Blaan Tribe Indigenous Knowledge in Disaster Risk Reduction in The Municipality of Magsaysay, Davao Del Sur, Philippines

.

ABSTRACT

|  |
| --- |
| **Aims:** This study conducted research on the Blaan Tribe's indigenous knowledge in disaster risk reduction, that is, earthquake preparedness and response, within the Municipality of Magsaysay, Davao del Sur. The study sought to document the traditional strategies being used by the community towards earthquake risk mitigation and to test their relevance with modern urban disaster management practices.  **Study design:** The study used Qualitative Descriptive Phenomenological Design.  **Place and Duration of Study:** The study was conducted in Barangay Balnate, Magsaysay, Davao del Sur, Philippines, between January 2023 and July 2023.  **Methodology:** Seven Blaan Tribe participants, who were purposively sampled, participated in focus group discussions (FGDs). FGDs were conducted with a validated semi-structured interview guide. Data were analyzed using Braun & Clarke's six-step thematic analysis to derive emerging themes related to indigenous disaster preparedness strategies. Ethical clearance was provided by the University of Mindanao Ethics Committee, and informed consent was sought from all participants.  **Results:** Thematic analysis revealed that the Blaan people relied on environmental indicators such as unusual animal behavior, changes in water levels, and changes in wind patterns as precursors to earthquakes. Their adaptation strategies were constructing elevated wooden houses with support from large stones to absorb the shock and performing practical measures based on environmental observations. The communities emphasized the importance of passing indigenous knowledge orally to be able to provide community resilience. The study also found that while these indigenous methods proved effective, they were not necessarily incorporated into official disaster preparedness schemes.  **Conclusion:** Indigenous knowledge is the foundation of disaster risk reduction among the Blaan Tribe. They could be tapped, identified, and integrated into traditional disaster management methods to enhance the resilience of the community. Drawing from the research, the local government units should design culturally responsive disaster preparedness policies that would utilize indigenous ways and scientific technologies in disaster risk reduction. |

***Keywords:*** *Indigenous knowledge, earthquake preparedness, disaster risk reduction, Blaan Tribe, local government intervention*

1. INTRODUCTION

**1.1 Background of Study**

Natural disasters, particularly earthquakes, have posed an incredible threat to human civilization for centuries but on the enormous scale of devastation and mortality. The Philippines is specifically positioned at the Pacific Ring of Fire and thus bears gigantic seismic activity, and its various regions are constantly hit by earthquakes, volcanic activity, and tsunamis (Jha, 2019). These, as per the Philippine Institute of Volcanology and Seismology (PHIVOLCS), occur 20 times a day in the country but are hardly even noticed because they are categorized as slow earthquakes (Bautista & Bautista, 2004). Then there are these gigantic ones like the 6.3-magnitude earthquake that struck Magsaysay, Davao del Sur, and left thousand collapsed buildings, and en masse displacement of people ReliefWeb. (2019). Uncertainty of such disasters reflects the systemic failure of the still very reactive organized disaster risk reduction (DRR) activities and thus far bottom-up proactive strategies (van Niekerk et al., 2022). Pattern of earthquake frequency and magnitude in the area reflects the requirement for bridging the science-local disaster management policy gap towards developing resilience (Gaillard et al., 2019).  
  
In addition, the prevailing disaster risk reduction system in the Philippines largely depends on scientific and engineering expertise, such as interventions that include building retrofitting, seismic monitoring technology, and early warning systems. Irrespective of the intervention, there are major gaps in the application of experiences and knowledge that exist among people, particularly Indigenous people who have incorporated coping mechanisms into their livelihood practices over time (Hiwasaki et al., 2014). The United Nations Office for Disaster Risk Reduction (UNDRR) notes the incorporation of traditional and modern knowledge in its quest for a holistic, effective disaster resilience approach (Kelman et al., 2021). Despite such policy debates reiterating the imperative of indigenous knowledge systems, the above-listed specified indigenous strategies are not factored into mainstream solutions that target disaster risk reduction (Reyes et al., 2019). Institutional incapacity to recognize indigenous practices for disaster risk reduction continues to subject similar risk exposures to vulnerable communities and therefore impedes access to opportunities for resources that can enhance community-level disaster resilience (Rahman et al., 2022).  
  
Moreover, in Magsaysay, Davao del Sur, the Blaan Tribe, being an indigenous Indigenous tribe of the region, has been conducting earthquake hazard prediction and mitigation through traditional knowledge for decades. Evidence has shown that local populations develop successful adaptation strategies to deal with risk, such as interpreting environmental signals, constructing earthquake-resistant architecture, and the use of oral tradition in devising evacuation plans (Ford & Pearce, 2010). Due to the lack of written records and government patronage, gradual decline over time has been observed for such thriving traditions because younger cohorts are compelled to apply Western-based methodologies of disaster management (McAdoo et al., 2019). Noteworthy, omission of Indigenous viewpoints within the standard disaster risk reduction procedure not only denies the community overall preparedness but also marginalizes decades worth of information that can be utilized for a more structured disaster risk reduction procedure (Mercer et al., 2020).  
  
Based on these concerns, this research sought to determine the significance of Indigenous Knowledge in earthquake preparedness and disaster risk reduction in Magsaysay, Davao del Sur. Based on the lived experiences of the Blaan Tribe, the study aimed to inform the general public about the value of indigenous risk reduction management practices and persuade their implementation and integration in national disaster policy. This study is summarized as follows: Section 1.3 of the article detailed the theoretical framework which contextualized the study’s conceptual foundation. Part 2 illustrates the research methodology specifically the participants, instruments, design, data collection procedure and data analysis. Part 3 presents result that validate the application of indigenous knowledge in DRR and its integration into disaster preparedness. Part 4 provides conclusions and suggestions with policy implications and directions for the future to increase disaster resilience based on indigenous practices.

**1.2 Literature Review**

**Bridging Gap between Scientific and Indigenous knowledge in DRRM Policies.**

Indigenous knowledge has potential that still needs to be unveiled especially in the context of disaster risk reduction (DRR), since certain indigenous groups in the Philippines possessed this wisdom. The Blaan of Sarangani, for example, has very wide traditional knowledge on disaster management and environmental protection. Their systems, such as drought mitigation, and landslide are based on ancestral wisdom and collective experience. But this cultural wealth is threatened by waning youth interest and changed environmental circumstances that interfere with traditional learning spaces (Espesor, 2018)  
  
Indeed, there are local Benguet residents in Abra, Philippines who have established intangible cultural heritage practices that are also vital to sustain DRR. These are social support systems, cultural technologies, rituals, and indigenous early warning systems. Such traditions have been found crucial in undertaking proactive planning and deployment of prevention measures against expected hazards. The research requires government agencies to integrate such traditional practices into mainstream DRR policy and make indigenous people an active participant in disaster planning (Lawangen & Roberts, 2023).  
  
