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Indigenous knowledge representation in mitigation process: a study of communities' understandings of natural disasters in Aceh Province, Indonesia

Abstract

Purpose: This paper explores the case studies of communities' understandings of natural disasters in Aceh Province, Indonesia, where a number of cultures and traditions which belong to the ancestral heritage continue to be used in a more modern context.

Methods: This research used a qualitative descriptive research paradigm in which the researcher attempted to describe or construct in-depth interview results for the research objects. The interviews were conducted in six disaster prone areas in Aceh, i.e. Simeulue, Central Aceh, Aceh Tamiang, Pidie Jaya, North Aceh, and dan Pidie. The interviewees were the informants in this research, which included traditional leaders, religious leaders, community leaders, headmen, youth figures and disaster victims. The technique for determining informants was through purposive sampling in which the sample is specified based on the need of the research.

Findings: The majority of people in Aceh, especially those who live in earthquake and tsunami prone areas, still practice this form of knowledge as they have already realized that it makes a significant contribution to emergency management. They typically used their traditional knowledge to understand both the nature of local hazards and the risk-reduction mechanism related to response mechanisms. In some events, they also used it as an alternative to a recovery phase according to past information and experiences. This paper will discuss the contribution of traditional knowledge to emergency management by presenting some specific cases of indigenous stories in Aceh. The stories not only served as an early warning system but also can be used to develop more effective disaster risk reduction programmes to improve community awareness in order to deal with future threats.

Originality: On Simeulue Island, most of the indigenous people already possess the knowledge and value systems inherited through the generations, as a form of local wisdom— called *smong*—when encountering earthquakes and tsunamis. Beside *smong*, there is still a considerable amount of other similar indigenous knowledge that originated amid traditional people, especially in rural areas, in Aceh. Thus, this paper attempts to identify the knowledge and its representation in the implementation of disaster mitigation efforts in Aceh.

Keywords: indigenous knowledge, mitigation process, disaster, disaster mitigation, disaster management

1. Introduction

Aceh is well known as one of the area most prone to disasters in Indonesia, both natural and man-made disasters. This is due to some factors, such as its geographical and geological condition and other social factors like political and sociocultural ones. Geographically, Aceh is located at the northern end of Sumatera Island making it the westernmost province in Indonesia. Geologically this province lies on the Sumatera Fault, one of the most active faults in the world which has generated many earthquakes in this area.

One of the most shocking quakes was the very destructive earthquake and tsunami that devastated the coastal areas of Aceh and Nias on 26 December, 2004. Most of the coastal areas were shattered by the tsunami in just a few minutes. The catastrophe not only destroyed much of the infrastructure and many buildings but it also killed more than 200,000 people. These facts make it one of the biggest disasters that has occurred

this century in terms of magnitude, the number of deaths, economic losses and social disruption.

In contrast, on Simeulue Island, seven people died due to the earthquake and tsunami. When compared to the total number of inhabitants of Simeulue Island— approximately 78,128 people as of June, 2005 of which the majority resided in the coastal areas—the number is not significant (BRR Aceh-Nias, 2009).

Figure 1. Map of Simeulue Island (*Source*: *The Government of Simeulue Regency, 2005*)

Post the 2004 tsunami, some successful local wisdom concepts— for instance, one on Simeulue Island, Indonesia and another on Moken, Surin Island, Thailand—have emerged and attracted the interest of researchers and practitioners. They used their ancestors' stories, which are passed orally from time to time within their communities, to survive the tsunami. One important thing to note here is that both communities applied protective actions to save their communities from disaster by using their ancestor stories, without depending on modern alert systems. On Simeulue Island, most of the indigenous people already possess the knowledge and value systems that have been inherited through generations, as a form of local wisdom when encountering earthquake and tsunami; this is called *smong*.

Besides the well-known *smong*, there is actually considerable similar indigenous knowledge that has been inherited and is practised by local people, especially in rural areas in Aceh. For example, people have to build their houses with a distance of more than 50 m to prevent the threat of flood, they place their chicken cages high off the ground, or they build traditional elevated wooden houses (Hiwasaki, Luna, Syamsidik, & Shaw, 2014) that prevent flooding and attracting wild animals. However, to this extent, there are many more that have not yet been unexplored.

Therefore, this paper attempts to identify the knowledge and its representation in the implementation of disaster mitigation efforts in Aceh. It is hoped that the paper will make a worthy contribution both scientifically and socially to a better understanding of how indigenous knowledge effectively helps traditional people in Aceh in dealing with various natural changes.

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2. Indigenous Knowledge and Disaster Mitigation
2.1 Definition and Characteristics of Indigenous Knowledge

Basically, many researchers agree that indigenous knowledge refers to sets of social behaviours, practices, and approaches to modes of living used and developed by local people, particularly native people. This knowledge originates from and is based on their ancestors' experiences, is strongly related to the way they live and interact with their environments, and is passed from generation to generation (Baumwoll, 2008; Berkes, 1999; Shaw, Uy, & Baumwoll, 2008). It includes a number of social and environmental aspects, such as ideas, cultures and customs, technological knowledge, natural resource management practices, beliefs and worldviews, tools, techniques and other adaptive activities preserved over generations to ensure long-term survival (Athayde *et al*., 2015; Maferetlhane, 2013). Berkes (1999) also has a similar perspective that indigenous knowledge usually pertains to either economic or social matters and cannot be set apart from environmental challenges.

Maferetlhane (2013), on the other hand, has argued that indigenous knowledge should be inclusive, that it covers both past and present knowledge, and survives and adapts to different environments. In other words, indigenous knowledge connects the bridge between their ancestors' lives with their present life today (Shiwaku & Shaw, 2008). Therefore, it can be said that indigenous knowledge is an invaluable asset for the local community as a whole whether they are natives or newcomers.

As a part of knowledge, indigenous knowledge has several fundamental characteristics: 1) it is generated within and owned by communities; 2) it is unwritten or orally transmitted across generations; therefore, it is not documented systematically; 3) it is widespread in an informal form; 4) it is unique and specific to a certain region and culture as it was created and developed locally based on its local context and circumstances; 5) it is dynamic which means that it is adaptable to new circumstances and continually develops based on peoples' experiences (Baumwoll, 2008; De Guchteneire, Krukkert, & von Liebenstein, 2004; Flavier, De Jesus, & Navarro 1995; Maferetlhane, 2013; Mundy & Compton, 1991).

2.2 Disaster Mitigation

Disaster mitigation is one of the most important aspects in disaster risk reduction (DRR) measures taken before a disaster occurs which focuses on reducing the natural hazards scale, intensity and impact. This proactive and comprehensive measure is performed in structural and non-structural efforts. The structural efforts are related to physical construction or engineering techniques that are used and applied in order to reduce the impact of a potential natural hazard, while the non-structural efforts consist of non-physical construction to reduce disaster risks and impacts through regulations, policies, training and education (UNISDR, 2017).

Disaster mitigation is essential in managing potential hazards and disasters as it helps people adapt to natural changes and survive natural threats. However, the implementation of this measure is largely dependent on the active and effective participation of related stakeholders, particularly the government, community and concerned agencies. Mitigation is not only dealing with the impact of disaster and/or predicting the potential hazards; it should also address the underlying causes of vulnerability (Maskrey, 1989) and promote communication and knowledge sharing among scientists, stakeholders and indigenous people (Athayde *et al*., 2013).

2.3 Indigenous Knowledge in Disaster Mitigation

In many parts of the world, indigenous knowledge has proven to be one of the most powerful measures for local people to deal with natural disasters. There are numerous examples of this: the story of the Moken community on the coast of Thailand (Arunotai, 2008); the islanders' tsunami coping mechanisms on the Solomon Islands (McAdoo, Moore, & Baumwoll, 2009); local Nigerian people plant bamboo and raffia palms to prevent soil erosion and lansdlide, while in Swaziland, the local people use the presence of the specific bird species' on trees to welcome the rainy season and predict the potential of flood (Iloka, 2016); the tribal forecasting climate in Rajashtan India (Pareek & Trivedi, 2011), and other hundreds of similar types of wisdom that may exist around the world. These various forms of disaster mitigation efforts can be regarded as an invaluable wealth of cultural treasures that will assist in increasing community awareness and preparedness for any potential threats and risks in the future.

These facts have attracted the attention of many researchers and scientists, especially those who are involved in disaster risk reduction and other related study areas, to further study the relationship between indigenous knowledge and disaster mitigation. They believe that indigenous knowledge is a very effective coping mechanism for a community with respect to various natural hazards and threats (Cronin et al., 2004, Cronin, Petterson, Taylor, & Biliki, 2004; Dekens, 2007a, 2007b; Mercer *et al*., 2010; Shaw *et al*., 2008). Moreover, Gunawan (2008) argues that local wisdom and the spirit of mutual aid are two crucial aspects in the implementation of an early warning system which is assumed to provide a greater understanding of the perils compared to other external elements.

This strong relationship between indigenous knowledge and disaster mitigation has also been declared by several concerned bodies, both nationally and internationally. In 2008, the Government of Indonesia through their disaster management agency (BNBP) had also enacted Law Number 21 Year 2008 regarding the Implementation of Disaster Management. It states in the document that, "The disaster assessment must be conducted by authorized agencies/institutions and communities with regard to the existing local knowledge. Moreover, the development of any disaster-resistant buildings and infrastructures must also be carried out by taking into account the local context."

Internationally, in 1995 the United Nations also launched a second International Decade of the World's Indigenous Peoples to strengthen international cooperation and commitment regarding indigenous peoples (Baumwoll, 2008). In the report document of the experts' meeting titled *Safeguarding the Transmission of Local and Indigenous Knowledge of Nature* (2004), it reports that local and indigenous knowledge is directly related to the natural world and certain environmental contexts. In 2005, post the 2004 Indian Ocean earthquake and tsunami, UNISDR acknowledged indigenous knowledge as a source to build a community culture of safety and resilience through knowledge, innovation and education in their Hyogo Framework for Action (2005–2015) document.

To this extent, the implementation of various risk mitigation measures with concern to local knowledge has delivered priceless lessons to related stakeholders about its importance for disaster risk reduction programmes that encourage individuals to take more appropriate steps and decisions. However, indigenous knowledge should complement rather than compete against the established global knowledge system (Nyong, Adesina, & Elasha, 2007). It should be a driving tool for local people to increase their resilience level.

Moreover, the success of translating the knowledge into action (Hiwasaki *et al*., 2014) and bridging the communication to support risk mitigation programmes (Athayde *et al*., 2015) also facilitates communication between scientists and local people (Shaw, Sharma, & Takeuchi, 2009) and will greatly affect the community resilience level as well.

As there is very little literature on this matter in the context of Aceh, this paper tries to explore the existence of indigenous knowledge that may have been forgotten, or even worse, be unknown to most of the local people today. This paper may further provide access to the local knowledge studied and enhance the development of best practices.

3. Research Methodology

This research used a qualitative descriptive research paradigm in which the researcher attempted to describe or construct in-depth interview results from the research objects. The interviews were conducted in six disaster prone areas in Aceh, i.e. Simeulue, Central Aceh, Aceh Tamiang, Pidie Jaya, North Aceh, and dan Pidie. The interviewees were the informants in this research and included traditional leaders, religious leaders, community leaders, headmen, youth figures and disaster victims. The technique for determining informants was through purposive sampling in which the sample is specified based on the need of the research. The total number of informants was 300 people.

Field observations and in-depth interviews were conducted to acquire data, facts and information regarding local wisdom on disaster risk reduction, knowledge management, and community solutions for disaster awareness and preparedness. Documentation was performed to provide additional data so that all the data obtained could be accounted for. Field observations were conducted by directly assessing the vulnerable places and conditions that may generate potential hazards (e.g. visited the river which often causes flooding, visited the coastline, etc).

As with other qualitative data, the data in this research are divided into two categories, i.e. primary data and secondary data. The primary data of this research were acquired from information extracted from in-depth interviews and field observations, while the secondary data were obtained from various documents and literature like books, writing sheets, etc.

All the acquired data were analysed using an interactive model introduced by Miles and Hubbermen. According to Miles and Hubberman (1994) there are three processes that take place interactively in this analysis model: 1) data reduction—a process of selecting, focusing attention on selecting as well as abstracting and transforming rough data that have appeared from various resources; 2) a process of reinforcing, shortening, removing unnecessary, defining focus and organizing data; and 3) drawing conclusions from the data that has already passed through both of the above stages.

