TSUNAMI 2004 PREPAREDNESS FROM THE PERSPECTIVE OF THE PENANG COMMUNITY

Syakura A Rahim[1]
Aini Mat Said[1]
Elistina Abu Bakar[1]
Norhasmah Sulaiman[2]
Fakhru'l-Razi Ahmadun[3]
[1]Department of Resource Management and Consumer Studies,
Faculty of Human Ecology, UPM
[2]Department of Nutrition and Dieteties,
Faculty of Medicine and Health Science, UPM
[3]Department of Chemical and Environmental Engineering,
Faculty of Engineering, UPM

Introduction

It has been 10 years since the 2004 Sumatera-Andaman earthquake which was the largest earthquake in 40 years with a moment magnitude of Mw=9.2 with seismicity travelling 1600 km along the entire Andaman fault. Sumatra-Andaman earthquake affected 12 countries across the Indian Ocean (Lay *et al.*, 2005). The epicentre was about 100km from Aceh. The accurate number is unknown (Thomas, 2001) but an estimated number of 250 000 deaths was reported, 51 000 missing and around 1.5 million were displaced swept by the force of the tsunami wave. Property and economic damage were estimated to be worth billions of USD (Rodriguez, Wachtendorf, Kendra & Trainor, 2006).

Peninsular Malaysia lies in the shadow of the Pacific Ring of Fire. Besides extreme heat, storm, flood and the consequences of heavy rain, other natural disasters are as foreign as snow falling in the tropics. Although light tremors are felt from Indonesian earthquake but there is no devastating impact as Peninsular Malaysia is protected by Sumatera in the west and Borneo in the east. The unprecedented event is a wake-up call indicating Malaysia is no longer a natural disaster threat free country.

Malaysia was caught off guard facing the unforeseeable encounter with 2004 tsunami. The first tsunami wave hit Langkawi shoreline between 12.00 to 12.30 (local time) in the afternoon and between 1.00pm to 1.30pm along 200

km coastal line from Kedah, Penang to Selangor, implicating people by the beach causing 68 reported deaths, 6 declared missing, 91 hospitalized, 276 received treatment and 10,564 evacuated to safety (Aini, Fakhru'l-Razi, Ahmad Rodzi & Fuad, 2011). Penang reported the highest death toll of 54 lives which is 79 percent out of the total loss of life in Malaysia.

Research centres were established to conduct studies on tsunami, earthquake and other disasters as well as to promote scientists to collaborate on future studies. Simulation software was developed to explore the devastation of tsunami by calculating the force of tsunami wave and the magnitude of impact (Koh, Teh, Liu, Ismail & Lee, 2009; Teh, Koh, Liu, Ismail & Lee, 2009). The shallow waters of the Straits of Malacca and mangroves surrounding the island and peninsular act as natural barriers reducing the force, slowing down tsunami waves (Alongi, 2008; Hashim, Kamali, Tamin & Zakaria, 2010). Research conducted by Fisheries Research Institute Malaysia found the quantity of fishes remained normal with non-threatening level of bacteria in seafood (Ean, Siow & Ali, 2005).

In Malaysia, the magnitude of tsunami devastation was greater on rural coastline communities as most of them have low income and depend on the sea for their livelihood (Stobutzki & Hall, 2005) leaving psychological and socio economic impacts (Chamhuri, Mohd Zaki, Halina & Roslina, 2006; Horton *et al*., 2008; Krishnaswamy, Subramaniam, Indran & Low, 2012; Stobutzki & Hall, 2005) in the lives of many. Total value of property and economic damage is estimated to be around USD 55 million. The fisheries and aquaculture sector suffered greatly, affecting 7,721 fishermen and 232 fish farmers with a reported loss of 3,626 boats, vessels and aquaculture farms worth more than USD 17 million. Most of the victims were fishermen and settlements living near the water edge. According to Ibrahim *et al.* (2005) the average loss per home destroyed is estimated to be around USD 13,000 to USD 15,000. The ramification of the 2004 tsunami is alarming as many became homeless and lost their source of income (Asmawi & Ibrahim, 2013; Chamhuri *et al.*, 2006; Horton *et al.*, 2008). Minimal research has been conducted to explore the issues and challenges faced from a community's perspective. The community's first-hand experience with tsunami provides valuable information from which lessons can be garnered to improve the effectiveness of future disaster response.

