizes what they have learnt by directly enacting a simulation of a new method. This learning by doing process creates new insights within the individual and becomes tacit knowledge (Osatuyi & Andoh-Baidoo, 2013). From the field research, the above process was found among the elementary students in Mentawai. Before the 2010 tsunami, a number of the local NGOs had trained the students through simulations in schools. It was believed by the NGO activists that when a tsunami occurred the students would have the knowledge to escape

from the potential tsunami waves. The children would run directly to higher ground to escape from the tsunami waves.

However, when the 2010 tsunami occurred the children also became victims of the tsunami. Although they had been trained to run away from the coastal areas in the school setting they were never informed and trained that tsunamis could occur during the night. The children, including the adults did not understand the severity of the situation so did not apply or indeed generalise their knowledge to this particular situation and make plans to escape. Instead, they stayed in their homes and kept watching TV and ignored the earthquake that would trigger a massive tsunami. Moreover, the children, including adults, were never informed *tsunamigenic* earthquakes.

5.6. Implications of knowledge internalization to tsunami preparedness

The internalization can be processed through actions and practices as well as simulations. The processes require a decision by the individuals to make better choices. Based on the new decision, they will act and perform that the explicit knowledge begins very slow and deliberately adjustable. However, with repetitiousness the process progressively becomes automated into their daily activities (Nonaka & von Krogh, 2009). As the implications of the processes, tacit knowledge gradually is formed and skills are created. Consequently, individuals can increasingly do complicated activities in unexpected conditions.

The Sophocles' quote from 400 BC: "One must learn by doing the things, for though you think you know it, you have no certainty, until you try" is useful to elaborate what many people from Mentawai did who had an experience of the Tsunami. After having known several tsunami occurrences in Aceh and Nias, some of the participants still did nothing to save their lives. Especially for the community in North and South Pagai, the 2007 Bengkulu Earthquakes should have been serious warnings for them, as these quakes had created damage to their property and, in the future, a similar event could hit them worse. The local government and some NGOs had persuaded those who lived in the red zone for tsunamis to move but only few of the community members responded by moving to safer places. Therefore, the tsunami became a real test case for those who had known about tsunamis earlier from cadres and/or the knowledge providers or other channels of communication.

A number of significant findings from the study showed that the local community fell into two categories in responding to explicit knowledge. One contained those who moved their settlement to a new one and the other contained those who kept living in their old settlements. Below are detailed explanations of the categories.

5.6.1. Moving to safer places.

After acquiring explicit knowledge, community members need to use it for their own interests. In terms of tsunami preparedness, people who live on coastlines should move to safer places. Indeed, Bryant (2008) argues that not all locations along the coast may be affected by tsunamis including high coastal landscapes. Therefore, it is certainly necessary to move the people who live on either the coasts to higher landscapes or far inland. As this study revealed, there was a number substantial findings found in the Malakopa Village (South Pagai Island), as illustrated in Figure 5.4.

a. Moving to higher grounds

The study also reveals that all the community of *Dusun* Malakopa moved 1.5 to 2 km to uphill. When the Tsunami hit, the waves only reached the old settlements, which lay near the coasts. Thus, they were all safe.

> "Yes, I felt it [the 2007 earthquake]. And it was much bigger than the 2010 earthquake. That was why we [I] did not pay much attention to it [I thought] because the 2010 earthquake [had] very small shakes. Indeed we [I] felt it. But we [I] did not think if it would have triggered a tsunami" (Community Member No. 01).

> "….. [T]hat time [the 2010 Mentawai tsunami] was at night. The moon was clear. I remember it clearly. Some [his neighbour friends] had gone to sleep. But some had not yet. I myself had not yet because I was working at the time. I was working at the time, not sleeping. Suddenly the earthquake shook. I thought it was only a short while. But this one was lengthy. Actually [it was] not too big. I felt that the earthquake was not like usual earthquakes. But indeed [it was] lengthy. I then realized it could be dangerous. 'It could create a tsunami' I thought. I finally woke my wife and my children. My wife had actually been awakened, too because the bed was shaking around. My house was made of wood and the sound was loud. So we all [my family and I] were cautious. Indeed, my dog barked anxiously. My neighbours had also gathered and waited for any development. Some went down to see whether the sea tide was low. Some of them said the sea went down to a small level. But the others said there was no low tide. Suddenly, five minutes later the sea roared. It was never like that before. We ran away directly to save our lives. It was fortunate the moon was clear… [F]inally we arrived at a secure point. [It was only]

100 metres distant and we could have been hit by the tsunami if we had not run very quickly. My family was safe. My neighbours were also safe…" (Community Member No. 17).

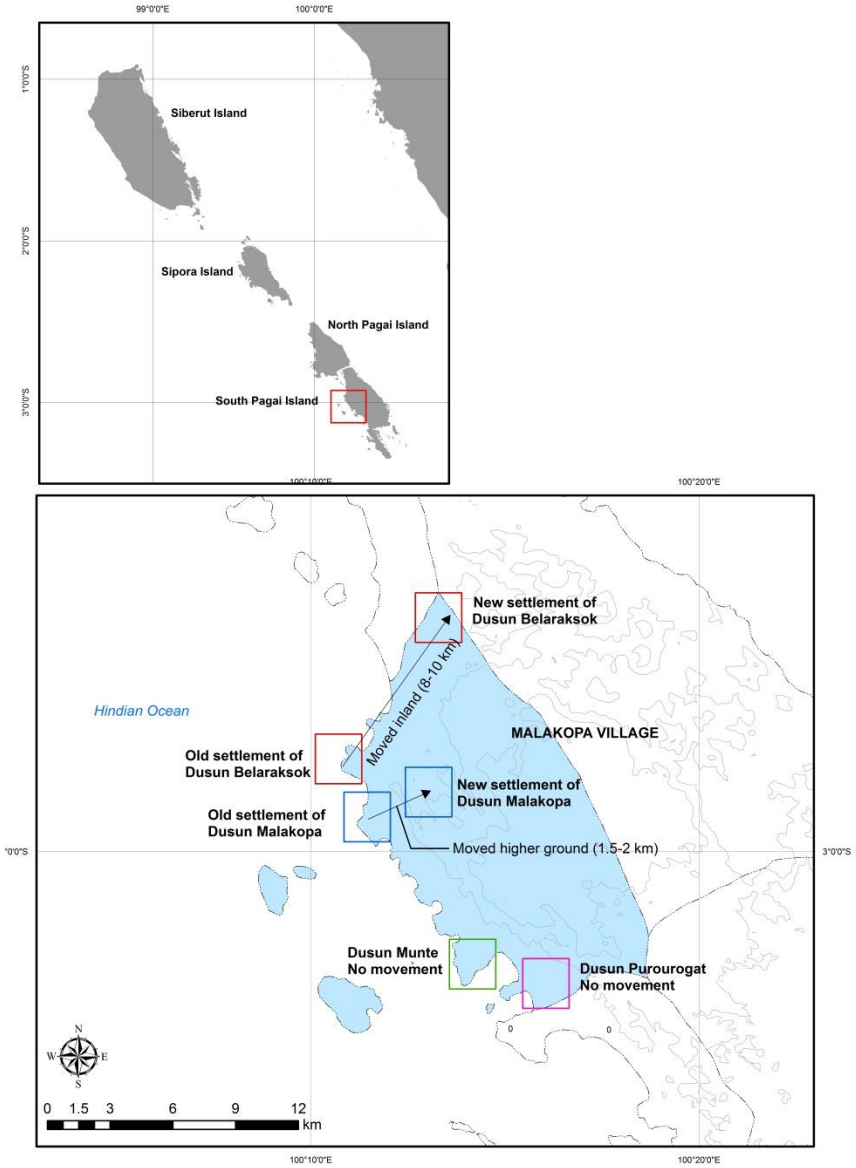

Figure 5. 4
The people from the Malakopa Village had responded differently to the explicit htsunami hazard knowledge and applied the knowledge in some different ways.

b. Moving farther inland

However, the above move seemed for some only to involve their houses but not their way of living. The people from *Dusun* Belaraksok (Malakok Village), for example, who had moved

about 8-10 km inland, still had small huts next to the coasts. They lived down in the gardens next to the coast and did the same jobs, namely gardening and fishing. Often they slept over in their huts during weekdays and went up to their new settlements over the weekend. Therefore, when the Tsunami hit the islands, some of them lost their lives. One of them participated in the field research as follows:

> "I had an experience of the 2010 tsunami. It was the 25th of October at the time. The problem [that I faced] was that it was not easy to find things to make a living with. My wish was we [I] could have caught some fish that I could sell it to fulfil my needs. In the afternoon I went down [to my garden next to the sea]. I [then] asked my wife to come along with me to fish. We had a house-like hut. [Suddenly] an earthquake took place but the shock was not too strong. But I made sure my wife was all right. My wife said 'Let see the net, maybe some fish are trapped.' We both went down to the sea, and then we pulled over the net. At that time, I saw [suddenly] the seawater lessened [significantly]. Then my canoe was aground. I could see the stones on the edge of the shore [not in the water anymore]. [Having] realized the seawater had lessened, we both left the canoe. [We both] ran.
> I shouted to inform the other friends to run away to higher ground because the seawater had lessened. Before [I arrived at] my hut, a [huge] wave hit my hut. My hut was only 50 metres from the shore. My wife and I were separated. The wave was so high and I was taken by the water somewhere [I did not realize anymore]. There was some wood which hit me and I stayed with it for hours. The waves came three times. I didn't know where my wife was. There were three waves in the tsunami. Some of my friends climbed up a tree.
> After it was dry, we went to a hill. The people were shouting that they were safe. I could not shout because I had swallowed a lot of [sea] water. Then my wife came to the hill. She asked me [if I had seen] my in laws....
> In the morning, we gathered and realized that some of us [who went down to the coast from my *dusun*] were lost. Some were hit by some trees, others by their house wood. In the morning [after the sun rose] I realized I had lost my niece and my brother. There were 28 people [from my *dusun*]. Some people who also died lived in the Sibegeu Islands [smaller islands next to the North Pagai Island]. One of them was my son who was 18 years old. Therefore, there were three people from my family who died [because of the tsunami]. At night, they didn't work, but they stayed in the Sibegeu Island. [However] the earthquake was small" (Community Member No. 14).

5.6.2. Living in the same place.

After gaining some knowledge of tsunamis, some local community members did not use this explicit knowledge to move to the safer place. The People from Munthe and Purourougat *dusun* (Malakopak Village) chose to stay in their existing settlements, instead. This study

reveals why they upheld this decision. However, they claimed to be able to increase their own sense to anticipate tsunamis, while others took passive action.

a. Using Own Sense

Those who relied on their own sense tried to compare the magnitudes of the 2010 earthquake with the 2007 earthquake. They concluded that the 2007 earthquakes were much bigger in terms of shaking than the 2010 earthquakes. This conclusion made them more complacent and they did hardly anything to prevent potential harm. Their wait-and-see actions caused them much harm because some of the neighbours lost their lives.

According to Howes and Classen (2014), using one's own senses is inadequate to rely on solely. Indeed, senses may be trained; however, much of it is the result of social conditioning. Therefore, relying on own senses for experience of whether earthquakes could trigger tsunamis or not could be dangerous for individuals. This concept also applied to the experience of one of my participants.

> "... Because the weather was [too] clear to do fishing. So, around 9 pm an earthquake [shook]. The shake was not too powerful. That's why we didn't run away and was not the same with [the shakes of] 2007 [earthquakes]. So, around 09.30 pm, another shake came again, [but] the shake was not from an earthquake. The shake came along with the tsunami. At the time, there were five of us at home. My father was at home. The two of three of my kids were also at home. My wife and I [were also at home]. [When I saw the tsunami came] I held one of my kids and my wife held the other one. [Luckily] my oldest son slept over in my brother's. I thought my oldest son did not save. My father died and my both of my kids died also [because of the tsunami]. Their mother [my wife] also died. So, four of my family members died [because of the tsunami]. At the time [when tsunami came, we] had no chance to run away. Maybe we [I only had time] to run up to my yard. Before the wave came, my house had moved away because of the water. [My house] had moved away up to the edge of the river. So, even if we had had time to go down [from my staged wood house], the house would had hit us. Maybe, all of us would have died" (Community Member No. 13).

The danger of using own senses to measure the magnitude of earthquakes is also mentioned by one of the researchers. He argues that since tsunami earthquakes, in particular, have small, lengthy shakes, using own senses would be fatal.

> "So, in the context of tsunami earthquakes, the 2010 [Mentawai tsunami] gave a clear message to researchers to provide clear information to community. Because it was wrong to tell the community about [lessons

> learnt] from the 2007 earthquakes by training them to sense to feel big earthquakes and then to run. With [human being] sense it would be difficult to persuade [the community] to run as [the community] had compared it [the 2010 Mentawai Earthquake] to the 2007 earthquakes. Precisely, the weak shake is the danger of tsunami earthquakes, because these earthquakes occur in shallow, sedimented [segments]. [They will make] small, lengthy shakes. The rupture process would be longer and slower but are very effective to produce high frequency waves. So, this gave us a home work so that local community does not use their sense anymore but instead the government needs to install instruments" (Researcher No. 06).

b. Passive action

Oliver-Smith (2002) states that passive actions resulted from inappropriate human actions related to economic reasons such as building houses on flood plains and fault lines. However, involving the political-economic perspective will change this attitude to positive ways; thus, community groups will be more active in preparedness measures. The study also finds out why some participants took passive actions in responding to the tsunami potential. They thought a death was fate and there was nothing they could do to prevent it. This attitude was mostly based on their low economic condition because some thought that to be safe from tsunamis they would need a huge budget to move their properties to higher ground. Additionally, a new settlement would have to be made much further away from the garden and the sea for their livelihood. Lastly, the uncertainty of tsunami occurrences also influenced passive actions.

> "I [could] not do much. I was just resigned to it [this condition]. What was I supposed to do? [I] had been here, how I could move to Sumatra. [Even] in Sumatra [people] were hit by other tsunamis, too. So…if [I had been] hit by a tsunami, yeah, [it had] just hit me" (Community Member No. 19).

Figure 5.5 below shows the summing up of this section.

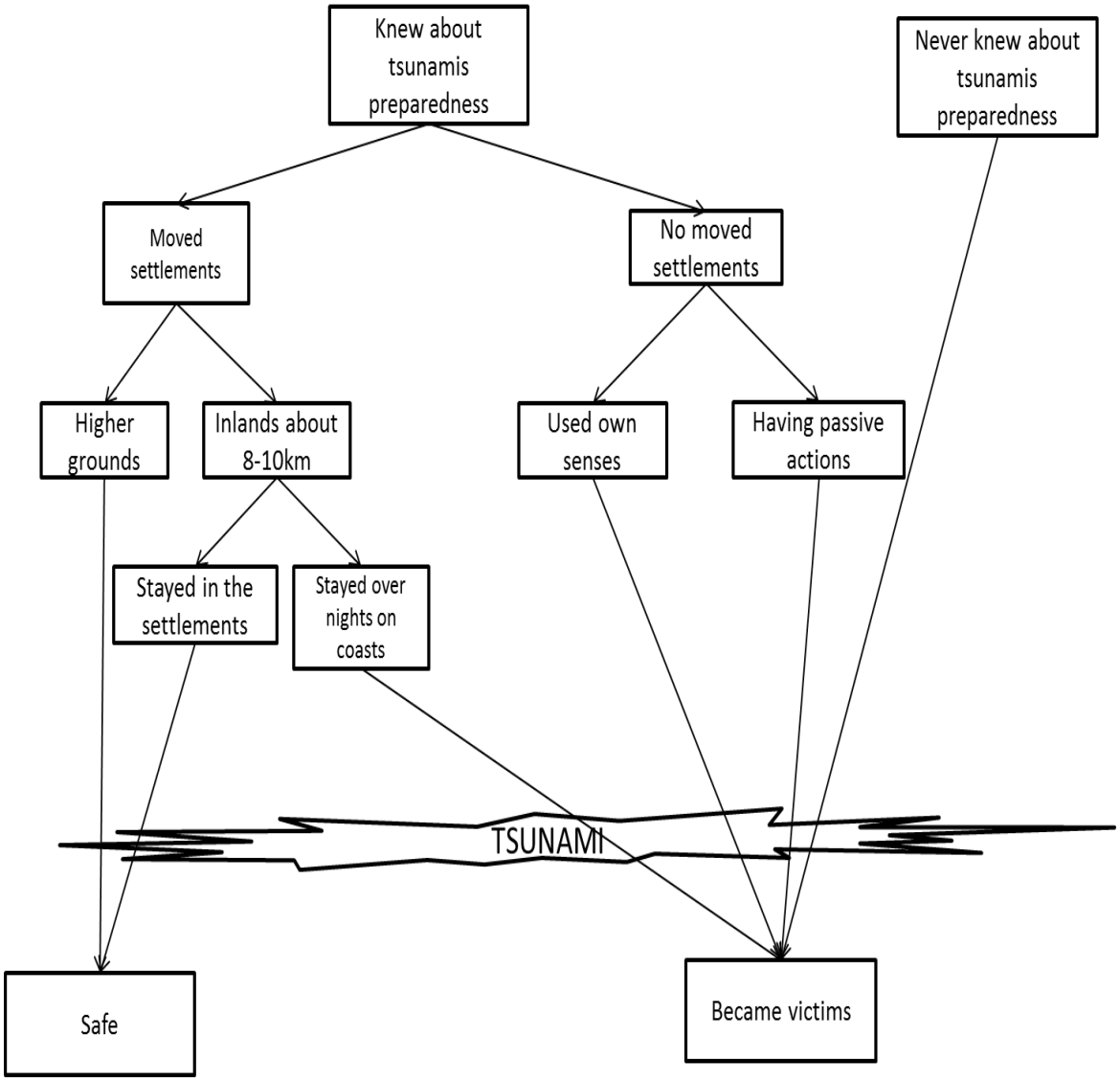

Figure 5. 5
The influence of knowledge on tsunamis to the decision of choosing settlements to live in, in Mentawai, West Sumatra

The above Figure indicates that the research found two categories of people in Mentawai regarding tsunami hazard knowledge. Mainly, the participants had heard about tsunami hazards and those of them decided to move or not to move to the new settlements. Some who moved, chose to live on the higher ground close to the sea, but others moved inland about 8 – 10 km from the coasts. However, those who just lived inland often stayed overnight on the coast. The others who did not move to the new settlements intended to use their own senses to indicate earthquakes and tsunamis, or simply remained passive.

When, the tsunami occurred those who stayed overnight on the coasts, used their own senses and became victims of the tsunami.

5.7. The Exclusive Reportage of Daily Singgalang

Below is a brief exclusive reportage from Daily Singgalang regarding the prediction of the earthquakes from the Mentawai islands and the panic of the community in Padang City. This reportage was written by Edwardi et al. (2010). On 12 October 2010, exactly 13 days before the 2010 Mentawai Tsunami occurred, some experts on earthquakes and tsunamis, known as "Team Nine" conducted a workshop with some provincial senior officers from the West Sumatra Province. This team had warned the senior officers about a potential earthquake in the western coast of Mentawai. This potential earthquake could reach a magnitude of 8.9 SR, called with *Mentawai Megathrust,* and could trigger a tsunami. Wahyu Triyoso, one of the Team Nine members said "We, the Team Nine feel like bringing a death message [to the public], but the scientific findings must be delivered so that we get prepared to face the disaster" (pp.14-15). It is good to note, however, that the earthquake the Team Nine had predicted was not the same with the 2010 Mentawai Earthquake.

In fact, at the time the Team Nine gave its consent to the potential condition of Padang City (Padang) it the predicted tsunami occurred. They never said anything about a potential damage to Mentawai. The team predicted that the tsunami would reach Padang in 2.5 hours after the earthquake with a run-up of 6 meters. The water could also reach the land for 2 km long. Indeed, if the tsunami occurred, it would had affected about 900,000 population of Padang, where this number was far above the population of Mentawai, around 78,000 people (Pemda Mentawai, 2011).

After this workshop published by the media to the community, several issues and invalid information were spread out among the local community of Padang. On 21 October 2010, for example, the local community was in panic due to the appearance of halo (optical phenomenon) surrounding the sun. The issues and hoaxes had related the optical phenomenon to a potential earthquake with a tsunami. Thus, the local community of Padang who stayed next to the coast flocked to evacuate to the higher ground. Not to mention, several of them also moved to other cities. This panicky situation was worsened by some hoaxes through social media.

After the Provincial Agency for Meteorological, Climatological, and Geophysical Management (BMKG) clarified that the optical phenomenon was not related to any occurrence of earthquakes, the local community started to be calm and went back home. But this calmness started again after an earthquake shook at 09:42 pm, 25 October 2010. All people of the city went down to the roads creating a huge congestion. The major of Padang (Mahyeldi Anysharullah) appeased the locals and persuaded not to be panic. The TV programs and the internet said the earthquake could trigger a tsunami. However, some sirens that had been planted in some bays of Padang did not sound. Nevertheless, the locals kept being panic and thought the sirens were not working.

But, no one realized what happened to Mentawai. Even the national and provincial senior officers and the media paid no attentions to Mentawai. As evidence, on 26 October 2010 (the day after) all local papers talked about the panics of the local community of Padang as this city was damaged once by a big earthquake on 30 September 2009. In fact that the landline and mobile communications were disconnected to Mentawai due to the earthquake, however, there were no concerns from the government officers and the media about it.

At about mid noon, 26 October 2010, some national TVs announced “breaking news,” mentioning the tsunami had hit Mentawai. The TVs obtained the information via satellite communication. This breaking news surprised all the people. Ironically, the Regent of Mentawai District (Edison Seleleubaja) was in Padang to attend a coordination meeting in Solok City (about 65 km from Padang) and knew nothing about the Tsunami.

In fact, several instruments of early warning had been planted in some bays in Mentawai, supported by the German Government. However, these instruments sent the information first to Germany and then to Indonesia. Meanwhile, BMKG had released a warning of potential tsunami 4 minutes and 46 seconds after the earthquake. But, “the local people in the western of the Mentawai coasts did not receive the information because of the limited facilities” said Sutopo Purwa Nugroho, a senior officer from BNPB.

5.8. Conclusion

To conclude this chapter, below figure indicates the findings from the field research.

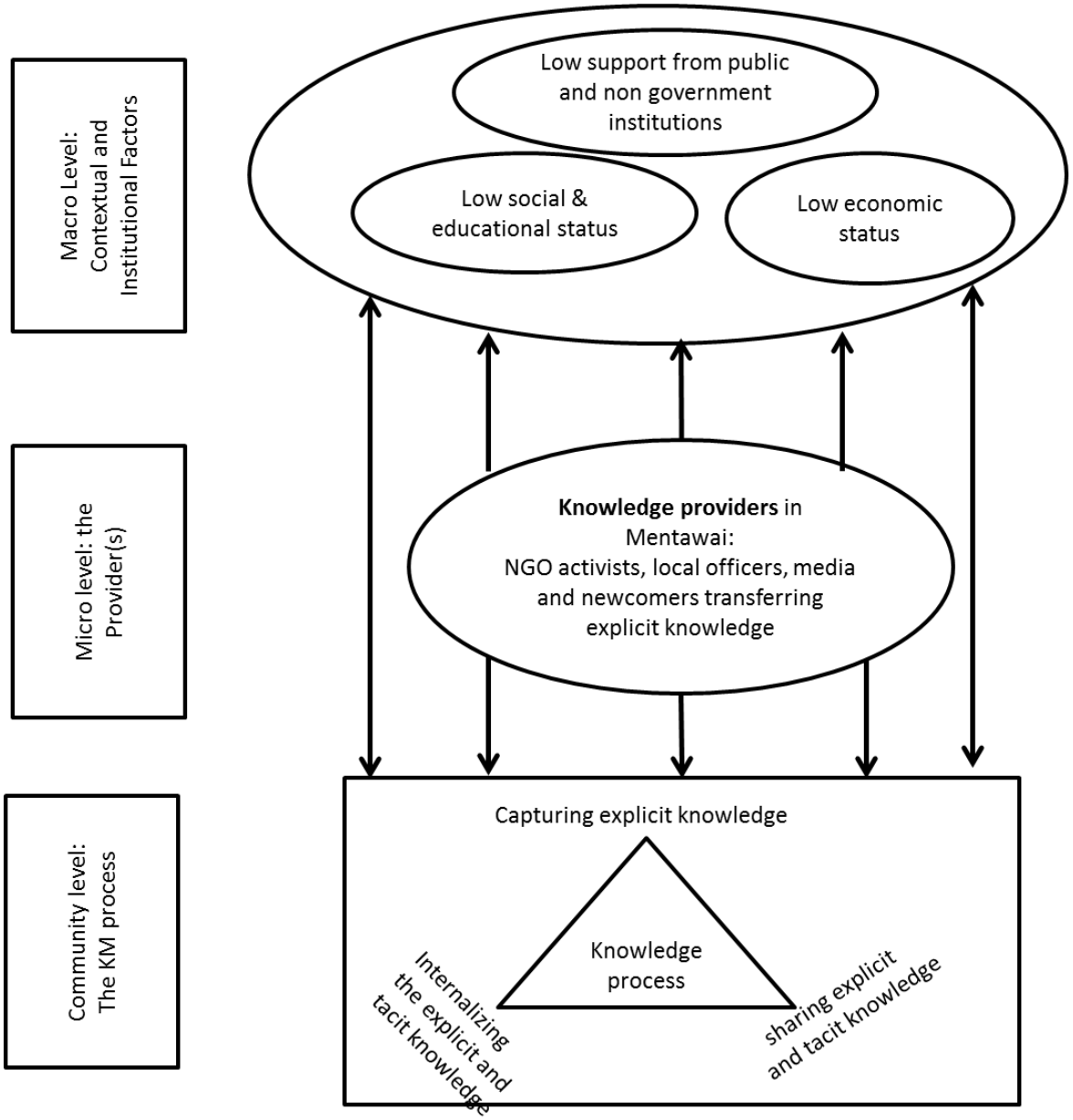

Figure 5. 6
The cross-cultural and institutional framework of KM
Relationship between macro, micro, and community dimensions in KM.
Sources: Adapted from Mohannak and Hutchings (2007).

In relation to the research findings, Figure 5.6 above shows how KM was applied to analyse the KM process to transfer tsunami hazard knowledge and preparedness in Mentawai. At the contextual and institutional levels, the District Government and the Parliament of Mentawai provided little support to implement the transfer and dissemination of tsunami hazard knowledge and preparedness. The findings indicate that the district government might have prioritised other programs rather than the implementation of tsunami hazard

education and preparedness programs within the community. More importantly, the local government thought that the tsunamis would not occur in Mentawai. This complacency resulted from there being no oral stories about tsunamis in the community and the misunderstandings about historical tsunamis that reached Sumatra. Moreover, the low social, educational, and economic status of the local community affected the acceptance of the program. The people tended to give less serious attention to tsunami knowledge and preparedness and to think more about their daily needs.

The figure also shows several knowledge providers were found within the local community of Mentawai. They were the NGO activists, public officers, media, and newcomers. The findings indicated the importance of the knowledge providers who transferred explicit knowledge of tsunami hazards and preparedness to the local community of Mentawai. The community considered that the NGO activists had significant roles in this. However, it is important for the activists to increase their own knowledge of tsunami preparedness as well as their sensitivity to the conditions of the local community of Mentawai. Meanwhile, the local government officers also need to enhance their commitments to disseminate knowledge to the community. At the community level, the figure indicates the knowledge processes took place among the people. The people captured the explicit tsunami hazard knowledge and shared it with others. Some of them internalized the knowledge into a new knowledge or necessary actions to avoid any potential tsunamis.