4. Representation of Indigenous Knowledge for Disaster Mitigation in Aceh

In Aceh, the existing indigenous knowledge is mostly influenced by traditional, religious beliefs and practices. As more than 90% of the population is Muslim, the people believe that all events which occur in their lives are governed by God. They used to practice *du'a* (pray) and other related rituals to prevent abad things that might happen in their lives by pleading for help only from God. This is also believed to be one of the most important driving forces in the process of post-disaster trauma healing.

Below, we will present a brief representation of several coping practices that still exist in the midst of Aceh society nowadays. The practices are spread in six regencies in

Aceh: Simeulue, Central Aceh, Aceh Tamiang, Pidie Jaya, North Aceh and Pidie. These areas were selected because they frequently experience disasters; therefore, the local knowledge on disaster mitigation is well nurtured there.

4.1. Indigenous Knowledge in Simeulue

The former regent of Simeulue Island, in a speech for the Kick-off Assembly Meeting in Kobe, Japan in January 2006, said that the relatively small number of the dead in the 2004 Simeulue Island tsunami was due to several reasons—the power and destiny of God, the existence of local wisdom, and the topographic conditions.

As other regencies in Aceh province, most of the inhabitants who live in the island are Muslims. This religious tenet of life makes them always relate all events that happen to them, either good or bad, to the aspect of divinity. Therefore, the 2004 earthquake and tsunami are also believed to be a trial from God concerning their faith as humans.

Furthermore, one other reason for the small number of deceased is because they still practise a local wisdom created by their ancestors—a hereditary story about past tsunamis (Yusuf, 2007). The local people called it *smong*. The word *smong,* which means a splash of water, is derived from one of the local languages, Devayan. This story urges people to head to higher places if a large magnitude earthquake causes the sea water along the coast to recede from the shore. Though the story has spread out across the island, the wisdom is not nurtured anymore. The arrival of migrants from outside the island might be one of the main reasons why the wisdom slowly began to disappear over time.

The third reason is the topographic conditions. Simeulu Island is a hilly area and surrounded by avast ocean, the Indian Ocean. Therefore, when the 2004 tsunami struck, the people along the coast could easily reach the higher places and were saved. According to the local community leaders (*tuha peut*), through brief interviews, the areas worst affected by the 1907 tsunami were mostly located along the western coast of Simeulue Island, starting from Salur up to Salang. Another badly affected area was the Alafan subdistrict, particularly Lafakha and Langi villages.

Though the epicentre of the earthquake of the 1907 tsunami was on the western coast of the island, its history has spread widely throughout the island and has been recorded in the form of an oral story as a lesson learned for future generations.

There are a couple of reasons that encourage such dissemination:
- The position of Sinabang, the capital city of Simeulue Island, located in the western part, and now the centre of government activities. It has been last since the colonial period until now. It is the prominent meeting point for local people from different parts of the island. From this place, the islanders who have visited bring the story home to their respective villages and spread it.
- The kinship between the people. When the 1907 tsunami hit Salang and Teupah on the western coast, the people from different parts of Simeulue Island came to help out, both morally and materially. This is also in accordance with the guidance of their Islamic religion that orders them to help others who are in trouble.

Post that 1907 catastrophic event, the colonial government reported that there were no efforts made to move people from affected areas immediately after the occurrence. Other stories that evolved in the community said that there were a number of people who were evacuated from the western to the eastern coast of the island later on.

The primary element for the creation of *smong* as local wisdom on Simeulue Island was the 1907 tsunami event in accordance with the sociocultural qualitative study about the tsunami's history. The year 1907 was assumed to be the one of the occurrence of the disaster based on several reasons: 1) geological studies' results on seismic activities on Sumatera Island and beyond; 2) colonial government reports; and 3) local traditions.

There are two major aspects that can be seen from the 1907 tsunami: 1) it was a traumatic event due to the number of victims and areas that were destroyed by the tsunami; and 2) the elders, who were directly affected by the tsunami, left the story about the horrible catastrophe behind so that the younger generation can take invaluable lessons from it and be more prepared when facing similar threats in the future. However, although the local people already possessed such knowledge, McAdoo, Dengler, Prasetya, and Titov (2006) revealed that there are various versions of this story which according to the survivors they interviewed. This is an unstructured pattern of knowledge sharing in which the story is only shared if it appears to be in accordance with the current conditions.

So far, there is no historical writing that tells about the cultural history of the Simeulue Island because its local people did not adopt a writing culture like the Japanese did. The evolution of oral knowledge is very dependent upon the person who owned the story. Consequently, it is not surprising that we now find various versions of the story about the *smong* event in 1907.

4.2. Indigenous Knowledge in Central Aceh

In the Gayo highlands, as many other areas of the world, local knowledge mostly arose from intuition, sense and memory, not intellect. This consists of the combination of natural knowledge and experiences which ultimately transform into local knowledge.

To comprehend the local knowledge, people should take into account the way they distinguish every type of knowledge and the practices they perform to acquire beliefs, perceptions and values. This is important because people have to have reasons for their attitudinal tendencies towards everything. Besides, the interaction between conventional science and local knowledge is not a new issue because, according to the history of science, both have long been linked.

Arul Item is one of the villages in the Gayo highlands where the exchange of knowledge and life necessities can be realized because of the existence of trade routes. These routes help people in transporting their crops to other areas and make their villages no longer isolated.

Here, some informal groups of farmer stand by for the orangutan's sounds as they have long been believed to be the sign of heavy rain and flooding. These farmers play a very crucial role in disaster awareness, risk management, and poverty alleviation. Each of the farmers' groups consist of four to five households. They protect animals from theft, avoid potential risks, arrange meetings, organize and share related information and make decisions together.

To prevent landslides, the groups prepare an emergency plan together by forming a movement called a *mungamol* (gathering) to solve problems if there is an emergency situation after a profuse rain. In protecting animals from predators and theft, the groups usually apply a rotation system which is an inter-household cooperation.

It is mostly the elders in the village who know very well the signs of a heavy rain and a potential landslide. "During *mumenge imo* (hearing the voice of an orangutan), the Gayo people who reside in Arul Item go down the hill and try to hear the sound of the

orangutan (*imo*) which shouted while pounding. If they hear that the pounding sound echoed within the forest and become longer and longer, this usually results in heavy rains and landslides," said a local villager.

In a heavy rain season, the people do not organize any feasts. This allows them to incorporate potential hazards into their daily lives in a well-established cultural construction structure so that they can contribute to normalizing natural hazards.

Prayer and collective meetings are another form of religious activities that are performed as part of the strategy of long-term prevention against natural hazards. There are rules in managing the natural resources; examples can be found with respect to water management, ensuring the maintenance of biodiversity, and helping to avoid local landslides.

4.3. Indigenous Knowledge in Aceh Tamiang

In Aceh Tamiang, some local chiefs use a local flood warning system along the banks of Tengguluin River to a lower area by diverse—before a new system is introduced—as the early sign of natural hazards. In predicting the potential flood, they usually observe the behaviour of ants who move their eggs to higher ground to create a network of guards when the river level grows higher and higher due to a heavy rain. The local people along the riverside have practised this knowledge for many years.

4.4. Indigenous Knowledge in Pidie Jaya

In Pidie Jaya, when a heavy rain occurs, some villagers will be assigned as guards to oversee the situation all night. If they hear the roar of the landslide on the surface of the mountainside, one of them will soon sound the alarm or shout or ring *kentongan* to let other people know that the landslide is coming. This is a public warning system to alert abount the possibility of landslides that burgeon within Pidie society.

Another form of local knowledge exists in Kleng village, Pidie Jaya. According to Bukhari Hisham, a local resident of Kleng village, a large magnitude earthquake usually occurs every 75 to 100 years and a small magnitude earthquake every 50 years in Pidie Jaya.

Bukhari Hisham's descendants usually predict a potential earthquake by observing changes in the behaviour of snakes. It is based on the fact that the snake feels the vibrations of earth before humans feel them. A snake will come out of its hole because the earth has trembled from its deepest layers. In Hisham's family, this knowledge has been passed down through the generations.

So far, there is no absolute agreement as to why the snake is the first to detect an earthquake tremble. Among the possible reasons is that the outside temperature is usually higher, the gas erupts through cracks in the ground, and the vibration that occurs before the earthquake can be felt by a snake.

Learning from the recent earthquake in Pidie Jaya, the failure to implement building codes and the lack of appropriate mechanisms for earthquake prediction are reasons to investigate innovative prediction methods using local knowledge and resources for cost-efficiency and ease of implementation. One of them, as Bukhari Hisham said, is by using signs from snakes.

4.5. Indigenous Knowledge in North Aceh

Before the 2004 tsunami struck, there was strange animal behaviour observed by some local people in Blang Mangat, Lhokseumawe. According to Mustafa Ibrahim, a community leader of Blang Mangat village, the animals might have heard a certain sound so that they instinctively became agitated and tried to stay away from the source of the sound and thus flew to a more pleasant place. Similar to the way that a bat can hear ultrasonic sound, they believed that the birds were able to hear the rumble of the underground ruins which marked the beginning of the earthquake.

Even a few days before the tsunami hit, Mustafa saw white herons showing unusual behaviour. The birds flocked back to the mainland during the day in a huge numbers. Usually, such flocking behaviour of birds occurs before sunset when they come from the mainland to their nest near the coast.

In order to know how to respond to natural changes, people need to know how to encounter, adapt, experiment, and innovate when facing the natural hazards. They also need to know how to take lessons from previous disasters (for example, mangrove plant that can preserve and protect the land from tsunamis and water management about where to get wood and water in times of crisis).

4.6. Indigenous Knowledge in Pidie

Heavy rain often causes flooding in Meunasah Raya Village, Pidie, as the river that crosses the village, known as Krueng Teungku Chik Di Reubee, overflows. Since this has been occurring for years and has become an annual destructive event, the people in this village have learned from nature's behaviour and have tried to cope with it by maximizing the use of their traditional stilt houses as their paddy storage space and by elevating their livestock barns.

Moreover, they have also used a dating method to predict the flood; this is known as *kutika* or *keununong*. The most common formula is usually called as *keununong sa* and *keununong dua ploh lhee*. *Kutika* or *keununong* is a matter of numbers to predict the signs of nature and is believed to be hereditary in studying the changes of nature within the Aceh community.

From their experiences, a huge flood usually occurs in the rainy season when *keununong sa* and *keununong dua ploh lhee* take place. In both those periods, the flood is ordinarily bigger than in other periods or months. This indigenous knowledge is also expressed in the form of rhyme as a lesson learned for the next generations.

Besides the knowledge above, the local people also observe natural phenomena in predicting the flood, such as:

- *Langet hitam di pucok krueng*—this means that if the sky is black in the headwaters area, the rice crops which are being dried should be moved as soon as possible because the flood will soon arrive.
- *Su megedum di glee*—this means that if there is a bombing sound in the mountains followed by a rumble in the sea, then a few people will soon drop some bamboo staples into to the river to block the water flow.
- *Umpung tikoh dipeu-ek u ateuh*—this means that field rats move their dens to a higher place. Usually, the field rats dig a deep hole for their dens, but when the flood is about to come, the rats will move to a higher place to avoid being washed away by the water.

- *Umpung sidom lagee nyan cit*—this means that ants also move to a higher place before the flood. Then if the anthills are spread on the ground, it indicates that the flood will come shortly.
- *Ka anyot boh pineung masak*—this means that if ripe nuts are floating on the river, it indicates that a heavy rain is taking place in the mountain area and will most likely bring large amounts of water downstream.

In this community, a flood is not only be understood as a trial and part of the destiny of God, but it is also believed to be the result of human intervention.

Table 1

Summary of Indigenous Knowledge Representation in Aceh

No.	Place	Hazard	Description
1	Simeulue	Earthquakes and tsunamis	When the sea subsides due to a huge earthquake, the local people sing a traditional song called *smong* to warn other people along the coastline to flee to higher places.
2	Arul Itam, Gayo highland, Central Aceh	Landslides	Groups that consist of four to five households called *mungamol* (a gathering) prepare for the possibility of natural threats.

Usually the elders in the village understood the signs of heavy rain and landslides. "During *mumenge imo* (hearing the voice of an orangutan), the Gayo people who reside in Arul Item go down the hill and try to hear the sound of the orangutan (*imo*) which shouted while pounding. If they hear the pounding sound that echoed within the forest become longer and longer, this usually results in heavy rains and landslides.