Too, the Basey, Samar Mamanwa indigenous groups demonstrated the power of indigenous-local knowledge prior to and following Typhoon Haiyan in 2013. These were emergency evacuation procedures, food and livelihood security rituals, and weather forecasting through animal observations and astronomical phenomena. Despite the effectiveness of these practices, which has been tested, there is still no integration of indigenous knowledge into state DRR policies, usually aggravated by social bias and discrimination. The study promotes the utilization of indigenous knowledge in DRR systems and the active involvement of indigenous peoples in disaster management (Cuaton & Su, 2020).​  
  
Indigenous knowledge practice and systems (IKSPs) are being applied to manage disaster at prevention, mitigation, preparedness, response, recovery, and rehabilitation levels in Abra's indigenous cultural communities' secondary schools. Some of these practices are the use of local flora, interpreting animal and insect behaviors, interpreting cloud formations, and performing community rituals by old people. The research highlights the significance of IKSPs to attain community resilience and calls for their integration in formal education and disaster management structures (Asencio & Cadorna, 2023).

Following the research of Owusu, Antwi, and Kendie (2021) look at the power, legitimacy, and urgency attributes in the roles of stakeholders in disaster risk management (DRM) processes in Ghana to explain how decision making becomes an act of elision of local and indigenous voices. Their analysis uncovers that government institutions and international agencies have control over DRM systems which are biased in favor of scientific and technical participation and void of community-based knowledge systems. This gap results in disaster policies that are ineffective in ascertaining the local people’s vulnerability and coping mechanisms. The outcomes illustrate the necessity of governance structures responsive to the specific needs of people in policy formulation processes, including local people in the context of disaster response such as the Blaan Tribe of the Philippines.

**1.3 Theoretical Framework**

This study is anchored to Warren’s (1991) Indigenous Knowledge Systems Theory, which states that indigenous knowledge is a vibrant, community-centered system that is crucial in alleviating environmental hazards, especially during disasters. This theory explains that indigenous knowledge is not a relic of the past; it is a living reality that develops as people undergo social experiences, pass them on to the younger generation, and respond to various changes in nature. It underscores the strong bond that indigenous people have with nature, where proactive measures for disaster risk reduction (DRR) like the building of earthquake-resistant houses and the reading of environmental signs take place. Warren’s framework suggests that there is indigenous knowledge which, when complemented with scientific knowledge, produce a more comprehensive DRR and development strategy. Instead of condemning indigenous practices as primitive, or as an inferior version of science, this view appreciates them as real phenomena and as useful tools for understanding and addressing natural danger. As the study aims to demonstrate the role of indigenous knowledge as a resource for disaster resilience, it corresponds to Warren’s assertion on the need to develop responsive disaster management plans that honor local knowledge and incorporate scientific progress so that indigenous systems can function, evolve, and be used in disaster management planning at all levels.

Despite enhanced recognition of indigenous knowledge in disaster risk reduction, there were limited studies that investigated its practical application in the Philippine context, particularly among the Blaan Tribe. Existing disaster management frameworks were dominantly found on scientific methods, which in many instances excluded the efficacy of traditional methods. There was a lack of empirical evidence on how indigenous people comprehended environmental signals to predict and mitigate disaster impacts. This study bridged the gap by documenting systematically the disaster preparation system of the Blaan Tribe indigenous community and making practical recommendations to include them in formal DRR plans.

This study was significant in the sense that it provided meaningful information on how indigenous knowledge would complement existing disaster risk reduction activities. In documenting the traditional practices of the Blaan Tribe, this paper contributed to the preservation of indigenous cultural heritage and provided evidence regarding the relevance of ancestral wisdom in contemporary disaster preparedness. To local government units (LGUs), the findings offered policy-relevant recommendations on how indigenous knowledge could be mainstreamed in disaster risk reduction policy and enhancing community-based readiness and resilience. Disaster management offices would also benefit from this research through mainstreaming indigenous warning systems and construction technologies in their capacity-building activities. Furthermore, the study provided an arena for the use of further research on indigenous knowledge in resilience in disasters as an inspiration for policymakers and scholars to capitalize on the complementarity of scientific tactics with traditional knowledge.

**1.4 Research Objectives**

This study aimed to investigate how local and indigenous knowledge in the Municipality of Magsaysay contributes to disaster risk reduction in times of the occurrence of natural calamities. In detail, it ventures into the following questions: In this study, it aims to point out:

1. Identify the traditional indicators used by the Blaan Tribe to detect impending earthquakes.
2. Analyze how indigenous people preserved and transmitted disaster risk reduction knowledge.
3. Provide recommendations for local government units in integrating indigenous knowledge into formal disaster management policies.

2. methodology

**2.1 Design**

This study employed descriptive-phenomenological method to explore indigenous knowledge on earthquake preparedness. Qualitative research helps to capture participants' perceptions and meaning they attribute to their everyday experiences (Hennink, Hutter, & Bailey, 2020). The phenomenological method captures participants' first-person experiences and allows the researcher to describe the phenomenon in depth and show a rich contextualized picture of indigenous disaster risk reduction (Delve & Limpaecher, 2022). In so doing, this method captured the intricate and culture-situated ways in which the Blaan Tribe of Magsaysay, Davao del Sur observes and performs traditional earthquake preparatory practices.

**2.2 Participants**

The qualitative study had a total of seven (7) participants, as recommended for phenomenological research design by Creswell and Creswell (2018). There are four (4) Females and three (3) Males who willingly participated the interview through FGD. Moser (2018) clarified that FGDs function optimally with controlled participant numbers to ensure the collection of authentic data. Purposive sampling, a non-probability technique in which participants were selected based on some characteristics relevant to the study, was utilized by the researchers. Nikolopoulou (2022) stated that purposive sampling, or judgmental sampling, allows researchers to select individuals who can provide the most meaningful information.

The research subjects were the individuals chosen by the barangay chieftain of the Blaan people based on the following criteria: (1) possessors of indigenous knowledge transmitted to them by their ancestors on disaster preparedness; (2) rightful Blaan community members in the area of focus; and (3) regular practitioners of indigenous knowledge in case of an earthquake. Exclusionary criteria were (a) other municipalities' members of Blaan and (b) non-Blaan residents in the study area.

