

Applying Indigenous Knowledge to Natural Disaster Preparedness

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Abstract

Many communities continue to be impacted by natural disasters regardless of geographical location, while relying on homogenous measures. This article aims at examining how to apply indigenous knowledge to natural disaster preparedness as part of disaster management. This article utilized qualitative content analysis as its key methodology. Various sources of indigenous knowledge such as anecdotes about animals behave before a disaster, plant conditions that may be indicative of an impending disaster, interpretation of certain constellations, and others were analyzed as to whether they can be considered sustainable measures in aid of disaster awareness, disaster operational planning, scientific research, and training and exercise. The key finding or recommendation is that it is necessary for the field of natural disaster preparedness to change its indigenous knowledge into sustainable measures.

Keywords: Natural disaster; knowledge management; Animal behavior; Plant condition; Constellation.



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1. Introduction

Diverse natural disasters such as earthquake, tsunami, wildfire, drought, hurricane, flood, snowstorm, sinkhole, yellow dust phenomenon, famine, and climate change, continue to devastate many regions globally. Accordingly, regional communities have tried to directly or indirectly deal with the occurrence of natural disasters. In particular, many stakeholders have made their efforts to prepare for natural disasters by relying on all means possible. However, it has not been easy to accomplish their mission due to complicated barriers such as politics, the lack of fund, environmental barriers, among others (Dekens, 2007).

In a sense, the issue of natural disaster preparedness has been led mainly by many experts following the top-bottom approach (Sillitoe and Marzano, 2009). Although various individuals have played their own roles in dealing with natural disaster preparedness, experts at top positions have also played many important roles such as diagnosing problems and providing solutions and related alternatives. Top-bottom approach is about seeing the big picture first and then breaks it down into smaller segments. Therefore, natural disaster preparedness at the local level or traditional context, which is located at the bottom position, has not been equally addressed.

As long as natural disaster preparedness focuses only on existing principles, processes, or other related measures such as men’s clearly discussed knowledge or routinized measures, its efforts come to be somewhat homogeneous. These efforts may not provide revolutionary alternatives for the field (Johnson *et al.*, 2016). To this point, the field needs to be diverse by paying attention to innovation, which has not been widely explored yet.

Top-bottom approach, homogeneity, and regular measures may be transformed by utilizing indigenous knowledge as a tool for dynamic changes toward natural disaster preparedness via bottom-top approach, diversity, and revolutionary measures. Following table 1, indigenous knowledge has played a role in putting valuable insights to natural disaster preparedness. With the above in mind, this study examined how to utilize indigenous knowledge to prepare for natural disasters.

Table-1. Examples of natural disaster occurrence with the prediction of indigenous knowledge

Units		Prediction of Indigenous knowledge	Occurrence of Natural Disasters
Factors	Animals	<ul style="list-style-type: none"> - Catfish jumped in a pond in Edo, Japan in 1855. - A number of birds abandoned their nests in Thailand in 2005. 	<ul style="list-style-type: none"> - Edo earthquake occurred in Japan in 1855. - Indian Ocean tsunami hit the area in 2005 and thus killed more than 200,000 victims.
	Plants	<ul style="list-style-type: none"> - When either the Moretlwa (wild berry) or the Motlhatswa (red milkwood) produces many fruits in tree, it indicates drought in South Africa. - The Miriwoong residents in Australia have considered flowers of <i>Grevillea pteridifolia</i> (golden tree) as a sign of looming cold 	<ul style="list-style-type: none"> - High extent of drought has occurred in north west province in West Africa even now, when Moretlwa or Motlhatswa has plenty of fruits. - The Miriwoon people in Australia have continued to prepare for the start of cold season by distinguishing flowers of <i>Grevillea pteridifolia</i>.