Religious activities, such as prayers and collective meetings, can also be part of the strategy for long-term prevention of natural hazards. |
3	Aceh Tamiang	Floods	They observe the behaviour of ants that move their eggs to higher ground to create a network of guards when the river level becomes higher and higher. This indigenous knowledge has been applied for years as an early warning system for flood.
4	Pidie Jaya	Floods	A guard will be placed near the riverside to oversee the situation all night. When he has heard the roar of the landslide on the surface of the mountainside, he will then sound an alarm or shout and ring *kentongan*.
		Earthquakes	The change in the behaviour of snakes is observed as the snake is believed to be able to feel the vibration of the earth before humans can feel it. He

			will come out of the hole because the earth has trembled from its deepest layers.
5	North Aceh	Earthquakes and tsunamis	Strange animal behaviour is noted as they instinctively become agitated and try to stay away from the source the rumble of the underground ruins which marks the beginning of the earthquake. After a few days a huge earthquake will strike the land.
6	Pidie	Floods	The people in Meunasah Raya village usually use a dating method which is known as *kutika* or *keununong* to predict the flood. The most common formula is usually called *keununong sa* and *keununong dua ploh lhee*. *Kutika* or *keununong* is a matter of numbers to predict the signs of nature and is believed to be hereditary in studying the changes of nature within Aceh community.
			From their experiences, huge floods usually occur in the rainy season when *keununong sa* and *keununong dua ploh lhee* take place. In both those periods, the flood is ordinarily bigger than in other periods or months.
			Besides, they also observe natural phenomena which are known as *langet hitam di pucok krueng, su megedum di glee, umpung tikoh dipeu-ek u ateuh, umpung sidom lagee nyan cit,* dan *ka anyot boh pineung masak.*

The indigenous knowledge presented above is orally transmitted through an unstructured pattern. The stories usually appear once a similar disaster to one in the past has occurred. This keeps being repeated from generation to generation. The unstructured pattern means that the stories are only shared if the context is relevant to the current conditions.

5. Existing Gaps

Although there are many indigenous knowledge concepts which have evolved within Indonesian communities, especially in Aceh, only few remain. This study found that the lack of community understanding of the importance of the knowledge has become one of the main factors that has eroded the wisdom, in addition to the rapid development of advanced technology and the disinterest of the younger generation in such knowledge.

With respect to the younger generation's disinterest, we assume that the advancement of information technology has limited the interaction between the older and younger generations. This has led to a breakdown in the communication channel which is perceived to be a key factor in handing down knowledge to the next generation. It can be said that the breakdown of this communication channel means the end of the inheritance of such wisdom, and as such, it cuts off one of the most effective modes of risk mitigation. If it continues to be neglected, one day the indigenous

knowledge will no longer be regarded as a superior tool in any risk reduction initiatives and programmes.

In some locations in which the local knowledge of disaster in Aceh was investigated, it has been revealed that the utilization of local knowledge runs concurrently with a flexibility in the provision of management systems. This is also a new adaptable discourse in developing a participatory approach. The approach of the local government in Aceh was carried out in several ways, such as empowering civil society, carrying out community-based disaster risk reduction, and adaptive management. However, this approach seems to be stuck at the policy level. While in practice it has been widely proven that the involvement of the community in the process of assessing hazards and implementing coping mechanisms in the form of constructive thoughts and funding support is a central point to the success of risk mitigation efforts.

Another critical issue that is confirmed from the field is that many mitigation efforts and programmes tend to centralize on the development of infrastructures (disaster resistant buildings) and sophisticated early warning systems, rather than utilizing the existing wisdom. It is admittedly important to provide secure infrastructures and develop a well-established and advanced early warning system, but it is also necessary to incorporate those measures within the local knowledge existing in society and to engage the community to actively participate for the successful implementation of mitigation programmes.

In terms of scientific literature, there is very limited literature available regarding this issue. Most of the literature which exists only talks about the vulnerability of this region to environmental hazards and how to deal with those threats. Very little attention is given to the significant role that indigenous knowledge can play in mitigating potential hazards and in enhancing community resilience to cope with disasters.

Moreover, it was also found that there is a quantity of such knowledge living in the midst of communities. However, not all indigenous practices contribute to a sustainable community and development. There are only a few which have been authenticated through scientific validation. Validation is a critical step that can confirm the presence of indigenous knowledge and the extent to which it develops in the midst of the community. That is why, before knowledge is disseminated and adopted, it should be investigated first to assess its appropriateness. This is crucial since appropriate indigenous knowledge can help the government to better implement their disaster mitigation activities and programmes at the very basic level, i.e. the community. Besides, this validation may ensure that the recommended protective actions are accepted by the threatened community as well.

Furthermore, the integration of indigenous knowledge studies into the educational curriculum is an additional crucial concern that is often overlooked by the government and its educational agencies. The current developed curriculum that integrates risk reduction issues discusses at length the process of a disaster occurrence, predisaster basic preparation, rescue actions and how to respond before and after a disaster. The educational agencies, who play a major role in the development of the curriculum, give very little concern to this inexpensive measure. We assume that this indifference is due to their lack of understanding and information regarding the issue.

By recognizing the gaps, more comprehensive and effective strategies and policies can be formulated to fill in the gaps. However, the gaps can only be bridged if the communities are the key actor in the engagement. For this reason, it is necessary for the government to build better communication and interactions with communities. The

government should play their vital role to guide them in assessing and identifying factors that contribute to their vulnerability. By encouraging communities to actively participate in such the process, the government will alleviate their work in formulating appropriate decisions and policies by receiving feedback directly from the communities. In other words, it can be said that an understanding and respect for local knowledge will contribute to the effectiveness of the implementation of those activities from both social and cultural perspectives.

Further attempts that can be made to enhance community resilience is to improve the understanding of communities and related governmental institutions/agencies regarding the importance of integrating indigenous knowledge into disaster mitigation efforts. If this attempt is successfully applied, then the community and government will have the same view on this matter which will eventually strengthen the implementation of any risk mitigation programmes and initiatives.

Moreover, the establishment of a tsunami early warning system and disaster preparedness schools in some vulnerable areas are important system and inititiatives to address future hazards.

6. Conclusions

Indigenous knowledge has led the local people to deal with disaster more effectively by using their intuitive rather than technological sophistication. The intuitiveness, originating from their ancestors' experiences and embedded in their day-to-day activities, makes them more reactive and quick to respond to any changes in nature. This is contrast to an advanced early warning system which needs time to be operated to relay the warning to people thoroughly and which may experience technical failure at any time.

In the context of Aceh, indigenous knowledge within the Aceh community is orally transmitted through an unstructured pattern. The stories usually appear once a disaster similar to one in the past has occurred. This keeps being repeated from generation to generation. The unstructured pattern means that the stories are only shared if the context is relevant to the current conditions.

Understanding and respect for local knowledge will contribute to the effectiveness of the implementation of disaster management activities from both the standpoint of social and cultural perspectives. From a social perspective, the public will understand the local knowledge and practices that can help them in identifying the needs. From the cultural perspective, by taking local knowledge and practices into consideration, it will increase acceptance, common understanding, and sense of community ownership of their own culture. For that purpose, the concerned parties should work hand in hand for the successful implementation of all mitigation programmes. However, the local communities should be given the chance to set their own methods and strategies to cope with the changing environment as it is associated with the terms of both the local practice and context.

As with other similar studies of such experiences conducted by researchers in Indonesia and beyond, this study also focused on the investigation of the role of indigenous knowledge within a traditional community and how the knowledge is used to deal with changes in nature.

This paper provides a valuable contribution both scientifically and socially for a better understanding of how indigenous knowledge effectively helps traditional people in Aceh in dealing with various natural challenges.

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Hasil Turnitin

by Paper Cek

Indigenous knowledge representation in mitigation process: a study of communities' understandings of natural disasters in Aceh Province, Indonesia

1. Introduction

Aceh is well known as one of the areas most prone to disasters in Indonesia, both natural and man-made disasters. This is because of some factors such as its geographical and geological conditions and other social factors like political and sociocultural ones. Geographically, Aceh is located at the northern end of Sumatera Island making it the westernmost province in Indonesia. Geologically, this province lies on the Sumatera fault, one of the most active faults in the world which has generated many earthquakes in this area. One of the most shocking quakes was the very destructive earthquake and tsunami that devastated the coastal areas of Aceh and Nias on 26 December 2004. Most of the coastal areas were shattered by the tsunami in just few minutes. The catastrophe not only destroyed much of the infrastructure and buildings, but it also killed more than 200,000 people. These facts make it one of the biggest disasters that has occurred in this century in terms of magnitude, number of deaths, economic losses and social disruption. In contrast, on Simeulue Island, seven people died because of the earthquake and tsunami. When compared to the total number of inhabitants of Simeulue Island – approximately 78,128 people as of June, 2005 of which majority resided in the coastal areas – the number is not significant (BRR Aceh-Nias, 2009) (Figure 1). Post the 2004 tsunami, some successful local wisdom concepts – for instance, one on Simeulue Island, Indonesia, and another on Moken, Surin Island, Thailand – have emerged and attracted the interest of researchers and practitioners. They used their ancestors' stories, which are passed orally from time to time within their communities, to survive the tsunami. One important thing to note here is that both communities applied protective actions to save their communities from disaster by using their ancestors' stories, without depending on modern alert systems. On Simeulue Island, most of the indigenous people already possess the knowledge and value systems that have been inherited through generations as a form of local wisdom when encountering earthquake and tsunami; this is called smong. Besides the well-known smong, there actually is considerably similar indigenous knowledge that has been inherited and is practised by local people, especially in rural areas of Aceh. For example, people have to build their houses with a distance of more than 50 m to prevent the threat of floods, they place their chicken cages high off the ground or they build traditional elevated wooden houses (Hiwasaki et al., 2014) that prevent flooding and attracting wild animals. However, to this extent, there are many more that have not yet been unexplored. Therefore, this paper attempts to identify the knowledge and its representation in the implementation of disaster mitigation efforts in Aceh. It is hoped that the paper will make a worthy contribution both scientifically and socially to a better understanding of how indigenous knowledge effectively helps traditional people of Aceh in dealing with various natural changes.

2. Indigenous knowledge and disaster mitigation
2.1. Definition and characteristics of indigenous knowledge

Basically, many researchers agree that indigenous knowledge refers to sets of social behaviours, practices and approaches to modes of living used and developed by local people, particularly native people. This knowledge originates from and is based on their ancestors' experiences, is strongly related to the way they live and interact with

their environments and is passed from generation to generation (Baumwoll, 2008; Berkes, 1999; Shaw et al., 2008). It includes a number of social and environmental aspects such as ideas, cultures and customs, technological knowledge, natural resource management practices, beliefs and worldviews, tools, techniques and other adaptive activities preserved over generations to ensure long term survival (Athayde et al., 2015; Maferetlhane, 2013). Berkes (1999) also has a similar perspective that indigenous knowledge usually pertains to either economic or social matters and cannot be set apart from environmental challenges. Maferetlhane (2013), on the other hand, has argued that indigenous knowledge should be inclusive, that it covers both past and present knowledge, and survives and adapts to different environments. In other words, indigenous knowledge connects the bridge between their ancestors' lives with their present life today (Shiwaku and Shaw, 2008). Therefore, it can be said that indigenous knowledge is an invaluable asset for the local community as a whole whether they are natives or newcomers. As a part of knowledge, indigenous knowledge has several fundamental characteristics:

▪ it is generated within and owned by communities;
▪ it is unwritten or orally transmitted across generations; therefore, it is not documented systematically;
▪ it is widespread in an informal form;
▪ it is unique and specific to a certain region and culture, as it was created and developed locally based on its local context and circumstances; and
▪ it is dynamic which means that it is adaptable to new circumstances and continually develops based on peoples' experiences (Baumwoll, 2008; de Guchteneire et al., 2003; Flavier et al., 1995; Maferetlhane, 2013; Mundy and Compton, 1991).

2.2. Disaster mitigation

Disaster mitigation is one of the most important aspects in disaster risk reduction (DRR) measures taken before a disaster occurs which focusses on reducing the natural hazards scale, intensity and impact. This proactive and comprehensive measure is performed in structural and non-structural efforts. The structural efforts are related to physical construction or engineering techniques that are used and applied to reduce the impact of a potential natural hazard, while the non-structural efforts consist of non-physical construction to reduce disaster risks and impacts through regulations, policies, training and education (UNISDR, 2017). Disaster mitigation is essential in managing potential hazards and disasters, as it helps people adapt to natural changes and survive natural threats. However, the implementation of this measure is largely dependent on active and effective participation of related stakeholders, particularly the government, community and concerned agencies. Mitigation is not only dealing with the impact of disaster and/or predicting the potential hazards; it should also address the underlying causes of vulnerability (Maskrey, 1989) and promote communication and knowledge sharing among scientists, stakeholders and indigenous people (Athayde et al., 2015).

