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Indigenous knowledge management to enhance community resilience to tsunami risk: lessons learned from *Smong* traditions in Simeulue island, Indonesia

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Abstract: Knowledge accumulation and production embedded in communities through social interactions meant that the Smong tradition of indigenous knowledge of tsunami risk successfully alerted people to the 2004 tsunami, on the island of Simeulue, in Aceh, Indonesia. Based on this practical example, an indigenous management model was developed for Smong information. This knowledge management method involves the transformation of indigenous knowledge into applicable ways to increase community resilience, including making appropriate decisions and taking action in three disaster phases. First, in the pre-disaster stage, the community needs to be willing to mainstream and integrate indigenous knowledge of disaster risk reduction issues into related activities. Second, during disasters, the Smong tradition should make the community able to think clearly, act based on informed decisions, and protect themselves and others by using their indigenous knowledge. Last, in the post-disaster phase, the community needs to be strong enough to face challenges and support each other and “building back better” efforts, using local resources. The findings for the Smong tradition provide valuable knowledge about community resilience. Primary community resilience to disasters is strongly related to existing knowledge that triggers appropriate decisions and actions during pre-disaster, disaster, and post-disaster phases.

Keywords: Tsunami risk, indigenous knowledge, knowledge management, community resilience, disaster risk reduction, Smong

1. Introduction

The increasing number of disasters in recent years has already exceeded the disastrous events predicted, and this upward trend has become even more apparent in the over 200 million people affected each year since 1994 [1]. Understanding disasters is important to evaluating correctly the challenges that such cataclysms pose and the growing need to find appropriate ways to reduce disaster risk. The role of indigenous knowledge in managing this risk has been recognized in international frameworks for disaster risk reduction (DRR).



One of the success stories that has emerged—stimulating a new interest in the concept of indigenous knowledge for DRR—is the Simeulueans’ knowledge gained from living off the coast of Aceh, Indonesia. When the 2004 tsunami hit Aceh on December 26, the Smong tradition successful alerted people to run away to higher ground, allowing them to survive.

2. Research Purpose and Methods

This study’s purpose was to examine a process of preserving effective indigenous knowledge of tsunami risk on the island of Simeulue, in Aceh, Indonesia. This research applied a qualitative method based on an extensive literature review and semi-structured interviews.

3. Knowledge, Knowledge Management, and Indigenous Knowledge Enhancing Community Resilience

3.1 Knowledge and Knowledge Management

The critical role of knowledge in reducing the worst impacts of disasters has been addressed in the Sendai framework for disaster risk reduction (SFDRR) for 2015–2030. The SFDRR’s first priority of action relates to the topic of knowledge’s important contribution to community resilience, but improved knowledge by itself has failed to reverse the downward trend of community resilience [2]. In other words, disaster awareness has strengthened disaster knowledge but, in the process, communities have lost still more of their resilience. Therefore, the questions remain of why existing knowledge is not always applied or not used appropriately and how this knowledge can be maintained by improving on existing knowledge, especially community knowledge (see Figure 1). Researchers must examine the nature of this knowledge, including understanding knowledge production processes, the existence of different type of knowledge and their sources, and the transfer and use of information that increases knowledge. These processes can be improved, thereby greatly contributing to community resilience in the face of disaster [3].

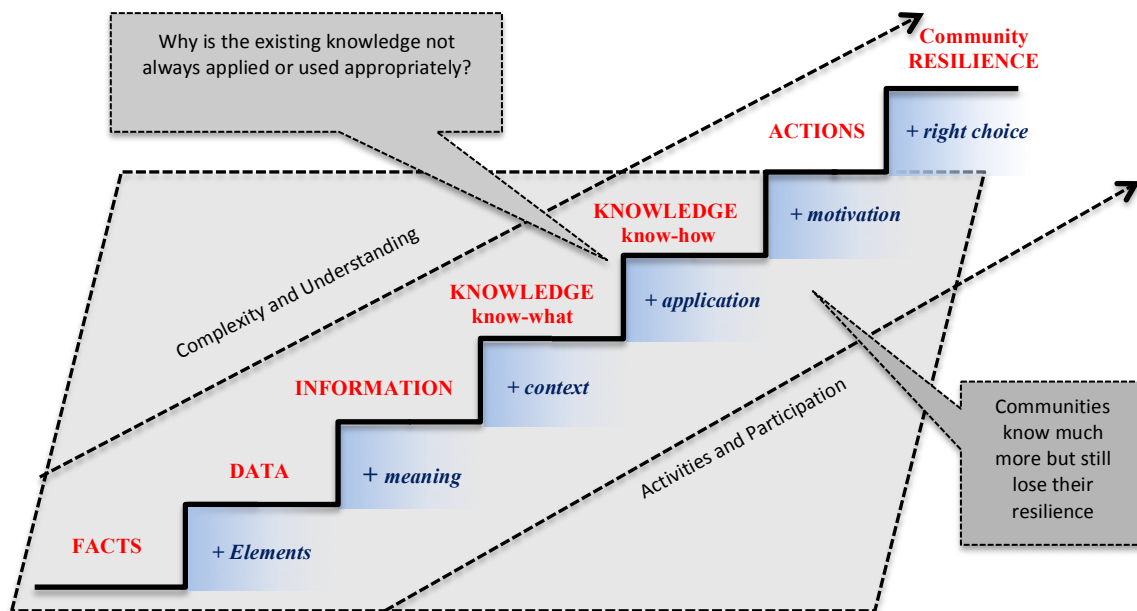


Figure 1: Knowledge ladder through community resilience

Source: Adapted from Klaus North (2014) and Weichselgartner (2015)