The main objective of the study is to ameliorate community preparedness by exploring the effectiveness of tsunami 2004 disaster response from the perspective of local community. The specific aim of this paper is to explore the challenges and lessons learnt during the 2004 tsunami as well as the involvement of villagers and agencies in disaster response and recovery.

Another objective, among others is to identify actions taken by locals to prepare for future tsunami events.

Literature Review

Disaster is an event concentrated in time and space in which society or its subdivision undergoes physical harm, social disruption with essential being impaired (Lindell, 2013). Disaster and emergency management activities are generally divided into three phases: preparedness, response and recovery.

In any disaster, government leaders (district, state, federal) will be the responsible group to oversee all emergency management tasks (response, mitigation, recovery, preparedness) and initiate funding for disaster recovery (Shaw, 2014). Navigating emergency management during disaster response is complex as it requires coordinating multiple agencies with hundreds of staff hence a systematic preparedness approach is needed to cater the complexity. Emergency responders under Directive 20 will be deployed immediately to ground zero for search and rescue. However, the community as the first responder needs to know and be prepared to evacuate and survive as timing is crucial before responding agencies arrive. For an emergency response to be effective, disaster preparedness must start locally.

Planning for a moderately sized disaster to kick start disaster preparedness is more realistic and achievable. Lack of funding or financial instability often results to apathy. It is important to start with limited interest and make-do with what is available before jumping into full swing disaster preparedness to engage and maintain interest within the community towards disaster preparedness. It is arduous to overcome apathy but by recognizing the community's need, it is possible to cultivate disaster preparedness attitude.

Preparedness is the first step in emergency management, being in a state of readiness to respond to disaster, crisis and emergency situation (Haddow, Bullock & Coppola, 2007). Preparedness focusses on sustaining the viability of the community by protecting lives, properties and government services. The navigation of a grave emergency management is very complex that involves inter-agency coordination with hundreds of staff. Out of this need, the preparedness cycle recognizes four major components: planning, equipment, training and exercise that is applicable to individual, household, business, government agencies and other entities (Haddow, Bullock & Coppola, 2011).

The planning phase involves tweaking and understanding the vulnerability of the emergency management, communities and individuals, to determine

resources, capabilities and weaknesses at hand. Emergency management planners will be able to foresee areas exposed to hazard risks and areas that will most likely bear heavy impact and identify appropriate measures to respond. Lessons learned (final step in preparedness cycle) from disaster response depicts emergency response capabilities, resources and limits as well as the community's susceptibility towards disaster hazard which is vital to improve future iterations. There is a gap when it comes to comparing natural disaster response, disaster recovery and impact of tsunami in the Malaysian context to the local community.

In 2005, the Inter-Agency Committee for Tsunami and Earthquake Risk Management (IACETRM) endorsed Seismic and Tsunami Hazard and Risk Study in Malaysia. The Academy of Sciences Malaysia was appointed to coordinate, manage and monitor the implementation of the research with an allocation of RM4 million to initiate a study to assess seismic related activity, mapping, structural behaviour and public awareness in Malaysia. The study continued venturing further in-depth with grant allocation from MOSTI under E-Science Fund, and the establishment of more research centres (Koh, Teh, Taksiah, Lau & Fauziah, 2012).

To reduce death tolls, property damages and disruptions of life, Hyogo Framework of Action was born through UN World Conference on Disaster Reduction in 2005, emphasizing on the Five Priorities; 1) Making disaster risk reduction a priority; 2) Improving risk information and early warning; 3) Building a culture of safety and resilience; 4) Reducing risks in key sectors, and 5) Strengthening preparedness for response.

The framework not only stresses on disaster risk reduction but also the importance of disaster preparedness to save lives, livelihood and sustainable social and economic development, to ensure the community can recover and re-bounce as soon as possible.

Community based approach recognizes the importance of reducing local vulnerabilities and develop into resilient community. Factors taken into account when implementing Community Based Disaster Management (CBDM) include mandate of the organizations involved, the community's socio-cultural and economic context as well as political structure. CBDM approach and guidelines complements Hyogo Framework of Action, assisting government officials, NGO's, civil society organizations and community leaders to formulate a programme tailored for their community hence improving the overall quality and effectiveness of the concept. Community Based Disaster Risk Management (CBDRM) approach is diverse due to the

various traits of a community but still bearing the same concept and underlying goal.