2.3. Indigenous knowledge in disaster mitigation

In many parts of the world, indigenous knowledge has proven to be one of the most powerful measures for local people to deal with natural disasters. There are numerous examples of this, namely, the story of the Moken community on the coast of Thailand (Arunotai, 2008); the islanders' tsunami coping mechanisms on the Solomon Islands (McAdoo et al., 2009); local Nigerian people plant bamboo and raffia palms to

prevent soil erosion and landslide; and while in Swaziland, the local people use the presence of the specific bird species' on trees to welcome the rainy season and predict the potential of flood (Iloka, 2016); the tribal forecasting climate in Rajasthan, India (Pareek and Trivedi, 2011); and other hundreds of similar types of wisdom that may exist around the world. These various forms of disaster mitigation efforts can be regarded as an invaluable wealth of cultural treasures that will assist in increasing community awareness and preparedness for any potential threats and risks in the future. These facts have attracted the attention of many researchers and scientists, especially those who are involved in DRR and other related study areas, to further study the relationship between indigenous knowledge and disaster mitigation. They believe that indigenous knowledge is a very effective coping mechanism for a community with respect to various natural hazards and threats (Cronin et al., 2004a, 2004b; Dekens, 2007a, 2007b; Mercer et al., 2010; Shaw et al., 2008). Moreover, Gunawan (2008) argues that local wisdom and the spirit of mutual aid are two crucial aspects in the implementation of an early warning system which is assumed to provide a greater understanding of the perils compared to other external elements. This strong relationship between indigenous knowledge and disaster mitigation has also been declared by several concerned bodies – national and international. In 2008, the Government of Indonesia through their disaster management agency had also enacted Law Number 21 Year 2008 regarding the implementation of disaster management. It is stated in the document that: The disaster assessment must be conducted by authorized agencies/ institutions and communities with regard to the existing local knowledge. Moreover, the development of any disaster-resistant buildings and infrastructures must also be carried out by taking into account the local context. Internationally, in 1995, the United Nations also launched a second International Decade of the World's Indigenous Peoples to strengthen international cooperation and commitment regarding indigenous peoples (Baumwoll, 2008). In the report document of the experts' meeting titled "Safeguarding the Transmission of Local and Indigenous Knowledge of Nature (2004)", it reports that local and indigenous knowledge is directly related to the natural world and certain environmental contexts. In 2005, post the 2004 Indian Ocean earthquake and tsunami, United Nations International Strategy for Disaster Reduction (UNISDR) acknowledged indigenous knowledge as a source of building a community culture of safety and resilience through knowledge, innovation and education in their Hyogo Framework for Action (2005-2015) document. To this extent, the implementation of various risk mitigation measures with concern to local knowledge has delivered priceless lessons to related stakeholders about its importance for DRR programmes that encourage individuals to take more appropriate steps and decisions. However, indigenous knowledge should complement rather than compete against the established global knowledge system (Nyong et al., 2007). It should be a driving tool for local people to increase their resilience level. Moreover, the success of translating knowledge into action (Hiwasaki et al., 2014) and bridging communication to support risk mitigation programmes (Athayde et al., 2015) also facilitates communication between scientists and local people (Shaw et al., 2009) and will greatly affect the community resilience level. As there is very little literature on this matter in the context of Aceh, this paper tries to explore the existence of indigenous knowledge that may have been forgotten, or even worse, be unknown to most of the local people today. This paper may further provide access to the local knowledge studied and enhance the development of best practices.

3. Research methodology

This research used a qualitative descriptive research paradigm in which the researcher attempted to describe or construct indepth interview results from the research objects. The interviews were conducted in six disaster-prone areas in Aceh, i.e. Simeulue, Central Aceh, Aceh Tamiang, Pidie Jaya, North Aceh and dan Pidie. The interviewees were the informants in this research and included traditional leaders, religious leaders, community leaders, headmen, youth figures and disaster victims. The technique for determining informants was through purposive sampling in which the sample is specified based on the need of the research. The total number of informants was 300 people. Field observations and in-depth interviews were conducted to acquire data, facts and information regarding local wisdom on DRR, knowledge management and community solutions for disaster awareness and preparedness. Documentation was carried out to provide additional data so that all the data obtained could be accounted for. Field observations were conducted by directly assessing vulnerable places and conditions that may generate potential hazards (e.g. visited the river which often causes flooding and visited the coastline). As with other qualitative data, the data in this research are divided into two categories, i.e. primary data and secondary data. The primary data of this research were acquired from the information extracted from in-depth interviews and field observations, while the secondary data were obtained from various documents and literature like books and writing sheets. All the acquired data were analysed using an interactive model introduced by Miles and Hubbermen. According to Miles and Hubberman (1994), there are three processes that take place interactively in this analysis model:

- Data reduction:a process of selecting, focussing attention on selecting and abstracting and transforming rough data that have appeared from various resources;
- a process of reinforcing, shortening, removing unnecessary, defining focus and organizing data; and
- drawing conclusions from the data that have already passed through both of the aforementioned stages.

4. Representation of indigenous knowledge for disaster mitigation in Aceh

In Aceh, the existing indigenous knowledge is mostly influenced by traditional, religious beliefs and practices. As more than 90 per cent of the population is Muslim, people believe that all events which occur in their lives are governed by God. They used to practice du'a (pray) and other related rituals to prevent bad things that might happen in their lives by pleading for help only from God. This is also believed to be one of the most important driving forces in the process of postdisaster trauma healing. Later, we will present a brief representation of several coping practices that still exist in the midst of Aceh society nowadays. The practices are spread in six regencies in Aceh: Simeulue, Central Aceh, Aceh Tamiang, Pidie Jaya, North Aceh and dan Pidie. These areas were selected because they frequently experience disasters; therefore, the local knowledge on disaster mitigation is well nurtured there.

4.1. Indigenous knowledge in Simeulue

The former regent of Simeulue Island, in a speech for the Kickoff Assembly Meeting in Kobe, Japan, in January 2006, said that the relatively small number of the dead in the 2004 Simeulue Island tsunami was due to several reasons – the power and destiny of God, the existence of local wisdom and the topographic conditions. As other regencies in Aceh province, most of the inhabitants who live on the island are

Muslims. This religious tenet of life makes them always relate all events that happen to them, either good or bad, to the aspect of divinity. Therefore, the 2004 earthquake and tsunami are also believed to be a trial from God concerning their faith as humans. Furthermore, another reason for the lesser number of deceased is because they still practise a local wisdom created by their ancestors – a hereditary story about past tsunamis (Yusuf, 2007). The local people called it smong. The word smong, which means a splash of water, is derived from one of the local languages, Devayan. This story urges people to head to higher places if a large magnitude earthquake causes the sea water along the coast to recede from the shore. Though the story has spread out across the island, the wisdom is not nurtured anymore. Arrival of migrants from outside the island might be one of the main reasons why the wisdom slowly began to disappear over time. The third reason is the topographic conditions. Simeulu Island is a hilly area and surrounded by avast ocean, the Indian Ocean. Therefore, when the 2004 tsunami struck, people along the coast could easily reach higher places and were saved. According to local community leaders (tuha peut), through brief interviews, the areas worst affected by the 1907 tsunami were mostly located along the western coast of Simeulue Island, starting from Salur up to Salang. Another badly affected area was the Alafan sub-district, particularly Lafakha and Langi villages. Though the epicentre of the earthquake of the 1907 tsunami was on the western coast of the island, its history has spread widely throughout the island and has been recorded in the form of an oral story as a lesson learned for future generations. There are a couple of reasons that encourage such dissemination:

- The position of Sinabang, the capital city of Simeulue Island, located in the western part, and now the centre of government activities. It has been past since the colonial period until now. It is a prominent meeting point for local people from different parts of the island. The islanders who have visited this place bring the story home to their respective villages and spread it.
- The kinship between the people. When the 1907 tsunami hit Salang and Teupah on the western coast, people from different parts of Simeulue Island came to help out both morally and materially. This is also in accordance with the guidance of their Islamic religion that orders them to help others who are in trouble.

Post that 1907 catastrophic event, the colonial government reported that there were no efforts made to move people from affected areas immediately after the occurrence. Other stories that evolved in the community said that there were a number of people who were evacuated from the western to the eastern coast of the island later on. The primary element for the creation of smong as local wisdom on Simeulue Island was the 1907 tsunami event in accordance with the sociocultural qualitative study about the tsunami's history. The year 1907 was assumed to be the one of the occurrence of the disaster based on several reasons:

- geological studies' results on seismic activities on Sumatera Island and beyond;
- colonial government reports; and
- local traditions.

There are two major aspects that can be seen from the 1907 tsunami:

1. it was a traumatic event because of the number of victims and areas that were destroyed by the tsunami; and
2. the elders, who were directly affected by the tsunami, left the story about the horrible catastrophe behind so that the younger generation can take invaluable lessons from it and be more prepared when facing similar threats in the future.

However, although the local people already possessed such knowledge, McAdoo et al. (2006) revealed that there are various versions of this story according to the survivors

they interviewed. This is an unstructured pattern of knowledge. sharing in which the story is only shared if it appears to be in accordance with the current conditions. So far, there is no historical writing that tells about the cultural history of the Simeulue Island because its local people did not adopt a writing culture like the Japanese. The evolution of oral knowledge is very dependent upon the person who owned the story. Consequently, it is not surprising that we now find various versions of the story about the smong event in 1907.

4.2. Indigenous knowledge in Central Aceh

In the Gayo highlands, as many other areas of the world, local knowledge mostly arose from intuition, sense and memory, not intellect. This consists of a combination of natural knowledge and experiences which ultimately transform into local knowledge. To comprehend the local knowledge, people should take into account the way they distinguish every type of knowledge and the practices they perform to acquire beliefs, perceptions and values. This is important because people have to have reasons for their attitudinal tendencies towards everything. Besides, the interaction between conventional science and local knowledge is not a new issue because, according to the history of science, both have long been linked. Arul Item is one of the villages in the Gayo highlands where the exchange of knowledge and life necessities can be realized because of the existence of trade routes. These routes help people in transporting their crops to other areas and make their villages no longer isolated. Here, some informal groups of farmers stand by for the orangutan's sounds, as they have long been believed it to be sign of heavy rain and flooding. These farmers play a very crucial role in disaster awareness, risk management and poverty alleviation. Each of the farmers' groups consist of four to five households. They protect animals from theft, avoid potential risks, arrange meetings, organize and share related information and make decisions together. To prevent landslides, the groups prepare an emergency plan together by forming a movement called a mungamol (gathering) to solve problems if there is an emergency situation after a profuse rain. In protecting animals from predators and theft, the groups usually apply a rotation system which is an interhousehold cooperation. It is mostly the elders of the village who know very well the signs of a heavy rain and a potential landslide: During mumenge imo (hearing the voice of an orangutan), the Gayo people who reside in Arul Item go down the hill and try to hear the sound of the orangutan (imo) which shouted while pounding. If they hear that the pounding sound echoed within the forest and become longer and longer, this usually results in heavy rains and landslides, said a local villager. During the season with heavy rains, people do not organize any feasts. This allows them to incorporate potential hazards into their daily lives in a well-established cultural construction structure so that they can contribute to normalizing natural hazards. Prayer and collective meetings are another form of religious activities that are performed as part of the strategy of long-term prevention against natural hazards. There are rules in managing the natural resources; examples can be found with respect to water management, ensuring the maintenance of biodiversity and helping to avoid local landslides.

4.3. Indigenous knowledge in Aceh Tamiang

In Aceh Tamiang, some local chiefs use a local flood warning system along the banks of Tengguluin river to a lower area by diverse – before a new system is introduced – as the early sign of natural hazards. In predicting the potential flood, they usually observe the behaviour of ants who move their eggs to higher ground to create a

network of guards when the river level grows higher and higher because of heavy rains. The local people along the riverside have practised this knowledge for many years.