The people applied their knowledge in some different ways. Some moved their old settlements in to the safer hills and inland, but others just stayed in their old settlements. But those who moved inland often lived overnight next to the coasts to fish or garden. When the tsunami occurred the people who move inland but stayed overnight on the coast and those who kept living in their old settlements became victims.

After the local community of Mentawai have experienced how devastating the tsunami was, they should be more alert to tsunami hazards in the future. They should actively figure out how to use their existing potential, knowledge, experience, and strategies to avoid tsunami hazards in the future, or at least to minimalize the impacts of them. The next chapter explores the current preparedness measures for anticipating tsunami hazards at the individual, household, community and district levels.

CHAPTER 6
Current Tsunami Preparedness Measures in Mentawai

> "...[But] the problem would be when they are running through the narrow evacuation route and there is a steep bank on one side..." (Community Member, No. 12).

6.0. Introduction

After the discussion of the knowledge of tsunami hazards in the previous chapter, we understood that most of the field research participants had tacit and explicit knowledge of such hazards before the 2010 Tsunami occurred in Mentawai. It has also been explained that the participants have different applications of the knowledge to avoid potential tsunamis. Some participants responded by saying they would move to safe places close to their daily means of livelihood. Others said they would move inland, but they often came back and stayed overnight in the coastal areas for their livelihoods. The others just said that they would not move anywhere and would stay where they were. When the Tsunami hit their coastal areas in 2010, the impact of it was also different for the community.

In response to what happened in 2010, this chapter is about the results from the second research question about current community preparedness measures for tsunami hazards. This chapter consists of five sections, as follows:

Section 6.1. Introduces a multi-level approach to implement tsunami preparedness in Indonesia.

Section 6.2. Presents and analyses the field research findings at the individual and household level.

Section 6.3. Presents and analyses the field research findings at the *dusun* level.

Section 6.4. Presents and analyses the field research findings at the district level.

Section 6.5. Concludes the chapter.

6.1. A multi-level approach model for tsunami preparedness

When people face uncertainty, they tend to request assistance from government, private institutions or other persons (individuals, family and community members) to reduce or eliminate the uncertainty. For many people, a tsunami hazard is an uncertain event, so it is necessarily important to provide tsunami information and interpretative processes of the event (Paton et al., 2009). Tsunami information will be one of the key resources for

individuals or households so they can be aware of and understand the hazard that they could face. Furthermore, cumulatively the community could develop the ability for specific knowledge and expertise to avoid or counter the problem (Paton, 2006b).

BNPB (2013b) has introduced a model of a multi-level approach as adapted in Figure 6.1. This model is an ideal model to increase tsunami awareness and preparedness at the individual/household, community and district levels. At the individual/household level, the people and household members can actively increase their awareness, understand tsunami evacuation procedures, and provide a number of items that are needed in an emergency. At the community level, community members can collectively develop plans and evacuation procedures. They can disseminate and test the procedures by conducting education and simulation exercises. They may develop a system to assist the community members in the event of tsunamis through deployment development. Lastly, at the district level, local governments conduct tsunami risk assessments and regional chain warnings. Furthermore, the governments develop tsunami maps and evacuation plans that can be used by the community members. All these three levels are interlinked.

As a number of scholars (Apatu, 2013; Carter, 2008; Reynaud, Aubert, & Nguyen, 2013; Scheer et al., 2011) emphasize that it is necessarily important to prioritise tsunami preparedness measures started from individual or household level; therefore, the analyses of the findings will start from the individual level (Section 6.3), followed by the community (or dusun) level (Section 6.4), and district level (Section 6.5).

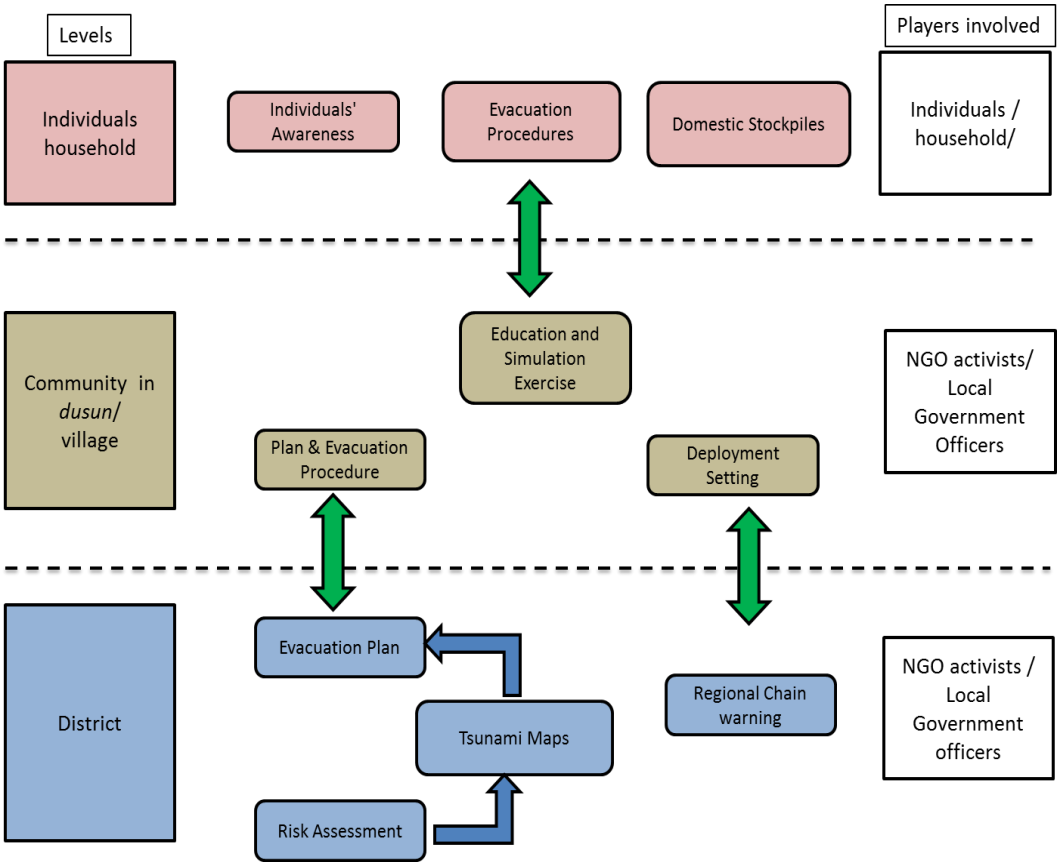

Figure 6. 1
A model of multi-level approach of tsunami preparedness
Adapted from BNPB (2013)

6.2. Tsunami preparedness at the individual or household level

Carter (2008) clearly emphasizes that tsunami preparedness efforts are inclined to become firmly focused on actions by individuals or household members. For someone to prepare, they firstly have to believe that a risk does exist. As they had experienced the Tsunami in 2010, it was expected that the awareness in individuals or household members would be fully or partly formed. Therefore, this awareness could influence them to develop or understand the household evacuation processes and to provide domestic stockpiles.

6.2.1. Individual or household awareness

LaBerge (1998) claims that awareness in an individual occurs when "an experience" becomes "my experience". It is very clear that when an individual has “the experience” of something, they will give a different meaning and attention to it. As awareness of tsunami hazards might increase the skill in avoiding tsunami waves, it is necessary to maintain or raise awareness over time. There are certain techniques to develop effective awareness in

individuals, namely enhancing personal efficacy (Paton, 2006b) and protective behaviour (M. L. Edwards, 1993).

a. Personal efficacy

Bandura (1998) claims that personal efficacy is an individual's belief in their capability to generate specific degrees of achievement which utilize influence over hazardous threats. Mastery of experiences is the most effective approach to build robust personal efficacies. Therefore, personal efficacies entail experiences to solve impediments or problems through persevering actions. This claim is consistent with what I found in the field research, as follows:

> "If I am at the shoreline [when an earthquake shakes], I will run away to a secure place....[I] will run as fast as I can. At any rate, if an earthquake shakes, I will run [no matter how]. But, if I am at the sea [to catch the fish], I would keep staying there". (Community Member No. 17)

The above quote shows a strong determination to avoid the tsunami waves. The experience of escaping from the tsunami by running away to find a secure place has provided the research participant with strong personal efficacy in facing the same problem in the future.

In addition, strong personal efficacy can also be obtained by conducting certain training. (Gelkopf et al., 2008; Smith & Woodworth, 2012). Individuals or household members need to be encouraged continuously, so that they have the capacity to master specified actions. Through mastery actions, they may also potentially mobilize better actions. Moreover, they may maintain their efficacies to develop certain skills. In relation to the field research findings, no specific individual training was found that could build personal efficacy for the participants themselves as well as for their family members; whereas, the Government encourages individuals to increase their efficacy to escape from any potential tsunamis.

However, some of the participants can easily climb coconut trees or run away in the dark in the jungle or along small grassy tracks because they are used to it. These kinds of abilities are formed by the daily experiences of living that could help them to escape from tsunami waves.

> "…[I] have known the road that we [I] used to step on. So, even [if] it is in the night, we [I] have known [memorized how to reach] the small roads. We [I] can run" (Community Member, No. 01).

In short, personal efficacy among the participants is mostly formed by their daily activities. Their daily activities enable them to have the ability to create personal efficacy to avoid the potential hazard in the future. However, self-efficacy by training needs to be concerned about the near future.

b. Protective behaviours

It is possible to reduce risks by undertaking protective behaviours. Protective behaviours allow an individual to identify conditions in which their personal space and sense of safety may be compromised. They are the preventive actions of someone to counter potential risks from certain problems or hazards (Natawidjaja et al., 2006; Nelan & Grineski, 2013; Reynaud et al., 2013; Scheer et al., 2011). There are three kinds of protective behaviours when someone takes a risk, namely, individual risk assessment, an understanding of risk proximity and the capacity to react.

Firstly, **individual risk assessment** is how someone assesses that the risk as important or hazardous for them. It can also be said that this kind of assessment is the probability of a specific individual becoming a victim as a result of exposure to tsunami waves (Nelan & Grineski, 2013; Reynaud et al., 2013; Scheer et al., 2011). Similarly to the situation of the local community of Mentawai before the Tsunami, some of the participants thought that tsunamis only hit other people, but not the Mentawai people. Unfortunately, after having such a tragic learning experience, some participants still ignore their own safety by looking at the sea level as an earthquake is shaking. The reason is just to see if a tsunami is coming or not. They argue that if they always run away after earthquakes, they would pay less attention to earthquakes in the future. However, tsunamis could reach the shores in less than ten minutes after earthquakes (BNPB, 2013a).

> "….[T]hen I would look at the sea [to know whether it] has lessened. I would try [to look at it for] some moments there [to confirm] whether a tsunami would come or not. Because my fear is if [the tsunami] does not happen, while the people have been at the evacuation point. So if the same cases repeatedly take place, [where] in every earthquake, [the people] run away, the people would pay no attention anymore [if a real tsunami comes]" (Community Member, No. 04).

It seems that the above participant tends to risk his own and others' safety by assessing the sea surface after an earthquake. His action is potentially jeopardizing himself and others, because he builds a perception that tsunamis only occur after the sea surface subsides. In

fact, the earthquakes in Mentawai can generate tsunamis before the people recognize that the waves have reached them.

Secondly, **the understanding of risk proximity** is the way someone rates the risk of potential impacts on their valuable goods. In the event of a tsunami, many cases are found where someone takes risks to save their belongings (Nelan & Grineski, 2013; Scheer et al., 2011). The field study also disclosed some different potential actions by the participants about taking risks in relation to valuable property. Some participants would not save their valuables such as birth or education certificates just before a tsunami was about to hit the area.

> "I don't think [I should save my child's education certificates]. Nowadays certificates [mostly elementary to high school certificates] have no use. The most important is firstly to save ourselves. Why bother to think of other [things]" (Community Member, No. 19).

> "I have nothing to save except my life. What is [my] property [it is valueless]" (Community Member, No. 16).

On the other hand, to anticipate the potential loss of valuable documents, one of the participants has placed them in his hut in the jungle. This hut is believed to be out of the reach of tsunamis waves, thus, in the event of a tsunami he would not take a risk for the documents.

However, another participant seems to be willing to take a risk to save her valuables, even though she has placed such valuable documents and property in an easy to reach place for when an emergency situation occurs.

> "Actually the certificates and other important documents have been placed in a particular point [at home]. If the earthquakes take place, I [can easily] take them with me" (Community Member, No. 05).

Another participant would also take risks to save his belongings. He would save his pigs if a tsunami was about to come. I noticed that the pig cages are placed above the sea next to his house. Pigs are part of the Mentawai culture and they become additional income for some. Almost every cultural and religious ritual uses pigs for sacrifices or as parts of communal meals.

> "…. I would strive to open the cages so that they would find out their way out to be saved. It would be a pity if they were dead like that. My pigs are

> important [to me]. You can imagine, my children can go to school because I also have had [sold] some pigs. If I had any chance, I would let them out" (Community Member, No. 02).

It is interesting to know that some of the participants would prioritise their own safety rather than save their belongings. However, some others would take any chance to save their valuable belongings. Whereas, as the above scholars warn, taking such a risk would potentially jeopardise their own lives.

Lastly, **the capacity to react** is the way someone has the opportunity to control or avoid certain risk. In the tsunami hazard context, the capacity to react is more to avoid rather than to control the risk (Nelan & Grineski, 2013; Reynaud et al., 2013). This argument is also found in the field research where the participants will avoid the risk by taking some urgent actions. Mainly, the participants would run on foot or use a motorcycle to avoid the hazard.

> "Then we [I] would find out a safer point to gather, then to try to run to the evacuation point until it was quite safe. Maybe after one hour in the evacuation point, [to make sure] it's safe" (Community Member, No. 02).

Two other participants said that they would climb up the coconut trees to avoid tsunami waves. Many coconut trees have sufficient height to take the evacuees above the level of tsunami inundation and have the strength to resist the effects of tsunami waves in Mentawai. I then reminded them that the Tsunami uprooted many coconut trees on the coastlines.

> "This is [my] safest way. [I have] no choice any longer. In the 2010 [tsunami] indeed many coconut trees were uprooted. But those [the trees] were precisely on the shorelines. We [I] would not climb on the edge, [instead] a little further [from the edge]" (Community Member, No. 19).

I could say that during the field research, all participants had the capacity to avoid tsunami hazards by running away from the coasts on foot or motorcycle or by climbing coconut or other trees. This kind of capacity is important in order to avoid the hazard in the future. Although plentiful evidence shows that coconut trees can save tsunami survivors; however, as Forbes and Broadhead (2007) remind, the bending of a coconut tree from the forces of the tsunami waves can reduce its mitigation capacity. In general, we often find a wide spacing between coconuts and they own no branches that lessen the flow rates of tsunami waves.

In conclusion, the research participants have certain levels of individual or household awareness of tsunami waves in the future. Some have strong self-efficacy from their experiences of escaping from the Tsunami as well as of performing daily work that increases their ability to escape the waves. For others, however, personal efficacy by training is important to be carried out in the future. Meanwhile, some participants also have strong individual protective behaviours in avoiding tsunami hazards. However, others would still take risks in order to save their valuable belongings. Therefore, it is important to inform individuals and increase their awareness of the tsunami hazard.

6.2.2. Evacuation procedures

There are three important elements to address in relation to evacuation procedures: namely an evacuation plan, household exercises, and tsunami *tendenko*. As this section focuses more on individuals' and household members' preparedness measures, this sub-section will explain the roles of household members for other members.

a. Evacuation plans

A recent study from American Samoa suggested that the factor most necessary in order to escape from tsunamis is a household evacuation plan (Apatu, 2013). An evacuation plan can be guidance for affected people from their current position to run away through evacuation routes towards evacuation points before the first tsunami wave hits them. Reynaud et al. (2013) and Scheer et al. (2011) mention that an evacuation plan can be invoked if warning systems signal, so that the people respond properly to save their lives from the incoming tsunami waves. Therefore, a household evacuation plan is a critically important plan in which a member or members of a family know what to do and where to go in the case of a tsunami, to make the evacuation process as efficient as possible.

As the tsunamis are potentially triggered by earthquakes in Mentawai, a number of messages are needed to inform the household member about the household evacuation plan:

1) Drop, cover and hold on

   This protective action can apply to those who are indoors and outdoors when an earthquake shakes. It is recommended that one drop to the floor with their hands protecting vital organs and knees to prevent movement and falls. From this position,

they can crawl a short distance to the nearest cover to protect themselves from falling and moving objects, if they are in range of such objects. Furthermore, they should hold their position until it is safe to move (Wood, 2015).

2) Move to higher ground

   Soon after the shake stops, the household members should move to higher ground nearby. Those who are using a motorcycle to evacuate should consider the motorcycle's condition, the availability of gasoline and collapsed or damaged roads (Wood, 2015).

3) Stay on the higher ground until it is safe

   It is critically important to make sure the household members come back to the house after the local authority gives an official confirmation of the safety. In the absence of the confirmation, however, they could come home one or two hours after the earthquake. As the Mentawai Islands are geographically close to the earthquake sources, a tsunami could only occur a few minutes after an earthquake.

Unfortunately, the field research in Mentawai revealed that no participants have a household evacuation plan. The main reason is that they do not understand the importance of it. Another reason is they do not know how to carry out the plan. In addition, they believe people can do things to protect themselves. The other is they believe that earthquakes are not their problems.

The lack of understanding of the participants seems more likely to create the absence of an evacuation plan at the household level. Whereas, as Apatu (2013), Reynaud et al. (2013) and Scheer et al. (2011) mention, having an evacuation plan would help them remember where to escape to if a tsunami comes.

b. Household exercises

In order to escape from and understand where to go in the event of a tsunami, individuals or family members should be trained. More importantly, a family needs to have its own exercises to ensure all family members, particularly the children and persons with special needs, understand the procedures on where to go in the event of a tsunami (Johnston &

Dudley, 2009). However, the field research reveals that no participants had conducted a household exercise. Even worse, the children are not told about the procedures at homes.

One participant tended to leave the household exercise to his child's school activities and NGO's activities.

> "I think [my children] have done it [the simulation] at their [elementary] school. And if NGO [activists] come down here, we [the *dusun* people] will do it together. I think it is enough to redeem my worry [about tsunamis]" (Community Member No. 02).

Interestingly, it seems that tsunami simulation exercises have been introduced in Mentawai at the elementary school and I found that one elementary school in Sikakap has regularly conducted an earthquake and tsunami exercise. This activity is supported by an NGO. Unfortunately, at the household level, the participant as a parent leaves it as part of the education process only, without being followed up at home.

Another never thought that household exercises were important to increase tsunami preparedness.

> "Ah, I never do it [a household exercise]. Because, [I] never thought to do it" (Community Member No. 05)

The other assumes that his family members would find their own ways to escape from tsunami waves.

> "....[B]eside I think [everybody] knows where to go if an earthquake [shakes]" (Community Member No. 03)

The above quotes signify that some of participants had not realized or still ignore their own safety regarding the tsunami hazard. Since most of the participants had not realized the necessity of a household exercise, therefore, it is important to ensure all family members understand the procedures on where to go in the event of a tsunami. However, the failure to adopt household plans and exercises might reflect tsunami *tendenko*.

c. Tsunami *tendenko*

Tsunami *tendenko* is necessarily important to every person. *Tendenko* (a Japanese word) means 'go separately'. It is a maxim that expresses "the individual is not to stay and help others, but to run and preserve their life instead" (Kodama, 2015b, p. 361). Therefore, every person in a community should know what to do and where to run in the event of a tsunami,

to self-evacuate and reach an evacuation point. By conducting tsunami *tendenko*, "the rescuer" and "the rescued" will avoid the deaths of the rescuer and the rescued. Therefore, every person who experiences the event of a tsunami should immediately run to save their own life rather than helping or waiting for others in order to avoid potential deaths of "the rescuer' and "the rescued".

This maxim is still debatable and not widely adopted in Japan. However, Kodama (2015a) identifies two main criticisms of tsunami *tendenko* that should be carefully considered. One is that tsunami *tendenko* increases egoism. As this maxim seems selfish and immoral, a concern with saving individuals' lives collectively maximises the total number of lives saved. Kodama explains it through the table below.

Table 6. 1
The Tsunami Dilemma

	A does not search for B (runs for his/her life)	A searches for B
B does not search for A (runs for his/her life)	Both likely to survive (tsunami-*tendenko*)	B likely to survive, A likely to die
B searches for A	A likely to survive, B likely to die	Both likely to die

Source : Kodama (2012)

Table 6.1 illustrates what might happen if tsunami waves are about to attack a settlement and potentially kill the inhabitants, unless they run away soon. It will be a lose-lose situation if A and B choose to seek and wait for each other. They will be more likely to die from the tsunami. However, if one of them chooses to evacuate, he/she will be more likely to be safe. More importantly, if both decide not to search for each other, but to self-evacuate, both are more likely to be safe (tsunami *tendenko*) (Kodama, 2012).

The other criticism is that psychologically people find it problematic to comply with the maxim. It is natural for people to tend to save others in dire need. There are some possibilities of associations between "the rescuer" and "the rescued" in the event of a tsunami. Firstly, the rescuer might not know if the rescued has saved themselves because they can evacuate. Secondly, the rescuer might not know if the rescued has been saved, as

they cannot evacuate themselves. Lastly, the rescuer might know the rescued could not be saved and cannot evacuate (Kodama, 2015a).

However, the field study showed some findings contradicting the tsunami *tendenko* maxim. All participants from among the community members mentioned they would save others in the event of tsunamis. They would save particularly the children, pregnant women, their family members and elderly and sick people.

> "[If a tsunami is about to occur and I am in my garden] I would try to come to my *dusun*. Because [my] children are there" (Community Member, No. 04).

Generally, family links in Indonesia are very close. Similarly, in Mentawai a family usually has siblings staying nearby. For many, neighbours are important as the participants mentioned below:

> "Of course [I would save them]. All here are like brothers and sisters. So, the sadness of one is ours, too. For example, my neighbour [very close to my house] is my brother. Next to him is my brother's father in law. In that corner is my father in law. So the family [from my side] has eleven [families] here. So, we are here to care for one another" (Community Member, No. 13).

> "……[I]f no neighbours, whom do we [I] ask for? It is the neighbours who are also my brothers and sisters. Mostly in this *dusun* there are siblings. It means kinsmen, in laws, uncles, nieces. All are related. So if you asked if it is important, it is [very important]" (Community Member, No. 19).

I then asked them if they directly knew the number and the places of the elderly, the pregnant females, or the sick people in the *dusun*. Generally, they could not answer directly and needed some period of time to identify them. This means that they would search the places or houses to find those people to save. By searching, they would waste the time necessary to save themselves.

> "[While he tried to remember by starting counting and pointing to the houses] saying there are seven elderly people that cannot walk. [They] need assistance. But I don't know if any are pregnant here. But there is no big [mature] pregnancy here now" (Community Member, No. 13).

It was also revealed that they would save the vulnerable people by using pickaback, sarongs and straight branches of tree (pillars) to carry them, or giving rides on motorcycles. However, the sarongs and the pillars are stored in the *Satlinmas* posts or in the house of the

dusun head. This also means that they need more time to get those tools. *Satlinmas* stands for *Satuan Perlindungan Masyarakat* =Community Protection Task Force). *Satlinmas* is a group of the local community members that have been trained to take care of any impacts of potential earthquakes and any potential tsunamis caused by an earthquake, in particular at night-time in one *dusun*.The main tasks of the *Satlinmas* are readiness to provide information and to provide assistance to others if earthquakes and tsunamis hit.

In conclusion, the study found that no participants conducted household evacuation plans and exercises and tsunami *tendenko*. Contradicting tsunami *tendenko* where the affected people should run away from the coast to avoid the tsunami , the participants would even come to the dusun close to the coast to assist the others. Indeed, tsunami *tendenko* seems to be not easy to apply to adults due to strong kinships in the community. Therefore, it is imperative for the participants to consider their own safety from tsunamis through having household evacuation plans, conducting regular household practices and considering the tsunami *tendenko*.

6.3.3. Domestic stockpiles

A recent study conducted by Arlikatti et al. (2010) in India identifies ten types of tools or facilities that a household needs to prepare for tsunamis, namely: shelter, a portable water supply, illumination, packaged foods, cutlery, waste disposal, portable cooking equipment, washing devices, dish washing, and transportation. All these ideal domestic stockpiles, however, seem not to be applicable to the local community of Mentawai, since some of them are naturally available and are just not needed. Therefore, only some of the items are pertinent to this study.

a. Stockpiling a shelter

Stockpiling a shelter is an incremental process, which could support accommodation for family members potentially affected by a tsunami hazard. The process considers the security of land rights, providing materials to build the shelter or using a built-up shelter, and developing and maintaining a coordinated, integrated, and comprehensive inter-sector (Kelly, Nunes, & Centre, 2012). In connection with the field research, it is common in Mentawai for one household to have “two houses”. One “real” house is used for daily living in and the other is a “hut” that is used for temporary shelter. Therefore, if one household has a “real” house next to the coast, this household usually has a hut in the jungle. Likewise,

if another household has a "real" house in the jungle, a hut will be built next to the coast. Therefore, if they evacuate from a tsunami, they will have a shelter in the jungle. Or in the case that they do not have one in the jungle, they can easily build a temporary shelter since many trees are available there.

b. Food preparation

Experts say that it is important to prepare foods, especially non-perishable ones. These easily prepared foods should be enough for at least a three-day supply for evacuation. Naturally, in the jungle of Mentawai many foods are found. As the local people normally also plant some kumara, taros or bananas in the jungle, therefore, it seems that food supplies in the case of evacuation are not problems for the local community for a few days. In fact, there were two participants who stated that there has been a mutual agreement by two different *dusun* to keep planting and caring for some kinds of crops such as kumara, taros and bananas in the forests. The reason for this is if any tsunamis hit them, emergency foods are available. They also agreed that the *dusun* people only take some of them except in an emergency.

> "...[B]ut if there is any earthquake [followed by a tsunami], we can directly use the huts and kumara etc. [We have] hoes and other tools there [in the jungle]. Now, every *dusun* has their own garden above [in the jungle]..." (Community Member No. 18).

> "We have a community garden with a lot of banana trees. We have [developed] this garden after the Tsunami. It is not very wide, but [what we want to plant] depends on us [all community members]" (Community Member No. 07) .

It is good to know that in some *dusun* the people have planted some crops for a time that they might need them. It is also interesting that the *dusun* people have a mutual agreement to take care of the plants and take them only when they need them in emergency circumstances.

c. First aid and other supplies

Many experts and institutions suggest that a household stockpile contains a compact kit with first aid or other important tools. The stockpile usually consists of whistle, antibiotic ointment, bandages, iodine, and a folding pocketknife. However, I found no participants who had such supplies. However, I am confident that the local community could use some natural herbs from the jungles as medicine for injuries. My confidence is also confirmed by

the findings of the Ministry of Health which conducted a survey on Siberut Island in 2014. Mostly the participants from that survey said that they often use natural herbs to heal their injuries (Agung, Purwaningsih, Zamzami, & Rahanto, 2014).

In short, the study revealed that the key elements for the local community of Mentawai to be prepared for a tsunami hazard are the experiences of daily living and the Tsunami, and the natural condition of Mentawai. However, some other elements such as protective behaviours and evacuation procedures that can be increased through some training or information dissemination to the individuals are needed. These efforts are believed to make the community preparedness stronger in the future.

6.3. Tsunami preparedness at the *dusun* level

Based on the model in Figure 6.1, three elements are important for the local community at the *dusun* level to prepare them to be resilient in the face of a tsunami hazard. These are plan and evacuation procedures, education and simulation exercises and deployment setting.