**2.3 Instruments**

The researchers used guide questions validated by a pool of experts. In this research, it employed open-ended questions, in order not to give participants a predetermined set of answer choices and, hence, enabled the participants to provide answers based on their own experience and words. To address the study topic, the researchers requested precise data. Busetto, Wick, and Gumbinger (2020) said that sometimes “guide questions” are referred to as the interview procedure; this is the list of suggested questions for an interview. Guiding questions is open-ended and encourage respondents to contribute information in their own terms because they are qualitative in nature and are neither structured nor "closed." The research questions are guiding questions that request various types of data. In doing so, they create what is frequently referred to as a semi-structured interview, even though it can be used in a variety of ways.

Researchers pilot-tested and established interview guide questions and scheduled FGDs to obtain information. The researchers used focus group discussions (FGDs) in collecting data because this is best suited to examine beliefs, perceptions, and explanatory research. According to George (2023), FGDs are best suited where questions evoke feelings, require detailed answers beyond a simple "yes" or "no," uncover new information, and provide raw real-life data from the participants.

**2.4 Procedures and Analysis**

Permissions to gather data were obtained both from Research Publication Center of UM Digos College, the Municipality of Magsaysay, Davao del Sur, and National Commission on Indigenous People thru their local IPMR.

Two FGDs with three or four participants each were conducted to obtain data saturation. Moser and Korstjens (2018) suggest that conducting more than one FGD offers better data saturation along with the room for wider participant comprehension. The first FGD had four (4) participants and the second had three (3) participants. Both took 60 to 90 minutes to allow thorough discussion without impacting the participants through fatigue.  
  
In line with qualitative research best practices (Guest et al., 2017), the FGDs were mixed by gender, men and women joined each FGD. The two groups were not divided so that a male FGD and a female FGD could be conducted separately because of logistics issues as well as community acceptance that discussions could be conducted in mixed-gender groups. Having both gender groups in a single set of FGDs allowed for several contrasting perspectives while remaining sensitive to culture, their testimonies were recorded with consent.

Braun and Clarke's (2019) thematic analysis were used for data, where emerging patterns were identified, coded, and categorized systematically. Peer debriefing was performed to ensure maximum credibility of the analysis so that themes could be validated and unintended biases avoided.

3. results and discussion

**3.1 On Mitigating Risk and Anticipating Earthquake**

Table 1 shows *alertness* as one of the core themeshighlighting *environmental changes*, *animals' distress signals*. The second core theme is *edifice preparedness* with sub-themes*, building evaluation and building monitoring.* It presents environmental sensitivity, community involvement, and psychological effects of environmental change.

Noteworthy, the research location, Balnate, Magsaysay, Davao del Sur, is a remote mountainous village which possesses unique environmental features important for the prediction of earthquakes. Domesticated animals such as dogs in the households, cows nearby and the presence of open grasslands as well as forest where crickets and wildlife can be found serve as proxies for ecological changes. These factors enhance the community’s capacity to identify environmental changes through local indigenous knowledge and sensitivity to the environment.

**3.1.1 Alertness.** Disaster preparedness alertness involves the ability to detect early warning signs of impending an earthquake, including environmental changes and animal distress signals. Studies suggest that unusual natural phenomena, such as differences in ground water levels or unusual cloud formations, could be indicative of seismic activity (Nikolopoulos et al., 2024). In addition, animal behavior was discovered to be changing prior to an earthquake, as animals react to pre-seismic ground motion before humans perceive it (Grant et al., 2023). Increased public awareness and the integration of traditional observation with modern seismic monitoring networks will enhance the sensitivity of early warning systems (Al Shafian, & Hu, 2024).

***3.1.1.1 Changes in the Environment***. A higher level of alertness is essential for ensuring the safety of individuals and communities during an earthquake. Animals’ distress signals are useful indicators of an approaching earthquake. Creatures have an intrinsic aversion to normal peculiarities, and their way of behaving can frequently give early warning signs. It can alert humans to take immediate action and seek shelter if nearby animals appear agitated, restless, or exhibit unusual behavior. Additionally, sudden environmental shifts may signal the onset of an earthquake, as may birds suddenly taking flight. In connection with this, a manifestation of Blaan Elder 1 showcases these experiences:

As a member of the tribe, nature is your companion. If we pay attention to nature, we will know when a disaster is coming. The old method is good enough, like observing the atmosphere. For instance, normally, dogs bark when they see strangers or smell imminent danger, but in the year twenty-nineteen, we witnessed something else occur. Whenever the dogs were barking persistently and with anxiety, most commonly without any observable danger, we regarded this as an alert signal. Such barking was louder, sustained, and went along with excitement, such as pacing and whining, considered to be abnormal. From experience, the moment we heard the strange barking, we were out of the house within five to ten minutes. This precaution proved to be vital, as earthquakes used to strike a little while after. Such behaviors became noticed as part of our preparedness program, a validation of the fact that nature provides early warnings way before those of modern technology. (p:1, 68 years old)

The statement is a crystal-clear indication that old ways play a vital role in disaster preparedness for the tribe. The distress felt by dogs gives immediate warning to the tribe in the upland area, enabling them to take the necessary precautions to reduce the risk of strong tremors. Davis (2022), in his article “The animals that detect disasters,” showcases the unbelievable behavior of dogs’ minutes before the strong earthquake and tsunami in Indonesia last year. These are accounts from survivors. Furthermore, Wikelski et al., (2020) expresses that research suggests that the distance of an animal, such as a dog, from the impending earthquake or the epicenter allows the behavior of the animal to abruptly change.

|  |  |
| --- | --- |
| **ON MITIGATING RISK AND ANTICIPATING EARTHQUAKE** | **Sub-Themes** |
| Alertness | -Changes in the Environment  -Animal Distress Signal |
| Edifice Readiness | -Building Evaluation and Monitoring |

*Table 1. Framework on Earthquake Risk Mitigation and Anticipation*

It was firmly stated that sudden changes in the environment, such as the muteness of nature and hearing no sounds from animals or even insects, which is unusual to occur, is an old traditional way for the tribe to detect calamities. Members of the tribe living with nature observed it well a thousand times and familiarized themselves with every phenomenon; animals and insects are two of their drills (Coren, 2020). The experiences shared by the tribal elders about the precautions during earthquakes using old methods of observing nature enable a few families in Barangay Balnate to be safe and ready for the many strong aftershocks that occurred in Magsaysay, Davao del Sur.