4.4. Indigenous knowledge in Pidie Jaya

In Pidie Jaya, during heavy rains, some villagers will be assigned as guards to oversee the situation all night. If they hear the roar of the landslide on the surface of the mountainside, one of them will soon sound the alarm or shout or ring kentongan to let other people know that the landslide is coming. This is a public warning system to alert about the possibility of landslides that burgeon within Pidie society. Another form of local knowledge exists in Kleng village, Pidie Jaya. According to Bukhari Hisham, a local resident of Kleng village, a large magnitude earthquake usually occurs every 75 to 100 years and a small magnitude earthquake every 50 years in Pidie Jaya. Bukhari Hisham's descendants usually predict a potential earthquake by observing changes in the behaviour of snakes. It is based on the fact that the snake feels the vibrations of earth before humans feel them. A snake will come out of its hole because the earth has trembled from its deepest layers. In Hisham's family, this knowledge has been passed down through the generations. So far, there is no absolute agreement as to why the snake is the first to detect an earthquake tremble. Among the possible reasons, one of it is that the outside temperature is usually higher, the gas erupts through cracks in the ground, and the vibration that occurs before the earthquake can be felt by a snake. Learning from the recent earthquake in Pidie Jaya, the failure to implement building codes and lack of appropriate mechanisms for earthquake prediction are reasons to investigate innovative prediction methods using local knowledge and resources for cost-efficiency and ease of implementation. One of them, as Bukhari Hisham said, is by using signs from snakes.

4.5. Indigenous knowledge in North Aceh

Before the 2004 tsunami struck, there was strange animal behaviour observed by some local people in Blang Mangat, Lhokseumawe. According to Mustafa Ibrahim, a community leader of Blang Mangat village, the animals might have heard a certain sound so they instinctively became agitated and tried to stay away from the source of the sound and thus flew to a more pleasant place. Similar to the way that a bat can hear ultrasonic sound, they believed that the birds were able to hear the rumble of the underground ruins which marked the beginning of the earthquake. Even a few days before the tsunami hit, Mustafa saw white herons showing unusual behaviour. The birds flocked back to the mainland during the day in a huge numbers. Usually, such flocking behaviour of birds occurs before sunset when they come from the mainland to their nest near the coast. To know how to respond to natural changes, people need to know how to encounter, adapt, experiment and innovate when facing the natural hazards. They also need to know how to take lessons from previous disasters (for example, mangrove plant can preserve and protect the land from tsunamis and help in water management and about where to get wood and water in times of crisis).

4.6. Indigenous knowledge in Pidie

Heavy rain often causes flooding in Meunasah Raya Village, Pidie, as the river that crosses the village, known as Krueng Teungku Chik Di Reubee, overflows. As this has been occurring for years and has become an annual destructive event, the people in this village have learned from nature's behaviour and have tried to cope with it by maximizing the use of their traditional stilt houses as their paddy storage space and by

elevating their livestock barns. Moreover, they have also used a dating method to predict the flood; this is known as kutika or keununong. The most common formula is usually called as keununong sa and keununong dua ploh lhee. Kutika or keununong is a matter of numbers to predict the signs of nature and is believed to be hereditary in studying the changes of nature within the Aceh community. From their experiences, a huge flood usually occurs in the rainy season when keununong sa and keununong dua ploh lhee take place. In both those periods, the flood is ordinarily bigger than in other periods or months. This indigenous knowledge is also expressed in the form of rhyme as a lesson learned for the next generations. Besides the knowledge aforementioned, the local people also observe natural phenomena in predicting the flood, such as:

- Langet hitam di pucok krueng: this means that if the sky is black in the headwaters area, the rice crops which are being dried should be moved as soon as possible because the flood will soon arrive.
- Su megedum di glee: this means that if there is a bombing sound in the mountains followed by a rumble in the sea, then a few people will soon drop some bamboo staples into to the river to block the water flow.
- Umpung tikoh dipeu-ek u ateuh: this means that field rats move their dens to a higher place. Usually, the field rats dig a deep hole for their dens, but when the flood is about to come, the rats will move to a higher place to avoid being washed away by the water.
- Umpung sidom lagee nyan cit: this means that ants also move to a higher place before the flood. Then if the anthills are spread on the ground, it indicates that the flood will come shortly.
- Ka anyot boh pineung masak: this means that if ripe nuts are floating on the river, it indicates that a heavy rain is taking place in the mountain area and will most likely bring large amount of water downstream.

In this community, a flood is not only understood as a trial and part destined by God, but it is also believed to be the result of human intervention (Table I).

No	Place	Hazard	Description
1	Simulele	Earthquakes and tsunamis	When the sea subsides because of a huge earthquake, the local people sing a traditional song called smong to warn other people along the coastline to flee to higher places
2	Arul Item, Gayo highland, Central Aceh	Landslides	Groups that consist of four to five households called mungamol (a gathering) prepare for the possibility of natural threats Usually, the elders of the village understood the signs of heavy rain and landslides. During mumenge imo (hearing the voice of an orangutan), the Gayo people who reside in Arul Item go down the hill and try to hear the sound of the orangutan (imo) which shouted while pounding. If they hear the pounding sound that echoed within the forest become longer and longer, this usually results in heavy rains and landslides Religious activities, such as prayers and collective meetings, can also be part of the strategy for long-term prevention of natural hazards
3	Aceh Tamiang	Floods	They observe the behaviour of ants that move their eggs to a higher ground to create a network of guards when the river level becomes higher and higher. This

			indigenous knowledge has been applied for years as an early warning system for flood
4	Pidie Jaya	Floods	A guard will be placed near the riverside to oversee the situation all night. When he has heard the roar of the landslide on the surface of the mountainside, he will then sound an alarm or shout and ring kentongan
		Earthqua kes	The change in the behaviour of snakes is observed, as the snake is believed to be able to feel the vibration of the earth before humans can feel it. It will come out of the hole because the earth has trembled from its deepest layers
5	North Aceh	Earthqua kes and tsunamis	Strange animal behaviour is noted, as they instinctively become agitated and try to stay away from the source the rumble of the underg
6	Pidie	Floods	People in Meunasah Raya village usually use a dating method which is known as kutika or keunonong to predict the flood. The most common formula is usually called keununong sa and keununong dua ploh lhee. Kutika or keununong is a matter of numbers to predict the signs of nature and is believed to be hereditary in studying the changes of nature within Aceh community From their experiences, huge floods usually occur in the rainy season when keununong sa and keununong dua ploh lhee take place. In both those periods, the flood is ordinarily bigger than in other periods or months Besides, they also observe natural phenomena which are known as langet hitam di pucok krueng, su megedum di glee, umpung tikoh dipeu-ek u ateuh, umpung sidom lagee nyan cit and dan ka anyot boh pineung masak

The indigenous knowledge presented earlier is orally transmitted through an unstructured pattern. The stories usually appear once a disaster similar to one in the past has occurred. This keeps being repeated from generation to generation. The unstructured pattern means that the stories are only shared if the context is relevant to the current conditions.

5. Existing gaps
Although there are many indigenous knowledge concepts which have evolved within Indonesian communities, especially in Aceh, only few remain. This study found that lack of community understanding of the importance of the knowledge has become one of the main factors that has eroded the wisdom in addition to the rapid development of advanced technology and the disinterest of the younger generation in such knowledge. With respect to the younger generation's disinterest, we assume that the advancement of information technology has limited the interaction between the older and younger generations. This has led to a breakdown in the communication channel which is perceived to be a key factor in handing down knowledge to the next generation. It can be said that the breakdown of this communication channel means the end of the inheritance of such wisdom, and as such, it cuts off one of the most effective modes of risk mitigation. If it continues to be neglected, one day the indigenous knowledge will

no longer be regarded as a superior tool in any risk reduction initiatives and programmes. In some locations in which the local knowledge of disaster in Aceh was investigated, it has been revealed that the use of local knowledge runs concurrently with a flexibility in the provision of management systems. This is also a new adaptable discourse in developing a participatory approach. The approach of the local government in Aceh was carried out in several ways such as empowering civil society, carrying out community-based DRR and adaptive management. However, this approach seems to be stuck at the policy level. While in practice, it has been widely proven that the involvement of the community in the process of assessing hazards and implementing coping mechanisms in the form of constructive thoughts and funding support is a central point for the success of risk mitigation efforts. Another critical issue that is confirmed from the field is that many mitigation efforts and programmes tend to centralise on the development of infrastructures (disaster resistant buildings) and sophisticated early warning systems, rather than using the existing wisdom. It is admittedly important to provide secured infrastructures and develop a well-established and advanced early warning system, but it is also necessary to incorporate those measures within the local knowledge existing in society and to engage the community to actively participate for the successful implementation of mitigation programmes. In terms of scientific literature, there is very limited literature available regarding this issue. Most of the literature which exists only talks about the vulnerability of this region to environmental hazards and how to deal with those threats. Very little attention is given to the significant role that indigenous knowledge can play in mitigating potential hazards and in enhancing community resilience to cope with disasters. Moreover, it was also found that there is a quantity of such knowledge living in the midst of communities. However, not all indigenous practices contribute to a sustainable community and development. There are only a few which have been authenticated through scientific validation. Validation is a critical step that can confirm the presence of indigenous knowledge and the extent to which it develops in the midst of a community. That is why, before knowledge is disseminated and adopted, it should be investigated first to assess its appropriateness. This is crucial, as appropriate indigenous knowledge can help the government to better implement their disaster mitigation activities and programmes at the very basic level, i.e. the community. Besides, this validation may ensure that the recommended protective actions are accepted by the threatened community as well. Furthermore, the integration of indigenous knowledge studies into the educational curriculum is an additional crucial concern that is often overlooked by the government and its educational agencies. The current developed curriculum that integrates risk reduction issues discusses at length the process of a disaster occurrence, predisaster basic preparation, rescue actions and how to respond before and after a disaster. The educational agencies, who play a major role in the development of the curriculum, give very little concern to this inexpensive measure. We assume that this indifference is because of their lack of understanding and information regarding the issue. By recognizing the gaps, more comprehensive and effective strategies and policies can be formulated to fill in the gaps. However, the gaps can only be bridged if the communities are the key actors in the engagement. For this reason, it is necessary for the government to build better communication and interactions with communities. The government should play a vital role to guide them in assessing and identifying factors that contribute to their vulnerability. By encouraging communities to actively participate in such process, the government will alleviate its work in formulating appropriate decisions and policies by receiving feedback directly from the

communities. In other words, it can be said that an understanding and respect for local knowledge will contribute to the effectiveness of the implementation of those activities from both social and cultural perspectives. Further attempts that can be made to enhance community resilience is to improve the understanding of communities and related governmental institutions/agencies regarding the importance of integrating indigenous knowledge into disaster mitigation efforts. If this attempt is successfully applied, then the community and government will have the same view on this matter which will eventually strengthen the implementation of any risk mitigation programmes and initiatives. Moreover, the establishment of a tsunami early warning system and disaster preparedness schools in some vulnerable areas are important systems and inititiatives to address future hazards.

6. Conclusion

Indigenous knowledge has led the local people to deal with disaster more effectively by using their intuitive rather than technological sophistication. The intuitiveness, originating from their ancestors' experiences and embedded in their day to-day activities, makes them more reactive and quick to respond to any changes in nature. This is contrast to an advanced early warning system which needs time to operate and to relay the warning to people thoroughly and which may experience technical failure at any time. In the context of Aceh, indigenous knowledge within the Aceh communities is orally transmitted through an unstructured pattern. The stories usually appear once a disaster similar to one in the past has occurred. This keeps being repeated from generation to generation. The unstructured pattern means that the stories are only shared if the context is relevant to the current conditions. Understanding and respect for local knowledge will contribute to the effectiveness of the implementation of disaster management activities from both the standpoint of social and cultural perspectives. From a social perspective, the public will understand the local knowledge and practices that can help them in identifying the needs. From the cultural perspective, by taking local knowledge and practices into consideration, it will increase acceptance, common understanding and sense of community ownership of their own culture. For that purpose, the concerned parties should work hand in hand for the successful implementation of all mitigation programmes. However, the local communities should be given a chance to set their own methods and strategies to cope with the changing environment, as it is associated in terms of both the local practice and context. As with other similar studies of such experiences conducted by researchers in Indonesia and beyond, this study also focussed on the investigation of the role of indigenous knowledge within a traditional community and how the knowledge is used to deal with changes in nature. This paper provides a valuable contribution both scientifically and socially for a better understanding of how indigenous knowledge effectively helps traditional people of Aceh in dealing with various natural challenges.