Various on-going efforts and collaborations have been made by UNISDR, Asian Disaster Reduction Centre, Asian Disaster Preparedness Centre, non-governmental organizations (NGO) and international organization supporting CBDRM to mobilize and integrate activities as well as policies into national and state jurisprudence in ministries, government bodies and departments.

The main aim of CBDM is to create and develop a resilient community in a resilient environment within a resilient country by applying risk reduction measures, reducing the consequences of loss of lives, properties, injuries and identify patterns that can stall or become a hurdle to a prominent recovery. CBDM approach is based on the following principles: 1) Priority to the role the community will play, 2) Priority to the highest level of risk, 3) To differentiate the difference between risk and capabilities, 4) Multi-sectorial approach and discipline area, 5) Integrating disaster risk management in the process of local development, 6) Priority to disaster risk reduction, and 7) To take into account global issues such as climate changes, epidemics, etc. Unlike most conventional disaster management, decision making comes from the top (top-down) while CBDM applies the opposite approach of bottom-up whereby the community participates in identifying the hazard risks and solutions in their area by working hand in hand with agencies to build a resilient community. Disaster management is not a single combat issue because society and culture are deeply rooted in a community. Therefore it is important to incorporate socioeconomic activities of the people into community-based activities to create a sense of belonging, enabling them to express their needs, priorities, life hurdles and concerns (Shaw, 2012). People of the community consist of residents, schools, local associations, business entities, government agencies (National Security Council, Police Force, Fire and Rescue, Department of Public Works, etc.) and non-governmental agencies (Red Crescent, Mercy etc.). The local community has the highest stakes when it comes to disaster impact as they will be the first to be hit regardless of the size of the impact and the most vulnerable to hazard, and at the same time the first to gain from the outcome of being disaster prepared.

Penang is an exceptionally urbanized island with the highest population density in Malaysia that is rapidly developing along the shoreline. Coastal reclamation is also a favourite option to build high-rise buildings. New coastal reclamation projects have been approved by the Penang government to build high-rise mix complexes (resident area, office and shopping complex) on 3 man-made islands just off the shoreline of Jalan Tokong, an area that was swept by the 2004 tsunami. In general, tsunami is a household

term but community are oblivious to the devastation of the impact and ignorant to take precaution, partly because it is a rare natural disaster. Posters and brochures were dispersed throughout the community, complemented by workshops and disaster drills conducted by government agencies (e.g: National Security Council and District Office) as well as non-governmental organization (e.g: Red Crescent) to create awareness.

The most vulnerable areas based on the 2004 tsunami were fishing villages, business entities and settlements by the shore, and tourist areas along the beach. Most of the household are in the below and low income category with little to zero knowledge on tsunami response. In 2004, the first tsunami wave hit Penang shore between 1.00pm to 1.30pm killing 54 people, destroying 615 homes, 1161 boats, 79 aquaculture projects and sea farms amounting to RM50 million in Penang alone. The time interval provide more than enough time to evacuate compared to the Islanders of Simeulu Island who had only about 8 minutes before the first wave of 10 metres hit the shore. Lessons learned from previous disasters act as a bench mark for the government and other entities to avail from the experience to develop a comprehensive organizational structure and develop a disaster response and preparedness programme.

Methodology

Focus group discussion was the chosen method for conducting the study. This is to provide a dimension for the target participants to interact among each other, to exchange ideas, point of views and to acquire knowledge, perspectives and perceptions that can explain a certain behaviour which is considered more accessible to share in-depth exploration of the theme topic compared to a one to one interview (Wong, 2008).

The location of the study consists of two districts, North West and South West of Penang that was badly affected by the recent tsunami. It was estimated to have about 6590 families residing about 100 metres to 2 kilometres away from the shoreline from Pantai Pasir Panjang, Balik Pulau to the end border of Batu Ferringhi. The highest tsunami wave to hit was about 6 metres high (Ibrahim *et al.*, 2005).