	season.	
Constellation	<ul style="list-style-type: none"> - The people in An Hai community in Vietnam have traditionally believed that the change of the moon indicates either drought or rainy season. - Astrologists predicted the occurrence of a major natural disaster in the Netherlands in 1950s. 	<ul style="list-style-type: none"> - When corona has appeared around the moon, expect drought to have also occurred in Vietnam. When a halo has formed around moon, Vietnam is challenged by a rainy season. - In February, 1953, flood with heavy rains actually occurred in Netherlands that victimized 1,826 people.
Others	<ul style="list-style-type: none"> - The appearance of either nimbus clouds or red clouds has meant rainfall in Africa sooner or later. - Inuit hunters in Canada have always been concerned about the issue of wind in the region. 	<ul style="list-style-type: none"> - When many nimbus clouds have appeared or red clouds have formed in the morning, heavy rains have fallen in Uganda and Zimbabwe within 1-3 days. - Thanks to the observation of wind speed, direction, or variability, Inuit hunters have frequently expected sea ice or other weather conditions and thus, have managed their travel, hunting, and other activities.

Sources: (Kaya and Koitsiwe, 2016; Lakshmi *et al.*, 2014; Mafongoya *et al.*, 2017)

The objective of this paper is to comprehensively study how to apply the issue of indigenous knowledge to the field of natural disaster preparedness. It will ultimately contribute to the goal of natural disaster management including minimizing human loss, economic damages, and psychological impact. This study analyzed two major approaches, namely indigenous knowledge purely as anecdotes or stories and indigenous knowledge as sustainable measures.

Indigenous knowledge from anecdotes is those stories based on animal behavior, plant conditions, constellation, and others. Indigenous knowledge as sustainable measures are those already assessed and validated to have scientific bases that may aid in disaster management, especially on awareness, planning, scientific research, and training and exercise.

2. Literature Review

Via globalization in the 21st century, many professional fields have not relied upon only finance, strength, or strategic results. Rather, knowledge management is a key player in various fields (Dalkir, 2005; Omotayo, 2015). Knowledge, which is a collection of various information, insights, understanding know-how, or personal beliefs, is power. Knowledge management is about systematically managing knowledge to meet many technical requirements or to invent or add value in each field where it is applied.

Indigenous knowledge is being utilized by local people to survive under their own environment. It is usually rooted from a particular local place. Indigenous people or local residents have generated such knowledge with reference to their practical experiences. Additionally, the contents of indigenous knowledge have been passed from generation to generation via rituals or word of mouth. Overall, indigenous knowledge plays a role in helping indigenous people deal with various problems in their communities.

Indigenous knowledge relates to many aspects of human society such as agriculture, food production, medicine, land management, ecological management, natural resource management, development activities, pastoral systems, disaster risk management, and so forth (Iloka, 2016). It is also known by different names including local knowledge, local wisdom, non-formal knowledge, traditional knowledge, folk knowledge, native knowledge, and cultural knowledge.

Some researchers have stipulated that indigenous knowledge is opposite to that of western science (MacKenzie, 2014). However, in reflection, even some communities in advanced nations have also lived with indigenous knowledge such as Alaskan native communities in the United States, the community of Indjalandji-Dhidhhanu in Australia, many agricultural areas in Germany, and the Cevennes National Park in France. This article maintains that indigenous knowledge is available in both developed and developing nations.

If indigenous knowledge is the only recognized knowledge within a local community in either advanced nations or developing nations, then maximizing knowledge management may not be addressed fully. In this context, knowledge management may play a role in further capturing or utilizing indigenous people's experiences or best practices by adopting and then utilizing the right indigenous knowledge. At the same time, the effects of indigenous knowledge will be steadily maximized in many places with the support of proven dos and don'ts lists.

The cycle of natural disaster management consists of four phases, namely disaster prevention/mitigation, preparedness, response, and recovery (FEMA, 2013). Indigenous knowledge has been directly or indirectly involved in each phase. However, indigenous knowledge may be more influential in the phase of natural disaster preparedness than in the other phases. The reason being that indigenous knowledge is related to predicting the occurrence of various natural disasters in communities, therefore, the phase of natural disaster preparedness may benefit from its application.