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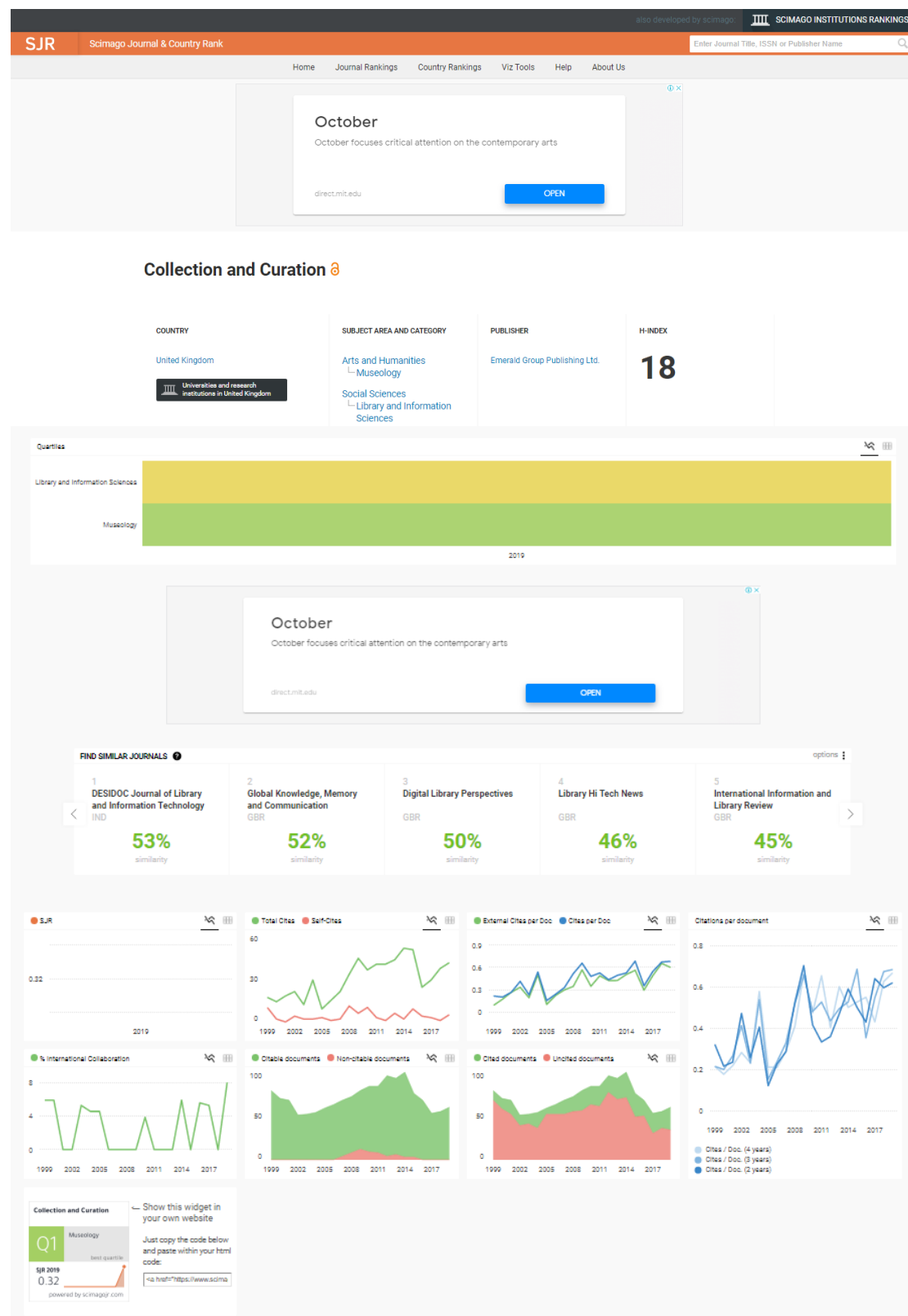
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Indigenous knowledge representation in mitigation process: a study of communities' understandings of natural disasters in Aceh Province, Indonesia

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Abstract

Purpose: The purpose of this paper is to explore the case studies of communities' understandings of natural disasters in Aceh Province, Indonesia, where a number of cultures and traditions which belong to the ancestral heritage continue to be used in a more modern context. Design/methodology/approach: This research used a qualitative descriptive research paradigm in which the researcher attempted to describe or construct in-depth interview results for the research objects. The interviews were conducted in six disaster-prone areas in Aceh, i.e. Simeulue, Central Aceh, Aceh Tamiang, Pidie Jaya, North Aceh and dan Pidie. The interviewees were the informants in this research, which included traditional leaders, religious leaders, community leaders, headmen, youth figures and disaster victims. The technique for determining informants was through purposive sampling in which the sample is specified based on the need of the research. Findings: Majority of the people in Aceh, especially those who live in earthquake- and tsunami-prone areas still practice this form of knowledge, as they have already realized that it makes a significant contribution to emergency management. They typically used their traditional knowledge to understand both the nature of local hazards and the risk reduction mechanism related to response mechanisms. In some events, they also used it as an alternative to recovery phase according to past information and experiences. This paper will discuss the contribution of traditional knowledge to emergency management by presenting some specific cases of indigenous stories in Aceh. The stories not only served as an early warning system but also can be used to develop more effective disaster risk reduction programmes to improve community awareness to deal with future threats. Originality/value: On Simeulue Island, most of the indigenous people already possess the knowledge and value systems inherited through the generations, as a form of local wisdom "called smong" when encountering earthquakes and tsunamis. Beside smong, there is still considerable amount of other similar indigenous knowledge that originated amid traditional people, especially in rural areas, in Aceh. Thus, this paper attempts to identify the knowledge and its representation in the implementation of disaster mitigation efforts in Aceh. © 2018, Emerald Publishing Limited.

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Abstract

Purpose – The purpose of this paper is to explore the case studies of communities' understandings of natural disasters in Aceh Province, Indonesia, where a number of cultures and traditions which belong to the ancestral heritage continue to be used in a more modern context.

Design/methodology/approach – This research used a qualitative descriptive research paradigm in which the researcher attempted to describe or construct in-depth interview results for the research objects. The interviews were conducted in six disaster-prone areas in Aceh, i.e. Simeulue, Central Aceh, Aceh Tamiang, Pidie Jaya, North Aceh and dan Pidie. The interviewees were the informants in this research, which included traditional leaders, religious leaders, community leaders, headmen, youth figures and disaster victims. The technique for determining informants was through purposive sampling in which the sample is specified based on the need of the research.

Findings – Majority of the people in Aceh, especially those who live in earthquake- and tsunami-prone areas still practice this form of knowledge, as they have already realized that it makes a significant contribution to emergency management. They typically used their traditional knowledge to understand both the nature of local hazards and the risk reduction mechanism related to response mechanisms. In some events, they also used it as an alternative to recovery phase according to past information and experiences. This paper will discuss the contribution of traditional knowledge to emergency management by presenting some specific cases of indigenous stories in Aceh. The stories not only served as an early warning system but also can be used to develop more effective disaster risk reduction programmes to improve community awareness to deal with future threats.

Originality/value – On Simeulue Island, most of the indigenous people already possess the knowledge and value systems inherited through the generations, as a form of local wisdom "called *smong*" when encountering earthquakes and tsunamis. Beside *smong*, there is still considerable amount of other similar indigenous knowledge that originated amid traditional people, especially in rural areas, in Aceh. Thus, this paper attempts to identify the knowledge and its representation in the implementation of disaster mitigation efforts in Aceh.

Keyword Disaster

Paper type Research paper

1. Introduction

Aceh is well known as one of the areas most prone to disasters in Indonesia, both natural and man-made disasters. This is because of some factors such as its geographical and geological conditions and other social factors like political and sociocultural ones. Geographically, Aceh is located at the northern end of Sumatera Island making it the westernmost province in Indonesia. Geologically, this province lies on the Sumatera fault, one of the most active faults in the world which has generated many earthquakes in this area.

One of the most shocking quakes was the very destructive earthquake and tsunami that devastated the coastal areas of Aceh and Nias on 26 December 2004. Most of the coastal areas were shattered by the tsunami in just few minutes. The catastrophe not only destroyed much of the infrastructure and buildings, but it also killed more than 200,000 people. These facts make it one of the biggest disasters that has occurred in this century in terms of magnitude, number of deaths, economic losses and social disruption.

In contrast, on Simeulue Island, seven people died because of the earthquake and tsunami. When compared to the total number of inhabitants of Simeulue Island – approximately 78,128 people as of June, 2005 of which majority resided in the coastal areas – the number is not significant (BRR Aceh-Nias, 2009) (Figure 1).

Post the 2004 tsunami, some successful local wisdom concepts – for instance, one on Simeulue Island, Indonesia, and another on Moken, Surin Island, Thailand – have emerged and attracted the interest of researchers and practitioners. They used their ancestors' stories, which are passed orally from time to time within their communities, to survive the tsunami. One important thing to note here is that both communities applied protective actions to save their communities from disaster by

Figure 1 Map of Simeulue Island

using their ancestors' stories, without depending on modern alert systems. On Simeulue Island, most of the indigenous people already possess the knowledge and value systems that have been inherited through generations as a form of local wisdom when encountering earthquake and tsunami; this is called *smong*.

Besides the well-known *smong*, there actually is considerably similar indigenous knowledge that has been inherited and is practised by local people, especially in rural areas of Aceh. For example, people have to build their houses with a distance of more than 50 m to prevent the threat of floods, they place their chicken cages high off the ground or they build traditional elevated wooden houses (Hiwasaki *et al.*, 2014) that prevent flooding and attracting wild animals. However, to this extent, there are many more that have not yet been unexplored.

Therefore, this paper attempts to identify the knowledge and its representation in the implementation of disaster mitigation efforts in Aceh. It is hoped that the paper will make a worthy contribution both scientifically and socially to a better understanding of how indigenous knowledge effectively helps traditional people of Aceh in dealing with various natural changes.

2. Indigenous knowledge and disaster mitigation

2.1 Definition and characteristics of indigenous knowledge

Basically, many researchers agree that indigenous knowledge refers to sets of social behaviours, practices and approaches to modes of living used and developed by local people, particularly native people. This knowledge originates from and is based on their ancestors' experiences, is strongly related to the way they live and interact with their environments and is passed from generation to generation (Baumwoll, 2008; Berkes, 1999; Shaw *et al.*, 2008). It includes a number of social and environmental aspects such as ideas, cultures and customs, technological knowledge, natural resource management practices, beliefs and worldviews, tools, techniques and other adaptive activities preserved over generations to ensure long-

term survival (Athayde *et al.*, 2015; Maferetlhane, 2013). Berkes (1999) also has a similar perspective that indigenous knowledge usually pertains to either economic or social matters and cannot be set apart from environmental challenges.

Maferetlhane (2013), on the other hand, has argued that indigenous knowledge should be inclusive, that it covers both past and present knowledge, and survives and adapts to different environments. In other words, indigenous knowledge connects the bridge between their ancestors' lives with their present life today (Shiwaku and Shaw, 2008). Therefore, it can be said that indigenous knowledge is an invaluable asset for the local community as a whole whether they are natives or newcomers.

As a part of knowledge, indigenous knowledge has several fundamental characteristics:
- it is generated within and owned by communities;
- it is unwritten or orally transmitted across generations; therefore, it is not documented systematically;
- it is widespread in an informal form;
- it is unique and specific to a certain region and culture, as it was created and developed locally based on its local context and circumstances; and
- it is dynamic which means that it is adaptable to new circumstances and continually develops based on peoples' experiences (Baumwoll, 2008; de Guchteneire *et al.*, 2003; Flavier *et al.*, 1995; Maferetlhane, 2013; Mundy and Compton, 1991).

2.2 Disaster mitigation

Disaster mitigation is one of the most important aspects in disaster risk reduction (DRR) measures taken before a disaster occurs which focusses on reducing the natural hazards scale, intensity and impact. This proactive and comprehensive measure is performed in structural and non-structural efforts. The structural efforts are related to physical construction or engineering techniques that are used and applied to reduce the impact of a potential natural hazard, while the non-structural efforts consist of non-physical construction to reduce disaster

risks and impacts through regulations, policies, training and education (UNISDR, 2017).

Disaster mitigation is essential in managing potential hazards and disasters, as it helps people adapt to natural changes and survive natural threats. However, the implementation of this measure is largely dependent on active and effective participation of related stakeholders, particularly the government, community and concerned agencies. Mitigation is not only dealing with the impact of disaster and/or predicting the potential hazards; it should also address the underlying causes of vulnerability (Maskrey, 1989) and promote communication and knowledge sharing among scientists, stakeholders and indigenous people (Athayde *et al.*, 2015).