6.3.1 Evacuation procedures

The purpose of an emergency plan and evacuation procedure is to serve the local community engaged in a potential tsunami response within the locality. Its aim is to increase the local community members' and stakeholders' resilience by ensuring all community members understand what to do and where to go. At this stage, the local community at the *dusun* level might conduct many activities. The community could develop or design a *dusun* committee to prepare a series of preventive activities; determine a particular point as an assembly area for the community; plan an education and training session for the community members or cadres or build physical structures to facilitate the community to escape. Scheer et al. (2011) argue there are three critical elements that should be available in the community in order to maximize evacuation processes, namely tsunami hazard maps, evacuation areas and evacuation routes and signs.

a. Tsunami hazard maps

It is important to identify some factors that could enable or hinder evacuation processes in an area. A tsunami hazard map ideally shows all things that potentially facilitate or obstruct ways to escape from the tsunami waves and the potential inundation area of a tsunami. To

develop this map, technical skills and time are required. Topographic data, all buildings, and information about potential tsunamis are needed (Samant, Tobin, & Tucker, 2008).

However, at the community level like a dusun or village in Mentawai, those data and technical skills are not available. In the absence of such data and skills, Cadag and Gaillard (2012) suggest developing a participatory map. Participatory mapping is a method where members of a community are encouraged to develop and use a map or maps in order to communicate their knowledge and ideas more clearly (Forrester & Cinderby, 2012). This simple map only requires local community participation and the identification of the most needed information and data in the community. Patras and Koutis (2010) identify a number of steps to develop participatory mapping, as follows:

1. Gathering and preparing the community for the mapping activity.
2. Determining the purpose(s) of making a map for the participants.
3. Collecting information from the participants.
4. Creating the map on drawing paper(s) and determining the legend.
5. Analysing and evaluating the information.
6. Displaying the developed map to the community.

The study has unveiled that no *dusun* has such tsunami hazard maps. One participant acknowledged that the *dusun* people once gathered and developed a map in order to decide where the evacuation route would be built. Since then, no maps have been developed and displayed.

> "We once made a map before the [*dusun*] people decided where the evacuation route would be built. But, since then ....[I don't know where the map is]" (Community Member No. 04).

In addition, one participant from an NGO mentioned that some *dusun* have made tsunami risk assessment maps. The participant mentioned that the maps had been developed together with the *dusun* people. However, he could not show me the physical evidence of the maps in the NGO office, nor on the community notice boards to display to the community.

b. Evacuation routes and signs

As a continuous and unobstructed path of exit from any point within a community to a place of safety (Pu & Zlatanova, 2006), an evacuation route is needed in order to escape from tsunamis. In determining the evacuation route, it is important to consider the fastest way to reach the evacuation point. In relation to the field study, all *dusun* next to the shorelines, have one or two evacuation routes. Some participants feel satisfied that they have these evacuation route(s) in their *dusun*.

> "Now there is an evacuation route built by the government. [I] could run faster if any tsunami. I feel a little bit relieved." (Community Member No. 12)

Some others, however, need more evacuation routes to be built because for them it is too far to reach the evacuation road if a tsunami is about to come.

> "Actually, if [it is] possible, [for more evacuation routes to be built] next to [several] households. The evacuation route [that we have now] was built almost in the middle of the kampong [*dusun*]. But from the end [of the *dusun*] if [someone] runs they will also need time. So, there should be more" (Community Member No. 06).

One participant who is an elementary teacher is confident that her children would run away up to the hill in the event of a tsunami, through the small evacuation route next to her school. However, she also raised the issue of inappropriate evacuation routes.

> "... [But] the problem would be when they [the elementary students] are running through the narrow evacuation route and there is a steep bank on one side [they could have fallen]. This could potentially become a problem. They should have put a hand rail so that no people would fall when running" (Community Member, No. 02).

Other participants are pleased to have the evacuation route(s) built. They would use the route with their motorcycles to evacuate, but also mentioned the same problem of the narrowness of the evacuation routes.

> "…[I]t [the route] is a small alley. [I believe] if in a panic [situation] we would be stuck there. [I believe] my motorcycle will be the first before others. So, it would be possible to come again to help some" (Community Member, No. 03).

A local community needs to maintain evacuation routes. In some cases, a route could become inaccessible due to, for example, road works. Moreover, putting something on the routes will reduce the road capacity, and even worse will block the way when they are to be used (Nelan & Grineski, 2013; Reynaud et al., 2013; Scheer et al., 2011).

From the field findings, it is regrettable that in some *dusun* the evacuation routes are used for other purposes or just carelessly abandoned. During my visit to Dusun Berkat Baru in Sikakap, North Pagai, the evacuation route was blocked by some motor cycles (Figure 6.2).

Figure 6. 2
Some motorcycles were parked next to the evacuation route that would potentially block the evacuation process if needed
Source: Courtesy of CDRM & CDS taken during the field study

It was also found that other evacuation routes in Dusun Makukkuet (Matobe, North Pagai) were blocked by a water pipe from the hill nearby (Figure 6.3).

Figure 6. 3
The evacuation route was blocked by a water pipe to flow clean water the several households nearby in Dusun Makukkuet
Source: Personal documentation taken during the field study

In addition, the route in *Dusun* Pasibbuat (Taikako, North Pagai) is too steep to be climbed and is greatly eroded by rain water (Figure 6.4).

Figure 6. 4
The evacuation route is steep to climb and eroded from the rain in Dusun Passibut
Source: Personal documentation taken during the field study

One participant from *Dusun* East Sikakap (Sikakap, South Pagai) found that often the evacuation route in his *dusun* is used for other purposes.

> "..... [someone] uses it [to dry the crops] like that... Indeed the evacuation route becomes a good place to dry cocoa beans or coconut. Because the place [the route is concrete] is dry and hot in the sunshine...]" (Community Member , No. 08).

Evacuation route signs use a symbol that direct people to a pre-defined evacuation route away from potential tsunami areas. Scheer et al. (2011) argue that evacuation signs should be the most visible way to educate the local community about evacuation routes and evacuation points. The signs are generally arrow directions: left, right, veer left, veer right and ahead. These signs may be added with simple, but clear messages such as "tsunami evacuation route" with wave-like pictures.

In addition, Scheer et al. (2011) claim that additional supplementary text is needed to maximize the evacuation signs. This complementary text would advise the local community where to go when a warning sounds. The text should say the name of assembly point; how far the evacuation sign is to the assembly point; and which direction will lead to it. In fact, BNPB (2013a) has provided standard evacuation route signs (shown in the next section).

In some *dusun* that I went to, I found that the evacuation signs were designed in different ways from the standardized design. The evacuation signs in Dusun Malakopa (Malakopa) (Figure 6.5), Dusun Tuapeijat and Dusun Berkat (Sipora), Dusun Sagitsi Timur (Nem Nem Leleu), and Dusn Gobik (Bosua) were slightly different from the national design standard, but still contained the basic information of the standardized design. Below is one example of the evacuation routes found in Dusun Malakopa (Malakopa, South Pagai).

Figure 6. 5
The evacuation route sign mentioning “the tsunami evacuation route” is placed next to the evacuation route. It gives the message and shows the direction to the evacuation point in *Dusun* Malakopa
Source: Personal documentation taken during the field study

There were some other signs with different designs from the national standard. In *dusun* Sibabai and Berkat Baru (Sikakap), the evacuation route sign was smaller in size, had smaller written messages, and different colours (Figure 6.6).

Figure 6. 6
The evacuation route sign is placed next to the evacuation route and is different from the standardised design in Sikakap.
Source: Courtesy of CDRM & CDS taken during the field study

In *Dusun* Pasibbuat, the evacuation sign was also found to be of a different standard as well as the main message being unclear and almost unreadable anymore (Figure 6.7).

Figure 6. 7
The evacuation route message is faded and unreadable
as found in Pasibbuat
Source: Personal documentation taken during the field study

However, it was also found that there were no evacuation signs in *Dusun* Makukkuet (Matobe, North Pagai) and *Dusun* Asahan (Bulasat, South Pagai). One participant said:

> "There are no evacuation signs found here, because the people have no particular fund [to provide them]. Because the people have [too] little money. But actually, if the people had high awareness, they [we] would have provided the money to make the signs." (Community Member, No. 06)

It is clear that no actions have been taken by the *dusun* people to develop the evacuation signs because of poverty. However, if they commit to collecting money little by little, they could acquire some.

c. Evacuation points

BNPB (2013a) emphasises that evacuation points or safer areas are designated inside or outside locations of the community, which are on higher ground or inland from coastal waters for evacuated occupants. Evacuation points, also known as assembly points, are considered to be easily accessible points. They are often positioned at a reasonable range

that people can reach in a timely manner from the point of departure. All research participants that lived in the *dusun* which is next to the shorelines said that each *dusun* has at least one evacuation point. According to my observations of some evacuation points in Mentawai, the evacuation points are mainly located in the *dusun* at approximately 15 m above sea level. They can accommodate the *dusun* people if evacuation occurs since they are relatively wide and flat. However, some evacuation points are neglected and overgrown with grass.

d. Emergency messages or signs

People who live on the shoreline have to be aware of the signs of potential tsunami occurrence. In general, there are two basic indicators to indicate tsunami waves could hit the shores, namely 1) earthquakes and 2) abnormally rapid retreat or draw-down of the sea (Scheer et al., 2011). However, often people fail to recognize the signs due to, for example, an earthquake shaking when people are sleeping, some children never having experienced earthquakes, or the earthquake is too small or too far away to feel. Meanwhile, modern communication technology does not always exist in a community. Therefore, a mutual agreement among community members is important to decide how to deliver the warnings. It is also imperative to involve community members in identifying the best communication mechanism and strategies. Community members can design warning messages based on custom to ensure others receive and understand them.

King (2006) reminds us that there is no assurance that the community will receive, accept, and respond homogenously to a warning sign or an emergency message pattern. According to Drabek (1969) there are three general patterns of an early warning process, namely 1) warning by authority; 2) warning by peer (friend); and 3) warning by mass media. In the absence of early warning patterns by authority and mass media, such as those discussed in the previous chapter, it is necessary to rely on the warning pattern by peers. Thus, the local community needs to decide how the emergency messages or signs pattern will be used and understood by members of the community.

In relation to the field study, recently the local people from some *dusun* in Mentawai have developed and used *kentongan* or *tutuko* in the local Mentawai word to communicate an emergency to the others. *Tutuko* is a traditional simple communication gong that is made

from bamboo or timber. In some areas in Indonesia, *tutuko* is used to define signal long distance communication and danger signs. *Tutuko* size ranges between 40cm in diameter and a height of 1.5 metres and is often identified with time immemorial communication, a tool that is often used by people living in the countryside and mountains (Mei et al., 2013; Restyandito, Chan, Mahastama, & Saptadi, 2013). Usually, a *tutuko* is placed in a *posko* (a public post for watching the area situation in a village). However, I found that the *tutuko* in Dusun Pasibuat was of smaller size and produced a smaller sound than those of the bigger *tutuko* (Figure 5.8). I suspect that when it is activated in the event of a tsunami the local community might not hear the sounds, in particular at night time.

Figure 6. 8
Small *tutuko* in a simulation exercise in *Dusun* Pasibbuat
Source: Personal documentation taken during the field study

It is also a concern of one of the participants. Instead of using the *tutuko*, he preferred using a handy, mobile loudspeaker.

6.3.2. Education and exercise activities

As tsunami warning cannot replace tsunami education for individuals and communities, a comprehensive approach to educating the community is important. This approach consists

of having face-to-face or group meetings, providing education materials and conducting simulations exercises. This approach should be implemented continuously and simultaneously.

a. Tsunami education programs

Community education is vital, especially in the event of local tsunamis. As local tsunamis can reach shores before the authority's warning reaches the community, it is important to educate the local community through setting up tsunami education programs. However, it is quite different to provide education for those who live in remote areas as mentioned on the previous chapter.

A tsunami education program is a program to improve individual and community members' knowledge about tsunamis and to ensure they take appropriate actions while preparing for and responding to future potential tsunamis. Program activists need to take tsunami information and communicate it effectively so all targeted individuals or communities understand the issues and, as a consequence, are motivated to take necessary actions (Bernard, Dengler, & Yim, 2007). The field study also revealed that some participants acknowledged that the visiting program from the NGOs and the local government is less suitable to educate the local community about tsunami preparedness. The visiting programs only allow them to visit the community a few times yearly and it is also revealed that they need a more comprehensive and intensive education program. Such a program empowers the participants to discover their problems and the potential solutions on the preparedness. In addition, the program also enables the local community to obtain some training and practices to avoid harm from earthquakes and tsunamis. Lastly, the young people are also involved in this program (Bernard et al., 2007).

b. Dissemination of tsunami education materials

Dissemination of tsunami education materials is one of the main key ways to prepare a community for a tsunami hazard. In order that the community has access to the materials, it is crucial to distribute tsunami education materials to them. There are many kinds of materials that could be accessible to the community such as tsunami module sets, booklets, banners, trivia worksheets, games and puzzles (UNESCO, 2006). Similarly to the study findings, some NGOs have also developed some banners and plastic-printed billboards with tsunami information and warnings on them in some *dusun* in North Pagai (Figure 6.9).

However, some participants do not understand all the messages written or pictured on the billboards. Some English words, abbreviations, and pictures are found and they are not easily able to understand or digest.

> "I understand if the words are in Bahasa. But, [unfortunately] there are some in English…… [I]f I see the pictures of some persons I understand what they are doing [on it]. But, there are some pictures that I don't understand" (Community Member, No. 06).

Figure 6. 9
Some of the messages on the billboard are not understandable.
Some words are in English and the map is too small to identify the Mentawai Islands
Source: Personal documentation taken during the field study

After clarification related to the billboard design, one participant from the NGO revealed that the NGO that produced it did no assessment of the design prior to printing. The NGO took the pictures and the messages from someone's PowerPoint presentation. Indeed, the participant understood that the readers of the billboards might have no clear understanding after reading the billboard. In fact in order to make education materials effective, it is necessary to conduct an assessment of designs or formats and contents (Keo, Keynes, & MacLeod, 2003).

> ".....But sure [I believe] some are illiterate. But others can explain it to them. That's the reason to focus on some pictures on it" (NGO Activist, No. 01).

c. Simulation evacuation exercises

A tsunami simulation evacuation exercise is one of operation-based exercises to test community capability to respond to earthquakes and to evacuate to safe areas or assembly points. This exercise is necessary to raise awareness of tsunamis by involving all affected community members and using all potential resources. It is also thought that the exercise will identify the needs for the community to be better prepared (UNESCO, 2011a). The exercise development process (as shown on Figure 6.10) is designed to be flexible for whoever will use it to satisfy their unique needs.

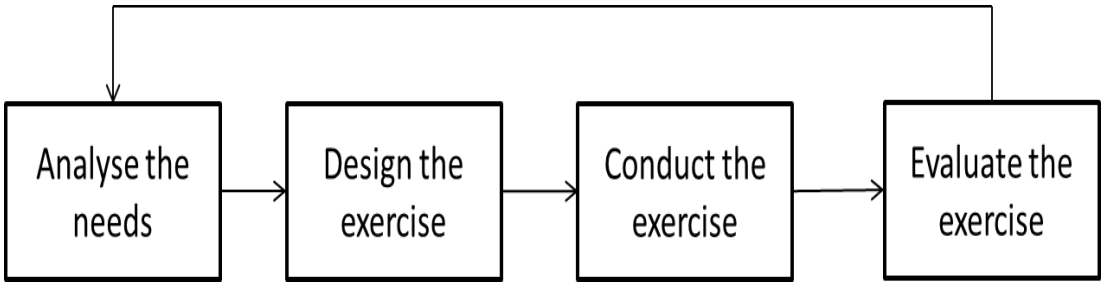

Figure 6. 10
Exercise development process
Source: UNESCO (2011)

I had one chance to observe a tsunami simulation exercise during my field research in Mentawai, conducted by an NGO in *Dusun* Pasibbuat, Taikako, Sikakap. The aim of this simulation was to test the community preparedness on tsunami hazards. The observation of the simulation is contained in Box 6.1, while some interviews from two simulation

participants are placed below. These interviews revealed a clear understanding of how the simulation exercise proceeded.

From the interviews, it was found that the analysis of the needs to conduct an exercise and the design of the exercise came from the NGO that works for the local community. As mentioned in Box 6.1, the NGO mainly dominated the design of how to do the simulation exercise. This is understandable as the *dusun* people have no experience of such an activity, but it would be good to discover what the local people thought or wanted to do. However, it is clear to me that why the NGO activists tended to tell all the people what to do was because hardly any *dusun* members gave their opinion. Therefore, all scenario flows were the NGO's idea or design.

During the conducting of the simulation, the *dusun* people participated. However, as I observed, I found some "unnecessary actions". Firstly, one of the exercise participants had to look at the sea surface and then tell the others to run away since a tsunami would potentially occur. It seems that in the event of tsunamis, the *dusun* people had to rely on that person's information before they ran away, whereas, tsunamis could reach the shores in less than ten minutes in Mentawai. Moreover, the "appointed" person may not be in the *dusun* when an earthquake strikes.

I then tried to have clarification of the 'looking at the sea surface' action from the NGO activist. His response was that he prefers to avoid boring the community and rather ensure their safety,

> "Because [we] indeed need to make sure no tsunamis come. The problem is, if each earthquake occurs, and then [they] run [to the hills] but there are no tsunamis, they will feel 'tsunamis never happen'. So we need to make it sure first" (NGO Activist, No. 01).

My further question was: "If earthquakes occur at night time, how do the people see the sea in the dark?" His response contradicted the above statement.

> "If at the night [an earthquake shakes], ya [they should] directly run away to an evacuation point [without looking at the sea surface]" (NGO Activist, No. 01).

Secondly, some people were instructed to take "action" as the "vulnerable" such as the blind, lame, pregnant, and wounded. However, further research showed that currently

there were no blind, lame and pregnant people in the *dusun*. Since this simulation would test the community preparedness, the local people should have identified and prioritised their own actions to reduce their own risk (Mukhier, 2012).

> "We had been taught [before the simulation] that someone 'A' acted like that and someone "B" acted like that. So step by step they had been informed to be the 'pretend' persons" (Community Member, No. 04).

Lastly, prior to the execution of the simulation, an unofficial conversation with the head of the *dusun* revealed that the evacuation point was not the church and the evacuation route was not the dirt road to the church. The real, approved evacuation route was situated in middle of the *dusun*, among the houses. I had checked it and found some parts of it were too steep to be climbed by some people, particularly pregnant women or children. The evacuation point was wide and flat around 25 m at the sealed surface. There were two small houses in it that could be used if needed for the babies or the injured, for example, before external assistance came in an emergency.

Using non-mutual agreement regarding evacuation routes or points could perplex the local community. The NGO activists as the facilitators should understand this situation, so in the event of tsunamis in the future, all local community members would run towards the agreed points through the agreed routes. However, in fact during the simulation, the NGO activists suggested using a different route, since the developed evacuation route in the *dusun* had improper conditions as shown in Figure 6.4. Similarly, the *dusun* people also needed to criticise the improper instructions from the activists or the *dusun* people needed to restore the route before the simulation. Therefore, constructive interactions between the local community members and the NGO activists are necessary.

> "No [I did not suggest using the evacuation route and point]. I wouldn't feel alright if I had have suggested it. It had been some people from the NGO who worked [on the scenario]. They should have suggested it [since the NGO activists had known much about tsunami preparedness]" (Community Member, No. 04).

In terms of evaluation of the simulation, no community members said anything related to the exercise. In fact, the NGOs activists gave chances to the members several times. Unfortunately, the activists did not provide other ways for the members to express their feelings, opinions, or feedback, such as providing something to write or to draw on.

However, one of the participants stated in the interview that in the future they could have some simulations with more real actions, tools, and the usage of approved facilities.

> "[The earthquake and tsunami] simulations like this [that the NGO just designed for them] are also good, Sir. Because we [I] know what we should do [now]. But maybe it will be good [to have] like-real simulations. Some people are still in the gardens. Some others are somewhere else…. [A]nd then next, what should the people do. Not a simulation where we are gathered like today. So, it is really where the people are in that time when an earthquake shakes" (Community Member, No. 04).

Additional to the above information, out of 20 research participants, ten had participated in the simulations and two of them had participated more than once.

> "Here [in Sikakap] two [earthquake and tsunami] simulations have been conducted. But I only watched [the last one]. But if [the simulations repeatedly] are done, does it [mean that] no more tsunamis will hit us?" (Community Member, No. 03).

The above interview shows that in particular area(s) in Mentawai the tsunami simulation exercise has been conducted more than once. However, seemingly the participant feels the exercise now has no meaning for him.

The rest never participated in the simulations. My further question was about why they were never involved. The reasons were: 1) they did not go to church at the time the simulation or training invitation was announced; 2) they were too busy working; 3) there were no simulations in their *dusun*.

> "What can I say, Sir. We [I work] in the garden with my three children. Actually, having seen [the impacts of] the tsunami in 2010 in the other *dusun*, we [I] want also to do the prevention [preparedness]. But [it is] hard on my family economy. If we [I] don't work where do my [family's] foods come from? [Nowadays] all are expensive" (Community Member, No. 05).

Box 6.1.

Observation of the simulation exercise in *Dusun* Pasibuat, Taikakto

After having an official invitation from the head of *Dusun* Pasibbuat, Taikako, Sikakap on Sunday, 18 May 2014, about 75 out of 225 people of *dusun* Pasibbuat attended the earthquake and tsunami simulation on 24 May 2014. The CDRM activists (an NGO) divided the attending people into two groups. One group consisted of 12 selected persons who were guided by two NGO activists. This

group was separated from the other and discussed what they should do during the simulation. The discussion was about the group tasks at the simulation. The group also prepared some tools such as a *tutuko* (a bamboo pipe with a small hole which was hit to produce sounds), some wooden pillars with two sarongs, a first aid box, some A3-sized papers and ballpoints. The NGO activists briefed the group.

The other group consisted of some elderly persons, adults, juveniles, and children. The group was guided by some other activists explaining about earthquakes; how to prevent injuries in earthquakes; and how to escape from any potential tsunamis triggered by earthquakes. The activists also taught a familiar song to the community with the lyrics changed. The lyrics are as follows (with some movements):

If any earthquakes come, cover your head (with both hands on the head)
If any earthquakes come, go in under the table (they make a move to go below the bench)
If any earthquakes come, go away from glass
If any earthquakes come, run away to a clear point

The activists paraded the song with some movement followed by the second group. They repeated singing and parading it until the group did it correctly and fluently.

After hearing some explanations about earthquakes and tsunamis, and practising and parading the song for around one hour, the two groups were ready to do the simulation. Two members of the first group then explained the detailed scenario to the other group. The step-by-step actions were explained in the local language. After all messages had been delivered, they all went out of the church and took their positions in some houses in the *dusun*.

Suddenly, someone hit the *tutuko* several times symbolizing that an earthquake had just taken place. At this moment, the people seemed watchful with fearful faces. After about a minute from the first sound, the *tutuko* sounded once more reminding someone to look at the sea level. The appointed person ran to look at the sea and then told the *tutuko* hitter that the sea level was down. The *tutuko* sounded for the third time meaning that all people should run to the "appointed" evacuation point through the "appointed" evacuation route. I watched them running up to the church.

The "vulnerable" were acted as a pregnant mother (with a tag on her chest with "PREGNANT"), a blind person (with a tag "BLIND"), an injured (with a tag "INJURED") and an elderly person (with a tag "ELDERLY"). Those "vulnerable" were assisted by some members of the first group. The injured and elderly were brought to the evacuation point by using the two wooden pillars inserted into the sarong. The first group members also made sure all the people were at the evacuation

point at this time.

During the simulation, other NGO members also spread out to monitor and record every session of the moves that the people did. One took some pictures of the people. Another was time watching with a stop watch.

It took only around five minutes to do all the core simulation. After that, the activists evaluated what was right and not right. They also explained some additional information regarding the simulation. However, no one from the second group talked about their experience, even though a chance was given.

The above simulation exercise was supported by an NGO, called the Centre for Disaster Risk Management and Community Development Studies (CDRM&CDS) from Nommensen University (Pematang Siantar, North Sumatra). One of the aims of the NGO is to recruit and train the local community and volunteers (*Satlinmas*) to adapt disaster preparedness measures into their daily activities. In 2013, the NGO recruited and trained 16 groups of *Satlinmas* from 16 dusun in North and South Pagai Islands where these dusun are close to the coasts. In addition, each group conducted one simulation exercise for the dusun people. The other aim of the NGO is also to reach out to the elementary schools in those areas and train the students about the evacuation processes in the event of a tsunami (CDRM & CDS, 2014).

6.3.3. Emergency deployment

An emergency deployment is defined as a readiness by trained persons or specific tools to deploy if any tsunamis occur in a tsunami prone area. Therefore, it is important to have in advance trained personnel and a ready stock of supplies. The situation regarding community volunteers will be addressed below since first aid and other supplies have been addressed in the section above.

Letz (2006) argues that community volunteers support the local community in effective ways and lead the local community in taking proactive steps to mitigate potential risks. However, it is important to ensure the ownership and sustainability of this community volunteerism by recruiting, mobilizing, enabling and training local volunteers. Community volunteers can participate in different tasks such as in awareness raising, training, risk assessments, contingency planning, and receiving and disseminating the warnings (Letz, 2006).

According to some of the participants, there are some *dusun* where *Satlinmas* have been formed and this is also worthy of appreciation. *Satlinmas* are for the community and by the community to take care of any potential earthquakes and tsunamis, in particular if they should occur at night-time. However, the participants also reminded the community that they should support *Satlinmas*, and *Satlinmas* members have a high commitment to participating in them.

According to one participant from an NGO, *Satlinmas* members have certain tasks that they agree on. They are: 1) to gather ideas, opinions or suggestions from the community members and pass them on to the chief of the *dusun*; 2) to provide a roster for the adult males from the *dusun* on duty to watch for any potential harm in the night,; 3) to give an emergency sign to others if necessary, and 4) to provide necessary assistance to others before and after a tsunami. In order to carry out these tasks, the participant also mentioned that the NGO has trained the *Satlinmas* members on certain subjects such as to look at the sea level when an earthquake shakes, to sound the *tutuko* as an emergency sign, to help vulnerable people, and to give basic medical care.

It was acknowledged by two participants that every night two or three adult males would be on duty to watch for any potential harm. Satlinmas members wrote the roster every week on the *Satlinmas* board in the *dusun*. However, after finishing the interview, I went to check the board in *Dusun* Pasibbuat (Village Taikako) and *Dusun* Matobe (Village Matobe) and found no written roster on the board.

At the *dusun* level, a number of tsunami preparedness measures have been conducted in Mentawai, even though the improvement of the efforts in quality and quantity is still needed. The evacuation signs and routes have been found in certain *dusun* that are close to the coasts; however it is necessary to consider that they should be clearly visible and unblocked. Similarly, education and exercise activities are also found, but they are still limited for some *dusun*. The involvement of the community volunteers is also useful to watch any unexpected circumstances, but they also need clear procedures to do their tasks. Meanwhile, one key element of tsunami preparedness seems to be seriously needed and this is the tsunami hazard map development to inform the local community members or new comers about potential hazards in Mentawai and how to escape from them. Lastly, it is

also necessary to revitalize the local heritage - *tuddukat*, and bring it to tsunami preparedness as a warning tool in order to sound emergency signals to the community.

6.4. Tsunami preparedness at the district level

In order to build strong tsunami preparedness at the district level, systematic programs or much effort should be provided, particularly by local government. However, for the sake of my study, I picked up some important points to discuss namely, disaster risk assessment, tsunami risk maps, and tsunami evacuation plans (BNPB, 2012).

6.4.1. Conducting a disaster risk assessment

BNPB (2012) defines risk assessment as an integrated mechanism to capture the comprehensive disaster risks of one particular area by analysing hazards, possible loss and capacity to cope with the potential problems. Risk assessment is useful as a scientific basis to develop specific action plans from public policies. Therefore, it is also important to integrate mainstream disaster mitigation and preparedness programs into other public programs. More importantly, it enables the development of community-based programs at village level. Lastly, it is an important tool, for example, to build evacuation routes (BNPB, 2012).