Indigenous knowledge regarding natural disaster preparedness have encountered challenges including helplessness, cultural exploitation, racism, violence, being disregarded by society, denial of traditional knowledge, and others (Mercer *et al.*, 2010). Even though indigenous knowledge is more qualitative or geographically minute, it has been dismissed or hidden in the international field of natural disaster preparedness. In this context, indigenous peoples in developing or developed nations have recently asked the change of indigenous knowledge status in particular via cutting-edge information technology or globalization arena, as well.

The issue of indigenous knowledge began to get attention from the field of natural disaster preparedness in the early 1990s, in particular with the rise of climate change. Because of earthquakes and tsunamis in the Indian Ocean in 2004, the role of indigenous knowledge has been often mentioned in the research field. Some international institutions have made their own efforts to recognize the importance of indigenous knowledge for the goal of natural disaster preparedness. As such, the World Bank set up a database for indigenous knowledge in 1998, as the United Nations have let their own specialized agencies plan and implement multiple projects on indigenous knowledge.

However, not much has been generally known regarding how the international community should approach the topic of indigenous knowledge in the field of natural disaster preparedness (Maferethane, 2012). Similarly, little has been perceived about how traditional communities have dealt with indigenous knowledge. In other words, the field of natural disaster preparedness only recently has begun to fill the gap between indigenous knowledge and scientific knowledge. With the above in mind, this paper has a potential value in the viewpoint of pursuing research opportunities or related agenda on indigenous knowledge and scientific knowledge.

In a macro viewpoint, culture includes the totality of socially recognized behavior, beliefs, arts, organizations, and other outcomes (Hoppers, 2004; Leonard *et al.*, 2013). Culture also reflects human life, the natural environment, and others. As such, culture has not been genetically transmitted but socially transmitted in a human society, somehow making culture, a learned process. Therefore, culture is a total body of learned behavior, which is common to any human community. Also, cultural learning plays a role in acquiring skills to deal with many difficulties in human life.

In the context of culture, indigenous knowledge may be classified as one of the dominant cultures of a region. In addition, indigenous knowledge can be evaluated as a means of solving thorny problems in communities either in developing nations or developed nations. Therefore, indigenous knowledge may be considered the local people's intellectual property or intellectual right, which has been developed through the years (Howitt *et al.*, 2012). Therefore, the field of natural disaster preparedness has to approach the topic of indigenous knowledge with respect to related cultural property or its right.

Moreover, indigenous knowledge may be classified as a sort of local resources in the field of natural disaster preparedness (Jha and Jha, 2011). Each local community or each nation has its own indigenous knowledge that have one way or the other, contributed to minimizing the physical and social impacts of natural disasters in the region.

Further, worldviews have been developed and have evolved throughout peoples' lifetime, socialization, or interaction with various environments. Accordingly, each community has its own cognitive or perceptual worldview. Thus, indigenous knowledge may be considered as a kind of worldview (Hart, 2010). In today's society of cutting-edge technology, indigenous worldview may be unheard of or unfamiliar. To this point, a systematic study or encounter of indigenous knowledge may help expand peoples' worldviews in the field of natural disaster preparedness.

3. Methodology

While it is true that many indigenous communities in Africa and Asia have been studied, this paper also made an effort to record indigenous knowledge in North America, Australia, Europe, South America, and others. Thus, the scope of this study is not limited to a specific region only, but also covers the international community.