The focus group discussion was conducted among 17 agencies under the Penang District Disaster Management and Relief Committee as well as key community leaders amounting to a total of 34 participants. Agencies involved include uniformed bodies such as local police, firemen, civil defence and maritime enforcement and responding agencies which include the district and land office, health department, Red Crescent, welfare department, road works

department, education department and the broadcasting department. Key community leaders from the area were also contacted to represent the community. Representatives from each of the agencies and community were invited and were divided into two groups according to their roles which were responding agencies (25 representatives) and community (19 representatives).

All the members of the team were present during the group discussion with two researchers acting as moderators for each group and the others as observers. The focus group discussion took about 90 to 120 minutes. Notes were taken and the discussion for each group was videotaped and audio recorded with the permission of the participants and later transcribed verbatim. Their responses were then analysed and a thematic analysis was done to group the responses according to the themes that emerged.

The questions asked were in the form of open ended question to elicit their experience during the 2004 disaster response and lessons learned. A list of questions to steer the FGD taken from Aini *et al.* (2011) are listed below:

- Describe your experience in responding to 2004 tsunami;
- Identify the strengths and weaknesses of the tsunami 2004 emergency response and suggest ways for improvement;
- Explain the roles and responsibilities of your agency in handling the 2004 tsunami disaster.
- How do you rate your agency in terms of its level of preparedness to disaster response in general and which areas need to be enhanced?
- Give your opinion on the comprehension and implementation of Directive 20 in disaster response and relief efforts; and
- Describe efforts undertaken by your agency in enhancing public awareness to disaster and suggest ways to achieve it.

Findings and Discussion

From the raw data obtained, seven themes were extracted after analysis and interpretations were done using the codes that were assigned to identify overt and covert contents.

Collaboration

The 2004 tsunami was the first experience for all disaster responders and an epitome when facing an unknown disaster. Personnel from responding agencies and local authorities reported that they did not know the person in charge to contact from other agencies to collaborate for the search and rescue. Approvals and decision making took time as the approach was top-

down and decision makers had to refer to a specialist. Responsibilities of each agency were unclear with ambiguity on the roles played and the chain of command, leading to miscommunication. The lack of understanding of the nature of tsunami itself made it difficult to inform the community and to guide them to safety. Flood shelter was used as a temporary tsunami shelter. Community leaders claimed they had issues in the opening of the shelters. For example, a) the key to open the shelter was missing, b) the shelter key bearer failed to be contacted, c) had to get formal approval to open shelter. These issues could have been avoided with better communication.

Communication

The village headman reported during the discussion that there are warning towers along the beach equipped with hailer but the towers were empty almost all the time. Due to the topography of the island, warning sounds via a hailer or sirens can only be heard around the beach and is not within the hearing of residential areas along the coastal line. Community leaders and local head of village propose the placement of more sirens nearer to residential areas.

Emergency responders expressed difficulty finding clear reception and proper frequency to communicate with other emergency responders using radio control. A common frequency was also non-existent, making it very challenging to change one frequency to another. Action plans were unclear, due to the inexperience of tsunami participants from responding agencies who admitted that they were stunned and did not know how to respond appropriately.

Early warning

There are many international hotels in Batu Ferringhi, full of patrons all year round. According to one of the head of hotel security, who was also one of the participants in the discussion, they received tsunami warning from the hotel's branch in Thailand. Note that international hotels with extensive network successfully warned their patrons to vacate the beach to higher ground. Early warning and immediate action had saved the lives of tourists in the area as there were no casualties among foreign visitors. Warnings were given to them by their sister hotels in Thailand. Hotels in Batu Ferringhi aided the surrounding community in relief efforts as part of their Corporate Social Responsibility Programme.

Disaster Evacuation Centres

Tsunami evacuation centre was non-existent. According to the participants, houses were either swept away or badly damaged. They were put up in schools nearby, cramped for a few weeks before they were moved to a temporary shelter. There is a difference in criterion between flood and tsunami evacuation centre due to the nature of disaster where tsunami is a forceful wave with a sudden increase in height and run-up (Suppasri *et al*., 2012). Buildings in high grounds or are vertically structured are ideal as evacuation centres. Disaster Evacuation Centre which is located in a tsunami safe zone should act as a final destination for safety, must be equipped with food, medical supplies and basic necessities. Every evacuation route will have its own evacuation centre spread out to cater for the community evenly.