BNPB (2012) has conducted a disaster risk assessment measurement in the Mentawai District. The conclusion of the assessment is that most potential hazards in Mentawai are earthquakes and tsunamis. Furthermore, BNPB (2012) also reports that the tsunami hazard could inundate about 83,185 ha and affect a population of 11,000 (14 % of the total population). Similarly, Horspool et al. (2013) rate the Mentawai Islands as one of the districts most likely to be hit by tsunamis in Indonesia. They say that the probability of tsunamis with a run-up of 3 m in height hitting the district yearly is 6.9 %. Furthermore, they also predict a return period of a run-up 7.5 m in height in 100 years, 20.6 m in 500 years and 42.3 m in 2500 years.

According to BNPB (2012), there are three aims in producing the disaster risk assessment document. Firstly, the assessment could be used as an additional document for the local government of the Mentawai District to develop public policies on tsunami preparedness. The local government needs to synchronize all district public institutions to have the same

vision to develop community tsunami preparedness. However, according to one participant from the local government:

> "There is no synchronization...[b]ecause the main document,[RPJMD=the District Medium Term Development Plan)has not yet accommodated [what was written on the disaster risk assessment document]... Up to now in every synchronization meeting that is facilitated by LIPI [the Indonesian Academy of the Sciences], it is difficult to have a consensus [among the related institutions]. RPJPMD only accommodates the BPBD [District Agency for Disaster Management]. It should have [accommodated] all disaster mitigation [programs] into the related institutions. For example, if the District General Work Institution builds a road not only to boost the local economy, but also to enable [the people] to evacuate or to distribute assistance in any emergency" (Government Officer, No. 04)

Secondly, the risk assessment document can be used as a foundation to develop community outreach for local partnership programs. As the document shows the magnitude of the problems occurs when the local community is threatened by tsunamis, there are many chances for NGOs to work in Mentawai. According to a BPBD officer, in the near future more NGOs will come and work in Mentawai to handle the problems. He also identified one NGO just started working in Siberut Island.

> "...BPBD cannot work alone. For [tsunami] preparedness, we [BPBD] is developing a pilot project for a "Resilient Village" in Kature Village, but with the assistance from ASB [an NGO] four other villages are handled" (Government Officer, No. 06).

In a further interview, he also mentioned one other NGO that had just started working in Mentawai. He also identified some potential programs for NGOs such as developing a resilient village, evacuation shelters, a rapid emergency team, and conducting simulation exercises at the community level.

6.4.2. Tsunami risk map

Furthermore, BNPB (2012) argues that disaster risk assessment is useful to provide information to design disaster risk maps. These maps will show the level of the risk of hazards. It is also possible to overlay it on other maps such as a map of vulnerability and/or a map of capacity. Therefore, the overlain map will show more information on potential risks.

The development of a tsunami risk map can be used as basic information to develop a tsunami preparedness program such as the local government building a tsunami evacuation plan. Below are the maps to show the tsunami risk of the Mentawai islands.

Figure 6. 11 indicates a number of the people's settlements in Siberut are risky to tsunami hazards. Mainly, the settlements in the northern east to the southern east of the coasts have high risk.

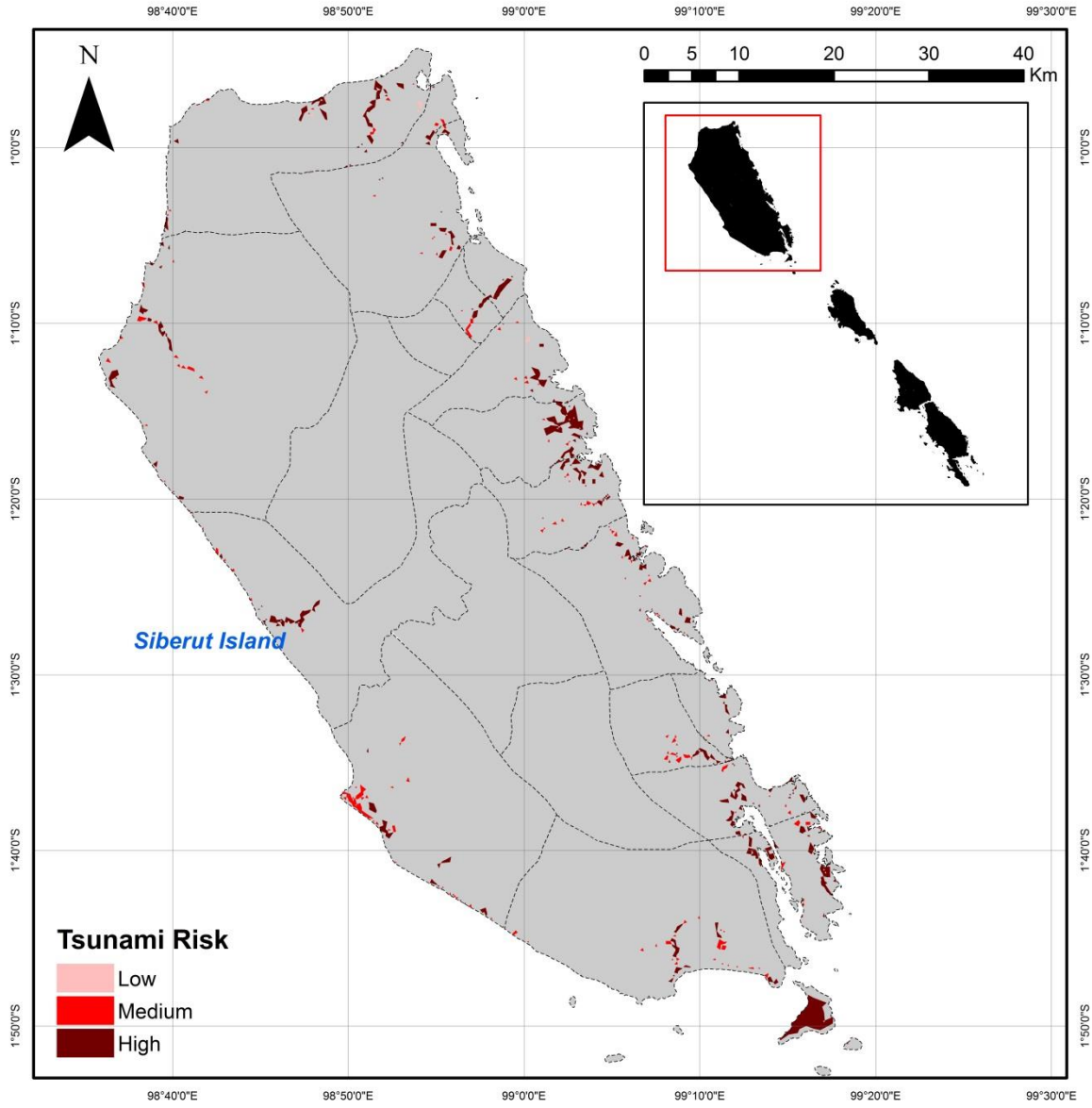

Figure 6. 11
Tsunami Risk Map in the Mentawai District
Source: BNPB, 2012

Figure 6. 12 shows that the settlements in Sipora have high risk to tsunami hazards in almost all around the island

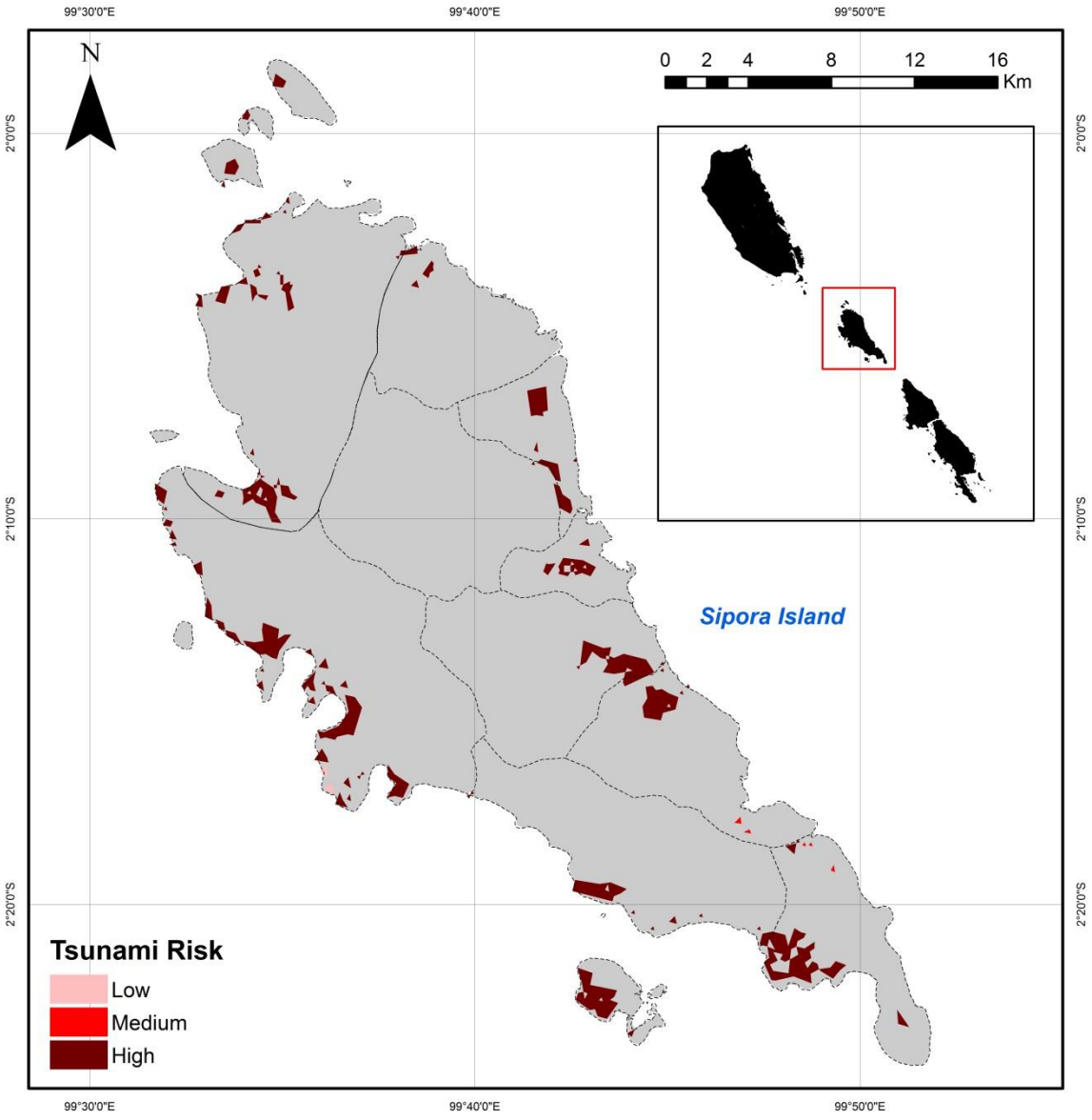

Figure 6. 12
Tsunami Risk Map in the Mentawai District
Source: BNPB, 2012

Figure 6. 13 also shows that the settlements in both North and South Pagai have high risk to tsunami hazards in almost all around the island.

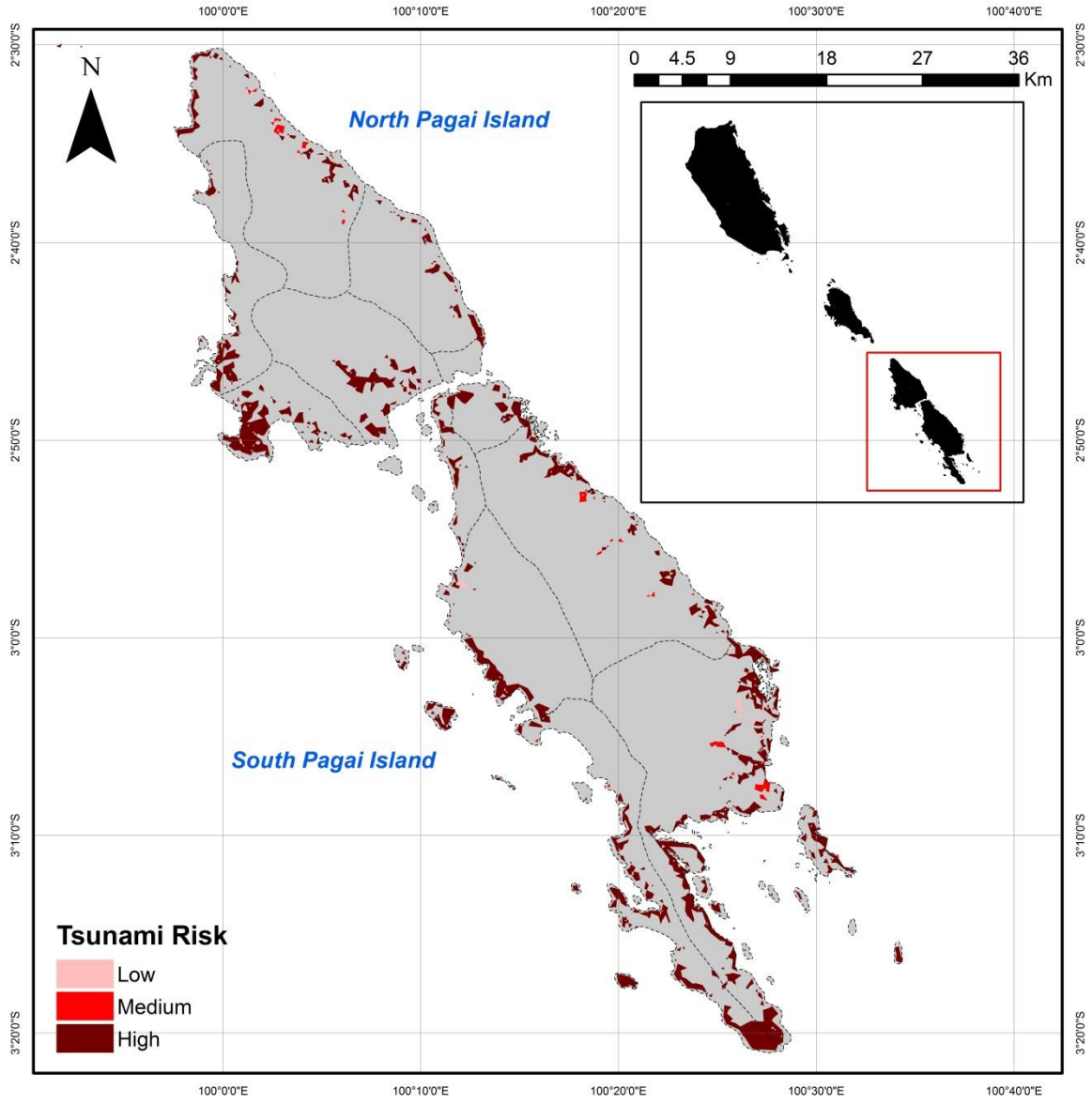

Figure 6. 13
Tsunami Risk Map in the Mentawai District
Source: BNPB, 2012

6.4.3. Tsunami evacuation plan

After acquiring the Disaster Risk Assessment Document in the Mentawai District and the tsunami risk map, the next step is to develop a tsunami evacuation plan at the community level. Under this evacuation plan BNPB (2012) prioritizes the development of the evacuation routes and evacuation (assembly) points.

a. Evacuation routes

Based on the geographical condition of the Mentawai islands that are situated next to the subduction zone, BNPB (2013a) urges that the evacuation period of the community in the event of tsunamis is about seven minutes after the earthquakes. If the BMKG (National Agency for Meteorology, Climatology, and Geophysics) in Jakarta needs at least five minutes to analyse potential tsunamis after earthquakes, it will be too late to disseminate the information to the local government agency or to the public through TV channels. Therefore, BNPB has developed an evacuation plan in which the local community can reach the safer points in about seven minutes, while the first waves of tsunamis are predicted to reach the shore in about nine minutes (BNPB, 2013a).

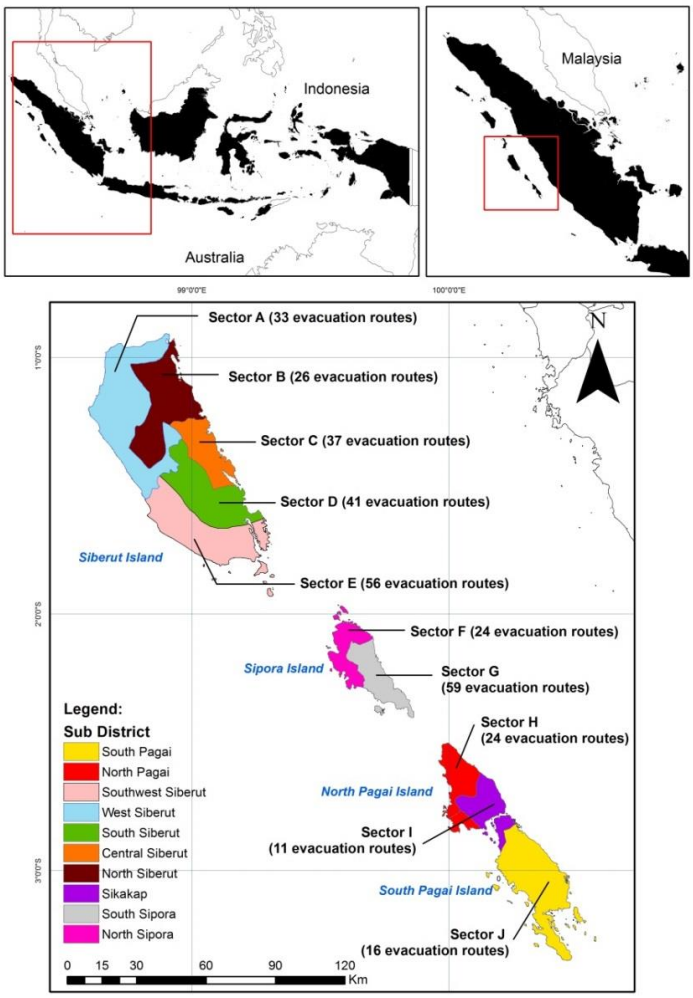

Figure 6. 14
The BNPB has divided the Mentawai District into ten sectors in order to develop evacuation routes. Each sector has been determined a minimum number of the evacuation routes.
Source: BNPB (2013a)

BNPB (2013a) divides the Mentawai District into ten sub-districts as the evacuation sectors for tsunamis (Figure 6.14). It is planned for each sector to build particular evacuation routes and through these vulnerable people could reach safer points within seven minutes after earthquakes. However, the development of the evacuation routes is only prioritised to Sectors B and G (BNPB, 2013a)

From its viewpoint, the local government has undertaken a number of efforts to increase tsunami preparedness. One of them is to build the evacuation routes in the community. It was acknowledged by one of the participants from the local government who has one of top positions in the Mentawai District that the development of the evacuation routes is a short-term goal. For a longer-term goal, the local government has been persuading the local community to spontaneously relocate to special areas where it would rebuild and move some community health centres and public schools to higher ground. Therefore, the local people will also move next to the public facilities.

> ".....[O]ur steps are mainly short term [actions] through the district budget. We are building temporary evacuation routes. For example, many villages now have the routes up to the hills. ……. [E]xcept in the smaller islands. If the people stay up in the hills [when tsunamis happen] it means they are OK. The next step is to undertake self- relocation. We [persuaded the people] in Southern Tukai [in Siberut island] to relocate [by themselves]…... [T]he public school and the community health center will be relocated [by the government]. In Sukabaluan [in Siberut Island] the community health centre that was on the coast has been moved inland. [But] it needs a big budget" (Government Officer, No. 01).

However, the local government seems not to realize what happened to the *dusun* people of Belaraksok as discussed in the previous chapter. The people had moved inlands about 8-10 km from the coasts, but they still came down and stayed over nights in the coasts from to garden or to fish.

b. Temporary evacuation points

BNPB (2013a) identifies two potential temporary evacuation points in Mentawai. One is the escape hills which are good for several areas where hills are found. The other is multi-storey buildings. Escape buildings are important to use to evacuate the people in the short term.

Several private schools have two storey buildings that can potentially be used as temporary evacuation points.

During the field research, I observed several temporary evacuation points in several *dusun* and was able to conclude that the evacuation points are safe for tsunami waves of 20 m high. They are located in flat lots up hills. However, the main problem is how to reach these lots. As observed in *Dusun* Passibuat and *Dusun* Matobe the evacuation points are difficult to reach, particularly by special needs people (as shown in Figure 6.4). Therefore, the local government needs to design proper evacuation routes to some *dusun*, so that the people can easily reach the evacuation points.

c. Evacuation signs

In the event of tsunamis, the evacuation signs are important to inform the evacuees of the way to temporary evacuation points. The Government of Indonesia has standardised the evacuation signs as pictured below. These standardised signs are developed through a deep assessment for the people to easily understand (Figure 6.15). However, the signs in the community are mainly very different from the standard. It is also important to place the signs in strategic ways for people to see them (BNPB, 2013a). However, during my field study, none of the evacuation signs was fixed to the standard.

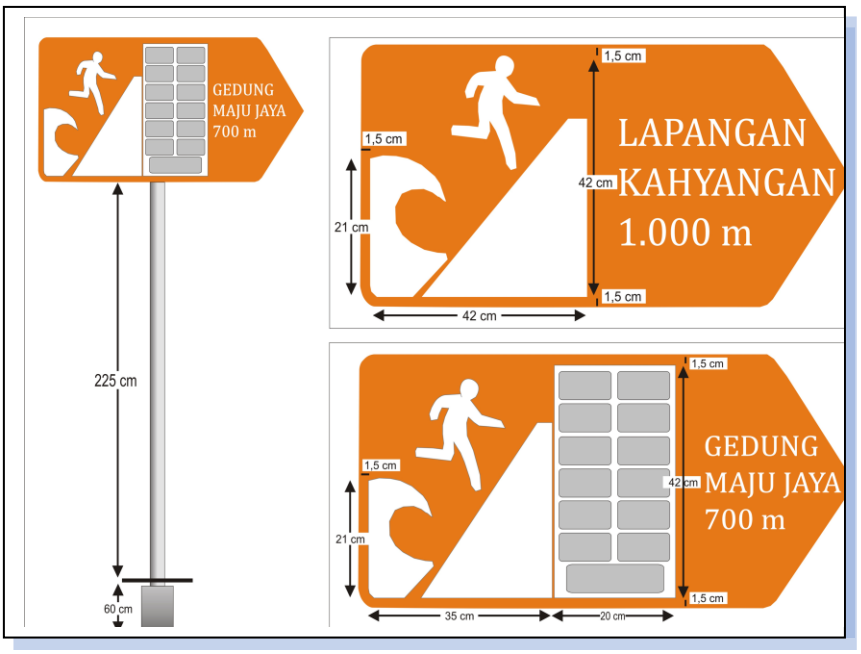

Figure 6. 15
Standardized evacuation signs
Source: BNPB (2013)

In fact, one participant from the local government stated that the Central Government never socialized the new standardization of the evacuation signs to provincial or district levels.

> "Indeed [I know] there is a guideline to design evacuation signs from the Central [Government]. But, there are never any socialization [activities on the new designs] to districts. The Central (Government) should have done it in a serious way, in particular in the tsunami-prone areas. And again, mostly the evacuation signs had been produced here [in Mentawai] before the guideline was developed." (Government Officer No. 06).

The above quote shows that the Central Government of Indonesia is also required to allocate special programs to disseminate the new guideline to the Mentawai District, so that the District can adopt and implement it. Moreover, it seems that most of the evacuation signs in Mentawai are very old, but they have not changed or replaced them.

6.4.4. Regional chain warning

When an earthquake shakes, it is a sign that a tsunami may occur. Therefore, a rapid consideration of the situation is required, in particular in the tsunami prone areas. Coastlines often suffer from tsunamis in a very short time. Experts (Lay et al., 2011; Newman et al., 2011) argue that an earthquake in the Mentawai Segment may produce tsunami waveswhich have very short travel time to reach the coasts in Mentawai. However, in view of a lack of technology in Mentawai, the Central Government has provided one operational emergency centre (OEC) in the capital town of the Mentawai District, Tua Pejat in Sipora Island. This centre becomes an implementing unit of the local government to facilitate operational controls and to conduct information communication systems in an emergency (BNPB, 2013a). The EOC centre in Tua Pejat has the minimum standard of an EOC according to the BNPB standard of EOC.

As mentioned on the BNPB Head's Regulation No. 6 of 2013, all OECs in Indonesia have the same frequencies of High Frequency Radio and Very High Frequency Radio. It is hoped that the OEC emergency warnings can be delivered to the community or vice versa, through other channels of communication such as community radio or Handie Talkie radio. However, in Mentawai one participant said:

> "I would say that [it is important] that each *dusun* has *Satlinmas* [that watch the situation] in the night time. They need to be trained also about

> how to respond in such a situation. But I am doubtful too, whether they would understand their own tasks, [tsunami] preparedness, communication. [I could say] the [emergency] communication is not good here. Often, mobile phones have no signal. HT [Handie talkie] cannot be operated. No community radio, too." (Community Member No. 18).

On the other hand, it is also important to have a supply and distribution of a relief system. This system aims at quickly distributing suitable relief items to the affected areas to avoid further hardship and loss of lives (Balcik, Beamon, & Smilowitz, 2008). The district government of the Mentawai District has a similar system that provides some crucial items for affected persons when tsunamis or other disasters occur. However, it has been realized that the distribution of the items will face some difficulties due to the geographic condition. The Central Government has built a National Supply and Distribution Centre in Padang and it might be faster and more realistic to distribute the relief items from Tua Pejat to other parts of Mentawai.

6.5. Conclusion

Tsunami preparedness is one important key element for people in the event of a tsunami. A multi-level model of tsunami preparedness (Figure 6.1) focuses on three levels of approaches (individual/household, *dusun*, and district) and the above sections have addressed them in the Mentawai context. The model enhances the efforts at each level to be prepared for tsunamis. As often they are the main victims of tsunamis, individuals and household members should know what to do and where to go in the event of tsunamis. Consequently, individuals and household members should build robust preparedness measures at the *dusun* or village level. In addition, the whole community also should work hand in hand to provide community efforts. Similarly, the local government also should provide clear guidelines and procedures for the community to adopt and to easily understand.

The study did unveil a few efforts that have been carried out in Mentawai and still more efforts need to be established in the future. At the individual or households level, awareness of tsunamis exists, particularly since some of the participants of the research experienced the Tsunami. Mostly the participants have understood that they live in an area of very high risk of tsunamis and identified several ways to escape in future events. However, most of them will save other people and some other things if they have the chance to do it and

neglect their own safety. These actions could potentially endanger their own lives. In addition, the study also revealed that other efforts such as family evacuation plans and exercise activities have never been conducted. Even worse, some participants have never told their younger children what to do and where to go if an earthquake strikes. Therefore, in the future, intensive programs to increase the awareness and knowledge of individuals are important. Interestingly, the study also revealed that in the event of tsunamis some households have a 'temporary house" that can be used as an evacuation shelter and have planted some bananas, kumara, and taros for food in emergency. Therefore the individual or household level could stand alone and it is interrelated to the preparedness at the *dusun* level.