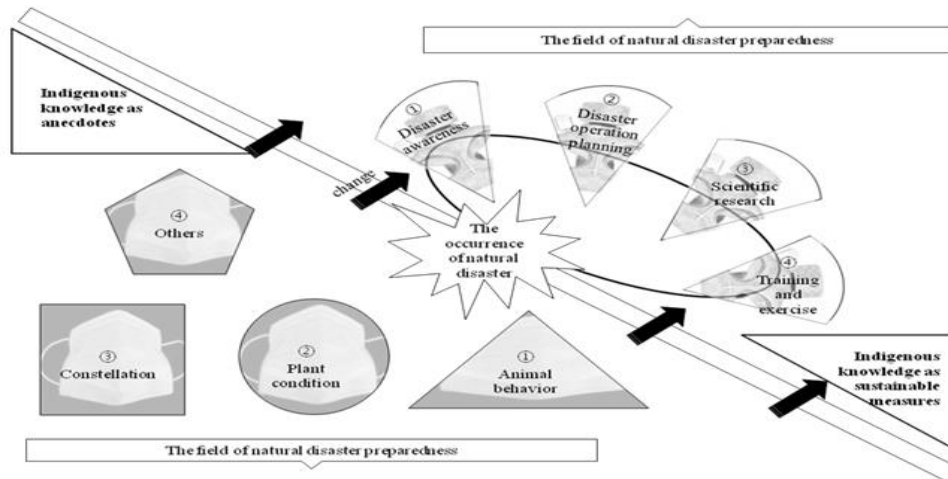
At the onset, this study searched and identified appropriate information and data via internationally known search engines. Several keywords such as 'knowledge management,' 'indigenous knowledge,' 'natural disaster,' 'animal behavior and natural disaster,' 'plant condition and natural disaster,' 'astrology and natural disaster,' and 'cloud formation, wind direction, and natural disaster' were used.

Moreover, three internationally recognized search engines contain quite a significant number of information and data on the subject than other search engines did. These were Google.com (eg, 'animal behavior and natural disaster,' 'plant condition and natural disaster,' and 'astrology and natural disaster'), Yahoo.com (eg, 'knowledge and disaster management' and 'indigenous knowledge and disaster management'), and ScienceDirect (eg, 'indigenous knowledge and natural disaster').

The data from the above sources consist of many manuscript types such as articles, books, official documents, and websites. More than the quantitative information and data, this study utilized qualitative content analysis as its major methodology, specifically interpreting text information and data (Mayring, 2000).

Following Fig.1, this research focuses on two distinct approaches or classifications: (1) indigenous knowledge purely as anecdotes and (2) indigenous knowledge as sustainable measures. In this regard, basic definitions are as follows: 'anecdote' being a usually short narrative of an interesting account or incident and 'measure' being a step planned or taken as a means to an end (Merriam-Webster., 2018).

Fig-1. Analytical framework



Four major analytical factors are considered in the former approach. These are animal behavior, plant condition, constellation, and others (cloud formation, wind direction, and the like). These four have been suggested by the comprehensive literature review (Meenakshi and Juvanna, 2013; Secret of the U.N. Permanent Forum on Indigenous Issues, 2014). Under the former approach, each factor (the image of temporary disposable mask) is located in different diagram without mutual interaction.

Each four analytical factor has own reason to be included into the former approach. Many variables are available in indigenous knowledge. Among them, both animals and plants are major players on the land, while stars are another player in the sky. Therefore, the majority of local communities have mentioned animal behavior, plant condition, and constellation as three key factors in their indigenous knowledge. The other variables will be included into the category of others such as cloud formation, wind direction, etc. In summary, these four factors may include almost all aspects of indigenous knowledge regarding natural disaster.

Four relative factors will be included into the latter approach. In particular when addressing that four analytical factors under the former approach are to show the problematic aspects of current indigenous knowledge, four analytical factors under the latter approach are a sort of solutions for the field of natural disaster preparedness. In short, four relative factors under the latter approach include disaster awareness, disaster operation planning, scientific research, and training and exercise in order.

4. Indigenous Knowledge as Anecdotes

4.1. Animal Behavior

Some indigenous communities recognize that many animals react in advance before to the occurrence natural disasters as hurricane and volcanic eruption. Sparrows, silkworms, hamsters, rats, elephants, sharks, dolphins, minnows, among others have also reacted to the occurrence of earthquakes and tsunamis via geophysical stimuli, electrical signals, electromagnetic effect, or mechanical reception. Therefore, this animal behavior has been used to predict the occurrence of earthquakes and tsunamis in the short-term.

Similarly, some local communities have made their own efforts to study the relationship between earthquakes and animal behavior. For examples, some Chinese communities predicted the occurrence of Haicheng earthquake in 1975 by studying rats and snakes' earlier coming out of hibernation as well as large animals' (eg, horses, cows, pigs, and dogs) unusual behavior (Bhargava *et al.*, 2009). A few communities in the United States summarized a list of animals' abnormal behavior prior to the occurrence of earthquakes. Such behavior included dogs' barking, bees' swarming, cats' jumping, rats' running, birds' screaming, among others. Nonetheless, this animal behavior has not been generally recognized as a means to improve disaster preparedness in the majority of other less-dangerous communities.