Knowledge management is a new vital issue in the DRR strategies involving social constructions [4]. Lessons learned from every disaster have proved that reusing and sharing knowledge can enhance

community resilience to manage disaster risk. The challenge of implementing knowledge management in the construction of community resilience is the lack of systematic management strategies for developing and applying community knowledge. Knowledge management models of community resilience have not been widely recognized by academics and practitioners as a tool to support community knowledge development. However, communities' existing knowledge may present challenges, which prevent it from being used efficiently and effectively [5]. The present study sought to provide a knowledge management approach that could overcome such problems and provide a successful and efficient way to manage existing knowledge in the strengthening of community resilience to disaster risk.

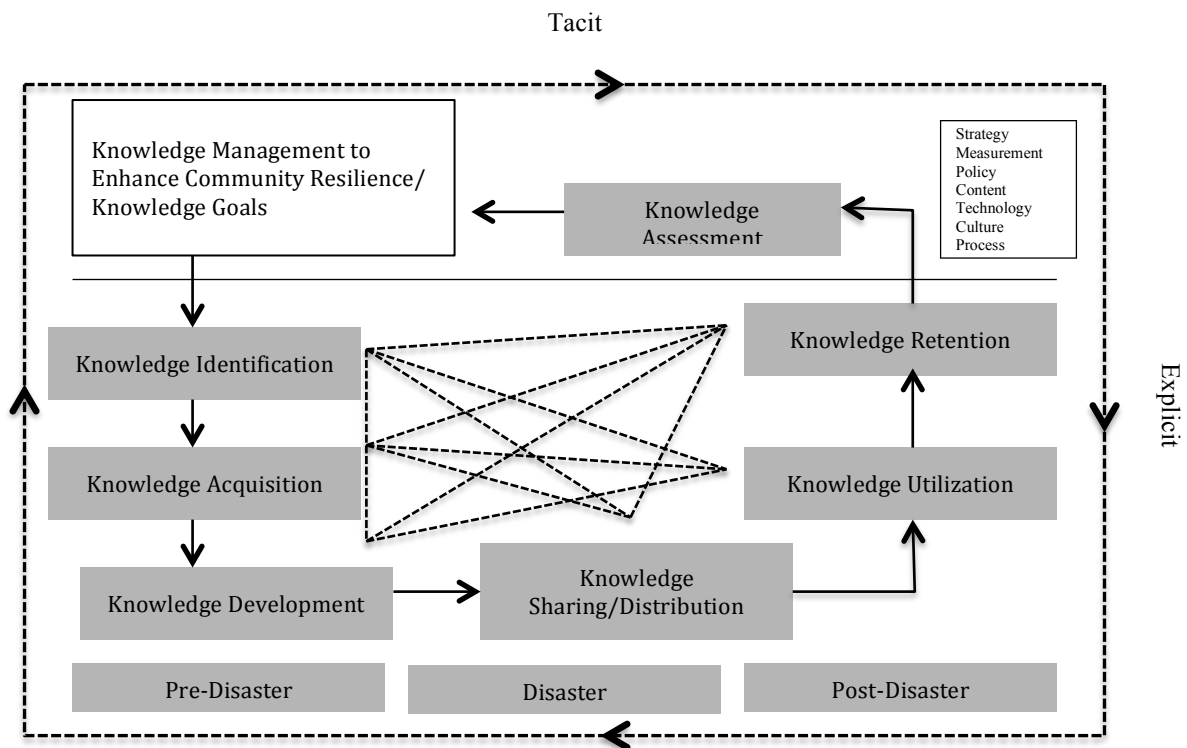


Figure 2: Framework of knowledge management to enhance community resilience

Source: Adapted from Probst, Raub, and Romhardt (2000)

Figure 2 shows the framework of knowledge management to enhance community resilience as a basic approach to understanding the flow of knowledge in communities. Effective local community resilience that manages risks and recovers from crises involves steps in knowledge management: 1) identification, 2) acquisition, 3) development, 4) sharing/distribution, 5) utilization, and 6) retention. Another important thing in knowledge management is assessment, which is responsible for maintaining and ensuring that knowledge can sustainably achieve community goals [6].