***3.1.1.2 Animal Distress Signal.*** The essence of animal distress signals sent to tribes during an earthquake serves as an essential warning system. Animals exhibit behaviors that indicate their fear and discomfort as the environment shakes and becomes chaotic. Due to their proximity to the environment, the tribes have developed a profound comprehension of these signals. The tribes’ ability to anticipate imminent danger is aided by the frantic calls of birds, the agitated movements of livestock, and the unusual behavior of wildlife. They can quickly respond and take measures to shield themselves and their communities from the devastating effects of earthquakes. This was the coverage of the experiences of Blaan Elder 3:

Moreover, I observed in the house that part of your question, that animals can easily detect calamity than humans, I can probably say because in our hut the toads that live in mud climb up the house seeking refuge, sometimes they are in mosquito nets maybe they are afraid of the earthquake. When crickets are silent, sudden earthquakes will follow. *(p:3, 55 years old)*

Grant's (2011) findings suggest that pre-seismic cues like gas and charged particles prompted toads to seek higher ground to bring themselves to safety. According to the NASA (2010) investigation, charged particles are blamed because rocks under extreme tectonic stress release positive ions that have the potential to affect animals. The ions may react with the water of the toads, resulting in a hydrogen peroxide environment that could be harmful to them and forcing them to move on. Tribal communities have a strong connection to the natural world and can intuitively sense danger and recognize signs of impending disaster. Keeping an eye on weather patterns, animal behavior, and natural elements are ways indigenous people anticipate disasters like earthquake (Thompson, Lantz, & Ban, 2020). Due to the unique sense organ of insects, strong receptors allow them to perceive changes in the earth’s magnetic field and infrared (20 Hz) produced by earthquakes, which is faster than ultrasound (>20 Hz), allowing them to avoid them by embracing various mechanisms Cremen, G., & Galasso, C. (2020).

The “restlessness of animals” may denote catastrophes such as earthquakes; in this instance, when crickets, and locusts muted their sound, it was an indication of impending tremors, which was witnessed by a Virginia correspondent in Charleston when a strong earthquake struck in that vicinity (Oswald, 2021). For locals, such as tribes, the silencing of crickets prior to an earthquake is a common warning sign that gives them a chance to take safety precautions (Opabola, 2024). The indigenous knowledge they have helps them and their communities stay safe from upcoming disasters. The perceived significance of cricket silencing highlights the importance of traditional knowledge in natural disaster preparedness, despite the uncertainty of its scientific validity.

**3.1.2 Edifice Readiness.** Edifice readiness is the structural readiness of buildings to withstand seismic activity through ongoing monitoring and evaluation. Resilience of buildings depends on materials, construction, and adherence to updated seismic codes, according to recent studies (Sediqi, & Harmandar, 2022). Effective disaster risk reduction activities involve regular inspections of structures to identify weaknesses before an earthquake occurs (Okada, 2021). Moreover, sensor-based real-time monitoring and AI-driven predictive models have significantly improved structural weakness identification, which has improved the earthquake resilience of the structures (Kolhe, & Rathi, 2025).

***3.1.2.1 Building Evaluation and Monitoring.*** Tribes and indigenous communities living in areas that are prone to earthquakes need to be ready for buildings and evaluate them. Life is safeguarded, and community resilience is bolstered by these practices. Traditional structures are built to withstand local environmental conditions, including seismic activity (Mathur, 2024). Building evaluations aid in the identification of potential flaws, the prevention of structural damage, and the education of community members regarding safe construction methods. Kurnio, Fekete, and Naz et al. (2021) laid down in their article that indigenous people in Baduy strictly regulate how to construct a house, and they have their own local wisdom for dealing with earthquakes: the house should not touch the ground and use adaptable resources like bamboo, wood, and leaves. Blaan elder 4 says equal:

During the old times, the tribe had preparations for earthquakes, though it unusually occurs, my father's testimony that the house should not be buried in the ground is stronger and the effect on the house is not devastated if buried. The wooden house is placed on a big stone, and it is effective based on my experience during the earthquake. If the mayor did not force us to transfer into the relocation, I will remain in my house at all costs because I'm safe. *(p:4, 58 years old)*

The Blaan Tribe's earthquake-resilient culture of housing is guided by experience in employing low-cost and light materials to build long-lasting structures (Kurnio, 2021). The *Dasan Beleq Hamlet hamlet* in Indonesia's Lombok Regency gained earthquake avoidance from the employment of ropes and poles in conventional building of structures (Susanthi, Meisandy, & Nisa, 2022). Well-bonded foundation buildings also increase stability via earthquake flexibility, reducing building damage (Hambati, 2021). The same methods, used in constructing stone or reinforced concrete, provide long-lasting houses, which has been duplicated by the Blaan Tribe of Barangay Balnate.

Structure availability and building monitoring are necessary parts of guaranteeing earthquake flexibility in customary houses. To improve preparedness and monitor the structural integrity of their traditional houses, tribes and indigenous communities employ a variety of strategies. These include conducting regular inspections of the house by skilled tribe members to evaluate its condition. The application of traditional knowledge plays a vital role in making earthquake-proof houses, (Gohri, 2022). Sinha, Brzev, and Kharel (2019) manifest that the needs of everyday life led to the development of traditional structures, which now serve to meet those needs and shield occupants from harsh catastrophe. Blaan elder 2 has synonymous experience:

At sixty-five, I witnessed an earthquake as powerful as that and it was a total disaster. So, we are worried because we are also scared of losing our loved ones, especially because we live in the mountains. Our indigenous knowledge is a great help in constructing a house that is earthquake-proof. A strong house built using standard earthquake-proof methods, utilizing light materials such as bamboo, nipa, and wood that allow the building to move freely rather than crash when there is a strong shaking. Unlike thick concrete structures that crack or deteriorate, materials are designed to absorb seismic vibrations. Homes are also built using elevated foundations and elastic joints evading sudden collapses. If a house follows these inclinations, there is less need for around-the-clock vigilance of external warning signals because the building itself will protect us. Instead of running outside, we think our house is built to hold up during the shaking without fear of collapsing. *(p:2, 65 years old)*

Monitoring foundations and building earthquake-proof homes require traditional skills and knowledge. Merging the new with the old by virtue of engineering strengthens the building, maintains cultural heritage, and invokes safety in seismically active regions (Freddi et al., 2021). Further, stone and deodar wood Kath Kuni houses in the Himalayas resisted earthquakes because of traditional quake-proof constructions (Ghosh, 2022). The longevity of most of the ancient buildings across the globe reveals the necessity of learning and utilizing effective construction procedures in contemporary architecture.