2.3 Indigenous knowledge in disaster mitigation

In many parts of the world, indigenous knowledge has proven to be one of the most powerful measures for local people to deal with natural disasters. There are numerous examples of this, namely, the story of the Moken community on the coast of Thailand (Arunotai, 2008); the islanders' tsunami coping mechanisms on the Solomon Islands (McAdoo *et al.*, 2009); local Nigerian people plant bamboo and raffia palms to prevent soil erosion and landslide; and while in Swaziland, the local people use the presence of the specific bird species' on trees to welcome the rainy season and predict the potential of flood (Iloka, 2016); the tribal forecasting climate in Rajasthan, India (Pareek and Trivedi, 2011); and other hundreds of similar types of wisdom that may exist around the world. These various forms of disaster mitigation efforts can be regarded as an invaluable wealth of cultural treasures that will assist in increasing community awareness and preparedness for any potential threats and risks in the future.

These facts have attracted the attention of many researchers and scientists, especially those who are involved in DRR and other related study areas, to further study the relationship between indigenous knowledge and disaster mitigation. They believe that indigenous knowledge is a very effective coping mechanism for a community with respect to various natural hazards and threats (Cronin *et al.*, 2004a, 2004b; Dekens, 2007a, 2007b; Mercer *et al.*, 2010; Shaw *et al.*, 2008). Moreover, Gunawan (2008) argues that local wisdom and the spirit of mutual aid are two crucial aspects in the implementation of an early warning system which is assumed to provide a greater understanding of the perils compared to other external elements.

This strong relationship between indigenous knowledge and disaster mitigation has also been declared by several concerned bodies – national and international. In 2008, the Government of Indonesia through their disaster management agency had also enacted Law Number 21 Year 2008 regarding the implementation of disaster management. It is stated in the document that:

> The disaster assessment must be conducted by authorized agencies/ institutions and communities with regard to the existing local knowledge. Moreover, the development of any disaster-resistant buildings and infrastructures must also be carried out by taking into account the local context.

Internationally, in 1995, the United Nations also launched a second International Decade of the World's Indigenous Peoples to strengthen international cooperation and commitment regarding indigenous peoples (Baumwoll, 2008). In the report document of the experts' meeting titled "Safeguarding the Transmission of Local and Indigenous Knowledge of Nature (2004)", it reports that local and indigenous knowledge is directly related to the natural world and certain environmental contexts. In 2005, post the 2004 Indian Ocean earthquake and tsunami, United Nations International Strategy for Disaster Reduction (UNISDR) acknowledged indigenous knowledge as a source of building a community culture of safety and resilience through knowledge, innovation and education in their Hyogo Framework for Action (2005-2015) document.

To this extent, the implementation of various risk mitigation measures with concern to local knowledge has delivered priceless lessons to related stakeholders about its importance for DRR programmes that encourage individuals to take more appropriate steps and decisions. However, indigenous knowledge should complement rather than compete against the established global knowledge system (Nyong *et al.*, 2007). It should be a driving tool for local people to increase their resilience level.

Moreover, the success of translating knowledge into action (Hiwasaki *et al.*, 2014) and bridging communication to support risk mitigation programmes (Athayde *et al.*, 2015) also facilitates communication between scientists and local people (Shaw *et al.*, 2009) and will greatly affect the community resilience level.

As there is very little literature on this matter in the context of Aceh, this paper tries to explore the existence of indigenous knowledge that may have been forgotten, or even worse, be unknown to most of the local people today. This paper may further provide access to the local knowledge studied and enhance the development of best practices.

3. Research methodology

This research used a qualitative descriptive research paradigm in which the researcher attempted to describe or construct in-depth interview results from the research objects. The interviews were conducted in six disaster-prone areas in Aceh, i.e. Simeulue, Central Aceh, Aceh Tamiang, Pidie Jaya, North Aceh and dan Pidie. The interviewees were the informants in this research and included traditional leaders, religious leaders, community leaders, headmen, youth figures and disaster victims. The technique for determining informants was through purposive sampling in which the sample is specified based on the need of the research. The total number of informants was 300 people.

Field observations and in-depth interviews were conducted to acquire data, facts and information regarding local wisdom on DRR, knowledge management and community solutions for disaster awareness and preparedness. Documentation was carried out to provide additional data so that all the data obtained could be accounted for. Field observations were conducted by directly assessing vulnerable places and conditions that may generate potential hazards (e.g. visited the river which often causes flooding and visited the coastline).

As with other qualitative data, the data in this research are divided into two categories, i.e. primary data and secondary data. The primary data of this research were acquired from the

information extracted from in-depth interviews and field observations, while the secondary data were obtained from various documents and literature like books and writing sheets.

All the acquired data were analysed using an interactive model introduced by Miles and Hubbermen. According to Miles and Hubberman (1994), there are three processes that take place interactively in this analysis model:

- *Data reduction*:a process of selecting, focussing attention on selecting and abstracting and transforming rough data that have appeared from various resources;
- a process of reinforcing, shortening, removing unnecessary, defining focus and organizing data; and
- drawing conclusions from the data that have already passed through both of the aforementioned stages.

4. Representation of indigenous knowledge for disaster mitigation in Aceh

In Aceh, the existing indigenous knowledge is mostly influenced by traditional, religious beliefs and practices. As more than 90 per cent of the population is Muslim, people believe that all events which occur in their lives are governed by God. They used to practice *du'a* (pray) and other related rituals to prevent bad things that might happen in their lives by pleading for help only from God. This is also believed to be one of the most important driving forces in the process of post-disaster trauma healing.

Later, we will present a brief representation of several coping practices that still exist in the midst of Aceh society nowadays. The practices are spread in six regencies in Aceh: Simeulue, Central Aceh, Aceh Tamiang, Pidie Jaya, North Aceh and dan Pidie. These areas were selected because they frequently experience disasters; therefore, the local knowledge on disaster mitigation is well nurtured there.

4.1 Indigenous knowledge in Simeulue

The former regent of Simeulue Island, in a speech for the Kick-off Assembly Meeting in Kobe, Japan, in January 2006, said that the relatively small number of the dead in the 2004 Simeulue Island tsunami was due to several reasons – the power and destiny of God, the existence of local wisdom and the topographic conditions.

As other regencies in Aceh province, most of the inhabitants who live on the island are Muslims. This religious tenet of life makes them always relate all events that happen to them, either good or bad, to the aspect of divinity. Therefore, the 2004 earthquake and tsunami are also believed to be a trial from God concerning their faith as humans.

Furthermore, another reason for the lesser number of deceased is because they still practise a local wisdom created by their ancestors – a hereditary story about past tsunamis (Yusuf, 2007). The local people called it *smong*. The word *smong*, which means a splash of water, is derived from one of the local languages, *Devayan*. This story urges people to head to higher places if a large magnitude earthquake causes the sea water along the coast to recede from the shore. Though the story has spread out across the island, the wisdom is not nurtured anymore. Arrival of migrants from outside the island might be one of the main reasons why the wisdom slowly began to disappear over time.

The third reason is the topographic conditions. Simeulu Island is a hilly area and surrounded by avast ocean, the Indian Ocean. Therefore, when the 2004 tsunami struck, people along the coast could easily reach higher places and were saved. According to local community leaders (*tuha peut*), through brief interviews, the areas worst affected by the 1907 tsunami were mostly located along the western coast of Simeulue Island, starting from Salur up to Salang. Another badly affected area was the Alafan sub-district, particularly Lafakha and Langi villages.

Though the epicentre of the earthquake of the 1907 tsunami was on the western coast of the island, its history has spread widely throughout the island and has been recorded in the form of an oral story as a lesson learned for future generations.

There are a couple of reasons that encourage such dissemination:

- The position of Sinabang, the capital city of Simeulue Island, located in the western part, and now the centre of government activities. It has been past since the colonial period until now. It is a prominent meeting point for local people from different parts of the island. The islanders who have visited this place bring the story home to their respective villages and spread it.
- The kinship between the people. When the 1907 tsunami hit Salang and Teupah on the western coast, people from different parts of Simeulue Island came to help out both morally and materially. This is also in accordance with the guidance of their Islamic religion that orders them to help others who are in trouble.

Post that 1907 catastrophic event, the colonial government reported that there were no efforts made to move people from affected areas immediately after the occurrence. Other stories that evolved in the community said that there were a number of people who were evacuated from the western to the eastern coast of the island later on.

The primary element for the creation of *smong* as local wisdom on Simeulue Island was the 1907 tsunami event in accordance with the sociocultural qualitative study about the tsunami's history. The year 1907 was assumed to be the one of the occurrence of the disaster based on several reasons:

- geological studies' results on seismic activities on Sumatera Island and beyond;
- colonial government reports; and
- local traditions.

There are two major aspects that can be seen from the 1907 tsunami:

1 it was a traumatic event because of the number of victims and areas that were destroyed by the tsunami; and
2 the elders, who were directly affected by the tsunami, left the story about the horrible catastrophe behind so that the younger generation can take invaluable lessons from it and be more prepared when facing similar threats in the future.

However, although the local people already possessed such knowledge, McAdoo *et al*. (2006) revealed that there are various versions of this story according to the survivors they interviewed. This is an unstructured pattern of knowledge

sharing in which the story is only shared if it appears to be in accordance with the current conditions.

So far, there is no historical writing that tells about the cultural history of the Simeulue Island because its local people did not adopt a writing culture like the Japanese. The evolution of oral knowledge is very dependent upon the person who owned the story. Consequently, it is not surprising that we now find various versions of the story about the *smong* event in 1907.

4.2 Indigenous knowledge in Central Aceh

In the Gayo highlands, as many other areas of the world, local knowledge mostly arose from intuition, sense and memory, not intellect. This consists of a combination of natural knowledge and experiences which ultimately transform into local knowledge.

To comprehend the local knowledge, people should take into account the way they distinguish every type of knowledge and the practices they perform to acquire beliefs, perceptions and values. This is important because people have to have reasons for their attitudinal tendencies towards everything. Besides, the interaction between conventional science and local knowledge is not a new issue because, according to the history of science, both have long been linked.

Arul Item is one of the villages in the Gayo highlands where the exchange of knowledge and life necessities can be realized because of the existence of trade routes. These routes help people in transporting their crops to other areas and make their villages no longer isolated.

Here, some informal groups of farmers stand by for the orangutan's sounds, as they have long been believed it to be sign of heavy rain and flooding. These farmers play a very crucial role in disaster awareness, risk management and poverty alleviation. Each of the farmers' groups consist of four to five households. They protect animals from theft, avoid potential risks, arrange meetings, organize and share related information and make decisions together.

To prevent landslides, the groups prepare an emergency plan together by forming a movement called a *mungamol* (gathering) to solve problems if there is an emergency situation after a profuse rain. In protecting animals from predators and theft, the groups usually apply a rotation system which is an inter-household cooperation.

It is mostly the elders of the village who know very well the signs of a heavy rain and a potential landslide:

> During *mumenge imo* (hearing the voice of an orangutan), the Gayo people who reside in Arul Item go down the hill and try to hear the sound of the orangutan (*imo*) which shouted while pounding. If they hear that the pounding sound echoed within the forest and become longer and longer, this usually results in heavy rains and landslides, said a local villager.

During the season with heavy rains, people do not organize any feasts. This allows them to incorporate potential hazards into their daily lives in a well-established cultural construction structure so that they can contribute to normalizing natural hazards.

Prayer and collective meetings are another form of religious activities that are performed as part of the strategy of long-term prevention against natural hazards. There are rules in managing the natural resources; examples can be found with respect to water management, ensuring the maintenance of biodiversity and helping to avoid local landslides.

4.3 Indigenous knowledge in Aceh Tamiang

In Aceh Tamiang, some local chiefs use a local flood warning system along the banks of Tengguluin river to a lower area by diverse – before a new system is introduced – as the early sign of natural hazards. In predicting the potential flood, they usually observe the behaviour of ants who move their eggs to higher ground to create a network of guards when the river level grows higher and higher because of heavy rains. The local people along the riverside have practised this knowledge for many years.

4.4 Indigenous knowledge in Pidie Jaya

In Pidie Jaya, during heavy rains, some villagers will be assigned as guards to oversee the situation all night. If they hear the roar of the landslide on the surface of the mountainside, one of them will soon sound the alarm or shout or ring *kentongan* to let other people know that the landslide is coming. This is a public warning system to alert about the possibility of landslides that burgeon within Pidie society.