3.2 Community Resilience

The first conceptualization of resilience was recognized in the field of systems ecology and introduced in the literature on disasters in the 1970s, but only spread widely in the 1990s [7]. The concept of community resilience is defined in different ways depending on the background and viewpoint of each researcher, and, thus, this concept has many interpretations in academic discourse. The word “resilience” derives from the Latin word *resilio*, which means “to jump back,” and definitions emphasize a capacity for successful adaptation in the face of stress, disturbance, or adversity [8].

The scope of resilience here includes the ability of communities to manage, respond to, and recover from disasters by reusing existing knowledge. A focus on resilience means putting greater emphasis

on what communities can do for their members and how to strengthen these capabilities [9]. This makes it possible to use local perspectives and initiatives to build resilience that increases communities' capacity to recover effectively [10]

The significant contribution of knowledge to community resilience through managing disaster risks is mentioned by Twigg in his book entitled *Characteristics of a Disaster Resilient Community: A Guidance Note*. Although the concept of community resilience to disaster is complex and based on multiple factors, one of the specific characteristics that builds up community resilience is a focus on knowledge and education. More specifically, this includes the possession of appropriate technical and organizational skills and knowledge of risk reduction and disaster response at a local level. Community resilience, thus, more particularly refers to how local communities develop their capacity to cope with disaster by reusing local resources.

The definition of resilience used in the present study is communities' capacity to adapt to, reduce, manage, and recover from the worst impacts of hazards by utilizing their local resources through appropriate, actionable decisions in pre-disaster, disaster, and post-event phases. The adaptive component of resilience in the context of local communities is their capacity to make suitable and actionable decisions in the face of events. The proposed model argues that communities' existing knowledge is central to resilience when managing risk, including their ability to sustain systems and respond to, and recover from, disasters.

More specifically, good decisions are one of the most important ways to reduce the loss of life during crises. Comfort, Boin, and Demchak divide crisis management systems into four subsets of decisions: 1) detection of risks, 2) recognition and interpretation of risks in the immediate context, 3) communication of risks to the community, and 4) community structure and mobilization of systems to reduce risk and respond to events [11] (see Figure 3). In the present conceptualization of knowledge management to enhance community resilience, utilization of knowledge is one of many processes within communities' knowledge management system. Indigenous knowledge is a source of resilience because when indigenous knowledge is integrated into socio-ecological systems, these have demonstrated the ability to deal with complexity and uncertainty [12].

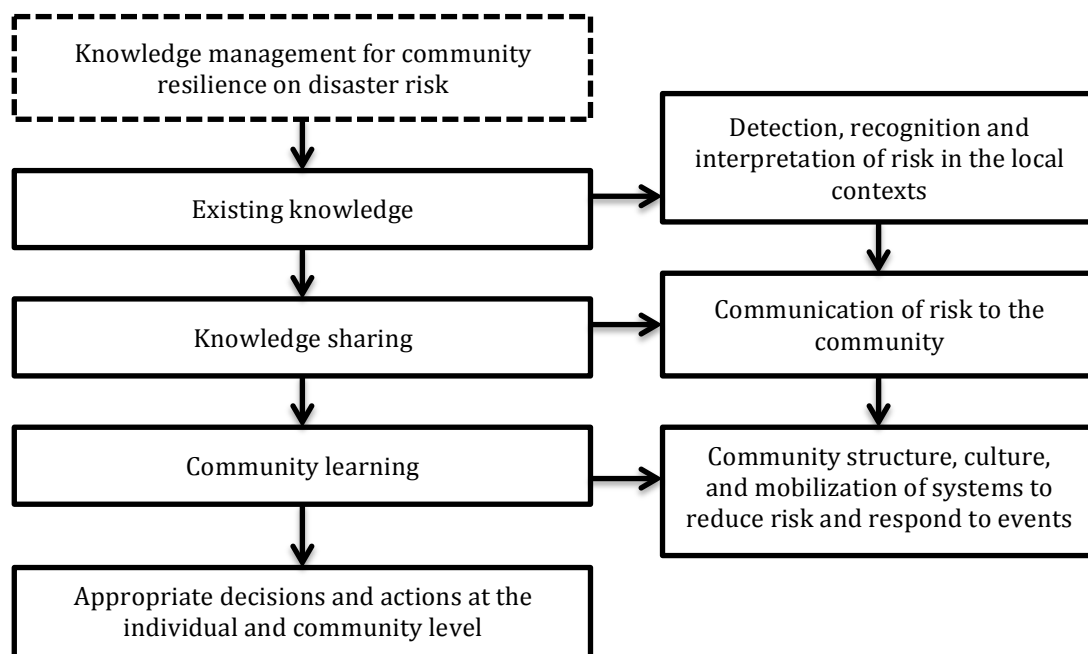


Figure 3: Knowledge utilization leading community in managing disaster risk

3.3 Overview of Indigenous Knowledge

Indigenous knowledge has emerged as a significant resource in dealing with many research and development issues. However, the increasing number of local and indigenous knowledge and practices documented in research on disasters have yet to lead to increased efforts to translate indigenous knowledge into initiatives that increase communities' resilience against disasters' impacts [13]. Indigenous knowledge has traditionally been regarded as inferior to science and technology [14], which has negatively affected communities' development processes [15].