Evacuation routes

Participants reported there is only one main road connecting coastline communities to main town. Emergency responders mentioned they had a difficult time reaching ground zero to bring medical supplies and extract victims to seek medical attention. An alternative exit needs to be identified to transport emergency supplies from the main town to the villages.

Recovery

Participants spoke of difficulty to sustain their life after the loss of their source of income. Many suffered from sleep disorder and anxiety. A family who lost all their children secluded themselves from society until today.

Awareness

As the back bone of a family, women as mothers and wives have strong influence and play an important role in educating their household members. Women spend more time at home, being in charge of the family when their husbands are out to work. Awareness campaign and adequate training involving women increases awareness in the household and promotes the importance to be prepared for emergencies (Kapucu, 2008).

Malaysia had a fair share of natural hazards in the form of periodic monsoon causing landslide, flash flood, flood and drought eliciting extreme heat and haze but nothing prepared Malaysia for tsunami. Albeit there was information received from international agencies and organizations, it did not reach the community and no warning was issued to minimize the impact from the disaster. International hotel chains received tsunami warning from their

siblings in Thailand. Malaysian authorities failed to generate effective tsunami warnings. Prior to the 2004 Great Sumatera Andaman tsunami, there was no tsunami warning system installed in the Indian Ocean to monitor underwater earthquake movement to warn of potential tsunami threat (Aini *et al*., 2011; Athukorala & Resoudarmo, 2005; Horton *et al*., 2008). A public warning system consists of three subsystems: a detection subsystem, a management subsystem, and a public response subsystem (Mileti & Peek, 2000). The communication process begin with the reception of information, how it is interpreted and responded. A warning consists of two parts: a description of the hazard or threat about to occur and how it threatens public safety. It is the responsibility of the authority to warn the public. Timely access to accurate information is the key to a successful emergency response that could save lives. A common problem cited by many responders is radio interoperability (Manoj & Baker, 2007).

A comprehensive approach to handle tsunami disaster was non-existent to guide responding agencies at the district, state and federal level. Every agency has a unique standard operation procedure and a chain of command to approve decisions made. Without approval from top management, agencies are withheld from taking any action that requires a sign-off. The absent of an appointed commander to lead and delegate the agencies' task on a neutral platform during a disaster emergency, created further complications posing misunderstanding and friction among search and rescue personnel. In the midst of the chaotic atmosphere, communication plays an important role in keeping the situation under control. Federal government had to formulate an action plan ad-hoc to manage the disaster, formulate an action, evaluate a plan and assist to salvage and contain the situation.

Malaysia National Security Council under the Prime Minister's Department is responsible for managing threats toward the country. The National Security Council Directive 20 was formed, a decree comprising of 29 titles and 19 appendixes that acts as a guideline focusing solely on the management of land disasters including the responsibility and function of numerous agencies that has been placed in the emergency management system. The primary function of Directive 20 is to formulate a comprehensive emergency management system with the aim to; a) extenuate the impact of various hazards, b) to take measures to conserve life and reduce damage to the environment at minimum level, c) to respond and provide during emergency effectively, and d) to establish a recovery system that will return the affected community to normalcy as soon as possible. Alas, on 26 December 2004 tsunami was non-existent in the decree. Tsunami disaster was met without any counter measure efforts. Later in 2005, tsunami was added into Directive 20.

Agencies must be in symphony working on a neutral platform, and establish an emergency frequency so that all responders can tune in during emergencies to form a cohesive response plan. Tabletop exercises among responding agencies provide insights on the strengths and weaknesses of the role they should play and at the same time act as a networking platform to get to know each other (Dausey, Buehler & Lurie, 2007). A regularly revised compilation of names and contact numbers of the person to be contacted during a crisis should be exercised in all the relevant agencies. A close inter-agency relationship is important during intense situations so as to respond effectively, and to be able to integrate an immediate search and rescue mission.

A crucial factor to consider when designing an evacuation route is the amount of time it takes to reach the disaster evacuation centre as well as the condition of the proposed path since after the tsunami warning is given, it takes around 20-40 minutes for the first wave to reach coastline (Lammel *et al*., 2010). Input from the community in designing an evacuation route is of great significance to identify and verify by in-site examination, the best route as they are well versed with the surrounding (Lammel *et al*., 2010).