At the *dusun* level, several activities have been implemented to increase community preparedness in Mentawai. The study noted that several evacuation routes exist in the *dusun*. These routes are believed to reinforce the community's efforts to reach safer points from tsunamis. Several evacuation signs to reach the evacuation points were also found. However, the evacuation routes and signs seem neglected and no efforts have been made to take care of them. Similarly, many evacuation signs have been damaged and are unreadable. However, these signs will provide the affected people with a direction in which to go. The study also disclosed that education and exercise activities at *dusun* level are still low. Indeed, some NGOs have worked in the local community to educate them about tsunamis; however, some education materials need to be evaluated and updated. In the future, the local community would then find it much clearer to digest the messages. Similarly, the tsunami simulation exercises should have had updated scenarios and been conducted on a periodic basis. It is also imperative to include the community members in all exercise development processes. In addition, the study also uncovered that some *dusun* where NGOs work have established community volunteers known as *Satlinmas* which will provide some important information regarding tsunamis and assistance in the event of them. However, more efforts to empower *sanlitmas* are needed. They need regular training and updated information. Similarly, this level is also interrelated with preparedness at the household and at the district levels.

The district government of Mentawai District has some key roles in amplifying the community preparedness on tsunamis. The study revealed that the local government has

conducted disaster risk assessments that have resulted in the risk index of tsunamis being classified as high. This means that if a tsunami occurs in the near future, it will affect many of the local community which has little capacity to counter it. It also found that the local government has provided maps of the areas that would potentially be inundated by the tsunami. However, these maps should have been used at *dusun* level to develop tsunami hazard maps. Furthermore, as the Central Government has established the standardised evacuation signs, the local government has responsibility to implement the standard to community level and monitor existing signs in the community. Lastly, the district government of Mentawai has operated an operational emergency centre (OEC). This OEC functions as an operational control and information communication facility in an emergency. However, not all *dusun* can reach the facility since few communication tools are provided.

This chapter is the last part of Part 2. I have discussed in Chapter 5 the research results on the tsunami hazard and preparedness knowledge found in Mentawai before the local community experienced the 2010 tsunami. I have also delivered how the local community captured, shared, and applied the knowledge to anticipate the tsunami. In Chapter 6, I have described how the complexity of current tsunami preparedness is found at the individual, household, *dusun*, and district levels.

Part Three of the thesis will focus on how the significant parts revealed previously will be synthesized to create a number of applicative programs in Mentawai. In order to do it, I will link the vulnerability of the local community to tsunami hazards, the research findings, and academic insights. Lastly, this will also conclude the thesis by answering the research questions and providing further research suggestions.

PART 3: SYNTHESES, CONCEPTUALIZATION, AND CONCLUSION

CHAPTER 7

Linking the Findings to Developing Capacity for Tsunami Preparedness in Mentawai

"Capacity development is a central strategy for reducing disaster risk" (UNISDR, 2007a, p. 4)

7.0. Introduction

This is the third or final part of the thesis and consists of two chapters. This part will bring the complexity of the topics from Part 1 and the compelling findings from Part 2. Chapter 7 outlines a synthesis based on the findings and literature reviews from the previous chapters. Moreover, it also demonstrates a number of applicative programs on how to develop capacity within the community. This is followed in Chapter 8 by the conclusions and answers to the research questions.

From previous chapters, we have a clear understanding on how the local community of Mentawai became vulnerable to tsunami hazards. We also know their tsunami hazards and preparedness knowledge before the 2010 Tsunami, and after tsunami preparedness measures. Now, it is important to consider how to increase their capacity to counter potential tsunamis. This chapter mainly discusses how to develop capacity to prevent and prepare for tsunami hazards in Mentawai.

There are six sections in this chapter.

Section 7.1. Indicates the differences between capability and capacity.

Section 7.2. Identifies several aspects that we need to consider to develop capacity within a community.

Section 7.3. Explains some definitions of coping capacity, how coping capacity is related to community early warning systems and their potential implementation in Mentawai.

Section 7.4. Explains some definitions of adaptive capacity.

Section 7.5. Specifies how adaptive capacity can be reached through disaster risk reduction processes in Mentawai.

Section 7.6. Shows several potential means of support to develop coping and adaptive capacities in Mentawai.

Section 7.7. Simplifies the chapter through concluding remarks.

7.1. Distinguishing capability and capacity

People are often confused about the meanings of capability and capacity in their daily conversations. However, both terms are different, yet they are frequently used interchangeably. Generally, a capability is mostly related to a qualitative ability. Capability is "a feature, faculty or process that can be developed or improved" (Vincent, 2008, p. 460). It could also refer to the ability that exists in an individual or a community that can be achieved or improved. Bevaola, Quamrul, and Siddiqui (2010) define capability as a numerous series of knowledge sets that are consistently delivered and augmented from various sources. It tends to focus on the ability of an individual or a community to learn about and evolve antecedent and strategic routines. This effort acquires resources, integrates them together, and recombines them so that the individual or the community can generate value-creating strategies. Furthermore, Bevaola et al. (2010) explain that capability has the attributes to enable the individual or community to exploit their resources by implementing strategies. Therefore, capability is a quality of being capable of exploiting opportunities and strategies in order to have an improved ability.

In order to achieve capability, UNISDR (2005) argues that the main key is to strengthen capacity. Capacity can be generally defined as the maximum amount or ability to receive or to contain. From this definition, Chaskin (1999) argues that the word 'capacity' signifies both the impression of containing (storing) and the notion of ability (of mind, of action). UNDP (2008) argues that capacity is how people, institutions, or societies in implementing utilities are able to resolve obstacles, establish and reach their objectives in an acceptable way. Furthermore, Chaskin (1999) argues that capacity implies the existence of particular capabilities, faculties, or powers within communities to do certain things. Capacity may have an impact on several aspects of community functioning, but it helps to promote or sustain the well-being of the community and its components such as individuals and social interactions. Baser and Morgan (2008) argue that capacity requires the understanding of what is inside the communities and what operational values can be added to the communities. However, capacity Therefore, capacity is the main part of capability in terms of being sustainable, strategic, and impactful in achieving objectives.

From the above discussions, I prefer to use the term and concept 'capacity' in this thesis in order to develop the abilities of individuals, community, and institutions in Mentawai to counter the tsunami hazards. As UNISDR (2005) argues, capacity development is, consequently, a part of a wider capability development that increases the quality of ability in the future. Because capacity is related to increasing their ability to the maximum to strengthen tsunami preparedness, at present the local people of Mentawai urgently need a number of efforts that can increase this ability. These efforts focus on using the existing resources and strategies that are available within Mentawai. By implementing a number of the below efforts to develop the Mentawai people's capacity in relation to tsunami awareness and preparedness, I believe that the people will subsequently have the feature, faculty, process, and quality of being capable of developing or improving their capability in the near future.

Therefore, from this context people need to develop their capacities in order to enhance their capabilities. In terms of tsunami preparedness, people can be given access to public campaigns and proper evacuation routes and signage, conduct regular simulation exercises and understand warning systems in order to increase their capacities. These efforts will enable the people to be more capable of avoiding or being away from tsunami waves in the event of a tsunami. This capability is based on their developed capacities in the previous stage.

7.2. Challenges to developing capacity

Capacity development becomes urgent within a community when a risk of a hazard exists. Developing capacity is a major challenge that involves much more than enhancing knowledge and skills. Disaster risk will be reduced if capacity exists in a community. Capacity will lessen vulnerability and/or widen distance from the hazard. Therefore, a probability of being devastated by a hazard will also decrease. From Figure 7.1, we can understand the relation of hazard, exposure, and vulnerability that creates an intersection of disaster risk. It also indicates how to reduce the intersection by developing capacity through decreasing vulnerability and the exposure to a hazard. The reduction of disaster risk can be developed through certain development capacity efforts such as boosting the people's qualitative capacity and developing their livelihoods.

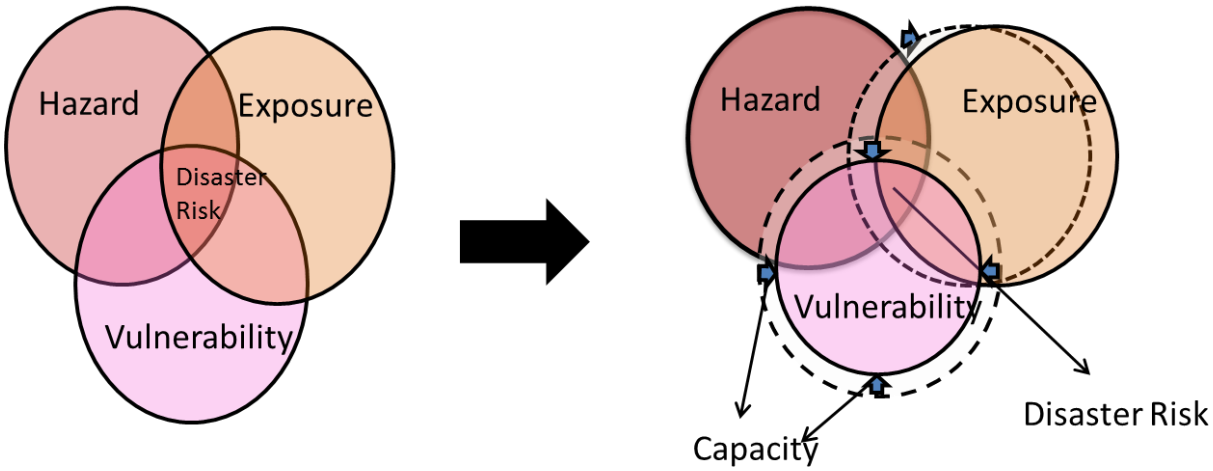

Figure 7. 1
Disaster risk reduction can be obtained by increasing capacity to decrease vulnerability and minimizing the exposure to hazards.
Source: Reese and Schmidt (2008) cited from Power (2013).

Figure 7.1 indicates that disaster risk results from the intersection of the existing hazard, vulnerability and hazard exposure of a community. Therefore, decreasing the intersection by developing capacity through a number of efforts or activities is considered. This development will reduce the vulnerability and/or the exposure.

Although capacity focuses on what is available within a community, external interventions in the form of technical assistance and functional improvements are required. Baser and Morgan (2008) identify five central aspects, which are challenges for developing capacity. Firstly, capacity is about empowerment and identity. In this context, capacity allows individuals, groups, and communities to grow, diversify, survive, and become more complex. Therefore, capacity is related to people acting together to take control of their own lives in some fashion (Baser & Morgan, 2008; Mulubiran, 2013). Supporting self-organization becomes one of the main priorities to enhance, conceive, and design sustainable activities.

Secondly, capacity needs collective actions (Baser & Morgan, 2008). Ireland and Thomalla (2011) argue that collective actions generally include voluntary individuals who are involved in common actions to achieved communal interests. These also include forms of resource mobilization, collaboration, information sharing, and improvement of individuals, groups, or communities. In relation to tsunami preparedness, collective actions can be used to integrate all abilities in communities to take part in the measures. This could be the

involvement of community volunteerism, community participation, social networking, government, non-government and private activities (Ireland & Thomalla, 2011). This also requires strong commitments to organize and integrate all abilities in the community in effective ways.

Thirdly, Baser and Morgan (2008) state that capacity as a state or condition is inherently embedded in a system. It requires a complex mixture of attitudes, capital, schemes, and skills, both tangible and intangible. It may occur as the effect of multiple interactions within a community (Baser, 2007). In the imminence of tsunami waves, for example, capacity could emerge within a community by evacuation of the affected people from the coasts after the tsunami warnings are received. All elements within the community can help each other all at once. Therefore, capacity has technical, organizational, and social aspects that could not be addressed through exclusively functional interventions.

Fourthly, capacity is a potential state (Baser & Morgan, 2008). It is elusive, transient, and dependent to a large degree on intangible things. It is also hard to induce, manage, and measure. Moreover, it could disappear quickly, particularly when an individual or a community has never had training or exercise. Motivations to develop or to maintain capacity can also disappear if the expected hazards never occur for a period of time (Baser & Morgan, 2008; Mulubiran, 2013). Therefore, it is important to realize that developing capacity needs repetitive, continuous, and encouraging activities.

Lastly, capacity is about creation of public values. According to Benington (2011, p. 50), a public value provides a "conceptual framework within which competing values and interests can be expressed and debated, in a deliberative democratic process, by which the question of what constitutes value is established dialectically". Public value highlights how co-creation of public services (education and health services) is made. Public value can be produced by communities and local government (Benington, 2011; Bromell, 2012). In the tsunami preparedness context, this requirement can be effectively formed by the involvement of all sectors within the community (Spahn, Hoppe, Vidiarina, & Usdianto, 2010). Therefore, local governments can work together with local communities to provide public value.

Beside the above challenges, scholars consider that two different kinds of capacity need to be developed. One is coping capacity, and the other is adaptive capacity. Peltonen (2005) suggests that coping capacity is frequently connected to how to handle extreme events. Furthermore, Levina and Tirpak (2006) argue that coping capacity can be increased with adaptation measures in the short-term. Therefore, coping capacity is a short-time and immediate measure from individuals or a group of people to survive unexpected disasters by using or degrading their existing resources. On the other hand, adaptive capacity is how a system is able to adjust under existing hazardous conditions. The adjustment encompasses its characteristics or performance as the progress of the implementation of coping capacities (Levina & Tirpak, 2006). This means that adaptive capacity is an endless coping capacity. It also strengthens a number of coping capacities to decrease vulnerability. Adaptive capacity implies that an existing system has the ability to adapt to possible disasters by having access to available resources. It can lessen potential harm by using the advantage of opportunities that exist within the system or dealing with the potential impacts. It generally indicates and signifies that people can learn before and after a risky occurrence (Peltonen, 2005). Therefore, adaptive capacity refers to how a system has the ability to adapt the potential adverse effects by using the system function of the availability of and access to resources.

In order to develop coping and adaptive capacities in Mentawai, it is important to involve the governance system. As mention in Chapter 5, Mentawai is led by a local government leader known as *Bupati*. This district consists of 266 *dusun* from 43 villages. The heads of *dusun* are supposed to have the main responsibility to develop coping capacity at the household and community levels as they are close to the people, while to develop adaptive capacity, it is suggested that the heads of villages are mainly responsible. *Bupati* is in charge to support both kinds of leadership in their tasks.

7.3. Developing coping capacity through CEWS

Numerous definitions of coping capacity are found in disaster management literature but are mostly variations on a common theme. Billing and Madengruber (2005) mention that coping capacity is the level of resources and circumstances in which individuals and communities utilize this capital and these abilities to counter risky events. UNISDR (2007b) defines coping capacity as “the ability of people, organizations and systems, using available

skills and resources, to face and manage adverse conditions, emergencies or disasters". Furthermore, it also necessitates ceaseless awareness and appropriate governance in usual and emergency conditions. For the longer term, it is also associated with a disaster risk reduction (UNISDR, 2007b). Additionally, WHO (1999) defines coping capacity as an ability of people to counter stressful events and conduct rapid recovery. Therefore, coping capacity can be a number of efforts to empower individuals, groups of people, or communities to face any potentially unexpected events by using their skills and resources.

In order to develop the coping capacities in Mentawai, I propose a community early warning system program (CEWS) that uses simple, traditional tools or methods. This people-centered program will result in accurate warnings in order to decrease the risk of mortality and damage to property from any potential tsunamis. According to the International Federation of Red Cross and Red Crescent Societies (IFCR, 2012, p. 13), CEWS is

> "an effort by or with, but not for, a community to systematically collect, compile and/or analyse information that enables the dissemination of warning messages that when actionable can help the community (or others 'downstream') reduce harm or loss from a hazard (or threat) event (or process)."

The warnings allow the people on coastlines to seek safer points in the event of a tsunami. However, as systems, CEWS necessitate resources, processes, and procedures, and result in significant impacts on potentially affected people. CEWS is a comprehensive and simultaneous effort within a community to avoid threats of hazards and/or the impacts of hazards. It also requires reinforcement from external supports such as their local government to maintain. However, the community itself has to strive in order to achieve an end-to-end effort. This effort entails a series of comprehensive elements to involve people who need to hear warnings. Thus the people will collect and trace hazard information (IFCR, 2012).

In order to achieve the end-to-end effort, BMKG (2012); Grasso and Singh (2012), Leon, Bogardi, Dannenmann, and Basher (2006), and IFCR (2012) identify four main foundations, namely risk knowledge, monitoring, response capability, and warning communication (Figure 7.2). Each one is interlocking and has to utilize efficient ways so that the system may be successful in delivering warnings.

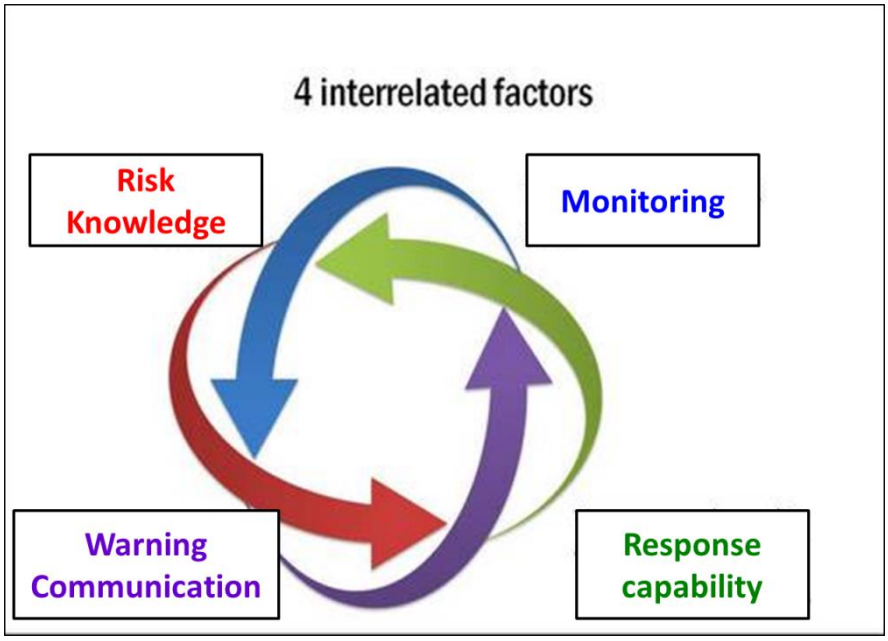

Figure 7. 2
The interlocked functions of a community early warning system
Source: (Grasso & Singh, 2012; IFCR, 2012; Leon et al., 2006)

The above foundations are also similar to the foundations of people-centered early warning from Ina-TEWS. These foundations enhance the coping capacities of the local people in Mentawai in order to improve current tsunami hazard knowledge and preparedness measures and to accurately act in the event of a tsunami

Below is a complete set of the identified foundations to connect the local community of Mentawai to be aware of tsunami hazards. In order to conduct this program, I would suggest that the heads of *dusun* should have the main responsibility to run the program at the household and community levels. The heads of *dusun* are also close to their people. However, due to capacity development, it requires the co-creation of public values, the involvement of the heads of villages and *Bupati* (the head of the district government).

7.3.1. Risk knowledge

Risks arise from both the exposure and vulnerability to hazards that are present in one community. It is important that the community understands and knows about their risks from certain hazards. According to Leon et al. (2006) and IFCR (2012), this risk knowledge can be gained by conducting a risk assessment and risk mapping. The involvement of local community members to develop tsunami risk assessment and risk mapping will make people understand and become aware of tsunamis. Therefore, the effort will also increase

the people's coping capacities in the recognition of their risk and in the increase of tsunami understandings.

As the research findings (in Chapter 6) indicated, risk assessments and mappings have existed at the district level, but not at the *dusun* or community level in Mentawai. Therefore, the head of each *dusun* (especially close to a coastal zone) must urgently persuade the *dusun* people to develop their own risk assessments and maps. One example of this activity is in Figure 7.3. below, taken from IFCR (2012). A local community in Sri Lanka developed a simple map to identify their risk to a hazard and their potential capacity to avoid the hazards. In order to support this aim, the heads of *dusun* require the heads of villages to issue an instruction for each *dusun* to develop their own risk assessment and maps. Since this kind of maps is very simple, I believe the *dusun* people can make them easily. They only need some pieces of 591 x 841 mm (A1) papers and several whiteboard makers with different colours.

Figure 7. 3
The local community drawing a simple risk assessment and map of how to escape from a hazard.
Source: IFCR (2012)

The risk assessment activity can also identify people's vulnerabilities and their potentials that could increase their capacities to deal with the tsunami hazard. The assessment can show the level of their hazard knowledge practices and may identify local knowledge or

practices of how to escape from tsunami waves. The research findings also disclosed that the research participants had misperceptions about tsunami hazards by mentioning that tsunamis only could hit the people in Sumatra, or tsunamis could only occur with relatively big earthquakes. Therefore, this activity can make their risk perceptions more realistic and explicitly update their knowledge by assessing their vulnerability and revealing potential and existing capacity. On the other hand, the activity can also capture the varieties of local and tacit knowledge about how they escape from the tsunami and disseminate the knowledge to others. If possible, the knowledge can be drawn on the maps. As Rajeev (2014) argues, the maps should be linked to their daily lives and livelihoods.

The next important step is to display the maps. The maps must be accessible for most people to see. In Mentawai, they must be placed in public places such as the religious ritual places (such as churches), schools, traditional markets, and *dusun posko*. It is also important to maintain the displays and to update them if necessary. Furthermore, the disseminations of what the maps are about to the people, including those with special needs, children, and new comers, are also important. With easily understood maps, the disseminations will be more effective. More importantly, the local community members are encouraged to be able to disseminate or inform about the information on the maps to others. By doing so, the members will keep reminding themselves about the essence of the maps. Therefore, through these efforts, the local community will be empowered and will show their capacity through public value to actively participate.

In brief, it is important to increase the people's coping capacities to recognise their tsunami risks through the involvements of the community members to develop the tsunami risk assessment and mapping along with the displays of the maps in strategic places for all to see.

7.3.2. Monitoring

In CEWS, monitoring is the capacity of a system to understand potential risk from the existence of hazards and to predict potential harm that may attack the people, in a timely manner (Grasso & Singh, 2012). Communities can use their existing traditional strategies or methods to carry out monitoring. As the research findings showed, *Satlinmas* exist in several *dusun* in Mentawai. Because *Satlinmas* only exist in a few *dusun*, this system is important to be sustained and expanded to other *dusun*. It is also suggested that existing or candidate

Satlinmas members should be obligated to attend regular training to have basic and specific skills as suggested by Baser and Morgan (2008). In 2015, BNPB recruited 20-trained persons to assist the community to assess their risk and vulnerability in Mentawai. Those persons can be used by the heads of *dusun* to train several *dusun* members to have the ability to lead the *dusun* people in risk assessment.

As we know, the earthquakes in the Mentawai Segment could probably produce tsunamis waves that reach the shores less than ten minutes after an earthquake (BNPB, 2013a). Therefore, *Satlinmas* members need a special skill to increase coping capacity in providing warnings to the community in less than ten minutes and to ensure the community moves away to safer points. In order to increase the *Satlinmas* skills, it is important to develop techniques to ensure all *dusun* people understand the warnings. These techniques must match the culture and customs in Mentawai (as discussed in the next section).

It is also important to expand the *Satlinmas* system to other *dusun* in the community. The heads of villages and other heads of *dusun* should encourage the local community from *dusun* to establish *Satlinmas* and recruit *Satlinmas* members. This expansion will increase coping capacity of other *dusun* in understanding of potential tsunami risk. Eventually, by doing so, all *dusun* in Mentawai will have active *Satlinmas* which will contribute to saving lives in the event of tsunamis. Lastly, regular meetings between *Satlinmas* members and the *dusun* people are important to discuss and evaluate this monitoring system. The meetings are also important to disseminate and update new information or knowledge.

In brief, by enhancing and expanding *Satlinmas*, the local community of Mentawai could have a new identity for developing their capacity and integrating their own potential as collective actions.

7.3.3. Warning dissemination

As briefly discussed above, local equipment can be used to pay people's attention for emergency warnings. This equipment can be appropriate and effective to increase coping capacities in order to deliver warnings as long as a consensus is developed within local communities (Grasso & Singh, 2012). Hamilton (1999) as cited by Glantz (2003) mentioned: "predictions are not useful, however, unless they are translated into a warning and action plan the public can understand and unless the information reaches the public in a timely

manner" (p.6). This means that the most effective early warning is potentially made by and within the community.

It is important for a community to develop effective CEWS by using their own resources that are available within the community. In Mentawai several traditional and existing local resources are available that can be used to produce the emergency disseminations. The local community of Mentawai uses *tutuko* to provide the emergency warnings. A *tutuko* is a gong-like bamboo or timber instrument which traditional communities in Indonesia can use to send a warning message to others. However, in Mentawai the *tutuko*s are too small to produce warning sounds that everyone in the *dusun* can hear it very well. Therefore, alternately the people can utilize several traditional instruments to produce better sounds. One is a *gajeuma* or *kateuba* (shown on Figure 7.4). A *gajeuma* is a drum-like bamboo or wooden instrument that can produce louder sounds than a *tutuko*. One side of a *gajeuma* has a tanned monitor lizard skin or monkey skin that is beaten to produce sounds (Susirawati, Lumban-Toruan, & Marzam, 2013; Yogawasista, 2011).

The research findings also reveal that there are a number of tangible products of *Arat Sabulungan* that can be used for tsunami warning disseminations. *Tudukkat* can potentially be used for warning disseminations. However, this tool (including the *gajeuma*) is not easy to find within the community because of the ban on traditional beliefs and practices in 1954 (Delfi, 2012; Schefold, 1988). At that time, many traditional tools in Mentawai were forcibly burned or destroyed. Despite their current rareness, *gajeuma* and *tudukkat* can be potentially created by the local community since the raw materials are easily found. If the skins of monkeys or lizards cannot be found or used anymore due to legal restriction, they can use skins of other domesticated animals that are easily found in Sumatra (Rifki, 2014).

Figure 7. 4
Gajeuma or *kateuba* is a traditional music tool from Mentawai.
This tool can be used as warning dissemination to the community.
Sources: Susirawati et al. (2013) and Yogawasista (2011)

Another prospective tool that I identified to disseminate warning sounds is the bells from churches and schools or drums from mosques. Bells and drums can potentially be used as a notification alert to other people. Usually, in Mentawai, each church or school has a bell. Beating a bell tells the people that the service is about to start or the school is about to start or finish the lesson. Beating the drum in the mosque also tells the time for prayer. However, from observation in the field in *Dusun* Passibuat, the church in the *dusun* has a relatively small bell that can produce a warning sound to the whole *dusun*. I also found almost the same sized bell in the other *dusun*. However, beating the bells and drums as an alert still provides an integration of warning disseminations to the community (UNISDR, 2010).

As found from the field research, some participants would make noises to attract the people's attentions; therefore, it would be thoughtful to provide whistles to the community. Whistles are good tools to notify people if there is an alert situation. A notification from a whistle, when a dangerous situation is about to occur, awakens other people (Molino, 2002; Rogers & Sorensen, 1988). Although whistles are "unofficial warning systems" (Molino, 2002, p. 55), they can alert people nearby. Therefore, it is important that the *dusun* people have their own whistles that they can use in emergencies. They can put the whistles close to themselves such as on their key rings.

Alternatively, the local community can also own handy, mobile megaphones, as suggested by one participant. The *dusun* people can pool money to buy one or more megaphones with sufficient dry batteries. Although owning a joint megaphone is doable, it does require a strong commitment as the community would be asked to continuously collect pennies to purchase the dry batteries. Placing the megaphone in the right place also requires consideration. Alongside the placement, it must be accessible for the people to use it and the megaphones must be secure from vandals and theft.

It is also considered that the local government create a standard of pre-designated codes for the whole district. The purpose of these pre-designated codes is to define a means of notification that is reliable for tsunami hazard warnings for the local community of Mentawai. These uniform codes can be applied to the above tools in which the *dusun* people understand that the codes are warnings. Schefold (1991) explains that in the village of Sakuddei in the Siberut Island, the people still use *tudukkat* to inform the others of important messages when they are in the forest or garden. *Tuddukat* is a traditional tool from Mentawai that consists of three bladdery logs. With three different sizes, each log produces different sounds. By hitting the logs with a wooden stick, a person can interact with others by translating various rhythms and tempos (Henry, 2014).