The term "indigenous knowledge" arises from the experiences of many academics and practitioners. Some other terms are found in the literature referring to indigenous knowledge, such as folk, local, rural people's, indigenous technical, and traditional environmental knowledge.

Previous research justifies viewing indigenous knowledge not only as underlying technical solutions to daily problems or only information functioning as an early warning but also as containing non-technical insight, wisdom, ideas, perception, and innovative capabilities that deal with physical, environmental, ecological, biological, or geographical phenomena [15]. This is the reason that most academics and practitioners working in the field of indigenous knowledge have based their interpretations on geography, anthropology, and sociology. Indigenous knowledge could also be a more acceptable alternative to researchers of many backgrounds and areas of interest. Many definitions have been developed in a variety of fields in the literature to help understand indigenous knowledge and distinguish it from other concepts.

Indigenous knowledge has several essential characteristics that differentiate it from other types of knowledge, including that it is 1) embedded and originates in particular communities, 2) maintained through non-formal transmission, 3) collectively owned, and 4) developed over several generations [14] [16]. Indigenous knowledge is a repetition process from generation to generation and an unsystematic accumulation of new data over generations [17]. However, indigenous knowledge can potentially be disrupted through the breakdown of traditional, oral communication channels; the movement of communities to another place on a daily basis; and a lack of interest in learning indigenous knowledge [18]. In the present study, indigenous knowledge refers to communities' knowledge practices—formed over numerous generations—arising from their capacity to deal with and understand their environment in particular contexts and places.

3.4 Indigenous Knowledge in DRR

Indigenous knowledge has received increasing attention in the fields of DRR by both scientists and practitioners in recent years [7] [19]. Work on indigenous knowledge began to permeate the DRR discourse in the 1970s. However, this research expanded quite slowly, and the link between indigenous knowledge and DRR remained vague and indirect. By the 1980s, indigenous knowledge was still being ignored within the established disaster management discourse even as more attention was given to the role and value of indigenous knowledge in others field [16].

The recognition of indigenous knowledge's role in SFDRR now includes that indigenous peoples, through their experience and traditional knowledge, significantly contribute to the development and implementation of plans and mechanisms, including early warning systems [2]. Another major tsunami could happen at any time [20] in the future, so indigenous knowledge needs to be integrated into the entire early warning system through a local understanding of risks. A successful application of indigenous knowledge can allow locals to recognize the emerging threat in sufficient time to take informed action, thereby reducing risk and mobilizing appropriate responses and actions for the entire community, with the great benefit of reducing loss of life. Indigenous knowledge has a significant role in local community, including how to manage dynamic interactions in community systems that move from the level of individuals' "know-how" to individual and community-level action.

Most indigenous knowledge is intangible and, consequently, not easily codified [21]. It is hard to communicate real but tacit knowledge to people with a different level of knowledge [22]. Some approaches have been developed to manage knowledge effectively and successfully transfer tacit knowledge into explicit formats, but researchers need to have a clear understanding of the dynamic nature of knowledge itself [23]. Development initiatives that pay attention to local ways and

perceptions are more likely to be relevant to people’s needs and to generate sustainable interventions [17].