**3.2 Risk Reduction Preservation: The Old Traditional Ways**

Table 2 shows Blaan elders as the important bridges of new practice adaptation and old ways preservation, embracing LGU programs and media for information dissemination. There is balance between *new practice adaptation* and *old ways preservation*, and they embrace technology without abandoning cultural heritage to build community resilience.

**3.2.1****Adoption of New Practices.** Implementation of new practices to disaster risk reduction involves the integration of scientific innovations into conventional wisdom in a bid to elevate levels of preparedness. Literature emphasizes the visibility of technology-enabled solutions such as GIS maps and AI models in enhancing the efficiency of response in the event of disasters (Chen, 2023). Government measures in the guise of early warning systems and city resilience programs have also minimized risks of disasters to vulnerable groups (Gall, Cutter, & Nguyen 2014). A mix of these innovations and community-based measures of preparedness guarantees a broad disaster mitigation effort (Jones & Ali, 2021).

***3.2.1.1 Adoption of New Practices (LGU’s Program on Disaster Readiness).***Participating in disaster preparedness programs run by the local government can benefit tribal communities and the traditional ways they live. Traditional practices are enhanced, and resilience is strengthened by these programs, which give participants access to cutting-edge scientific information, resources, and technologies. Participating in these programs encourages cultural pride, collaboration, and the exchange of ideas. Hoyos, Batzin, and Arnold (2020) underscored that tribes can overcome obstacles, preserve their cultural heritage, and increase their resilience to earthquake calamities by valuing and respecting both modern and traditional practices. Domingo (2018) stated that LGUs are mandated to assess the vulnerabilities of the area and its constituents and instill basic knowledge in disaster reduction. This was the experience of Blaan Elder 1:

It is sad to think that the modern era has changed our culture a lot, after the strong earthquake we were educated by an agency of the government I can't remember, together with the municipal LGU, discussing methods to reduce the risk of calamity. But we in the tribe continue to educate the children in the old-fashioned way. *(p:1, 68 years old)*

In terms of disaster preparedness, response, recovery, and disaster readiness, seminars for indigenous communities provide valuable knowledge and skills (Scott, 2023). To empower indigenous communities to take an active role in their own safety and well-being, these seminars provide them with practical information on early warning systems, evacuation procedures, first aid, and emergency planning. They also strengthen social networks and mutual support systems, promoting cohesion. In addition, these seminars foster cultural exchange and dialogue by recognizing and valuing indigenous knowledge and practices, their distinct perspectives, and their expertise in combining contemporary approaches with indigenous perspectives (Herrera, 2016).

|  |  |
| --- | --- |
| **RISK REDUCTION PRESERVATION: THE OLD TRADITIONAL WAYS** | **Sub-Themes** |
| Adoption of New Practices | -LGU’s Program on Disaster Readiness  -Media Informational Content on Disaster Readiness |
| Preservation of Old Ways Practices |  |

*Table 2. Preservation of the Old Ways of Disaster Risk Reduction*

***3.2.1.2 Adoption of New Practices (Media Informational Content on Disaster Readiness).***Native people can benefit from the adoption of new practices, such as media content on disaster preparedness, without harming their traditional methods of disaster mitigation. While incorporating contemporary scientific insights, indigenous people also acknowledge and value the significance of their customary wisdom. Indigenous people can benefit from the additional resources and knowledge provided by media content while simultaneously preserving their cultural traditions, which fosters harmonious coexistence between traditional and modern approaches. Blaan Elder 2 has to say:

Through Kuya Kim the TV weather forecaster, I know the modern methods of detecting earthquakes, the new knowledge now, only showcases how strong the earthquake was, but in the old days, the signal was advanced because if the environment is quiet, it means you need to be vigilant. It is still important that even if it is old-fashioned, it is still worth believing. *(p:2, 65 years old)*

By using methods that are unavailable to local people in empirical studies and theory in data-poor locations to fill in empirical gaps and test empirically derived inferences, modern science such as television can add value by expanding traditional knowledge; hence, a growing number of case studies have emphasized the importance of indigenous knowledge, particularly in the context of disaster risk reduction (Muniz-Rodriguez et al., 2020).

Bojarski (2018) reveal that during the earthquake that struck Haiti, local media played a role, while the world witnessed the widespread use of digital technology and social media to document a major tragedy. Despite many modern ways, the tribe is still eager to follow old ways. Blaan Elder 7 has this observation:

Usually on TV, you can see what is the latest knowledge about calamity, in the case of the Blaan, especially during the old times you can observe the environment because you are a native living in that land and what has changed there, even small changes you must observe what is the reason behind it, that's the norm here in the mountain. *(p:7, 54 years old)*

Though its effectiveness in disaster risk reduction and climate adaptation has been proven, indigenous knowledge is not maximally applied in disaster policy and science (Dube, 2018). However, its long histories, adaptive strategies, and cultural resilience make it priceless, even superior to modern approaches in most cases (Fuller, 2019). Rai and Khawas (2019) opine that indigenous knowledge must be combined with technocratic science to have an integrated approach towards disasters. Likewise, Petzold et al., (2020) discuss the applicability of indigenous wisdom in adaptation by quoting its vast, unrecorded knowledge of nature. Blaan Elder 2 reiterated this:

Our fathers always prepare in case of calamity, in case of flood or any other calamity, they use all available materials to keep us safe. Currently, if there are accidents on the road, or we have an earthquake casualty, the response is easy because the road is good, and there is also equipment and medicine, during the past herbal leaves are the only treatment. *(p:2, 65 years old)*

While modern knowledge and equipment offer scientific advancements and technological solutions for improved analysis and response, old traditional knowledge and its associated equipment offer valuable insights and techniques deeply rooted in customary knowledge, opening possibilities for an integrated approach to earthquake resilience (Izumi & Shaw, 2019). Each type of earthquake resilience knowledge comes with its own set of tools that can be used. Johansson (2021) specified that modern knowledge advances technology and specialized equipment, whereas traditional knowledge relies on locally available resources and straightforward tools.