One of the research participants realised that *tuddukat* can produce louder sounds in order to deliver warnings to others at a distance.

> "In case of an earthquake, how can we inform [the warning message] to others? We need more than *tutuko*, but [we] need a TOA [Indonesians usually mention TOA to refer a brand of a handy, mobile loudspeaker]. In relation to traditional *tuddukat*, no one know how to use it here" (Community Member, No. 06)

Figure 7.5 below indicates that a *tudukkat* consists of a set of three different long gong-like timbers. The short one symbolizes a " child", the long one represents a "father" or "adult male", while the medium one (in the middle) characterizes a "mother" or "adult female" (Febrianto & Fitriani, 2012; Schefold, 1991).

Figure 7. 5
A set of three different lengthy timbers that symbolize “father”, “mother” and” child”.
Source: Courtesy of Rob Henry

Different tones or beats that are produced from *tudukkat* have different meanings. The people can decode the messages from *tudukkat* such as the birth of a baby boy, an elderly female death, or an imminent inter-clan war or a disaster (Schefold, 1991). Therefore, it is important for the local government to inventory the codes that have traditionally been used within the community already so that particular sounds can be selected and used as the codes for the tsunami warnings. These codes should be socialized through several activities such as training and simulation exercises. Therefore, the whole or the majority of the local community will understand the warnings when the codes are activated.

In conclusion, several traditional tools that exist in Mentawai match the needs of warning dissemination in the event of tsunamis. Although the local community needs effort to produce more of these tools, most of them can be created from natural materials. Through this need, the community can creatively develop or revitalize their traditional tools. No complicated skills are required to operate them. However, uniform codes are also important so that all community members have the same understanding of the warning

disseminations. The usage of traditional or simple tools and codes for CEWS will provide a new identity to strengthen the coping capacities of the local community in Mentawai.

7.3.4. Response capability

After having the above activities to develop coping capacities i.e. the increase of risk knowledge, monitoring system and warning dissemination, it is time to develop a response capability. Response capability is the integrated coping capacities of communities to be ready to respond to a warning so that they can save their lives in the potential disaster (IFCR, 2012). When an early warning sounds, communities quickly carry out a set of response options they have been trained for. We can see from previous chapters that there are several substantial findings from the research about how the individuals and households, the local community, and the local government respond to any potential tsunami hazards. Below are a number of synthesised findings and several proposed ideas on how to increase the tsunami response capability in Mentawai at different levels.

a. Response capability at the individual and household levels

At the individual and household levels, there are a number of actions proposed to develop the response capacity of the local community in Mentawai. The research findings also indicate that running fast, climbing a coconut tree, or memorizing the surroundings even at night are several kinds of personal efficacy. These can be useful to escape from potential tsunamis. However, no training was found in order to boost their efficacy during the field study. Apart from the above kinds of efficacy, a number of different personal efficacies may exist within the community. Therefore, it is suggested that the heads of *dusun* identify and inventory the *dusun* people's specific efficacies to use in case of a tsunami. In order to strengthen their efficacy, they may need to do their own practice. For example, if someone has good personal efficacy in climbing a coconut tree, they can train or drill themselves to reach the top of the tree faster. Similarly, if someone can run at night, they can keep maintaining this efficacy through self-training by running at night time.

Alternately, the local community can also develop their personal efficacy through races. As J. S. Becker et al. (2011) highlight, personal efficacy develops because of people effectively solving problems and dealing with challenges in everyday life. Therefore, it is important to build up and maintain the individuals' efficacy over time as they accumulate such experience. The *dusun* leaders can easily organize a race as during the celebration of

Indonesia Independence Day, local communities organize a number of races such as climbing a fully-oily areca nut tree. On the top of the tree, several prizes are hanging that can be picked up by the first group reaching the top. Similarly, *dusun* heads, supported by the local community members, can organize the races, but they would focus more on how to build up and maintain personal efficacies. Every individual who wants to participate in the races keeps doing his or her own exercises. Consequently, the races will improve their personal efficacy which will be useful when a tsunami occurs.

Other field study findings have identified the absence of tsunami plans and exercises at the household level. To cope with these problems, the heads of *dusun* may need to encourage all households to have their own tsunami plans at homes and exercise the plans on a regular basis. It is important to hold a series of meetings at the *dusun* level to inform people how to develop a household plan and to practise it. It may be awkward at the beginning to practise the household plan, but the family members will get used to it if they keep on doing it. As a result, they can develop their response capability to tsunami hazards. However, the family members may experience burnout and to avoid this, encouragements from family members, *dusun* heads, neighbours, religious leaders, and NGO activists is important. Alternatively, new or updated information related to tsunamis can be distributed to the local community.

As scholars (Alston, 2015; Kottegoda, 2007; Mulilis, 1999) argue, gender may play a role in vulnerability. Women may be more at risk than men due to cultural and social constraints. The field findings also indicate that women are seemingly more at risk from tsunami hazards than the men in Mentawai are. Therefore, it is important to empower the local women of Mentawai through their involvement in developing household plans and exercises. As LIPI (2006) found, it is a common practice in Mentawai that every Saturday the household wives have one day off from work to go to church to discuss things such as health, caring for babies and children, and hygiene problems. It is suggested that the church leaders can use this time to discuss tsunami household plans and exercises. This will encourage the females to make tsunami household plans and do tsunami household exercises. This empowerment will contribute in a positive way for themselves as well as all family members. In addition, the church leaders support the NGOs and *dusun* leaders' programs in order to increase the

welfare of the community. Therefore, it is critically important to empower the women in Mentawai to participate actively in tsunami preparedness measures.

From the field findings, taking risks to save others is common among the participants. Despite their determination and ability to run to avoid the tsunami waves, they could become victims because they tend to assist others to escape from the tsunami waves. The local community members might not easily follow the tsunami *tendenko* maxim to save their own lives due to the solid sibling and neighbourhood linkages. Nevertheless, according to Yong and Indrarto (2013), there is a strong need to create a more synergetic and strategic approach among the teachers, community, and NGO activists in Mentawai. This approach can be used to introduce the tsunami *tendenko* maxim to the students which is to run away from the coast to a secure point as soon as an earthquake shakes. The school teachers can also keep teaching and practising the maxim with the students. I assume that the teachers will support this program that can save the children's lives. Additionally, the teachers can also communicate it to the students' parents through the student communication book. This will result in the student telling their parents that they are aware of any earthquakes and can find out a secure point to avoid potential tsunamis. Consequently, the parents would know that their children of school age would be likely to find a secure point to go to in the event of a tsunami. Therefore, this strategy to introduce tsunami *tendenko* will affect many people, and could save lives in the future.

It has been also revealed from the study that a number of participants would place their important documents outside their main house in a safer place. This best practice can be expanded to others. Alternatively, they can place the documents together along with other important items in their traditional rattan-made baskets, *opa* (as shown in Figure 7.6). This tangible product of *Arat Sabulungan*, *Opa,* can be placed in easily accessed points at home, thus, anytime the warnings are activated, this basket can easily be taken away.

Figure 7. 6
A woman bringing a traditional basket (*opa)* in Mentawai
The local people put into it a bottle of water, bananas, or kumara.
Source: Personal documentation taken during the field study

It is generally known in Mentawai that pigs are important for the local community. Delfi (2012) found that pigs have unchangeable roles for the local community of Mentawai. As well as for daily needs, they are a part of cultural and religious rituals. Pigs are used for the bride price, fine payments, healing rituals, and peace festivals. Delfi (2012, p. 18) also found that even the local people who are Muslims say "Islam is my *arat* [culture], but is not my body". This means that although they are Muslims, pigs (or pork meats) are not taboo to use in religious rituals. Therefore, pigs have cultural meanings for the local people, besides the economic aspects. As the study has revealed, saving the domesticated pigs could be practical for the community before a tsunami occurs. For this, I suggest that the pigs be placed outside the settlements. Since there is empty land in Mentawai, they could use this land to cultivate the pigs as long as it is not too far to feed them every day. Therefore, this strategy will help the people to not think about their possessions and to run as rapidly as possible in the event of tsunamis.

To conclude, it is important to conduct a series of activities at the individual and household levels in order to increase response capability. All types of personal efficacy of the individuals in Mentawai require a commitment to self-training as well as a community race to maintain the efficacy over time. Furthermore, each household should start to develop their tsunami plans and to do regular tsunami exercises. All elements within the community should encourage and support these repetitive and continuous activities. The encouragement of the household wives from the local churches, for example, will influence not only the women but also the whole family. Moreover, although the tsunami *tendenko* maxim is not easy to implement within the community in general, it could firstly be implemented in the schools. The schoolteachers and NGO activists can persuade the students to inform their parents that they would do the tsunami *tendenko* in a case of an earthquake. This will reduce their parents' concern for the children's safety. Thus, they will not go back to their *dusun* if, for example, they are in their garden. In addition, the use of *opa* (the traditional basket from Mentawai) will also useful for important documents and other items. This basket is placed in an easily reached point so that, in the event of an earthquake, a family member can quickly take the basket and run to a safe point. Lastly, it is important to consider a good place to cultivate pigs or other domesticated animals. So, when an earthquake strikes, the family members would have less concern for about the safety of their domesticated animals. Instead, they would consider their own safety. The above activities will increase the response capability of the individual and household members in the event of a tsunami.

b. Response capability at the community level

At the community level, several significant findings from the field study are also important to be emphasized in order to increase tsunami preparedness in Mentawai. The tsunami hazard disseminations through the mass media often cannot reach the community. Many cannot access TV programs or the radio for several reasons. The electricity coverage is very limited in Mentawai and is not available all day.

Similarly, because of the reluctance to read, many people do not receive information through printed materials. It was also found that some other people did not move to safer places, although they knew the risks from tsunami waves. Additionally, the study unveiled that no *dusun* has developed tsunami risk maps, so everybody can know where they are and

where to go in case of a tsunami occurs. Many of the evacuation points are also neglected and it seems that they have not been cared for. Moreover, the evacuation signs are also unclear, unreadable, and damaged. Furthermore, the *dusun* people allow others to use the evacuation routes for other purposes and have abandoned the routes because of the rain eroding the path and grass being overgrown. Lastly, the findings indicate that more tsunami education programs and dissemination of tsunami education materials, higher quality, and quantity of tsunami simulation exercises, and higher commitments to support the tasks of *Satlinmas* are needed.

There are a number of activities proposed in order to develop the community response capability and the heads of the *dusun* need to involve the local community, local government officers, religious leaders, and NGO activists. Firstly, the heads of the *dusun* should urgently invite all *dusun* people, church leaders, school teachers, and NGO activists to have a series of meetings. If possible, the heads should also invite the above partners to be involved in these activities. The main purpose of the meetings is to identify in detail why the above findings need to take place and how to solve the problems. According to Mathbor (2008), this step is important to identify ideas and solutions to the problems. Based on the outputs of the identifications, the *dusun* people can establish a plan that consists of goals and certain activities to achieve these goals. The plan should elaborate what activities and when, where, who and by whom and how they should be done. Once the commitments are accepted, all community members should adhere to their implementation, accordingly.

Secondly, it is also considered that the community especially should support and be part of the *Satlinmas* as they have important roles in the community monitoring system. *Satlinmas* are relevant and significant to control unexpected conditions during the earthquakes and can activate the warning dissemination tool(s). Therefore, the strengthening and expanding of *Satlinmas* to other *dusun* in Mentawai is imperative to provide early warnings to others. The male adults can participate as *Satlinmas* members. To avoid the inactivation of *Satlinmas*, the heads of the *dusun* must fill in and establish rosters on a regular basis. The roster should be displayed on the public noticeboard, and *Satlinmas* members should encourage each other to do this valuable task. As *Satlinmas* is voluntary, according to Aditama, Hasyim, and Adha (2013) willingness to save human lives is the main key for this kind of community participation to be successful. In order that *Satlinmas* have the right to

self-determination and knowledge on the situation, the right information, and suitable training are also essential. Once the pre-designated codes have been determined, special training to develop *Satlinmas'* skills in using the warning tool(s) is important. Bailey and Koney (1996) and Mathbor (2008) suggest that local government should support participatory needs through training and the provision of material, and other forms of assistance.

Lastly, the heads of the *dusun* are required promote *kerja bakti* as a manifestation of *Arat Sabulungan* on a regular basis. According to Koentjaraningrat (1987), *kerja bakti* is a spirit that is manifested by individuals through collective actions for the community and without ulterior motives. *Kerja bakti* can be used to build, develop, repair, or remake the tsunami evacuation routes, points, and signage in *dusun*. With the *dusun* people's commitments, the heads can decide the rosters for *kerja bakti*. Also, as the evacuation routes were covered with grass, the community can collectively trim the grass through *kerja bakti*. According to Ireland and Thomalla (2011), there are several collective actions that can contribute to developing response capacity and provide room for people to express, discuss and resolve their concerns. Lastly, it contributes to individuals' empowerment to reinforce interactions with local leaders to provide strong advocacy (Ireland & Thomalla, 2011). Through *kerja bakti,* the community may find any other problems and the solutions to the problems in order to facilitate their response capability for tsunami hazards.

Briefly, several activities can be implemented in order to increase the community's response capability. Firstly, it is important to identify the potential solutions to the findings in detail. The heads of *dusun* with their community members need to set up an urgent plan so that the community understands what to do in the event of a tsunami. Secondly, *Satlinmas* should be enhanced and expanded in order to provide the valuable response capability to the whole community. Lastly, the community must be motivated to do the collective action of *kerja bakti.* Through *kerja bakti* the maintenance of the evacuation points, routes, signage, etc. can be fulfilled so that when these facilities are used, the response capability of the community is greater.

c. Response capability at the district level

All the above downstream efforts at the individual, household and *dusun* levels should be implemented in an intensive, urgent, simultaneous, and serious way. In order to achieve the

aim, the local government should involve local NGOs, village leaders, provincial and central governments, and academics or scientists. The study findings showed that understanding hazard knowledge is a problem for the local community of Mentawai; consequently, easily understood materials for tsunami hazard disseminations are needed. In order to have scientific-based information, the local government could consult with the seismographic and social researchers or experts from the University of Andalas (Padang City), LIPI (Jakarta), ITB (Bandung) and BPPT (Jakarta). Similarly, the government can also have meetings with dusun leaders, church leaders, and NGO activists to discuss the development of this program. Based on the information, the local government can arrange the materials that the local community needs to easily understand the messages. It is suggested that these materials be colourful and pictorial in the forms of leaflets, booklets, flipcharts, posters, and billboards. As Musacchio et al. (2015) state dissemination requires a match between the creation of knowledge and the target audience. Therefore, these materials will become understandable by the community and a good reference for other entities such as NGOs or people who conduct tsunami disseminations in Mentawai.

The central government through BNPB has established the document concerning tsunami assessment risks and maps at the district level and identified the areas where evacuation routes are needed. Therefore, the provincial government of West Sumatra can assist the district government of Mentawai to support public programs in Mentawai. As the district government of Mentawai has financial limitations, the provincial government can build additional evacuation routes and provide tsunami signage as the community needs. Additionally, the local government may also request support from the local private businesses to multiply the dissemination materials and distribute them to the community. Even more, joint program(s) of the businesses can be provided in the sub-district(s). Therefore, it is important to involve other entities in order to create positive impacts on the community.

The local government also needs to support all activities at the *dusun* level. The local government should urgently respond to the needs of the *dusun* people. *Bupati* can closely monitor and evaluate the implementation of the programs at *dusun* level. If possible, the heads of villages should include the implementation of the tsunami preparedness activities into their monthly report to the district level.

It is urgently required to formulate several specific local policies from *Bupati* related to:

- The determination of tsunami risk assessment and maps at the *dusun* level.
- The movement of the *dusun* people who live in the red zones.
- The designs, establishment, and maintenance of the evacuation routes and points and signage in all *dusun*.
- The determination of regular tsunami simulation exercises at the district level.
- Public programs support the tsunami preparedness measures based on the disaster risk assessments and risk maps.
- The involvement of the private sector, religious leaders, teachers, and other elements to carry out tsunami preparedness measures.
- The approach on how to obtain potential external and internal assistance in an emergency.

With the support from the District Parliament of Mentawai, Bupati can legislate:

- The banning of the deforestation of the mangrove vegetation and support for efforts to replant the mangroves.
- The establishment of pre-designated codes for tsunami warnings.

Meanwhile, the BPBD Mentawai is also required to develop a number of technical guidelines in order to support the community's activities. These guidelines are about how to develop or do:

- evacuation plans
- household tsunami plans
- household tsunami exercises
- community simulation exercises.
- tsunami *tendenko*
- maintenance of personal efficacy.

Therefore, at the district level, a number of efforts must be developed and/or strengthened in order to support and create the individual, household, and community response capability. For the efforts, strong commitments from Bupati are required by developing certain policies that support the community. The above efforts enable the community to increase their response capability and an increase in this capability will also develop their capacity for tsunami preparedness. As Baser and Morgan (2008) remind us, capacity development necessitates a complex mixture of attitudes, capital, tactics, and skills, both tangible and intangible; therefore, the involvement of other entities becomes important.

From the above explanations, we can see that this people-centered early warning system will also increase current tsunami hazard knowledge and preparedness in Mentawai through the implementations of CEWS. Public campaigns on tsunami hazards are required through the involvements of school teachers and leaders from churches and mosques. In order that these people obtain correct knowledge about tsunamis, the NGO activists and government cadres need to train them. Also, regular and specific-skill training for *Satlinmas* is important so that *Satlinmas* has an ability to assist the community members to assess their risk and vulnerability. Moreover, it is important to use their traditional tools to produce warning sounds with understandable codes of the sounds. Lastly, regular tsunami simulations at the *dusun* and household levels are important to maintain their awareness and preparedness. Consequently, the implementation of CEWS will directly enhance the current tsunami hazard knowledge and preparedness in Mentawai as the requirements of Ina-TEWS as mentioned in Chapter 1.

In conclusion, the implementation of all foundations in CEWS perfectly connects to the Ina-TEWS requirements at the downstream level. The Ina-TEWS requirements are to increase capacities of communities regarding tsunami hazards and to ensure community members are safe from possibility of tsunami hazards. In order to achieve these requirements, CEWS has established four main foundations of the early warning system, namely risk knowledge, monitoring, warning communication, and response capability. These foundations will allow the people in Mentawai to have proper tsunami risk knowledge, reliable links between the warnings providers and community members, the capacity to produce timely, technically accurate warnings and the capability to respond to the warnings in appropriate ways. Therefore, the implementation of CEWS in Mentawai means that it supports the big scheme of Ina-TEWS to make people have proper knowledge on tsunamis and be safe in the event of a tsunami in a small community of Mentawai.

7.4. Developing adaptive capacity through disaster risk reduction program

As mentioned above, coping capacity is a series of activities to increase adaptation to unexpected events in the short term. However, in tsunami preparedness there is no particular period to determine that the coping capacity is sufficient. If we commit to coping capacity efforts continuously and mainstreaming them into our daily life, we can call these

efforts ‘adaptive capacity’. Therefore, generally adaptive capacity is a ceaseless and constant process.

Scholars have defined adaptive capacity as the ability to survive or cope with unexpected events by adjusting institutions, systems, and individuals to any potential damage in the events. Jones, Ludi, and Levine (2010, p. 2) define adaptive capacity as “the ability of a system to adjust, modify or change its characteristics or actions to moderate potential damage, take advantage of opportunities or cope with the consequences of shock or stress”. Moreover, J. Becker, McBride, and Paton (2012) also state that adaptive capacity occurs when a local community uses its individuals, collective and institutional resources and competencies to develop its capability. This enables the community to anticipate, cope with, recover from and learn from their needs, before, during, or after an emergency. Additionally, Marshall et al. (2009, p. 5) define adaptive capacity as “the ability to respond to challenges through learning, managing risks, and impacts, developing new knowledge and devising effective approaches”. It also entails a flexibility to adopt new solutions. Therefore, the main key of adaptive capacity is the involvements of individuals, community members, and local government in processes of adjustment. The relationship should also be strong enough to build trust with one another.

It is important to characterise adaptive capacity to understand how it can be influenced at the local level. Developing adaptive capacity becomes critical when a local community is exposed to external influences. It also cannot be measured directly. As adaptive capacity is independent and flexible, truthful and relevant knowledge, information and proficiency are required (Jones et al., 2010). Thus, effective and supportive institutions can create successful adaptive capacity within a community. Buckle (2006) also pinpoints that various characteristics influence adaptive capacity at the individual, family, and community levels. These characteristics encompass hazard knowledge, common values, and skills. Consequently, adaptive capacity is not only related to the understanding of knowledge, but also it needs external support to implement flexible efforts at the local level.

From the above arguments, I propose one relevant program that could increase adaptive capacity in Mentawai to reduce tsunami risk and this is a tsunami risk reduction program through adaptive capacity development. This program is about how to empower the

community to access to various factors of adaptive capacity development processes in order to increase the tsunami risk reduction.

Since the program requires the involvement of and commitments from many institutions within the wider community, a strong co-creation of public values becomes important (Baser, 2007; Benington, 2011; Williams, 2011). Therefore, I propose that the village heads be responsible for implementing the program. In the government system of Indonesia, the lowest government is a village government. The village government has a particular office, a selected village head, and several people to work at providing public services to the village people. A head of a village has a legal standing position within the community based on the Act No 5 of 1979 on The Village Government and the Act No. 6 of 2014 on Village. The head is respected within the community and one of village government's tasks is to develop the orderliness of village people. This task corresponds with the aim of this program to develop orderliness in adaptive capacity development to reduce the tsunami risk. In Mentawai, there are 43 villages and 40 of them are close to the coastal areas. Therefore, strong involvement of the heads of villages will impact on tsunami preparedness in Mentawai.

As mentioned previously in Chapter 3, several root causes and dynamic pressures have forced the local community of Mentawai to live in unsafe locations where there is potential for a tsunami. The exposure to external cultures, the changes of settlement patterns and of the social and economic system have been identified as the root causes for the community's tsunami vulnerability. The rapid population growth, limited support from the local government and deforestation have contributed to tsunami vulnerability. On the other hand, the islands of Mentawai are situated in a hot spot of fault lines that can trigger tsunamis when an earthquake occurs. These factors should be linked to the potential solutions of reducing their vulnerability by increasing their adaptive capacity. To build and sustain capacity is not easy; however, it is possible to do and systemic efforts are needed to reduce risk disasters (DRR).

UNISDR (2007b) defines DRR as:

> "the concept and practice of reducing disaster risks through systematic efforts to analyse and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events."

As indicated in Figure 7.1 above, as a concept, DRR is simply about increasing capacity so that vulnerability and exposure to the hazards are decreased. As a practice, DRR requires comprehensive strategies to reduce the disaster risks. It necessitates existing and diverse livelihood strategies, the usage of social networks and an increase of knowledge (Turnbull et al., 2013). Moreover, Turnbull et al. (2013) argue that a conceptual understanding of risk is required in order to develop adaptive capacity. These strategies mean that disaster risk is strongly related to hazard exposure and vulnerability. In order to decrease disaster risk, reduction in vulnerability and exposure to hazards is necessary. The development processes of adaptive capacity are influenced by a number of factors namely: political, institutional, cultural, social, environmental, human, economic, and physical. Therefore, it is important to decrease disaster risk through understanding the risk knowledge by conducting continual efforts to ensure surviving of unexpected events by adjusting systems within a community (as seen in Figure 7.7).

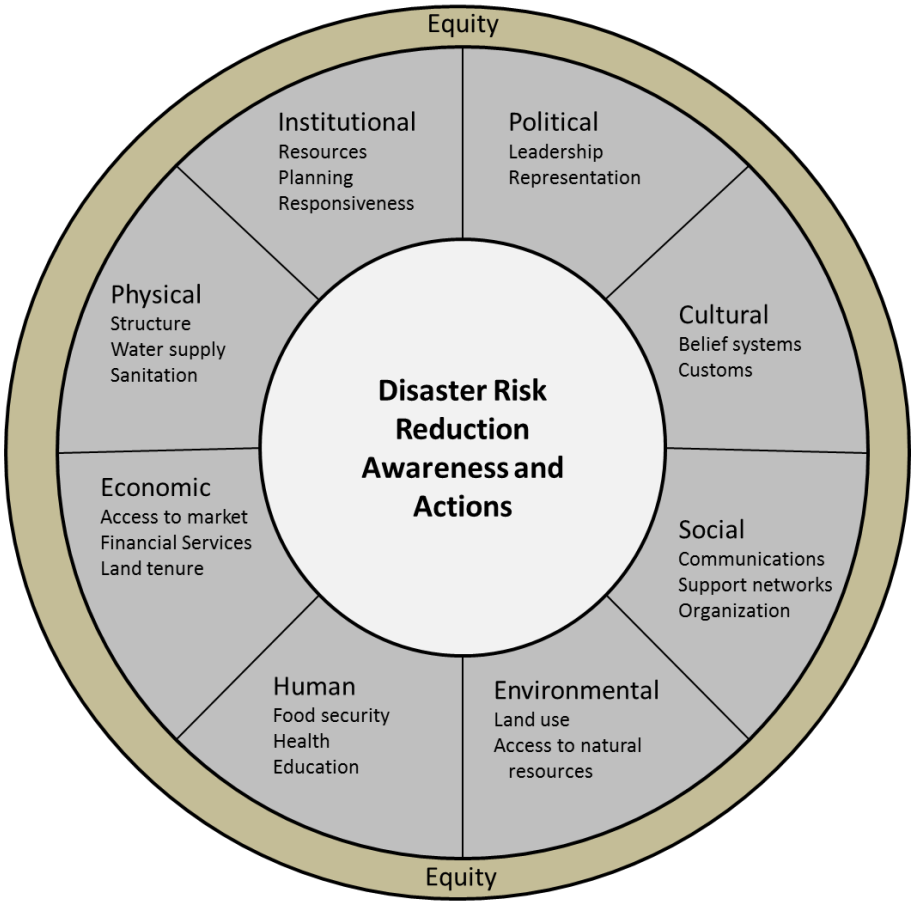

Figure 7. 7
Factors influencing adaptive capacity
Adopted from Turnbull et al. (2013)

In relation to the adaptive capacity development in Mentawai, this model is suited to implementation within the community of Mentawai to reduce potential risk of tsunami hazards through a comprehensive program. This program includes all factors that are mentioned in the Figure 7.7. I propose to name a program as Disaster Risk Reduction on Tsunami (DRRonT). Based on the research findings, DRRonT will be suitable for the local community of Mentawai to be able to survive from tsunami hazards. This program will involve the systems within the community such as the village governments and even higher levels of the governments (district and provincial levels). The aim of DRRonT is to develop disaster risk reduction on tsunami hazards within the local community of Mentawai through the efforts of adaptive capacity and it will encompass in an integrated perspective from a multi-faceted approach. Below are the comprehensive efforts proposed to develop adaptive capacity through the program in Mentawai.

a. Political factors

It is important to have political support for DRRonT. As discussed previously, traditionally the indigenous people of Mentawai were egalitarian with respect to social, political, and economic affairs (Schefold, 1991). Therefore, there was no particular position for leadership in the community. However, since the resettlement of isolated people (*PKMT*), the local community has been exposed to the system of *dusun* and village. Based on the Act No 6 of 2014 on Village, in Indonesia, the designation of a village head is based on a general election by the village people who are able to vote. In relation to DRRONT, the community can urge the candidates of village heads to have clear standpoints on the issue of tsunami preparedness. There are three waves of general election for the village heads in Mentawai. The first wave was conducted in January 2015 in several villages, and the second and the third waves will be conducted in 2017 and 2019. Therefore, there is a good chance to know the standpoints of the candidates about DRRonT for the other villages.