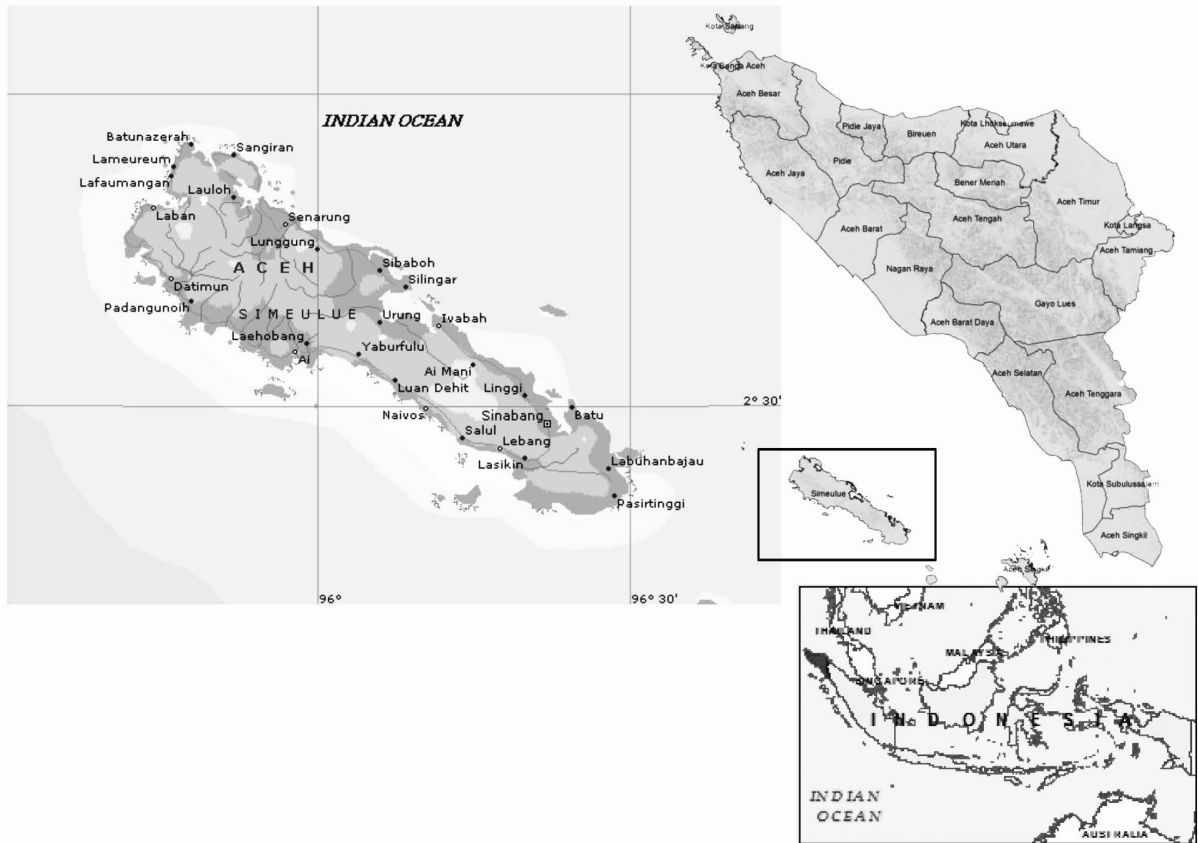


Figure 4: Map of the Island of Simeulue

Source: Adapted from Sumatransurfariis.com [24]

4. Underlying Lessons Learned from the Smong Tradition

The islands of Simeulue are located to the southwest in the province of Aceh, located 105 miles north of Meulaboh, West Aceh, or 85 miles from Tapak Tuan, South Aceh, at $2^{\circ}15' - 2^{\circ}55'$ north latitude and $95^{\circ}40' - 96^{\circ}30'$ [25] (see Figure 4.). Simeulue is a group of islands that comprises more than 147 large and small islands. The largest island is called Simeulue, and more than 90% of the archipelago’s total population live there. Simeulue’s total area is 1,838.09 km² or 183,809 ha.

The community on Simeulue is a heterogeneous society with several languages, namely, Devayan, Lekon, Sigulai, and Aneuk Jamee. Simeulue’s Department of Population and Civil Registry recorded that its population increased from 84,704 people, in 2010, to 93,499 people, in 2014, with a gender composition of 47,969 males and 45,530 females. More than 99.74% of Simeulueans are Moslem, which means their culture is influenced by Islamic values [25].

4.1 Smong Success Story

On January 4, 1907, a 7.8 magnitude earthquake hit Aceh, and a tsunami developed in the Indian Ocean and caused the death of 70% of people on Simeulue [20]. The survivors shared their sadness, experiences, and knowledge with the next generation by creating the Smong tradition. The survivors recorded their experience in oral stories and passed these to the next generation from the oldest generations to the younger generations.

The word “Smong” derives from the Devayan language, which means the splash of water or tidal wave. Smong further refers to tsunami warnings when big earthquakes occur on Simeulue. Smong also explains the tsunami disaster phenomenon when a big earthquake is followed by a low tide of seawater on the beach and a giant wave that sweeps across the land (See Table 1) [16] [26].

Table 1: Smong lyrics in Devayan, Sigulai, and English

Devayan	Sigulai	English
<i>Enggel mon sao curito</i>	<i>Longola amba curito</i>	Please listen to this story.
<i>Inang maso semonan</i>	<i>Pado zaman nafe'e</i>	One day in the past,
<i>Manoknop sao fano</i>	<i>Tobanam amba desa</i>	A village was sinking.
<i>Uwi lah da sesewan</i>	<i>Nak daya feila la curitokan</i>	That's what has been told.
<i>Unen ne alek linon</i>	<i>Ya lunen afe dulu</i>	Starting with earthquakes
<i>Fesang bakat ne mali</i>	<i>Lentuk bakat yu ekhi eba</i>	Followed by a giant wave,
<i>Manoknop sao hampong</i>	<i>Tobanam amban gampung</i>	The whole country was sinking
<i>Tibo-tibo mawi</i>	<i>Tibo-tibo amak</i>	Immediately.
<i>Anga linon ne mali</i>	<i>Bo dulu ni abe le</i>	If the strong earthquake is
<i>Uwek suruik sahuli</i>	<i>Idane yu ata'a</i>	Followed by the lowering of seawater,
<i>Maheya mihawali</i>	<i>Rongkap akhuli</i>	Please find in a hurry
<i>Fano me singa tenggi</i>	<i>Banuami yu ala wa</i>	A higher place.
<i>Ede smong kahanne</i>	<i>Nak daya emong deini</i>	This is called Smong,
<i>Turiang da nenekta</i>	<i>Curito nenek moyang ta</i>	A story of our ancestors.
<i>Miredem teher ere</i>	<i>Enuge ekhi-ekhi</i>	Please always remember
<i>Pesan dan navi da</i>	<i>Amanah afe nasehatla</i>	This message and instruction.