Another form of local knowledge exists in Kleng village, Pidie Jaya. According to Bukhari Hisham, a local resident of Kleng village, a large magnitude earthquake usually occurs every 75 to 100 years and a small magnitude earthquake every 50 years in Pidie Jaya.

Bukhari Hisham's descendants usually predict a potential earthquake by observing changes in the behaviour of snakes. It is based on the fact that the snake feels the vibrations of earth before humans feel them. A snake will come out of its hole because the earth has trembled from its deepest layers. In Hisham's family, this knowledge has been passed down through the generations.

So far, there is no absolute agreement as to why the snake is the first to detect an earthquake tremble. Among the possible reasons, one of it is that the outside temperature is usually higher, the gas erupts through cracks in the ground, and the vibration that occurs before the earthquake can be felt by a snake.

Learning from the recent earthquake in Pidie Jaya, the failure to implement building codes and lack of appropriate mechanisms for earthquake prediction are reasons to investigate innovative prediction methods using local knowledge and resources for cost-efficiency and ease of implementation. One of them, as Bukhari Hisham said, is by using signs from snakes.

4.5 Indigenous knowledge in North Aceh

Before the 2004 tsunami struck, there was strange animal behaviour observed by some local people in Blang Mangat, Lhokseumawe. According to Mustafa Ibrahim, a community leader of Blang Mangat village, the animals might have heard a certain sound so they instinctively became agitated and tried to stay away from the source of the sound and thus flew to a more pleasant place. Similar to the way that a bat can hear ultrasonic sound, they believed that the birds were able to hear the rumble of the underground ruins which marked the beginning of the earthquake.

Even a few days before the tsunami hit, Mustafa saw white herons showing unusual behaviour. The birds flocked back to the mainland during the day in a huge numbers. Usually, such flocking behaviour of birds occurs before sunset when they come from the mainland to their nest near the coast.

To know how to respond to natural changes, people need to know how to encounter, adapt, experiment and innovate when

facing the natural hazards. They also need to know how to take lessons from previous disasters (for example, mangrove plant can preserve and protect the land from tsunamis and help in water management and about where to get wood and water in times of crisis).

4.6 Indigenous knowledge in Pidie

Heavy rain often causes flooding in Meunasah Raya Village, Pidie, as the river that crosses the village, known as Krueng Teungku Chik Di Reubee, overflows. As this has been occurring for years and has become an annual destructive event, the people in this village have learned from nature's behaviour and have tried to cope with it by maximizing the use of their traditional stilt houses as their paddy storage space and by elevating their livestock barns.

Moreover, they have also used a dating method to predict the flood; this is known as *kutika* or *keun

unong*. The most common formula is usually called as *keununong sa* and *keununong dua ploh lhee*. *Kutika* or *keununong* is a matter of numbers to predict the signs of nature and is believed to be hereditary in studying the changes of nature within the Aceh community.

From their experiences, a huge flood usually occurs in the rainy season when *keununong sa* and *keununong dua ploh lhee* take place. In both those periods, the flood is ordinarily bigger than in other periods or months. This indigenous knowledge is also expressed in the form of rhyme as a lesson learned for the next generations.

Besides the knowledge aforementioned, the local people also observe natural phenomena in predicting the flood, such as:

- *Langet hitam di pucok krueng*: this means that if the sky is black in the headwaters area, the rice crops which are being dried should be moved as soon as possible because the flood will soon arrive.
- *Su megedum di glee*: this means that if there is a bombing sound in the mountains followed by a rumble in the sea, then a few people will soon drop some bamboo staples into to the river to block the water flow.
- *Umpung tikoh dipeu-ek u ateuh*: this means that field rats move their dens to a higher place. Usually, the field rats dig a deep hole for their dens, but when the flood is about to come, the rats will move to a higher place to avoid being washed away by the water.
- *Umpung sidom lagee nyan cit*: this means that ants also move to a higher place before the flood. Then if the anthills are spread on the ground, it indicates that the flood will come shortly.
- *Ka anyot boh pineung masak*: this means that if ripe nuts are floating on the river, it indicates that a heavy rain is taking place in the mountain area and will most likely bring large amount of water downstream.

In this community, a flood is not only understood as a trial and part destined by God, but it is also believed to be the result of human intervention (Table I).

Table I Summary of indigenous knowledge representation in Aceh

No.	Place	Hazard	Description
1	Simeulue	Earthquakes and tsunamis	When the sea subsides because of a huge earthquake, the local people sing a traditional song called *smong* to warn other people along the coastline to flee to higher places
2	Arul Item, Gayo highland, Central Aceh	Landslides	Groups that consist of four to five households called *mungamol* (a gathering) prepare for the possibility of natural threats
			Usually, the elders of the village understood the signs of heavy rain and landslides. During *mumenge imo* (hearing the voice of an orangutan), the Gayo people who reside in Arul Item go down the hill and try to hear the sound of the orangutan (*imo*) which shouted while pounding. If they hear the pounding sound that echoed within the forest become longer and longer, this usually results in heavy rains and landslides
			Religious activities, such as prayers and collective meetings, can also be part of the strategy for long-term prevention of natural hazards
3	Aceh Tamiang	Floods	They observe the behaviour of ants that move their eggs to a higher ground to create a network of guards when the river level becomes higher and higher. This indigenous knowledge has been applied for years as an early warning system for flood
4	Pidie Jaya	Floods	A guard will be placed near the riverside to oversee the situation all night. When he has heard the roar of the landslide on the surface of the mountainside, he will then sound an alarm or shout and ring *kentongan*
		Earthquakes	The change in the behaviour of snakes is observed, as the snake is believed to be able to feel the vibration of the earth before humans can feel it. It will come out of the hole because the earth has trembled from its deepest layers
5	North Aceh	Earthquakes and tsunamis	Strange animal behaviour is noted, as they instinctively become agitated and try to stay away from the source the rumble of the underground ruins which marks the beginning of an earthquake. After a few days a huge earthquake will strike the land
6	Pidie	Floods	People in Meunasah Raya village usually use a dating method which is known as *kutika* or *keununong* to predict the flood. The most common formula is usually called *keununong sa* and *keununong dua ploh lhee*. *Kutika* or *keununong* is a matter of numbers to predict the signs of nature and is believed to be hereditary in studying the changes of nature within Aceh community
			From their experiences, huge floods usually occur in the rainy season when *keununong sa* and *keununong dua ploh lhee* take place. In both those periods, the flood is ordinarily bigger than in other periods or months
			Besides, they also observe natural phenomena which are known as *langet hitam di pucok krueng*, *su megedum di glee*, *umpung tikoh dipeu-ek u ateuh*, *umpung sidom lagee nyan cit* and dan *ka anyot boh pineung masak*

The indigenous knowledge presented earlier is orally transmitted through an unstructured pattern. The stories usually appear once a disaster similar to one in the past has occurred. This keeps being repeated from generation to generation. The unstructured pattern means that the stories are only shared if the context is relevant to the current conditions.

5. Existing gaps

Although there are many indigenous knowledge concepts which have evolved within Indonesian communities, especially in Aceh, only few remain. This study found that lack of community understanding of the importance of the knowledge has become one of the main factors that has eroded the wisdom in addition to the rapid development of advanced technology and the disinterest of the younger generation in such knowledge.

With respect to the younger generation's disinterest, we assume that the advancement of information technology has limited the interaction between the older and younger generations. This has led to a breakdown in the communication channel which is perceived to be a key factor in handing down knowledge to the next generation. It can be said that the breakdown of this communication channel means the end of the inheritance of such wisdom, and as such, it cuts off one of the most effective modes of risk mitigation. If it continues to be neglected, one day the indigenous knowledge will no longer be regarded as a superior tool in any risk reduction initiatives and programmes.

In some locations in which the local knowledge of disaster in Aceh was investigated, it has been revealed that the use of local knowledge runs concurrently with a flexibility in the provision of management systems. This is also a new adaptable discourse in developing a participatory approach. The approach of the local government in Aceh was carried out in several ways such as empowering civil society, carrying out community-based DRR and adaptive management. However, this approach seems to be stuck at the policy level. While in practice, it has been widely proven that the involvement of the community in the process of assessing hazards and implementing coping mechanisms in the form of constructive thoughts and funding support is a central point for the success of risk mitigation efforts.

Another critical issue that is confirmed from the field is that many mitigation efforts and programmes tend to centralise on the development of infrastructures (disaster resistant buildings) and sophisticated early warning systems, rather than using the existing wisdom. It is admittedly important to provide secured infrastructures and develop a well-established and advanced early warning system, but it is also necessary to incorporate those measures within the local knowledge existing in society and to engage the community to actively participate for the successful implementation of mitigation programmes.

In terms of scientific literature, there is very limited literature available regarding this issue. Most of the literature which exists only talks about the vulnerability of this region to environmental hazards and how to deal with those threats. Very little attention is given to the significant role that indigenous knowledge can play in mitigating potential hazards and in enhancing community resilience to cope with disasters.

Moreover, it was also found that there is a quantity of such knowledge living in the midst of communities. However, not all indigenous practices contribute to a sustainable community and development. There are only a few which have been authenticated through scientific validation. Validation is a critical step that can confirm the presence of indigenous knowledge and the extent to which it develops in the midst of a community. That is why, before knowledge is disseminated and adopted, it should be investigated first to assess its appropriateness. This is crucial, as appropriate indigenous knowledge can help the government to better implement their disaster mitigation activities and programmes at the very basic level, i.e. the community. Besides, this validation may ensure that the recommended protective actions are accepted by the threatened community as well.

Furthermore, the integration of indigenous knowledge studies into the educational curriculum is an additional crucial concern that is often overlooked by the government and its educational agencies. The current developed curriculum that integrates risk reduction issues discusses at length the process of a disaster occurrence, predisaster basic preparation, rescue actions and how to respond before and after a disaster. The educational agencies, who play a major role in the development of the curriculum, give very little concern to this inexpensive measure. We assume that this indifference is because of their lack of understanding and information regarding the issue.

By recognizing the gaps, more comprehensive and effective strategies and policies can be formulated to fill in the gaps. However, the gaps can only be bridged if the communities are the key actors in the engagement. For this reason, it is necessary for the government to build better communication and interactions with communities. The government should play a vital role to guide them in assessing and identifying factors that contribute to their vulnerability. By encouraging communities to actively participate in such process, the government will alleviate its work in formulating appropriate decisions and policies by receiving feedback directly from the communities. In other words, it can be said that an understanding and respect for local knowledge will contribute to the effectiveness of the implementation of those activities from both social and cultural perspectives.

Further attempts that can be made to enhance community resilience is to improve the understanding of communities and related governmental institutions/agencies regarding the importance of integrating indigenous knowledge into disaster mitigation efforts. If this attempt is successfully applied, then the community and government will have the same view on this matter which will eventually strengthen the implementation of any risk mitigation programmes and initiatives.

Moreover, the establishment of a tsunami early warning system and disaster preparedness schools in some vulnerable areas are important systems and inititiatives to address future hazards.

6. Conclusion

Indigenous knowledge has led the local people to deal with disaster more effectively by using their intuitive rather than technological sophistication. The intuitiveness, originating from their ancestors' experiences and embedded in their day-

to-day activities, makes them more reactive and quick to respond to any changes in nature. This is contrast to an advanced early warning system which needs time to operate and to relay the warning to people thoroughly and which may experience technical failure at any time.

In the context of Aceh, indigenous knowledge within the Aceh communities is orally transmitted through an unstructured pattern. The stories usually appear once a disaster similar to one in the past has occurred. This keeps being repeated from generation to generation. The unstructured pattern means that the stories are only shared if the context is relevant to the current conditions.

Understanding and respect for local knowledge will contribute to the effectiveness of the implementation of disaster management activities from both the standpoint of social and cultural perspectives. From a social perspective, the public will understand the local knowledge and practices that can help them in identifying the needs. From the cultural perspective, by taking local knowledge and practices into consideration, it will increase acceptance, common understanding and sense of community ownership of their own culture. For that purpose, the concerned parties should work hand in hand for the successful implementation of all mitigation programmes. However, the local communities should be given a chance to set their own methods and strategies to cope with the changing environment, as it is associated in terms of both the local practice and context.

As with other similar studies of such experiences conducted by researchers in Indonesia and beyond, this study also focussed on the investigation of the role of indigenous knowledge within a traditional community and how the knowledge is used to deal with changes in nature.

This paper provides a valuable contribution both scientifically and socially for a better understanding of how indigenous knowledge effectively helps traditional people of Aceh in dealing with various natural challenges.

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