As a government, a village also has *Lembaga Ketahanan Masyarakat Desa (LKMD)*(The Village People Endurance Institution). *LKMD* is a parliament-like institution at the village level that accommodates and channels the aspirations from and to the village people and informs the people about their political rights. In conjunction with DRRONT, the community

can urge *LKMD* to push *Komisi Pemilihan Umum Daerah* (*KPUD*) (the district general election committee) to task the candidates' village heads with an additional requirement. This is to include the candidates' commitments to tsunami preparedness measures. At the village level, *LKMD* is also responsible for screening the potential candidates before it officially proposes the candidate to *KPUD*. Therefore, it is important that the candidates sign a political contract on this issue.

On the other hand, the existing heads of villages also need to have tsunami risk knowledge and to understand the urgency of tsunami preparedness. The village people can urge the heads of villages to have clear standpoints on tsunami threats and to actively involve to manage the coping and adaptive capacity programs in Mentawai. Therefore, it is important to ensure that the village governments plan and implement certain activities from their annual programs. If a head of a village pays less attention to the problem, the people must know they have a political right to propose to *Bupati* through *LKMD* that this designated head be fired. Therefore, it is important to inform the local community of their political rights regarding candidates and designated heads of villages and their tsunami preparedness measures.

b. Institutional factors

One way to support DRRonT is to empower institutions that exist within a community. Lack of awareness and knowledge regarding tsunami hazards is apparent among community institutions, the local community and religious leaders, private businesses, and government officials. As lack of knowledge increases the vulnerability of people, it is important to develop adaptive capacity among them regarding tsunami hazards. As briefly mentioned above, each village in Mentawai has a village government that consists of a head of village, *LKMD* members, and several persons to serve public values to the people. The heads of villages can use their annual budget to support the implementation of public activities with an orientation towards DRRonT.

To make sure the above aim is met, it is important to conduct a *Musyawarah Perencanaan dan Pembangunan* (*Musrenbang*) *Desa* (the village forum to conduct development planning) based on the Act No 32 of 2004 on the Rural Development. *Musrembang Desa* is an annual planning mechanism to meet the local needs through bottom up planning. The village

government and the village people need to have a series of meetings for participatory village appraisal and produce *Rencana Kerja Pembanguan* (*RKP*) *Desa* (an annual development program plan). Therefore, through this mechanism, the village governments can have strong commitments to DRRONT.

c. Cultural factors

Cultural factors are an important part in DRRONT. As discussed above, the traditional tools can be used to produce warning sounds in Mentawai and have a direct impact on tsunami preparedness. However, there are several other cultural elements of *Arat Sabulungan* that can be useful to develop DRRONT. G. A. Persoon (1997) explains that Mentawai is unique in many aspects of their lives and originally, the indigenous people had many traditional rituals or *punen* such as *punen kudduat* (having new *uma*), *punen sinuba* (festivals for good fishing catches), *punen patiti* (ritual for tattooing). However, many *punen* are never or seldom performed since the people have mainly become Christians or Muslims (Rudito, 2013).

Nevertheless, in particular *dusun*, the indigenous people still perform particular *punen*. Tamba (2009) provides an example from Simatalu Lubaga Village. The people from this village still use *kabit* (traditional loincloths) and live from hunting in the forest. The people are mainly tattooed and moreover, they often do *punen* by dancing *turuk* (Figure 7.8).

Figure 7. 8
A group of adult males from Mentawai people performing *Turuk* dance
Source: Reygina (2016)

We can also find several ornaments in Mentawai. Schefold (1991) found three basic patterns in their cultural ornaments with the first pattern being very conservative as a row

of dots (*legu*), triagles, jagged lines (*sot*), wave-like lines, spiral-like lines, webbing-like lines (*teleurui*), standing spiral lines (*pagagalik*), taika-labbo, and bilou. These are mainly found on the traditional tools such as traditional boats (*abak*) or *parang* (traditional knives). The second pattern is a combination of the first pattern into wooden crafts. Mostly the crafts are in the shape of human skulls (*jaraik*), turtles (*rerepak*), monkeys (*bokkoi*), or lizards. These crafts are placed in the *uma* (communal house), on the pavilion of *uma* or *abak*. The last pattern has several shapes such as traversing lines, stars, roses, suns (*matat sulu*), or asymmetric axes. They are normally used as tattoos (*titi*) for the people (Loeb, 1935; Schefold, 1991).

As defined that DRR is also related to the development of the people's livelihood, the above cultural factors have economic value if the people can use the opportunity. They can draw the ornaments on canvases and/or make wooden crafts which can be traded as souvenirs. In addition to this, nowadays the Indonesians love to wear batik and almost every district government in Indonesia produces its unique, traditional batik with its own patterns. It is a good chance for the local community of Mentawai to develop its own batik with the above patterns to preserve *Arat Sabulungan*. Aside from its economic values, this batik can preserve the traditional cultures. Similarly, their traditional livelihoods can be used for cultural tourism and these cultural factors can be used to develop tsunami preparedness as well as livelihoods. To adequately increase their livelihoods, it is critical to reduce the underlying drivers of the risks affecting the farmers, fishers and gardeners in Mentawai. They can have regular incomes by developing batik with Mentawai nuances and people can do their work far away from the coasts. Therefore, by building a resilient livelihood for the local community of Mentawai, it increases DRRonT.

d. Social factors

Social factors include the aspects relating to divisions defined by religion, ethnicity, and income that have an important effect on adaptive capacity development for tsunami risk reduction. As identified earlier, various ethnicities have come and lived in Mentawai and, aside from Mentawai ethnicity, Swasono (1997) identified that Minangkabau, Javanese, Batak, Aceh and Palembang are very common ethnicities found in Mentawai. Before the 2010 tsunami occurred, the newcomers transferred their knowledge on tsunami hazards to some of the local people so therefore, the local people experienced to have some benefits

from the newcomers, in particular tsunami prevention measures. However, the indigenous people often thought that the incoming ethnicities were more intelligent and civilized and called them "*Orang Tepi*". The indigenous people often judged themselves as old-fashioned (Febrianto & Fitriani, 2012; Swasono, 1997). This puts the indigenous people in a low bargaining position to sell their products, as previously discussed.

On order to make the community mix with one another, the heads of villages can do several things. Firstly, they can revitalize the local culture to gather the community. Another example of *punen* that the heads of villages can use to mix other ethnicities with the indigenous people is *punen pasambaat*. This *intangible product of Arat Sabulungan* is performed when there are new comers to the community. Therefore, it could be useful to make other ethnicities socialize with the indigenous people. *Punen pasambaat* can be followed by activities such as a cultural galas. The heads of villages can regularly organize cultural galas in which all ethnicities can participate and show their cultures with dances, foods, or crafts. Eventually, *punen pasambaat* and other socializing events can make all people at the village level mingle with one another

Secondly, the heads of *dusun* can organize inter-*dusun* races or contests for Indonesia Independence Day or the Commemoration Day of the 2010 Tsunami. Through the events, each *dusun* people can perform their personal tsunami escape practice and create *tudukkat* and *gajeuma*. It is also important to involve particular groups in these events including *Satlinmas*, children, and women. The children could participate in writing or drawing about a tsunami and the women could have running races. The victims of the 2010 tsunami could give messages regarding the eeriness of the waves. Therefore, their knowledge, experiences, abilities, and skills can be shared to increase others' knowledge and awareness to face potential tsunami hazards.

The Batak people have adapted well to the indigenous people (Sihombing, 1979). As we know, the local community of Mentawai now is mostly Christian and after the first Christian missionary, August Lett (a German), started in Mentawai in 1901, other German missionaries brought a number of teachers and missionaries from Batak (North Sumatra). In 1861 the Batak people had started to convert to Christianity through the German missionaries and many of them could read and teach, and even evangelize others (Aritonang, 1993; Sihombing, 1979). Therefore, the German missionaries used the Batak

missionaries to evangelize the indigenous people of Mentawai. Similarly, this method can be used to spread tsunami knowledge and tsunami preparedness to the people in Mentawai. As briefly mentioned, *Orang Tepi* is highly appreciated by the indigenous people; therefore, the heads of villages can persuade the newcomers, especially the Batak people, to disseminate the tsunami knowledge and tsunami preparedness to the people of Mentawai.

e. Environmental factors

Environmental factors also influence DRRonT through adaptive capacity. Natural barriers such as mangroves can provide protection from a tsunami as they can reduce the flow velocity (Pathirage et al., 2015). In earlier discussions, we understood how coastal vegetation can block tsunami waves from penetrating inland. We can see from Chapter 3 that the district government of Mentawai reports that 70 per cent of the coastal vegetation is still in good condition (Pemda Mentawai, 2010). However, Yayasan Minang Bahari (2009) reports that the condition is much worse than that. Many of the local community members have exploited the mangroves for making fires and coastal erosion due to human activities also wrecks the vegetation growth (Yayasan Minang Bahari, 2009). In fact, dense mangroves can be important aspects to protect coastal areas from tsunamis (Adger et al., 2005; Diposaptono & Budiman, 2008; Forbes & Broadhead, 2007). Accordingly, the heads of villages should organize the local community including children to plant new seeds on the coastal areas next to their *dusun*. Moreover, the schoolteachers keep teaching and encouraging their students to do this. In addition, the heads of villages can issue an official letter to ban the cutting of trees from the coastal areas. These efforts will help create a natural barrier for the tsunami waves in the future.

Traditionally, the indigenous people of Mentawai would do a "*tippu sasa*" ritual for someone who had committed a misconduct. *Tippu sasa* (another intangible product of *Arat Sabulungan*) was the most serious sanction by the community and consisted of making an oath. The oath was that the person would be dead if she or he repeated the same deed (Coronese, 1986). Therefore, *tippu sasa* may be applied to those who cut the mangroves. The heads of villages can instruct the people not to cut the mangrove trees. If someone is found guilty of cutting the mangrove trees, the community will ask for the *tippu sasa* ritual. By doing so, the community will take care of the mangroves and never cut them.

f. Human factors

Turnbull et al. (2013) argue that human factors are important to develop adaptive capacity and consist of food security, health, and education. In relation to food security at the household level, one of the research participants ever said:

> "The adults [in Mentawai] prefer having bananas or taro [as the main foods]. But [our] children prefer having rice [instead]. That is why [we] try to create [dry] paddy field. In fact, *subbet* [a traditional food from taro] is delicious. If [I] have enough money, we [I] will buy rice. The people buy rice Rp. 10.000 per kg [equals to USD 1.08]. If [I have] no money, ya [we are] back [to have] traditional foods." (Community Member No. 04)

The above finding implies that there has been familiarization to non-traditional food among the indigenous people in Mentawai. The people usually plant taro, bananas, and sago plants as their main food next to their *dusun*. However, the change of food preferences, particular for the children, can create problems for the people. They will not spend their time planting paddy rice as they have never known how to cultivate it (Febrianto & Fitriani, 2012; Schefold, 1991). Instead, they will spend about half of their income in buying the rice. It has been indicated previously that the household income average was USD 64.84 a month (Kamal, 2013) and Schefold (1991) found that normally the people eat three times a day. If we assume that a household uses one kg of rice a day (for three meals), they will use 30 kg of rice a month or equivalent to USD 32.43 a month. However, the finding also clearly emphasizes that they always go back to their traditional foods if they have not enough money to buy rice. It seems that they have no problems with accessing traditional foods.

One thing that needs consideration is that the people in Mentawai cook their foods in a very simple way. Usually, they steam the sago material after they have mixed it with coconut milk or shredded coconut in banana leaves (Schefold, 1991). They also boil the ripe bananas and have them for breakfast. This could make the people, especially the children prefer eating rice rather than the traditional foods. In order to make meals from the above viands, it is important for the local community members to develop new cooking skills. Therefore, it is suggested that the heads of villages organize a cooking training program for the people, targeted in particular towards women.

Consuming rice and other foods from the external islands and renouncing their traditional foods will keep the people in poverty because of the extra expenditure. The prices of the

external goods are higher in Mentawai than that in Sumatra. The poverty causes the people to be at high risk from tsunami hazards because they keep living in old settlements in the coasts. Therefore, the reduction of external food demands in Mentawai would allow the local community to save money that they can use for other purposes such as moving their settlements to safer places.

g. Economic factors

Economic factors are one of the keys to successful DRRonT. Economic planning measures comprise parts relating to production, circulation, and consumption of goods and services in a society (Pathirage et al., 2015). The research findings also indicate that it is easy to find taros, bananas, and sago in Mentawai. My observations during the field research also indicated that massive amounts of them were taken from Mentawai to Padang (in Sumatra) via the ferry. However, the local community always sells them to middlemen as raw materials as I have elaborated in the previous chapter. According to Jacobs, Nelson, Kuruppu, and Leith (2015), the people who are dependent on a natural resource as their livelihood should be able to convert them to another form. Therefore, it is necessary that the local community of Mentawai to produce and sell their products as intermediate goods or even finished goods.

In order to produce the intermediate and finished goods, it is important to develop new skills for the local community members and the heads of villages could organize several kinds of training to develop the people's skills. They could request assistance from *Bupati* to provide the related experts to train the people. One kind of training is about how the local people could turn goods such as sago or taro into flour and sell the flour outside Mentawai. Another is how to make finished goods from natural products, such as sago and taro cookies or banana chips. As we know, it is easy to find cookies made from sago in Indonesia, but cookies from taro are rare. In addition, as they normally sell raw sea food, they can also make and sell the fish as fish floss instead. Therefore, through such skills development, the local community can produce intermediate and finished goods, and sell them outside Mentawai.

To make it work, however, the heads of villages needs to form a particular "*kelompok tani*" by grouping about 20-25 *dusun* people who have the same interests, goals, and desires (Nuryanti & Swastika, 2011). A *kelompok tani* has the function of a means to study general

affairs, to increase skills, and to produce particular products. The *kelompok tani*, eventually, will also have a good engagement with the traditional markets and avoid price fraud by the middlemen.

Since the Mentawai Islands face the Indian Ocean, the sea waves are as high as 6 metres all year. Reygina (2016) found that 70 beaches have potential for surfing activities (Figure 7.9). However, Ponting (2001) argues that it is not easy to find agreement from the community to support tourism development. It is because the tourism sector never involves the local people and therefore cannot run very well. It is important that the heads of villages urge the tourism sectors to employ the local people as tourism guides, drivers of boats, or even as surfing trainers. However, commitment from the local government is also important to help train the local people.

Figure 7. 9
A high wave is enjoyable in Pantai Mapadegat, Mentawai
Source: Reygina (2016)

In addition, the local government is also required to promote the richness of Mentawai as a tourist destination. The local government can propose to the provincial government of West Sumatra or Central Government to carry out regular tourism festivals and exhibitions in domestic and overseas locations. Therefore, by using the different cultures in Mentawai, it is considered that adaptive capacity to tsunami risk will increase. However, strong commitments from the village, local, provincial and central governments are needed.

The above activities are considered to be able to generate incomes for the local community of Mentawai. Income-generation activities are critical for the potential to reduce tsunami risk. A study in Vietnam in 2005 indicated that such activities ensure adaptive capacity development among the participants (Turnbull et al., 2013). Therefore, involving the local community of Mentawai in the above activities will boost their economy. The people have access to the labour, knowledge and market linkages that make the people learn about many things including DRRonT.

h. Physical factors

The strengthening of buildings and infrastructure will reduce the exposure to tsunami hazards. Therefore, it is important to build settlements on hilly grounds, so that the tsunami waves cannot reach the settlements. The research findings have shown that the dusun people of Malakopa who have moved to a hilly ground from before the 2010 tsunami were saved from the waves. Similarly, other people from *dusun* that are next to the coasts must move to higher grounds next to the sea so that they can easily fish. Furthermore, as there are many trees in the forests, the people can obtain the timber to build their houses. According to Rudito (2013), the indigenous people used to build their *uma* from the logs of *katuka* (*Shorea bracteolatadyer*). This kind of tree is easily found in the forests. Therefore, the heads of villages must encourage those who are still there to move to higher ground. In the case that the people must pay other people who own the land, the heads of villages can discuss how to solve the problem. Traditionally, the durian plants and coconut trees paid the dowries (*alat toga*) or the cultural fines (*tulou*) (Febrianto & Fitriani, 2012) and this practice can be used to pay for the settlement land. Therefore, having the new settlements at a higher elevation will lessen the risks in the future.

As discussed above at the village level, there is a mechanism of planning by the community through the *Musrembang Desa,* and the same mechanism is also found which is known as District *Musrembang*. It is important to plan to rebuild and relocate the public schools and the community health centres (*Puskesmas*). These two public facilities should be mainly located next to the coasts on hilly ground. Therefore, by reallocating them, the local community also will tend to move next to the facilities.

To conclude this section, it is important to understand the local community's tsunami risk in order to develop adaptive capacity in Mentawai. Their vulnerability and exposure to

tsunami hazards put them at high risk of disaster in tsunami waves. It is thought that the adaptive capacity development can be implemented through the processes of DRR. Through a model of Turnbull et al. (2013), a multi-faceted perspective can elaborate on tsunami risk reduction in Mentawai. By using this perspective, we can find political, institutional, cultural, social, environmental, human, economic, and physical factors that can be developed, created, and expanded to develop tsunami risk reduction processes. Strong commitments from the local community, local leaders, and cross-government levels are required to use traditional, existing, and external resources and opportunities.

7.5. Potential support for sources of the programs

Since saving the people's lives is critically important, the implementation of the above programs is urgently needed. The heads of *dusun* must persuade the *dusun* people to participate in the programs; otherwise, the people will keep living in danger of tsunami hazards. Various potential sources can be identified for the proposed activities. As Baser and Morgan (2008) state that capacity needs collective actions and it is important for the community to grow and survive through their capabilities. Therefore, firstly and most importantly, the local community should show their collective commitments to supporting all these activities. It is thought that most opportunities to develop and increase coping capacity need no or little financial support. During the implementation of the activities, the community can bring "pot luck" for refreshments, as it is a common public practice in Mentawai. The venues for the activities can be the fields, houses, churches, or school classes. The churches or mosques can also donate a certain amount of money to support particular activities.

However, for longer-term goals, external financial support is needed. The heads of villages can allocate the programs as annual activities on the Annual Village Budget. In cases where they need more support, they can propose certain activities to the local community. Based on the Act 17 of 2003 on the State Finance, the local government allocates public services and social welfare to supporting the village governments. *APBD* consists of the detailed activities, budget resources, and the upper ceiling of expenses.

Furthermore, the heads of villages can propose activities to gain support from a special mechanism as known as the village budget allocation. This allocation is based on the Act No. 6 of 2014 on Villages which allows the villagers to have the right to know and to control the

planning and implementation of village development. It is clearly formulated in the Act that the State should provide the annual budget for each village. Referring to the Act, the Government of Indonesia has developed a Governmental Order No. 22 of 2015 on the Village Budget Sources from the National Budget. Based on the Act, the Minister of Village, Underdeveloped Regions, and Transmigration has issued a Ministerial Order No. 5 of 2014 highlighting two main priorities of the village budget namely physical and economic development and the empowerment of the villagers. This allows every village to develop its economic and social status and to preserve and revitalize its traditional cultures. Consequently, each village has an obligation to arrange annual and mid-term development plans based on its district or municipality strategic plan.

It is strongly suggested that the local community of Mentawai through the heads of villages propose their activities to develop their capacity to face tsunamis through the allocation budget from the government. Although the Act does not substantially mention that the budget can be used to empower the villagers on disaster preparedness, the Article 9 of the Act indicates that a village can be erased due to natural disasters. From the article, we can argue that the State acknowledges that disasters can substantially demolish the villages in Mentawai. By using the threats of tsunamis in Mentawai, they can propose certain activities to develop their capacity. Therefore, the villages with *dusun* close to the coastal zones are strongly advised to use the potential budget allocation to support their hazard management activities.

Another potential support to develop coping and adaptive capacity in Mentawai can be obtained from *PNPM Mandiri Perdesaan.* This is one tool of the Government of Indonesia to decrease poverty and unemployment rates through the development of infrastructures and socio-economic empowerment. As indicated in previous chapters, the development of the evacuation routes in Mentawai was from the support of *PNPM Mandiri Perdesaan.* As it has supported a number of activities in Mentawai, this mechanism can also support the DRRONT through adaptive capacity development at community level.

It is also considered that several of the above efforts involve the district government of Mentawai, the provincial government of West Sumatra and the Central Government and NGOs. For this purpose, the institutions can allocate their own money to support the development of coping and adaptive capacities to be able to survive tsunami threats.

7.6. Conclusion

We can see from this chapter that capacity can be impactful, sustainable, and strategic to protect people from hazards. Although a number of challenges are identified, the development of capacity is possible to counter tsunami hazards in Mentawai. As the field findings indicated a number of issues in conducting current tsunami preparedness, the heads of *dusun* and the heads of villages have the main responsibility to encourage the local community in tsunami preparedness measures, both emergency and longer-term mechanisms to respond to tsunami hazards. With the support from the local government and NGOs, coping and adaptive capacity development programs are potentially conducted in Mentawai by using existing and traditional strategies. However, intensive, integrated, repetitive, and intensive efforts are required to achieve these aims and a number of challenges are also identified. Nevertheless, through strong commitments, coping and adaptive capacity efforts will overcome the challenges. In increasing their coping capacity, the local community mostly not only needs to revitalize their own traditional tools but also to carry out new initiatives as part of community early warning systems. For this, the local government can show its commitments to serve its community. Meanwhile, the efforts to develop adaptive capacity require external financial and technical assistance. The processes of developing adaptive capacity take longer than that those of coping capacity; therefore, wider efforts are also required to adaptive capacity development. By conducting all the proposed efforts, it is believed that in the future the community of Mentawai will be able to face potential tsunamis.

This chapter has presented a number of applicative programs to enhance the capacities of the local people of Mentawai in coping with potential tsunami hazards. It is considered that this thesis has provided an integrated and comprehensive exploration of the research questions and of the proposed programs. Therefore, the next chapter will conclude all chapters and show the answers to the research questions.

CHAPTER 8
Conclusions and Recommendations

"The power of qualitative research lies precisely in the rich interaction with human stories that matter and in the fact that it cannot be reduced to a row of numbers but must retain the lives of its participants" (Pawson & DeLyser, 2016, p. 430)

8.0. Introduction

This thesis is a human story of the local community in Mentawai about how the people prepare for potential tsunami waves. The study is one of few academic studies to explore the social perspectives in relation to hazards knowledge and preparedness measures. The location of the study is in the Mentawai Islands (Mentawai), West Sumatra, Indonesia about 100 km offshore of western Sumatra. In comparison, many scholars have provided academic findings in connection to the seismic and paleo-tsunami studies in Mentawai (Collings et al., 2012; Horspool et al., 2013; Natawidjaja, 2007; Philibosian et al., 2014; S. C. Singh et al., 2010). Therefore, this thesis contributes to decrease a dearth of academic writing on tsunami preparedness measures in Mentawai.

This final chapter consists of six sections, as follows.

Section 8.1. Overviews the chapters of this thesis.

Section 8.2. Shows how the research questions have been answered from research findings.

Section 8.3. Shows a number of proposed programs as the recommendations.

Section 8.4. Identifies a number of public policy reforms or reviews based on the research findings.

Section 8.5. Offers further potential research.

Section 8.6. Shows the last remarks of the thesis.

8.1. Overview of the thesis

This study has focused on how the local community of Mentawai develops their tsunami preparedness. It provides a number of new, insightful facts that have never previously been revealed through academic studies. The basic understanding on preparedness measures is the central point of this thesis so therefore, the measures should be well embedded and mixed with people's daily activities. As the local community of Mentawai lives in an area

prone to earthquakes and tsunamis, they should have undertaken various measures to prepare for any potential tsunami waves.

This thesis contributes to a thorough understanding of the different aspects of hazard knowledge for tsunami preparedness measures. Chapter 1 delivers an overview of the national context and how the Indonesian Government has formulated its disaster preparedness policies. It also consists of some rationales of this study and the problem statements for the local community to counter potential tsunami waves in the future. Two main research questions were brought forward to identify the problems, and several subsequent questions were raised to elaborate on the main questions.

Chapter 2 concerns the theoretical contexts and key concepts that are employed in the study. It focuses on a number of academic definitions related to disaster preparedness. Generally, disaster is a serious occurrence that creates human, poverty and economic, social, and environmental disruption (Fritz, 1961; Gregg & Houghton, 2006; WHO, 2002). It often requires external assistance to relieve the sufferings of those affected. Therefore, disaster preparedness measures become the central point of disaster management (Alexander, 2002; Godschalk, 2007; Lindell & Perry, 2007; B. D. Phillips & Neal, 2007). Disaster preparedness measures are related to how people decrease their vulnerability by increasing their capacity and reducing their exposure to hazards. It also consists of how local communities build such measures in the local context. Furthermore, it shows how individuals and households have important roles to shape stronger community preparedness (Johnston & Dudley, 2009; Lin et al., 2009; Scheer et al., 2011). Lastly, it reveals the necessity of local partnerships to enhance and to promote the measures (Haddow & Bullock, 2006; Thompson, 2012; Zyck & Kent, 2014).

Chapter 3 covers the vulnerability progression to tsunami hazards in Mentawai based on the Pressure and Release (PAR) model (Wisner et al., 2004). This model traces the underlying root causes and dynamic pressures that cause the local community of Mentawai live in a location that is unsafe because of tsunami hazards. It is found that the root causes of the vulnerability are the history and the social changes of the people. The people originally lived in the jungles; however, over time they became victims of exposure to western cultures and the resettlement programmes to the coastal areas (Hernawati, 2007; G. A Persoon, 2007;

Schefold, 1988; Tulius, 2012a). The changes also resulted in the banning of their traditional beliefs and practices by the Government of Indonesia. These root causes are compounded by a number of dynamic pressures such as the rapid population growth, the local government's programme priorities, and deforestation. The last, for example, has significantly decreased the space and access to nature for the local community (Darmanto & Setyowati, 2002; Schefold, 2007; Sihombing, 1979). Indeed, their *Arat Sabulungan* was closely attached to the natural environment (Hernawati, 2007). Therefore, such pressures have forced them to live in the coastal zones - the unsafe locations for tsunamis.

Furthermore, this chapter also emphasises why the local community is physically vulnerable to tsunami hazards. The Mentawai archipelago is located above the Mentawai Segment (Ambikapathy et al., 2010; Borrero et al., 2006; Briggs et al., 2006; Natawidjaja, 2007; Weller et al., 2012) that is close the Sunda Megathrust. The Megathrust is the convergent boundary between the Indian - Australian Plate and the Eurasian Plate, moving at about 5-6 cm per year. The convergence cumulatively accommodates a huge energy to be released at any time as earthquakes that can generate tsunami waves. Also, the backthrusts from the Mentawai Fault Zone (Mukti et al., 2012; S. C. Singh et al., 2010; Wiseman et al., 2011) can deform the rear of the wedge from the Mentawai Basin. The backthrusts are active and have the potential to create steeply-dipping seismic events that create tsunami earthquakes. Lastly, coastal vegetation in Mentawai is also rarely found, caused by the natural conditions and human activities. (Anwar & Gunawan, 2006; Pemda Mentawai, 2010; Yayasan Minang Bahari, 2009).

Chapter 4 emphasizes how the field data was collected. In order to answer the research questions and to provide the research findings from the phenomena, a qualitative case study was designed (Gerring, 2007). The exploration of past and current social phenomena (P. Baxter & Jack, 2008) has been done within a particular, unique community (Yin, 2014) of Mentawai. With the semi-structured interview questions, the field research successfully interviewed 20 participants from 19 *dusun* and nine villages from three islands (North Pagai, South Pagai, and Sipora). The recruitment of the participants was based on the purposive sampling (Bryman, 2008; Creswell, 2013; Longhurst, 2010), with the snowball method (Mack et al., 2011; Parfitt, 2005). Ethical considerations were deliberated during the interviews and after the interviews (Yin, 2014). In order to avoid my subjective judgment affecting the

research findings, it was important to conduct a number of methods for the data triangulations (Ayoub et al., 2014; Creswell, 2013; Stake, 2008) through the interviews with the non-community participants, the observations and the insertions of statistical data into the text of the thesis. As Creswell (2013) suggested using the Data Analysis Spiral Model to analyse the voluminous and rich data from a qualitative research, I conducted step-by-step approaches in order to retain my objectivity as the outsider to ensure the quality of the research findings.