Source: Adapted from Wikipedia.org [27]

The transmission of Smong as indigenous knowledge across generations of Simeulueans is a complex but basic process embedded within deep sociocultural patterns. Most Smong knowledge is tacit, and it is created and shared through community interactions. Smong has been mainly acquired from local sources such as family, older people, and community events. Since Smong is a matter of pride for Simeulueans and, predominantly, tacit knowledge shared within their cultures, rituals, and ceremonies related to disaster reduction, this knowledge already exists. However, it is not formally recognized in the official social system, for instance, a failure to integrate explicitly Smong information into disaster education curriculum.

A Simeulue community leader interviewed on August 15, 2016 mentioned the existence of older people who had experienced the 1907 tsunami, reporting that these community leaders have played an important role in coordinating different local cultures' awareness of this experience among community members. The elderly have contributed greatly to the government's access to the oral story practices through which Smong knowledge is conveyed, but most have died from old age (see Table 2).

However, another factor explains more clearly how Smong has successfully been translated into community action. The main ethnic groups living in the coastal areas of Aceh, such as Banda Aceh and Aceh Singkil, include in their cultures descriptions of tsunami. The tsunami story and messages based on what happened in the past are implied in oral literature referred to as Ie-Beuna in Banda Aceh and Gloro in Singkil. However, the Aceh Besar and Aceh Singkil people do not recognize these as a message from the past about how to reduce disaster risks. This tradition is perceived as merely beautiful poetry. Although the Smong, Gloro, and Ie-Beuna traditions originated in the same province, they have developed differently for several reasons.

Table 2: Smong knowledge processes

Knowledge Acquisition	Knowledge Development	Knowledge Sharing	Knowledge Preservation	Knowledge Application
<u>1907–2004</u>				
<ul style="list-style-type: none"> • Smong knowledge acquisition is predominantly local, from family and old people who had personal experiences with the 1907 tsunami. 	<ul style="list-style-type: none"> • Smong developed as knowledge in oral stories. 	<ul style="list-style-type: none"> • Oral transmission. 	<ul style="list-style-type: none"> • Most Smong knowledge was preserved in oral stories. • Explicit sources were not used to maintain Smong knowledge. 	<ul style="list-style-type: none"> • The right decisions and appropriate actions were made when the 2004 tsunami occurred. • Smong successfully alerted people when the tsunami occurred.
<u>2004–present</u>				
<ul style="list-style-type: none"> • Smong knowledge has been acquired from the experience of the 1907 tsunami and the successful Smong alert of people in 2004. • Access to Smong is through a variety of informal knowledge sources across communities. 	<ul style="list-style-type: none"> • The term Smong is recognized within the community. • There are a few local initiatives based on Smong within efforts to raise community awareness of tsunamis. 	<ul style="list-style-type: none"> • Access to Smong is influenced by oral story and cultural patterns such as nandong, buai-buai (lullabies) and nafi-nafi (advice). • Few local people are involved in transforming Smong into various cultural formats. 	<ul style="list-style-type: none"> • No particular program includes Smong in formal disaster education. • Some documentation of Smong exists, but it is limited to the Smong success story rather than a plan for ways Smong could contribute to community knowledge. 	<ul style="list-style-type: none"> • Most of the local people easily recognize the term Smong. • Few knowledge intermediaries have preserved Smong in printed formats.

The head of the Majelis Adat Aceh (Acehnese Adat Board) at the province level, who was interviewed on September 14, 2016, mentioned the armed conflict and massive military presence before the 2004 tsunami. The conflict between the Free Aceh Movement and the Indonesian Military continued for more than 30 years and created cultural changes on the Aceh mainland that have only slightly affected Simeulue. He suggested this could explain why the Smong tradition survived in the Simeulueans' memory and successfully alerted them to danger when the 2004 tsunami occurred.

After the 2004 tsunami, many poets and writers created material that delivers messages to the next generation. Some authors tried to modify traditional song lyrics such as Nandong by adding some DRR messages to the community [26]. One author interviewed on September 3, 2016 observed that the initiative to modify Smong through new approaches has only come from individual and small group initiatives.

Key lessons learned from the Smong experience about community resilience in managing tsunami risk are as follows:

- The primary media storage for Smong knowledge is oral transmission through cultural patterns in which community members share their knowledge.
- Family, older people, and local leaders played a major role in disseminating and determining community members' actions when the tsunami occurred.
- The peaceful situation in this society has contributed to ensuring the sustainable development of culture patterns through which most Smong knowledge continues to exist.