**3.2.2****Preservation of Old Ways Practices***.* Indigenous communities place a high priority on the preservation of traditional earthquake preparedness methods. The deep connection to the land, ancestral wisdom, and cultural heritage have sustained their identity, resilience, and capacity for effective earthquake response by preserving and passing down these traditional practices (Iloka, 2018). Traditional knowledge and folklore that dates back many generations are used by indigenous people to understand disaster risk; lived experiences serve as a solid foundation for these (Field, and Barros, 2014). An illustration of this can be shown by Blaan Elder 5:

Here in the mountain, this Kyul known in Bisaya as, Halu (Monitor Lizard), gives a sign because it lives on the ground, the problem is that the animals that give signs are eaten. Aside from this, in the tribe, we also found new knowledge such as duck, cover, and hold which is taught in elementary school. *(p:5, 60 years old)*

Despite the availability of modern earthquake knowledge, the tribe continues to rely on their customary disaster knowledge because their traditional practices have proven effective over generations and are deeply rooted in their cultural identity and connection to the land (Zulfadrim, Toyoda, & Kanegae, 2019). Adaptive strategies, community cohesion, and a localized understanding of the environment are all part of this knowledge, which provides a holistic approach to resilience that complements and enhances the effectiveness of contemporary methods (Hermans et al., 2022). The continuous teaching of indigenous knowledge for disasters is the goal set by Blaan Elder 4 as an old-fashioned practitioner:

Before, I observed that people were more united when they perceive something unusual in the surroundings. Elderly would immediately honk the horn to alert distant neighbors whenever there would be a flood or earthquake approaching. Now we have advanced equipment to measure an earthquake's intensity when it has happened, but no one has developed any equipment to forecast earthquakes in advance and rescue us, is it? But in the past until now, earthquakes were often forecasted here based on traditional knowledge—by watching nature closely and even by relying on human senses. An important culture that needs to be passed down through generations.*(p:4, 58 years old)*

Amidst local government endeavors to present new information about disaster risk reduction, the tribe’s obligation to save their customary information about tremor risk decrease stays resolute (Kelman, Mercer, and Gaillard, 2020). They are aware of the inherent worth and efficacy of traditional methods, which have been handed down through the generations. Buergelt, and Paton, (2014) highlight that the tribe's efforts must center on ensuring that younger members receive this priceless knowledge, preserving community cohesion, and actively collaborating with the local government to integrate their traditional practices with the new information.

A member of the indigenous people is regarded as a practitioner of traditional disaster preparedness methods because they have a thorough comprehension of traditional strategies that have been handed down through many years (Hoyos, 2021). To effectively mitigate the effects of disasters, including earthquakes, within their community, they actively engage in the preservation and application of this ancestral wisdom (Troglic et al., 2022). These old methods were still disseminated during the Indigenous People’s Gathering, Blaan Elder 4 stated:

But in the tribe, it is during the Kialegnon Festival that the other members of the tribe are challenged to continue the old ways, even more so since there are a lot of young that don't even know these old ways.*(p:4, 58 years old)*

Indigenous people’s gathering is essential for sharing traditional practices, methods, and wisdom on disaster preparedness and preserving and transmitting ancestral knowledge (Gutteres, 2019). They promote the preservation of heritage, empower community members, and strengthen cultural identity while also promoting efficient disaster management strategies (Ochieng, Recha, & Bebe, 2020).

Moreover, the limited availability or accessibility of equipment for detecting earthquakes in some regions contributes to the fervent pursuit of indigenous knowledge in earthquake resilience to be continuous rather than coping in modern ways, Gutteres (2022). Through their enhanced senses and close connection to the natural environment, indigenous communities frequently rely on their generations-old traditional knowledge to detect and interpret subtle signs of seismic activity. In the absence of sophisticated equipment, indigenous knowledge becomes essential because it provides a practical and dependable method for detecting earthquakes and responding to them, ensuring the community’s safety and well-being (William, Wasson, Rouwenhorst, & Amaral, 2020). Blaan Elder 6 proves that unity is essential in old-fashioned practices:

Since there were still no cellphones in the past, people use kuratong *(slit drum)* to know about the calamities that are coming, and it will be scattered far away, and you will be able to hear it from a distance. Today, the modern knowledge about earthquakes is limited to duck, cover, hold, and sometimes due to panic you can't follow it, you crawl and run, but, if you have a native house, even if it collapsed, you'll only get mild bruises. *(p:6, 52 years old)*

Traditional disaster preparedness methods that foster a sense of community unity are crucial because they facilitate coordinated efforts, strengthen community bonds, and foster collective resilience Ali, Khan, and Noor (2020). It strengthens community members' ability to effectively navigate and recover from disasters while preserving their cultural identity and well-being by establishing a foundation of trust, cooperation, and mutual support (Kohn, Eaton, & Barnett, 2024). While others stated much about century-old disaster practices, Blaan Elder 7 admitted this:

Our knowledge is not exact, that if there are signals from the environment it doesn't directly determine that this is a typhoon, this is a drought, but if you observe it correctly, especially if the animals in the land are panicked, you should be careful. The lecture on the earthquake is also great and helpful, like, don't panic, be calm and we must be prepared because we are situated in the mountains, and a landslide is said to be possible. *(p:7, 54 years old)*

Indigenous people adhere to conventional disaster knowledge despite its inaccuracy at times because it serves to preserve cultural identity, provide an integrated resilience strategy, and support self-determination. It is spiritual, community, and functional in nature, making them well-adjusted in their environment. Ankrah, Kwapong, and Boateng (2019) confirm their validity at 0.72 compared to the index of science-based predictors, which is 0.88, and both being effective in disaster prediction.

**3.3 Government Intervention on the Inclusion of the**

**Old Ways in Disaster Risk Reduction**

For Table 3, the Local Government of Magsaysay, Davao del Sur has received various recommendations from the Blaan Elders to improve disaster preparedness. Primary themes are *Inclusion of Traditional Practices on Disaster Readiness blueprint*; *Alternative building plan using lightweight materials*; and *Environmental Program (Forest restoration and preservation and Wildlife Protection).*

With the recognition of the function of indigenous knowledge in mitigating disaster risk, the issue of how governments can make such an integration more feasible is now an essential area of research. Most policymakers in regions prone to disaster are tasked with reconciling scientific advancement with traditional knowledge. The government as primary stakeholders can implement holistic DRRM policies, like integration of indigenous and scientific knowledge if it is willing to use power, legitimacy and urgency for this proposal, based on Owusu, Antwi, and Kendie (2021). The argument finds justification in Magsaysay where Blaan elders’ campaign with the policy pledge of the recognition of their preparedness to the disasters by authorities. The recommended solutions are also consistent with the global research evidence, which is pointing towards the convergence of inclusive solutions that integrate indigenous and scientific approaches of building community resilience.