Tsunami awareness among the community is a crucial factor in order for them to be prepared and to evacuate before help arrives. Participating agencies commented that giving warning through patrol cars, television, radio and public address system are deemed effective. Early warning gives time for people to respond in a timely manner and to evacuate the area (Aini *et al.*, 2011). Welfare departments in charge of handling emergency sheltering need to identify a safe location for tsunami victims. The shelter should be equipped with basic facilities, infrastructure and well prepared for emergencies. Psychosocial support for the victims soon after the disaster in the form of counselling, funeral services, prayers and religious activities, family reunification as well as financial aids to start economic activities raises hope and provides emotional support, expedites the return to normalcy and reduces the probability of posttraumatic stress disorders (Krishnaswamy *et al.*, 2012). Compensations and housing schemes were encompassed to aid the victims who have lost their homes. Small businesses were encouraged to diversify their source of income (Horton *et al*., 2008).

Conclusion and Implications

To the best of our knowledge, this is the first focus group discussion examining the perception of responding agencies and communities during the Sumatra Andaman 2004 tsunami to improve tsunami emergency response and prepare the community for future tsunami disaster. As an initiative from

the government, research grants have been given to aid research in preparing the community. The current study which is funded by a grant from the Ministry of Science, Technology and Innovation, Malaysia is the first stage to create an emergency response plan that is viable to implement and flexible to fit the affected community.

The Malaysian Meteorological Department (MET) under the Ministry of Science, Technology and Innovation (MOSTI) has undertaken various measures to heighten mitigation and intensify preparedness such as the public awareness campaign by MET which centres around topics on extreme weather hazards like flood, haze and bushfire. In 2007, the module was upgraded to earthquake, tsunami and extreme weather public awareness campaign. The programme is held throughout the country but focuses more on earthquake and tsunami prone areas in North West of Peninsular Malaysia and East Sabah. Tsunami occurrence in Malaysia is so rare, the general public needs to continuously be reminded of the natural signs of tsunami, how to respond to tsunami warning, and what to do to be tsunami prepared in order to evacuate in a timely manner during critical moments. MET in collaboration with the National Security Council Malaysia aims to create awareness, as well as to spark interest that can lead to action to prepare for any disaster. The campaign is still on-going with participants from the community, media, government agencies and private sectors.

To monitor seismological activity, Seismological Division of Malaysian Meteorological Department was established in 1974, and later in 2007 was upgraded and renamed as the Geophysics and Tsunami Division. Following the 2004 tsunami under the watchful management of Geophysics and Tsunami Division, the Malaysian National Tsunami Early Warning System (MNTEWS) was set up to monitor real-time earthquake activities and tsunami occurrences on a 24-hour basis throughout the year with linkages to distant-source tsunami warning centres, the Pacific Tsunami Warning Centre (PTWC), Japan Meteorological Agency (JMA) and Indian Ocean Tsunami Warning Centre (IOTWS). Using the system's seismic sensor and tide gauge stations, the division will detect tsunamigenic earthquake occurrences and will disseminate informative bulletins (after careful analysis) to responsible agencies, authorities and entities within 15 minutes of the earthquake and other possible disaster threat through short messaging system, telefax, broadcasting system and public announcement using sirens and alarms.

MET is currently operating 17 seismological stations, 10 motion stations, 6 gauge stations, 3 operational deep water buoys, 4 operational coastal cameras with 18 to be installed in phases and 13 operational sirens installed in highly populated coastal areas with 18 more to be installed in phases. Tsunami

warning will be issued through a siren along the beach carrying messages, warning the community depending on the magnitude. There are two types of messages, i.e., Beware (avoid all beach activities) and Warning (evacuation will be ordered; follow instructions from authorities).

There is also a need for a neutral ground for all agencies to discuss, mingle and collaborate, to be equipped with an understanding of the roles they play and responsibilities to be carried out. Outlining roles, expectations from the outcome and studying the Penang District Disaster Management and Relief Committee help focus on the objectives as a team of responders rather than government departments.