4.2 Smong Knowledge Management Processes

The processes of a Smong knowledge management approach include the following: knowledge acquisition, development, sharing, preservation, and application of Smong information in community activities. The model proposes a transformation of information into an attitude based on the knowledge that the community can make the right decisions and take appropriate actions in every stage of disaster management. Figure 5 describes the elements of this indigenous knowledge management model to enhance community resilience to tsunami risk (see also Table 3).

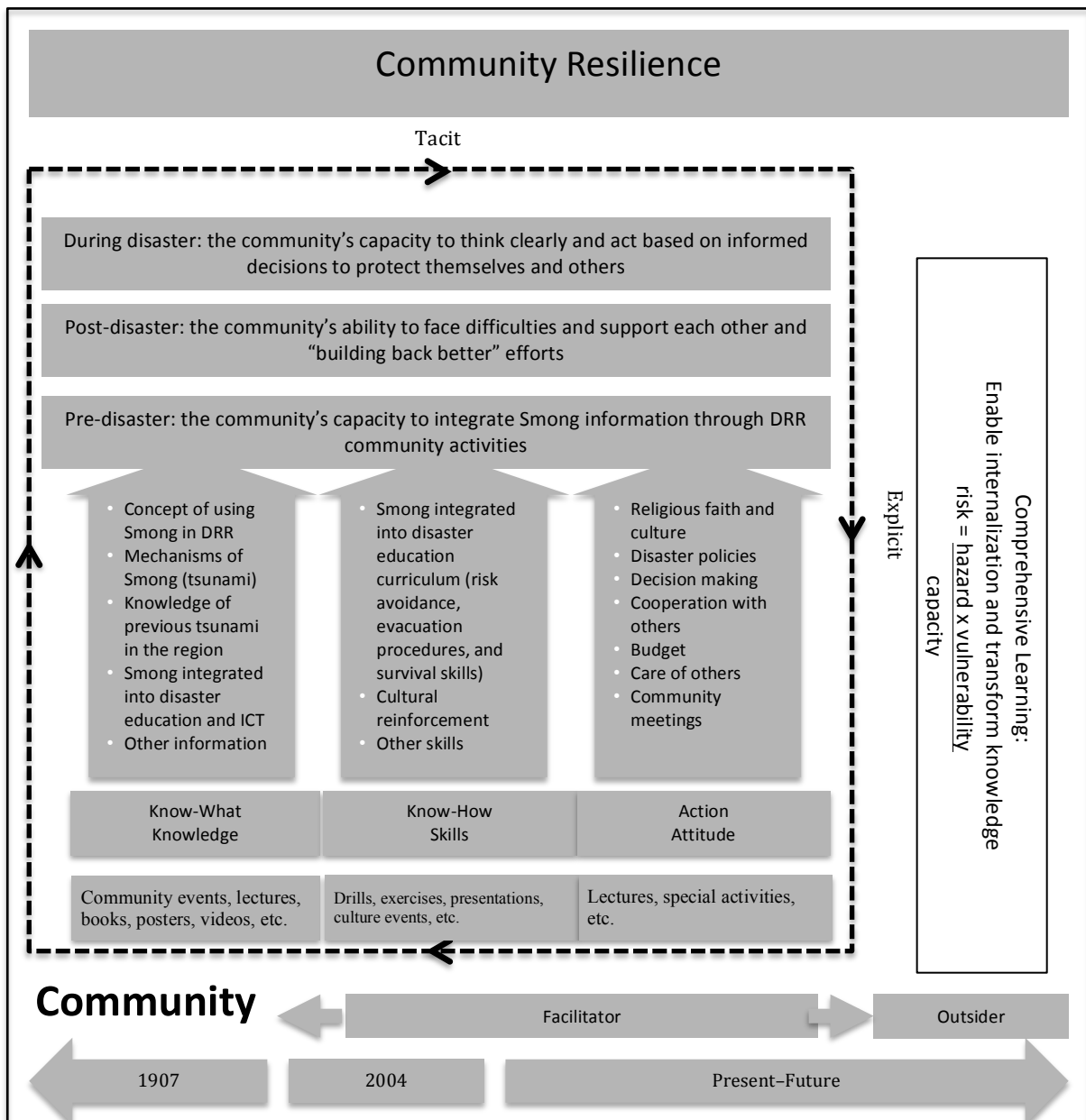


Figure 5: Smong knowledge management to enhance community resilience to tsunami risk

Table 3: Key terms in indigenous knowledge management to enhance community resilience to tsunami risk, on the island of Simeulue