Chapter 5 and Chapter 6 consist of the presentation of the search results. The next section will briefly cover the conclusions of both chapters as the answers to the research questions. Chapter 7 is about how the community can increase their capacity to counter their problems related to tsunami preparedness measures. The following section will also concisely address this chapter as part of the recommendation.

8.2. Answering the research questions

As written in Chapter One, there are two main research questions in conjunction with tsunami preparedness in Mentawai. They are:

1. *How great was the knowledge of the local community of Mentawai regarding tsunami preparedness prior to the 2010 Mentawai Tsunami?*
2. *How are the current tsunami preparedness measures formed in Mentawai?*

To answer the above questions, I carried out research procedures to collect the field data and the step-by-step data analyses. I found it fascinating to learn a number of paradoxical facts as “lightbulbs” from the study findings. Through reading this thesis, we can understand how historically and currently the local community of Mentawai has become vulnerable to tsunami hazards. In fact, the 2010 Mentawai tsunami that hit Mentawai is proof of how the people are vulnerable to tsunami waves. To recap the major findings, I will repeat a number of “lightbulbs” findings below.

To analyse the main first question in field data, a designed cross-cultural and institutional framework of knowledge management model from Mohannak and Hutchings (2007) was used. Through this model, several questions under the first main question were explained. Firstly, it was found that two groups among the participants had never heard or known

about tsunami hazards. There were several reasons that the first group had never heard or knew about tsunami hazards before the tsunami. Historically, the indigenous people of Mentawai lived in the jungles as the fruit gatherers and hunters. Although the great earthquakes (Mw 8.3-8.7) in 1797 and (Mw 8.9) in 1833 triggered tsunami waves in Mentawai and Sumatra (Collings et al., 2012; Natawidjaja, 2007), they did not experience both events. Furthermore, no anthropologists discovered oral stories and historical memories related to the tsunamis (Tulius, 2012a). In addition, no particular words are found in the local language to express a big wave in Mentawai. In addition, accessibility to media contributes to knowledge capture and sharing within a community. After a number of tsunamis have hit several areas in Indonesia since 2004, the national TV channels have aired news and programs related to tsunami hazards. However, the people from this group preferred to enjoy TV dramas rather than news or public programs, or hardly accessed TV programs. The unavailability or limitations of electricity also influenced the locals' access to TV or other electronic tools such as radio. Moreover, they never attended the local meetings regarding tsunami education for the community from the local activists. Lastly, they also rarely read the distributed education materials. On the other hand, the second group knew about tsunami hazards mainly through TV channels, and followed by the NGOs' activities, education materials, and new people who came to the community.

As the cross-cultural and institutional framework model shows three dimensions of the process of transferring knowledge in Chapter 5 (Mohannak & Hutchings, 2007), the research also discovered the same dimensions within the local community of Mentawai. For the first dimension (the macro level), how the political condition, the level of education and socio-economy had little influences in order to transfer the tsunami hazard knowledge and preparedness to the community. The district government had a complacency that tsunamis would never have occurred to Mentawai, since no oral histories about tsunamis within the community. Also, the local NGOs had conducted a number of knowledge transfer activities, however, because of difficult access to the community they found it hard to expand or continue their programs causing high –cost operational programs. Furthermore, the poverty and illiteracy of the community also made the people reluctant to attend the community meetings. As a result, at the macro level, the support of the knowledge transfer on tsunami hazards was very low.

The second dimension (the micro level) is about how the knowledge provider(s) transfer of explicit knowledge becomes an asset for the community (Mohannak & Hutchings, 2007). Based on the research, it was identified several types of knowledge providers were identified in Mentawai, namely the local NGO activists, local government officers, media and newcomers. The research findings also indicated that the participants preferred the knowledge providers from the NGOs rather than the local government. The activists were more sensitive, patient, and innovative in providing solutions to their problems. On the other hand, the government officers often just had a brief meeting with the community. However, it was suggested by the social researcher that the NGO activists should always update the knowledge they are transferring to the local community since the earthquake's characteristics in Mentawai are different from the earthquakes in other parts of Indonesia.

Furthermore, some of the local community could not access the knowledge about tsunami hazards. They did not like reading, the females preferred watching TV dramas rather than the news or public education, many adult males also perceived no benefits from watching TV, and the lack of electricity influenced their access to TV programs. Some others could capture and access the knowledge from the newcomers to the community, local government officers and NGOs activists, and mass media. For them, the tsunami knowledge had become an explicit knowledge (Dalkir, 2011; McIneeney & Koenig, 2011; Ribeiro, 2013; Roberts, 2010); however, they seldom discussed their knowledge among themselves. Therefore, some cadres were recruited to share the issues of tsunami hazards with the others. However, because of the geographical and demographical problems of the community and the financial programs of the NGOs, this seemed too difficult to implement. Thus, at this moment many of the community have no or limited ways to contextualize the knowledge. Meanwhile, their explicit knowledge about tsunamis was also mixed with their experiences of the previous earthquakes that did not trigger tsunami waves.

The third dimension (the community level) is about how the community captured the explicit tsunami hazard knowledge and preparedness from the knowledge providers. They tried to share and apply the explicit knowledge with their local knowledge and local cultures. Furthermore, the community also had tried to internalize the explicit knowledge into tacit knowledge with the combination of the explicit knowledge with their perceptions, emotions, beliefs, and values to become tacit knowledge (Dalkir, 2011; Kumar &

Chakrabarti, 2015; Lundvall, 2000; McIneeney & Koenig, 2011; Ribeiro, 2013; Roberts, 2010). Their traditional belief was that an earthquake, in the local word "*teteu*", was to be respected and blessing, but the explicit knowledge gave them a different view of *teteu*. Therefore, the knowledge confused them in relation to their traditional belief.

Other tacit knowledge was also found when they linked the magnitude of earthquakes to tsunami waves. As they had experienced the 2007 Bengkulu Earthquakes of Mw 8.4 and Mw 7.9 (Ambikapathy et al., 2010; Fujii & Satake, 2008; Natawidjaja, 2007) without tsunami waves, they thought that smaller earthquakes than they had experienced would not cause tsunamis. They were never exposed to tsunamigenic earthquakes that created a weak but long-period seismic wave energy from a low rupture velocity in a less rigid piece of land. Therefore, when a tsunamigenic earthquake shook the islands in 2010 the local community's tacit knowledge was that the earthquake would not have generated tsunami waves, but they were wrong. For those who lived in the coastal zones, they did nothing to anticipate the waves and became victims.

The next phase was they realized that they lived in a tsunami prone area; however, in relation to the application of the knowledge, I divided them into two groups according to their responses. Firstly, a number of local community members applied this knowledge to protect themselves from tsunami threats in the future by moving their settlement from the coast zones. Some of them moved about 1.5 to 2 km from the coast to higher ground and the others moved farther inland about 8 km. When the people from Mentawai experienced the tsunami, those who had moved to the higher ground were safe. However, from those who moved to further inland, many became tsunami victims, because they still lived down in their gardens next to the coast to do their old jobs, namely gardening and fishing. Often they slept over in their hut, which was next to the shore during weekdays.

Secondly, a number of community members kept living in their old settlements. They relied on their own intuition to anticipate any potential tsunamis triggered by earthquakes or just remained passive. These kinds of responses caused many of them to became tsunami victims.

To analyse the field data for the second main research question, I used the Multi-Level Model (Figure 6.1) to understand the present tsunami preparedness measures. This model

has examined the measures at the individual and household, at the *dusun* and at the district levels. At the individual level, I found that the research participants were aware of the devastating tsunamis that could hit Mentawai at any time. Some of them would run to safe points and climb the coconut trees. Others would ignore them or put their valuable things in their huts in the jungle to avoid loss from potential tsunamis. However, it is astonishing that they would hardly do anything to increase or maintain their awareness of tsunami hazards, such as training. Even worse, many people also put their motorcycles on the evacuation routes and blocked the pathway. Therefore, if they try and use the congested routes in the event of a tsunami, the people will find it difficult to reach the safer points.

Scholars (Apatu, 2013; Reynaud et al., 2013; Scheer et al., 2011) have shown evidence that household evacuation plans are the most necessary in order to escape from tsunamis. In relation to household evacuation plans, firstly, the field research in Mentawai revealed that no participants had them. The main reason was that they had no understanding of the benefits of the plans. Additionally, Johnston and Dudley (2009) mention that household exercises are also needed for family members to understand where to go in the event of a tsunami, thus, individuals or family members should be trained. However, the field research revealed that no participants had conducted a household exercise and relied on the tsunami simulation exercises from their children's schools. They also had no idea what the exercises meant for for them. Lastly, although some experts criticize the tsunami *tendenko* maxim as increasing selfishness and immorality in the event of a tsunami, others claim that the maxim will avoid the deaths of the rescuer and the rescued by going separately. However, the study findings contradicted the tsunami *tendenko* maxim. All participants would save their neighbours (the vulnerable) in the event of tsunamis, although they clearly had no idea where they were. The relationship among the community is very tight because they may be siblings.

Scholars (Arlikatti et al., 2010) identify several categories of domestic stockpiles that are functionally important to households in the event of a tsunami and the most applicable to the local community of Mentawai are shelters, food preparation, and first aid and other supplies. Mainly, the study revealed that no significant difficulties were found in the community to provide the above elements in the event of a tsunami. In an emergency, the people could live or move into their huts in the jungle, or build temporary shelters from the

wood in the jungles. Similarly, they can also find foods that they have planted in the jungles. Lastly, if they are injured they could use natural herbs from the jungles as medicine. In fact, the Ministry of Health conducted a survey in Mentawai in 2014 and found that the local people often used herbs to heal their wounds (Agung et al., 2014).

At the *dusun* level, preparedness measures were also found. Firstly, a simple tsunami hazard map is known to be a good tool to indicate all topographic data, buildings and information that will potentially be inundated by the tsunami waves (Cadag & Gaillard, 2012; Forrester & Cinderby, 2012; Samant et al., 2008). From the field research, there were no *dusun* found that had such tsunami hazard maps. There was an indication of developing tsunami risk assessment maps; however, no physical evidence of the maps was found nor were they displayed by the community.

Secondly, evacuation routes and signs are also important in the event of a tsunami within a community as the continuous and unobstructed path of exit from any point within a community to a place of safety (Pu & Zlatanova, 2006). As found from the study, all *dusun* next to the shorelines have one or two evacuation routes. Nevertheless, the research participants have not provided enough in the number and in the size of the routes. From the observations conducted, however, I found that some of them were blocked by parked motorcycles, water pipes, overgrown grass, or others. A number of experts have warned that the routes will be useless in an emergency if they are blocked (Nelan & Grineski, 2013; Reynaud et al., 2013; Scheer et al., 2011). Similarly, evacuation route signage was found in the *dusun* in Mentawai, but in some cases, the signs were unclear and almost unreadable. However, the local community had made no effort to restore them.

Furthermore, an evacuation point is considered an easily accessible point to avoid hazard(s) and is often placed at a reasonable distance from the point of departure either on higher ground or far inland (BNPB, 2013a). As I observed, all *dusun* near to the coasts have a certain evacuation point about 15 m above sea level. However, the study found the *dusun* people do not take much care in keeping the points free from overgrown grass. Few evacuation points are provided with signage to show people their function.

Additionally, an emergency message or sign in a community also could be mutually agreed on among community members to decide how to deliver an emergency warning, and then

to receive, accept, and respond to it (King, 2006). When I observed a tsunami simulation exercise in Dusun Pasibuat, I found that the people used a *kentongan* or *tutuko* (bamboo gong) to communicate an emergency to others, but its size was too small to produce enough strong sounds for the people in a wide *dusun* to receive the warning signs. In fact, old traditional tools such as *tuddukat* and *gajeuma* can be used to disseminate the warnings.

Moreover, public education on tsunamis and tsunami exercises are found in several *dusun* in Mentawai, but the *dusun* people need to work hard in order to increase the quality of the exercises. Additionally, information materials such as banners and billboards need to urgently appraised, so that the people easily understand the messages. Lastly, the roles of *Satlinmas* are also important to encourage and support the community to be prepared for a potential tsunami in the future. However, it is critically important to train the members to increase their capacity by utilizing the existing trained persons in Mentawai from BNPB.

I could say that the district government of Mentawai still provides little effort in supporting the tsunami preparedness measures. Several actions by the Central Government have been established; however, the local government still allocates few resources to expand or to continue them. The Central Government through BNPB has developed a disaster risk measurement in the Mentawai District with the conclusion that most potential hazards in Mentawai are earthquakes and tsunamis. From the report, a tsunami could inundate about 83,185 ha and affect a population of 11,000 (14 % of the total population) (BNPB, 2012). The risk assessment is aimed firstly as an additional document/input to support public policy making, but the local government has not synchronized the report with any public policies making process. Secondly, the risk assessment document also aims at developing a community-based program. However, the local government has not used it to develop its community-based program. Lastly, the risk assessment document can be used as a foundation to build practical programs such as the establishment of evacuation routes and points. Certainly, these efforts have been implemented within the community, but they were too far from the people or too difficult to reach, in particular for those individuals with special needs. In fact, the evacuation routes and signage are still insufficient in quality and quantity.

BNPB also has designed disaster risk maps for each sub-district in Mentawai. The maps can show the level of the risk of hazards, vulnerability, and capacity (BNPB, 2012). However, the local government has not zoomed out the maps at the *dusun* level to see clearer and more detailed features. This would identify the weaknesses and the strengths of the *dusun* people so they can counter the possible problems caused by tsunami waves in the future.

Lastly, BNPB has provided one operational emergency centre (OEC) in the capital town of the Mentawai District, Tuapejat in Sipora Island to facilitate operational controls and to conduct information communication systems in an emergency (BNPB, 2013a). The OEC centre in Tua pejat has the minimum standard of an OEC according to the BNPB standard of OEC. However, in order to communicate to and from the *dusun*, not all *dusun* have supporting tools such as community or handy talkie radios.

8.3. Recommended programs

Living in a prone tsunami area is a reality for the local community of Mentawai. Tsunami waves can be generated by earthquakes at any time so, in order to minimize the devastating impacts of a tsunami, conducting tsunami preparedness measures is a necessity. Therefore, as mentioned in Chapter Seven, I recommend the local community of Mentawai implement three intensive and simultaneous programs. One program is to increase their coping capacity through community emergency warning systems (CEWS). The other two are to increase their adaptive capacity through a community-based outreach program and a sustainability program for tsunami preparedness.

By implementing CEWS, the community would comprehensively and simultaneously increase both the individuals' and community members' coping capacity to avoid threats of hazards and/or the impacts of hazards. They are empowered to use their existing skills, resources, and strategies to increase their capacity. They will determine pivotal collective actions to increase their tsunami risk knowledge, tsunami monitoring strategies, capability to respond to potential tsunami waves, and warning communication (Grasso & Singh, 2012; IFCR, 2012). To do so, however, requires mainly technical support from the local NGOs and local government as well as the political will of the local government and parliament.

In order to develop adaptive capacities, I also recommend implementing a tsunami risk reduction program through adaptive capacity development at the community level. This

integrated and comprehensive program would look at the problems within the local community from a wider perspective. By involving the heads of villages and some key officers at the district level, it would mostly use the existing knowledge, skills, and opportunities in the progress of disaster risk reduction (Turnbull et al., 2013). This multi-faceted approach can use political, institutional, cultural, social, environmental, human, economic, and physical factors to develop, create, and expand tsunami risk reduction processes.

8.4. Policy implications from the research findings

This study has important implications for discourses on disaster preparedness, especially in Mentawai and generally in Indonesia. The scholars (Flyvbjerg, 2011; Yin, 2014) agree that the findings of a qualitative case study can be generalizable to all local community of Mentawai and even other parts of Indonesia. The generalizability of this study case is that tsunami preparedness measures are important to be implemented, especially in all parts of Mentawai. As we can see, the Mentawai islands are prone to tsunami hazards; therefore, all the population at risk, the heads of *dusun* and villages, religious leaders, NGO activists, the media, and the district government should be involved in the end-to-end preparedness measures. The planning, implementation, and evaluation processes of tsunami preparedness measures require the involvement of all. Moreover, the generalizability can be made that the Indonesian Government is required to develop a number of public programs, policies, and certain regulations to implement disaster risk reduction programs in general, and tsunami risk reduction programs in particular, in tsunami hazard prone areas in Indonesia.

Nowadays, people easily carry out activities for business, pleasure, or have social interactions with people from other areas, including coastal areas. Thus, in terms of tsunami threats, people who live inland can be exposed to tsunami waves. In relation to this, therefore, all communities of Indonesia should have public education on tsunamis. The Central Government needs to address and accelerate tsunami community preparedness measures and involve all elements to participate. As also found, a number of the traditional tools in Mentawai can be used for tsunami warning systems and I believe other communities have their traditional and local tools that can be used. Therefore, the Central

Government should develop standard pre-designated codes, so that all people understand the codes as warnings.

8.5. Areas for further research

This study focused on only small parts of the whole picture of Mentawai. Although the study produces a number of significant insights, it never completely describes the whole phenomena in Mentawai. Below are potential research questions that are important to be answered, as follows:

- The documentation of tacit knowledge related to escaping from tsunami waves is necessarily imperative to be done within the local community of Mentawai. This will enable the capturing of their tacit knowledge and then explicitly sharing it with other community members.
- The implementation of a public program from the study findings is important and involves the relationship of the community, the local NGOs and the local government. However, the findings also indicate, that somehow the relationship is not too harmonious. Hence, it is critical to discover the relationship model in order for a better implementation of the public program in Mentawai.
- The study findings also show the significance of how the women have important roles in developing tsunami preparedness as well as how they could potentially comprise more of the victims in the event of a tsunami. Therefore, undertaking further research on the importance of the women's roles is important. This research can focus on disaster risk reduction from a wide perspective and on tsunami preparedness from a more specific perspective in Mentawai.
- The research demonstrates that the local community of Mentawai seems to have less influence of the local government in term of tsunami preparedness. However, literature and evidence show that the role of local governments in developing a community's preparedness is central. Hereafter, a qualitative research on how the district government of Mentawai can provide proper insights about the local government can be undertaken.
- As found from the field, although a number of the local community members in Mentawai had moved inland, however, they still worked, and slept over night in the coastal areas. It could be that the same practice is found within the community.

Therefore, it is important to find a good model on how the local community could have livelihoods inland or, alternatively, how they can fish and not sleep over in the coastal areas. Thus, research to develop this model is imperative in the future.

- Besides the Mentawai Islands being close to the subduction zone of the India-Australia Plate and Eurasia Plate, a number of islands are also situated close to the same zone. The islands of Batu (located up north) and Nias and Simeulue (further north) and Enggano (far west) from Mentawai are also prone to tsunami waves. Therefore, it is also important to carry out a number of qualitative researches in those communities to provide better insights into how the communities are prepared for potential tsunamis.
- It is important to develop certain pre-designated codes to warn the community about the tsunami waves. As discussed, traditionally, the people used certain codes when hitting *tuddukkat* to inform of specific occasions to others. Therefore, it is good for the local government to research this potential and decide on suitable pre-designated codes to deliver warnings to the community. In the future, these pre-designated codes can be expanded to other communities in Indonesia.

8.6. Concluding remarks

It has been demonstrated throughout this thesis that there is high vulnerability of the local community of Mentawai to tsunamis and limited efforts in developing preparedness. It has also been revealed that a number of channels as information resources delivered the tsunami hazard warnings; however, a number of factors hindered the community's access to the needed information. These paradoxical conditions rooted my investigations that they are simple facts in the real-life situation in the community.

I have found that that several factors cause their vulnerability. The change in their old settlement from the coasts to inland was not accompanied by active alteration of livelihoods. Moreover, their ignorance or even complacency was increased by relying on passive actions that can jeopardise their safety any potential tsunamis. In addition, although tsunami preparedness measures at the individual, household, and *dusun* levels are found, the people have not maximized their potentials, resources, and local strategies to enhance their capacity. On the other hand, the local government, local NGOs, and media are important for the community, but they are not always available and accessible.

In the end, self-empowerment among the community and a beneficial relationship amongst the local government, local NGOs, and local community can be an integrated development approach to solving the limited capacity, to develop and sustain their livelihoods, and even to revitalize their own traditional identity.

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Attachment 1
The Recommendation Letter for The UC Human Ethic Committee

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

HUMAN ETHICS COMMITTEE

Secretary, Lynda Griffioen
Email: human-ethics@canterbury.ac.nz

Ref: HEC 2013/164

7 February 2014

Berton Panjaitan
Department of Geography
UNIVERSITY OF CANTERBURY

Dear Berton

The Human Ethics Committee advises that your research proposal "Factors influencing cultural adaptations to earthquake and tsunami hazards in the Mentawai Islands, Indonesia: past and future" has been considered and approved.

Please note that this approval is subject to the incorporation of the amendments you have provided in your email of 4 February 2014.

Best wishes for your project.

Yours sincerely

Lindsey MacDonald
Chair
University of Canterbury Human Ethics Committee

Attachment 2

The Recommendation Letter for doing the Research from the Provincial Government of West Sumatra

PEMERINTAH PROVINSI SUMATERA BARAT

BADAN KESATUAN BANGSA DAN POLITIK

Jln. Kuini No.79 A Telp / Fax. 0751 - 31554 Padang

Website :http ://www.sumbarprov.go.id e-mail: kesbangpolprov.co.id

REKOMENDASI PENELITIAN

No. B.070/584 / Was-BKPol / 2014

Dasar

1. Undang-Undang Republik Indonesia Nomor 18 Tahun 2002 tentang Sistem Nasional Penelitian, Pengembangan dan Penerapan Ilmu Pengetahuan dan Teknologi;
2. Undang-Undang Republik Indonesia Nomor 32 Tahun 2004 tentang Pemerintah Daerah sebagaimana telah diubah beberapa kali, terakhir dengan Undang-Undang Nomor 12 Tahun 2008;
3. Peraturan Menteri Dalam Negeri Republik Indonesia Nomor 20 Tahun 2011 tentang Pedoman Penelitian dan Pengembangan diLingkungan Kementerian Dalam Negeri dan Pemerintah Daerah;
4. Peraturan Menteri Dalam Negeri Republik Indonesia Nomor 64 Tahun 2011 tentang Pedoman Penerbitan Rekomendasi Penelitian;

Menimbang

a. Bahwa untuk tertib administrasi dan pengendalian pelaksanaan Pengambilan Datadan pengembangan perlu diterbitkan rekomendasiPengambilan Data;
b. Bahwa sesuai Surat Sekretariat Utama Badan Nasosial Penanggulangan Bencaba (BNPB) Nomor : B 415/50/HK.10/4/2014 tanggal 11 April 2014 perihal Izin Penelitian
c. Bahwa sesuai konsideran huruf a dan b, serta Hasil Verifikasi Badan Kesatuan Bangsa dan Politik Provinsi Sumatera Barat, berkas persyaratan administrasi penelitian telah memenuhi syarat sesuai pasal 4, 5 dan 6 Peraturan Menteri Dalam Negeri Republik Indonesia Nomor 64 tahun 2011 tentang Pedoman Penerbitan Rekomendasi Penelitian.

Gubernur Sumatera Barat, Memberikan Rekomendasi Kepada :

Nama	:	**BERTON SUAR PELITA PANJAITAN SKM, MHM**
Tempat/Tgl Lahir	:	Marihat, 5 Oktober 1969
Pekerjaan	:	PNS
Alamat	:	Jl. Gunung Merbabu 181, Mabad 124 Rempoa, Ciputat
No.Kartu Identitas	:	3674030510690003
Maksud / Judul	:	FAKTOR2 YANG MEMPENGARUHI ADAPTASI KULTUR TERHADAP GEMPA DAN TSUNAMI DI KABUPATEN MENTAWAI
Lokasi Penelitian	:	Kota Padang dan Kab. Mentawai
Waktu /Lama Penelitian	:	April- September 2014 (6 Bulan)
Anggota	:	

Dengan ketentuan sebagai berikut :

1. Berkewajiban menghormati dan Mentaati Peraturan dan Tata Tertib di Daerah setempat/Lokasi Pengambilan Data
2. Pelaksanaan Pengambilan Data agar tidak disalahgunakan untuk tujuan yang dapat mengganggu Kestabilan Keamanan dan Ketertiban di Daerah setempat/Lokasi Pengambilan Data;
3. Melaporkan hasil Pengambilan Data dan sejenisnya kepada Gubernur Sumatera Barat melalui Badan Kesatuan Bangsa dan Politik Provinsi Sumatera Barat dalam kesempatan pertama;
4. Bila terjadi penyimpangan dari maksud/tujuan rekomendasi penelitian ini, maka surat rekomendasi ini tidak berlaku dengan sendirinya.

Demikianlah Rekomendasi ini dibuat untuk dapat dipergunakan seperlunya.

Padang, 29 April 2014

An.GUBERNUR SUMATERA BARAT

KEPALA BADAN KESATUAN BANGSA DAN POLITIK

PROVINSI SUMATERA BARAT

U/B. KABID KEWASPADAAN

ZUL ALIMAN,SE.MM

Nip. 19590308 198110 1 001

Tembusan kepada Yth :

1.Bapak Gubernur Sumatera Barat (sebagai laporan)

2.Sdr.Kepala BPBD Prov. Sumatera Barat di Padang

3.Sdr Walikota Padang c.q Kepala Kantor Kesbang Pol Kota Padang di Padang

Attachment 3

The Supporting Letter for doing Research from BNPB

BADAN NASIONAL PENANGGULANGAN BENCANA
(BNPB)

SEKRETARIAT UTAMA

Jl. Ir. H. Juanda No. 36 Jakarta Pusat 10120
Telp. (021) 3442734, 3443078, 3458400, Fax. (021) 3505075, 3519737, 3458500
Website : www.bnpb.go.id

Jakarta, 23 April 2014

Nomor : B. 464 /BNPB/SU/PL.02 /4/2014
Lampiran : -
Perihal : *Permohonan bantuan penelitian a/n Sdr. Berton Suar Pelita Panjaitan*

Kepada Yth:

di
Tempat

Bersama ini kami sampaikan bahwa staf/pejabat BNPB atas nama:

Nama	: **Berton Suar Pelita Panjaitan**
NIP	: 19691005 199312 1 002
Pangkat/Gol.	: Pembina, IVa
Unit Kerja	: Biro Hukum dan Kerjasama (Settama, BNPB)

sedang melaksanakan pendidikan doktoral di *University of Canterbury*, Selandia Baru akan melakukan penelitian lapangan:

Judul Penelitian : Faktor-faktor yang Mempengaruhi Adaptasi Kultur terhadap Gempa Bumi dan Tsunami Di Kepulauan Mentawai, Sumatera Barat, Indonesia: Dari Masa Lalu ke Masa Depan
Waktu : April – September 2014.

Untuk maksud tersebut, mohon kiranya Bapak/Ibu/Sdr/i berkenan membantu dalam pengumpulan data melalui wawancara, observasi, dan atau memberikan data, salinan dokumen, informasi artefak atau yang lainnya.

Atas bantuan dan kerjasamanya, kami sampaikan terima kasih.

Sekretaris Utama

Ir. Fatchul Hadi, Dipl.,HE.

Tembusan:
Kepala BNPB (sebagai laporan)