Identifying tsunami safe zones and buildings based on tsunami inundation map is critical as tsunami inundation is different from flooding. Preparing an evacuation map and implementing the 30 minutes timeline to reach tsunami safe zone using the shortest route involving the community is an advantage as they are well versed with the area, and will promote community empowerment. A list of key person handling corporate social responsibility accounts and suppliers who can be contacted during an emergency for emergency aid kits, food and medications need to be tabled and updated. Awareness among community by spreading information (tsunami warning signal, evacuation zone and route) and knowledge using association, religious places, appointed community leaders and conducting tsunami awareness campaign need to be created as well. Although using social capital (community-based skills, network, resources) as an approach to post-disaster relief and recovery is time consuming, the result is significant and satisfying. Providing and promoting small and medium businesses among the local community helps diversify income and can act as a cushion to minimize any psychological impact.

Preparedness plays a critical role in disaster management from pre-disaster, during disaster to post-disaster. Disaster prevention planning, action and management, starts at the local level from the community, business entities, local authorities and agencies before a tsunami disaster strikes. Themes derived from the thematic analyses which are collaboration, communication, early warning, disaster evacuation centres, evacuation routes, recovery and awareness are the highlighted key areas critical for preparedness that need to be addressed. Long term endeavour, campaigns and investments in disaster prevention are essential (Haddow *et al*., 2007) to prepare communities for future disasters.

Preparedness programs and disaster drills organized by National Security Council, NGOs and other agencies must involve government agencies, local

residents, hoteliers, and business entities. Reiterating the importance of evacuating and responding in a timely manner and how to be prepared is a continuous and an on-going process. The involvement of government agencies, NGO's local responders, hoteliers, schools and community leaders has enabled the researchers to explore the community's experience and challenges they faced, giving insight to identify the weaknesses and hurdles to create an emergency response plan for the Penang community.

Acknowledgement

This research is funded by the Ministry of Science, Technology and Information Malaysia under the EScience Grant Scheme.

Reference

Aini, M.S., Fakhru'l-Razi, A., Ahmad Rodzi, M., & Fuad, A. (2011). Community preparedness for tsunami disaster: A case study. *Disaster Prevention and Management,* 20(3), 266-280.

Alongi, D.M. (2008). Mangrove forests: Resilience, protection from tsunamis, and responses to global climate change. *Estuarine, Coastal and Shelf Science,* 76(1), 1-13.

Asmawi, M.Z. & Ibrahim, A.N. (2013). The impacts of tsunami on the well-being of the affected community in Kuala Muda, Kedah, Malaysia. *Journal of Clean Energy Technologies,* 1(3), 246-250.

Athukorala, P.-c. & Resoudarmo, B.P. (2005). The Indian Ocean tsunami: Economic impact, disaster management and lessons. *Asian Economic Papers,* 4(1), 1-39.

Chamhuri, S., Mohd Zaki, I., Halina, M.H., & Roslina, K. (2006, 26-27 Disember). *Impact of tsunami on fishing, aquaculture and coastal communities in Malaysia.* Paper presented at the Development of Aceh International Conference Proceeding, Universiti Kebangsaan Malaysia, Bangi.

Dausey, D.J., Buehler, J.W., & Lurie, N. (2007). Designing and conducting tabletop exercises to assess public health preparedness for manmade and naturally occurring biological threats. *BMC Public Health,* 7, 92.

Ean, C.P., Siow, R., & Ali, M. (2005). Result of preliminary studies on the impact of the tsunami on fisheries and coastal areas of Penang and Kedah in

Malaysia by Fisheries Research Institute Malaysia. *WorldFish Center Newsletter,* 28(1 & 2), 25-25.

Haddow, G.D., Bullock, J.A., & Coppola, D.P. (2007). *Introduction to Emergency Management*. Butterworth-Heinemann.

Haddow, G.D., Bullock, J.A., & Coppola, D.P. (2011). *Introduction to Emergency Management* (Fourth ed.). Butterworth-Heinemann: Elsevier.

Hashim, R., Kamali, B., Tamin, N.M., & Zakaria, R. (2010). An integrated approach to coastal rehabilitation: Mangrove restoration in Sungai Haji Dorani, Malaysia. *Estuarine, Coastal and Shelf Science,* 86(1), 118-124.