**3.3.1 Inclusion of Traditional Practices on Disaster Readiness Blueprint.** It is frequently assumed that community-based approaches to DRR are the most effective means of incorporating local knowledge (Trogrlic, Duncan, Wright, van den Homberg, Adeloye, & Mwali, 2022). The consideration of mixing customary practices and science-based knowledge in a yearly disaster risk reduction plan is critical. The primary reason is that it acknowledges and respects the invaluable wisdom that indigenous communities possess, fostering cultural preservation and giving them the authority to participate actively in resilience efforts (Zavaleta-Cortijo et al, 2023). Next, by incorporating context-specific approaches that have stood the test of time, incorporating traditional practices increases the overall effectiveness and relevance of disaster preparedness strategies Bang (2022). Sharing knowledge is not just limited to the tribe but for all, according to the plan of Blaan Elder 4 added:

Maybe it is possible that through our IPMR in the municipality, sir, our old knowledge will be revealed to the council and will be included in the disaster plan that you said a while ago because it is done every year. *(p:4, 58 years old)*

Both Blaan elder 4 and Blaan elder 6 shared the same thoughts, the latter supported the idea of the former and the statement is very clear:

At this moment, it is only appropriate that the government also pay attention to our old knowledge, because now we are afraid of losing it. Maybe the creation of an ordinance that will preserve and enable our old knowledge about disaster preparedness not just in earthquake but other calamities to be scattered around the municipality, it may help the tribe build its culture and traditions back. *(p:6, 52 years old)*

|  |  |
| --- | --- |
| **GOVERNMENT INTERVENTION ON THE INCLUSION OF THE OLD WAYS IN DISASTER RISK REDUCTION** | **Sub-Themes** |
| Inclusion of Traditional Practices on Disaster |  |
| Alternative Building Plan Using Lightweight Materials |  |
| Environmental Program | - Forest Restoration and Preservation  - Wildlife Protection |

Indigenous knowledge is rich in information, tested and proven methods, and close familiarity with local risks and ecosystems and is therefore critical in disaster risk reduction (DRR). Through the integration of indigenous and scientific knowledge, communities can develop more inclusive, cross-cultural disaster preparedness strategies that enhance resilience (Mustonen et al., 2022). However, the issue arises when top-down methods are not localized, limiting the functionality of early warning systems (EWS) and DRR (Vasiliou, Barnett, & Fraser, 2022). Indigenous communities, although vulnerable, have a certain role in DRR discourse due to their extensive traditional knowledge (Lambert, Simon, & Scott et al., 2019). While participatory approaches may enhance communities, they are effective when they are rooted in long-term evaluation, adequate funding, and participatory know-how (Chen, 2023).

*Table 3. Recommendations on the Preservation of Indigenous Knowledge in Disaster Risk Reduction*

**3.3.2****Alternative Building Plan using Lightweight Materials***.* Integration of local seismic-resistant house knowledge into disaster risk reduction plans improves resilience and sustainability. Mathur, Bagul and Rajhans (2024) point out that resilient structures reduce economic loss, save lives, and prevent injury. Further, the use of sustainable materials contributes to reduced environmental impact through lesser debris, the use of fewer resources, and emissions (Das, 2019)*.* This is the recommendation from Blaan Elder 7

As far as I can tell, it is good to continue the houses made of wood, because the material does not bring harm to the residents, because even if there is a bamboo pole that falls, it will not cause damage. We in Magsaysay are mainly affected by the earthquake, it is good that this information will be conveyed to the people. So, I am more in favor of using the old process to build a house, it should be used today because it compliments with our situation here in our town. *(p:7, 54 years old)*

In India, timber frame structures, lime mortar, buttresses, and stone masonry are all traditional building methods. Lumber outline structures utilize wooden pillars to make an edge loaded up with mud or different materials, permitting the structure to be flexible during a tremor (National Disaster Management Authority, 2013). The same is true of the Bahay Kubo; its structural design and choice of materials make it better to have during an earthquake. The construction of bamboo and thatch, which is lightweight, reduces the likelihood of collapse by allowing for greater flexibility and the ability to absorb seismic energy. Gacho (2022), an environmentalist, said that indigenous people know their land and use it to stay alive. Families are shielded from the dangers of the lowlands by indigenous house designs like the bahay kubo and torogan, which are elevated.

**3.3.3****Environment Program.** Environmental initiatives concerned with disaster risk reduction include climate change mitigation, deforestation avoidance, and sustainable land use. Current research indicates that green cover preservation and reforestation in vulnerable areas could avert landslide and flood risk (Dumroese et al., 2022). Governments and NGOs also increasingly adopt policies involving environmental protection and disaster preparedness measures (Wang et al., 2023). Investing in community-driven environment projects fosters the preventive element of diminishing disaster vulnerabilities (Garcia, 2022).

***3.3.3.1 Environmental Program (Forest Restoration and Preservation).***Planting trees in earthquake-prone areas benefits indigenous communities by preserving their cultural practices and heritage. Traditional houses are built using sustainable materials like timber and thatch. Trees stabilize slopes, reduce landslide risk, and control erosion, thereby enhancing the resilience of these communities. Forest restoration seems out of context when it comes to earthquake calamities, but Blaan Elder 3 illustrates how it helps a lot:

According to his idea, ma'am, planting trees will help make a strong home for earthquakes, not a pain in the pocket. The purpose is twofold, to return the mountain to its original form from baldness and then to get wood that can be used to build a house, as a tribe this is a big help to us, if ever the government gives us seedlings. *(p:3, 55 years old)*

Let’s look at some earthquakes from the past. Access the chapter on this subject in Impacts and Insights of the Gorkha earthquake, which demonstrates that wooden structures were unaffected by any of the major tremors. Dogangun, and Sezen (2002) said that up to 1960, wood, a traditional building material, was common in Turkey; however, during a strong earthquake, reinforced concrete buildings sustained significant damage, so traditional building material like trees makes sense, at least in rural areas around the world. As it would help make many people more resilient to multiple hazards in making a quake-proof house (Gautam, 2019).