4.2. Plant Condition

Through plant conditions, natural disasters in developed or indigenous communities could be predicted. To elaborate, several plants around deserts including rushes (*Juncus*), cattails (*Typha*), giant reed grass (*Phragmites communis*), salt grass (*Distichlis spicata*), and sacaton (*Sporobolus airoides*) play a role in potentially indicating or predicting the extent of drought, based on how such plants customarily absorb ground water for their survival (Meinzer, 1927). Further, when leaves of fig mulberry (*Ficus sycomorus L.*) fall on the ground during autumn, local residents expect heavy rain. Also, when the *Vangueria infausta* Burch is abundant in Africa during winter, famine may be expected soon.

Few governments in the region have made their own efforts to study the issue of plant condition. The Royal Commission on Aboriginal Peoples in Canada attempted to study the topic in the beginning of 1990s (Battiste, 2005). The Commission basically considered their own indigenous people as First Nations and then published several documents on the topic reflecting the viewpoint of those people. Despite this fact, even Canadian

governments have not systematically reflected on the role of plant conditions to the contents of their disaster operation plans.

4.3. Constellation

The word 'disaster' comes from Italian *disastro* that means ill-starred event; and from *dis-* (expressing negation) plus *astro* that means 'star' from the Latin *astrum*. With this etymology, disaster is related to astrological position, which in turn, is beyond human control. Accordingly, Hinduism, among the many religions, strongly believes in constellation in terms of predicting the occurrence of natural disasters. Hinduism emphasized its own astrology or the heavenly body toward natural disasters, while studying the Vedas as a basis of universe. Vedas includes a huge amount of knowledge texts, which originated from Indian subcontinents. Also, those whose works are about or are connected to constellation are considered elites in many communities in Southeast Asia.

Further, indigenous people have made efforts to understand the cycle of natural events for the survival of the fittest (Barnhardt and Kawagley, 2005). Similarly, some people in developed communities, such as Europe, Far East Asia, and others, still believe in astrology to predict the constant patterns of climate change. In doing so, people in indigenous or developed communities have not considered just one factor but multiple factors under uncertain environment. Nevertheless, their reliance on constellation lacks many aspects of scientific research.

4.4. Others (Cloud Formation, Wind Direction, and the Like)

The process of cloud formation may also manifest signs that may aid in predicting the occurrence of natural disaster although more difficult when compared to other predictors. In particular while observing cloud formation for a long time, indigenous people in diverse places have noticed that a certain pattern of cloud formation has been reproduced and thus the occurrence of natural disaster, such as earthquakes, is imminent.

Other examples or signs used are the direction of water flow, water color, ice thickness, rainbow, and others (Gearheard *et al.*, 2010; Kruger *et al.*, 2016). Additionally, wind direction in Indonesia indicates a significant meaning in weather forecast: North wind means that it will be cold, while south wind suggests that rain will soon stop. Further, Canadian-Indians believe in the meanings of the color of the sky. A red sky during the night indicates a good weather the next day, whereas a red sky in the morning signals a bad weather. Still on signs, when animals are slaughtered in Africa, the color of their intestines indicates the possibility of a natural disaster. When their intestines are red, rainy season will soon start. Notwithstanding, the above cases have been rarely reflected in training and exercise programs in the field of disaster management.

5. Indigenous Knowledge as Sustainable Measures

5.1. Disaster Awareness

Disaster awareness is a fundamental requirement when fighting natural disasters and observing disaster management. Without appropriate disaster awareness, even with sufficient budget, a local community may not be as prepared to deal with disasters. Awareness requires appropriate timing and opportunities to develop strategies or integration of various related components in a community (International Federation of Red Cross and Red Crescent Societies (IFRC), 2000).