Horton, B., Bird, M., Birkland, T., Cowie, S., Eong, O.J., Hawkes, A., & Yasin, Z. (2008). Environmental and socioeconomic dynamics of the Indian Ocean tsunami in Penang, Malaysia. *Singapore Journal of Tropical Geography,* 29(3), 307-324.

Ibrahim, K., Djin, T.H., Latiff, M.A., Anuar, J.T., Shafeea, L.M., Chamhuri, S., & Raihan, T.M. (2005). *Bencana Tsunami 26.12.04 di Malaysia Kajian Impak Alam Sekitar, Sosio-Ekonomi dan Kesejahteraan Masyarakat*. Kuala Lumpur: LESTARI, UKM and Malaysian Science Academy.

Kapucu, N. (2008). Culture of preparedness: Household disaster preparedness. *Disaster Prevention and Management,* 17(4), 526-535.

Koh, H.L., Teh, S.Y., Liu, P.L. F., Ismail, A.I.M., & Lee, H.L. (2009). Simulation of Andaman 2004 tsunami for assessing impact on Malaysia. *Journal of Asian Earth Sciences,* 36(1), 74-83.

Koh, H.L., Teh, S.Y., Taksiah, A.M., Lau, T.L., & Fauziah, A. (2012). Earthquake and tsunami research in USM: The role of disaster research nexus. *Pertanika Journal Science and Technology,* 20(1), 151-163.

Krishnaswamy, S., Subramaniam, K., Indran, T., & Low, W.Y. (2012). The 2004 tsunami in Penang, Malaysia: Early mental health intervention. *Asia Pacific Jpournal of Public Health,* 24(4), 710-718.

Lammel, G., Rieser, M., Nagel, K., Taubenbock, H., Strunz, G., Goseberg, N., Birkmann, J. (2010). Emergency Preparedness in the Case of a Tsunami - Evacuation Analysis and Traffic Optimization for the Indonesian City of Padang *Pedestrian and Evacuation Dynamics 2008* Berlin Heidelberg: Springer.

Lay, T., Kanamori, H., Ammon, C.J., Nettles, M., Ward, S.N., Aster, R.C., & Sipkin, S. (2005). The great Sumatra-Andaman earthquake of 26 December 2004. *Science,* 308(5725), 1127-1133.

Lindell, M.K. (2013). Disaster studies. *Current Sociology,* 61(5-6), 797-825.

Manoj, B.S. & Baker, A H. (2007). Communication challenges in emergency response. *Communications of the ACM,* 50(3), 51.

Mileti, D.S. & Peek, L. (2000). The social psychology of public response to warnings of nuclear power plant accident. *Journal of Hazardous Materials,* 75(2), 181-194.

Rodriguez, H., Wachtendorf, T., Kendra, J., & Trainor, J. (2006). A snapshot of the 2004 Indian Ocean tsunami: Societal impacts and consequences. *Disaster Prevention and Management,* 15(1), 163-177.

Shaw, R. (2012). Chapter 1. Overview of Community-Based Disaster Risk Reduction. 10, 3-17.

Shaw, R. (2014). Post Disaster Recovery: Issues and Challenges. 1-13.

Stobutzki, I.C. & Hall, S.J. (2005). Rebuilding coastal fisheries livelihoods after the tsunami: Key lessons from past experience. *WorldFish Center Newsletter,* 28(1 & 2), 6-12.

Suppasri, A., Shuto, N., Imamura, F., Koshimura, S., Mas, E., & Yalciner, A.C. (2012). Lessons learned from the 2011 Great East Japan tsunami: Performance of tsunami countermeasures, coastal buildings, and tsunami evacuation in Japan. *Pure and Applied Geophysics,* 170(6-8), 993-1018.

Teh, S.Y., Koh, H.L., Liu, P.L.F., Ismail, A.I.M., & Lee, H.L. (2009). Analytical and numerical simulation of tsunami mitigation by mangroves in Penang, Malaysia. *Journal of Asian Earth Sciences,* 36(1), 38-46.

Thomas, D. (2001). Data, data everywhere, but can we really use them? *American hazardscapes: The regionalization of hazards and disasters,* (pp. 61-76).

Wong, L.P. (2008). Focus group discussion: A tool for health and medical research. *Singapore Medical Journal,* 49(3), 256-261.