Term	Description
Community Resilience	The community's capacity to adapt, reduce, manage, and recover from the worst impacts of hazards by utilizing local resources with the appropriate and actionable decisions in pre-disaster, disaster, and post-disaster phases
Local Community	The shared knowledge base for the relevant knowledge (i.e., Smong) because all members possess certain knowledge
Facilitator	A stakeholder who has the ability to manage the knowledge base, take responsibility for establishing and maintaining the knowledge base, and facilitate communication between the community and multiple stakeholders and outsiders.
Outsiders	The people who also possess relevant knowledge that could be used by the community, including technology, formal curriculum, and information and communication technologies
1907	The previous tsunami on January 1907, when more than 70% of Simeulueans were killed and lost: the basic source of knowledge through the local community's recognition of the Smong tradition
2004	The earthquake and tsunami on December 26, 2004, when less than five people were killed on Simeulue: a good lesson learned to construct further community knowledge
Present–Future	The conditions after the 2004 tsunami and ways the community prepares itself to face future tsunamis
Know-What	The knowledge resulting from interiorizing information
Know-How	The transformation of knowledge into skills or applications
Action	The abilities or attitudes needed to make decisions and take action using knowledge-based skills
Risk	The probability of tsunami events and their negative consequences affecting the community
Hazard	A tsunami event that may have negative consequences for the community.
Vulnerability	The community's assets, systems, circumstances or characteristics that make it susceptible to the damaging effects of tsunami hazards
Capacity	The combination of all the strengths, attributes, and resources available within the community that can be used to achieve goals for managing tsunami risk
Tacit Knowledge	The knowledge, ideas, and experiences that people have in their minds, which are difficult to access because this information is often not codified and may be hard to express
Explicit Knowledge	Knowledge that can be readily articulated, codified, accessed, and verbalized and then easily transmitted to the others.
Pre-Disaster	The appropriate decisions and actions before a disaster that reduce the potential for human, material, or environmental losses caused by tsunami hazards and ensure that these losses are minimized when disasters strike
During Disaster	The appropriate decisions and actions when disasters occur
Post-Disaster	The appropriate decisions and actions after tsunami events so that the community recovers effectively to face challenges and support each other and “building back better” efforts

The proposed approach begins with the community in which the platform for tsunami knowledge exists over numerous generations. The community provides the basic knowledge (see Figure 5 above).

Another important element is understanding ways that the community defines risks, recognizes and interprets risks, and communicates these risks to its members. Indigenous knowledge management can be used to manage Smong information. Its transmission can be encouraged with a combination of standard DRR approaches and the existing knowledge in the cultural material already respected by the community. The term Smong is widely recognized by locals, providing the root historical experiences of tsunamis that frequently devastate the area. Smong can be improved into new songs, stories, legends, proverbs, rituals, or ceremonies relating to DRR messages.

Although songs, stories, and cultural patterns relevant to the Smong tradition already exist, innovation is still needed to spread and ensure knowledge of Smong within the community. The model is concerned about not only transforming tsunami information into explicit knowledge but also, most importantly, ensuring that the knowledge can be transformed into community attitudes that help make right decisions and take appropriate actions when tsunamis strike. Smong knowledge should be encouraged and spread into formal education, to reinforce this cultural pattern. Some programs are described in this model including, among others, books, drills, lectures, posters, exercises, presentations, survival skills, and community meetings and cultural events.

The Smong tradition can be effectively managed and integrated to enhance community resilience when managing tsunami risk by appointing stakeholders who can manage the knowledge base, take responsibility for establishing and maintaining this knowledge, and facilitate the community's communication with other stakeholders and outsiders. Facilitators must work closely with community leaders to develop a good environment for knowledge sharing activities in local communities. This leadership has a significant role in creating cultural patterns that enhance knowledge sharing, utilization, and retention in local communities.

Finally, the proposed approach describes indigenous management processes that can achieve the main goal of enhancing community resilience to tsunami risk by making appropriate decisions and taking action. This goal can be reached in all phases of disasters. First, in the pre-disaster stage, the community could be willing to mainstream and integrate indigenous knowledge with DRR issues into their regular activities. Second, during disasters, Smong could make the community able to think clearly, act based on informed decisions, and protect themselves and others by using their Smong knowledge. Last, in the post-disaster phase, the community could be strong enough to face challenges and to support each other and "building back better" efforts, using local resources.

5. Conclusions

Smong provides valuable knowledge about enhancing community resilience when managing tsunami risk. The study's results indicate that the knowledge management approach can be used to manage the Smong tradition and introduce the involvement of knowledge facilitators, other stakeholders, and relevant outsiders. The findings support the conclusion that knowledge management is one alternative that can prevent the disappearance of Smong as indigenous knowledge on future tsunami risk, offering a way to strengthen the community's ability take the best decisions and take appropriate actions before, during, and after disasters. Finally, this study also found that, to achieve enhanced community resilience, indigenous knowledge needs to be linked to the entire range of disaster management activities in all disaster phases.

6. Future Avenues of Research

In the next stage of this research, this study will seek to formulate theoretical and empirical approaches to constructing a comprehensive and widely applicable indigenous knowledge management model for DRR. The next research should be conducted in participatory approach by involving the community to formulate the model.

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