Although the occurrence of many natural disasters is frequently region-specific, it does not mean that a disaster such as earthquakes or tsunamis will never occur in that region. Natural disasters may happen anywhere. For this reason, local communities need to consider all the possibilities, all the potential signs such as of animal behavior, to aid in disaster awareness.

5.2. Disaster Operation Planning

Indigenous and developed communities alike should establish operational plans to effectively prepare for multiple natural disasters. Such plans, which generally consist of both a basic plan and several annexes, are expected to explain how to manage personnel, resources, and other efforts within a community's jurisdiction (Federal Emergency Management Agency (FEMA), 2010). In so doing, problem-solving is handled analytically with the intention to minimize adverse impacts of the occurrence of natural disasters.

Research and documentation on plant conditions and similar indicators should be undertaken. Such an effort may strengthen the scientific basis of related phenomena that later on, may benefit disaster management, particularly on the planning side.

5.3. Scientific Research

For scientific transformation to succeed, indigenous peoples and astrologists and the scientific community should participate and join forces in research. Without involvement from stakeholders, empirical studies will not progress or improve.

Generally, it will take several steps to accomplish scientific research for indigenous knowledge on constellation in the field of natural disaster preparedness. To elaborate, after the field observes the reality of indigenous knowledge (or astrological information) in the region, appropriate documentation should be implemented. Then, the field has to validate all contents from various documents. At the same time, the field may categorize a number of indigenous knowledge by following its own classification. Lastly, the field will integrate indigenous knowledge with scientific knowledge (Hiwasaki *et al.*, 2014).

5.4. Training and Exercise

Training and exercise include not only discussion-oriented ones (eg, orientation, seminar, game, workshop, and table-top exercise) but also operation-oriented ones (eg, drill, functional exercise, and full-scale exercise). Indigenous knowledge on cloud formation, wind direction, rainbow appearance, and others may be discussed basically via low-stress discussions. Similarly, indigenous knowledge may mingle with high-stress operation. By relying both discussion-based ones and operation-based ones, the field may pursue the goal of effective training and exercise.

To further facilitate the inclusion of indigenous knowledge into training and exercise, the field may more actively utilize today's information and communication technologies maximizing its speed, access, convenience, among others. Also, while employing training and exercise for natural disaster preparedness, the field needs to address the aspect of related sustainability (Hunter, 2005; Magni, 2016). Cutting-edge technology, as part of training and exercise on indigenous knowledge should not be provided as a temporary alternative but as continuing solutions.

6. Conclusion

This study aimed to examine how to improve the role of indigenous knowledge to prepare for the occurrence of natural disasters, particularly analyzing indigenous knowledge as anecdotes and as sustainable measures. Reflecting on examples of indigenous knowledge such as animal behavior, plant condition, constellation, and others (cloud formation, wind direction, and the like) that may aid in disaster management, the four factors of awareness, planning, scientific research, and training and exercise, were discussed and addressed. Therefore, indigenous knowledge in local communities, as sustainable measures, had been confirmed, and thus, the goal of this paper has been successfully achieved.

The main theme of paper is that the field of natural disaster preparedness must reform its current indigenous knowledge as anecdotes into indigenous knowledge as sustainable measures in the near future. To implement this key tenet, all stakeholders must address work together to overcome barriers to the utilization of such measures.

This paper has multiple advantages, depending on individual perspectives. Among them, indigenous knowledge in the field of natural disaster preparedness has been more comprehensively studied in this paper than previous studies. Although some previous researches touched upon the subject of indigenous knowledge in various ways, they did not succeed in examining the issue in terms of a specific viewpoint, in this case, natural disaster preparedness. Not much is known regarding the relationship between indigenous knowledge and natural disaster preparedness. Therefore, the discussions in this paper may lead to innovations toward natural disaster preparedness.

While understanding and then utilizing the main theme, researchers may expand the perspective of indigenous knowledge to the field of natural disaster management in terms of disaster prevention/mitigation, disaster response, and disaster recovery. They may further apply the issue of indigenous knowledge to the case of other hazards such as manmade emergencies or technological hazards. International joint researches with the cooperation of global institutions may be the third option as a future study.

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