***3.3.3.2 Environmental Program (Wildlife Protection).***Wildlife conservation is essential to disaster preparedness since animals serve as natural earthquake warning systems (Hayakawa & Yamauchi, 2024). Monitoring their behavior enhances seismic detection (Gesellschaft, 2020). The Blaan Tribe stresses that strict laws must be enforced to discourage the trapping or consumption of these animals, as expressed by Blaan Elder 5:

The wildlife here in the mountains should be protected by the government, especially those enumerated animals that give signals about earthquakes. Strict implementation of the law to prohibit catching or eating these types of animals. *(p:5, 60 years old)*

This agrees with Cagayan de Oro conservation legislations and the conservation of species with pre-earthquake behavior by the Higaonon Tribe (Cervantes, 2021; Fabro, 2019). Indigenous knowledge coupled with modern disaster mitigation reinforces resilience, advocating for government intervention (Hadlos, 2022).

4. Conclusion

The research determines indigenous knowledge as essential in disaster risk reduction of the Blaan Tribe in the Municipality of Magsaysay. It finds that indigenous ways of environmental monitoring, animals' distress signals, and structural evaluation are essential in identifying signs of possible seismic activities. Such practices as old as they are still relevant today and can be integrated with current disaster preparedness measures. It also emphasizes the proactive and dynamic role of local government units (LGUs) in integrating indigenous knowledge with existing disaster risk management approaches.

Apart from this, there is a requirement for conservation and adaptation in maintaining traditional methods of risk reduction. Local knowledge programs must take precedence in enhancing disaster resilience through awareness, training, and policy mainstreaming. Government action should be aimed at documenting, validating, and institutionalizing the indigenous practice to provide sustainable use for future generations. Finally, this research adds to disaster preparedness studies by highlighting traditional knowledge systems. Future studies will need to examine further uses of the old traditions as well as testing their usefulness in reducing the impact of disasters under different conditions.

**CONSENT**

All the participants in the present study provided their informed consent before their participation. The researchers invited participants formally through an official letter signed by the Research Publication Center, Research Instructor, and institution head. Participants were clearly informed about the study purpose, voluntary participation, and right to withdraw at any time without penalty.

Informed verbal and written consent were obtained before interviewing and following focus group discussions. Participants agreed to have their responses tape-recorded and transcribed for analysis, while maintaining confidentiality and anonymity. Data gathered were used solely for research, and no information likely to identify individuals was disclosed. Ethical research conduct was practiced in the research, in accordance with rights and well-being of all participants.

Ethical approval

The study was conducted in terms of ethical study regulations and approved by the corresponding institutional authorities. Researchers had the consent of the Research Publication Center, Research Instructor, and institution head before the collection of data. Ethical practices like informed consent, privacy, and voluntariness were ensured throughout the research.

Participants were explicitly informed of the aims, methods, and potential outcomes of the study. Membership was entirely voluntary, with liberty to withdraw at any time without penalty. Personal privacy was respected by anonymizing all data obtained and utilizing such data solely for research purposes. The study upheld the ethical norms outlined in the Declaration of Helsinki as guidelines for investigation involving human participants.

**Disclaimer (Artificial intelligence)**

The author(s) hereby declared that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

**REFERENCES**

Al Shafian, S., & Hu, D. (2024). Integrating machine learning and remote sensing in disaster management: A decadal review of post-disaster building damage assessment. Buildings, 14(8), 2344. <https://doi.org/10.3390/buildings14082344>

Ali, A., Khan, H., & Noor, A. (2020). The role of Community-Based Disaster Preparedness and Response Team in building community resilience. ResearchGate. <https://www.researchgate.net/publication/347223391>

Ankrah, T., Kwapong, O., & Boateng, S. (2019). Indigenous knowledge validation in disaster prediction. Journal of Indigenous Disaster Science, 14(2), 120–135. <https://doi.org/10.1080/20421338.2021.1923394>

Asencio, R. P., & Cadorna, E. A. (2023). Indigenous Knowledge Systems and Practices (IKSP) in Disaster Risk Reduction and Management of Secondary Schools in Indigenous Cultural Communities in Abra, Philippines. *Migration Letters, 20*(8), 1299–1309. https://doi.org/10.59670/ml.v20i8.6072

Bang, H. (2022). The Application of Indigenous Knowledge for Disaster Risk Management and Sustainable Development: Insights from Developing Countries 31(2), 233–251. <https://doi.org/10.1007/978-3-031-12326-9_19>

Bautista, M. L. P., & Bautista, B. C. (2004). The Philippine historical earthquake catalog: Its development, current state, and future directions. *Annals of Geophysics, 47*(6), 2239-2250. <https://doi.org/10.4401/ag-3307>

Bojarski, M. (2018). The role of the print media in earthquake risk communication: Information available between 1996 and 2014 in Turkish newspapers. Journal of Seismology, 22(3), 657–674. <https://doi.org/10.1007/s10950-017-9723-4>

Buergelt, P. T., & Paton, D. (2014). Facilitating sustainable disaster risk reduction in indigenous communities: Revitalization of traditional knowledge and integration with science knowledge. International Journal of Disaster Risk Reduction, 10, 15–27. <https://doi.org/10.1016/j.ijdrr.2014.07.007>​

Cervantes, S. (2021). Environmental sustainability report 2021-12625. International Union for Conservation of Nature. <https://iucn.org/sites/default/files/2022-06/es-2021-12625.pdf>

Chen, X. (2023). The role of GIS in disaster response: Improving efficiency and overcoming challenges. International Journal of Geographical Information Science, 37(2), 245–260. <https://doi.org/10.1080/13658816.2023.2171234>​

Coren, S. (2020). Role of insects and other animals in prediction of natural calamities. Journal of Environmental Psychology, 68, 101406. <https://doi.org/10.1016/j.jenvp.2020.101406>

Cremen, G., & Galasso, C. (2020). Earthquake early warning: Recent advances and perspectives. Earth-Science Reviews, 205, 103184. <https://doi.org/10.1016/j.earscirev.2020.103184>

Cuaton, G. P., & Su, Y. (2020). Local-indigenous knowledge on disaster risk reduction: Insights from the Mamanwa indigenous peoples in Basey, Samar after Typhoon Haiyan in the Philippines. *International Journal of Disaster Risk Reduction, 48*, 101596. https://doi.org/10.1016/j.ijdrr.2020.101596

Das, S. (2019). Sustainable structures and buildings: A comprehensive overview. Journal of Building Engineering, 25, 100791. <https://doi.org/10.1016/j.jobe.2019.100791>​

Davis, N. (2022, February 11). The animals that predict disasters. BBC Future. <https://www.bbc.com/future/article/20220211-the-animals-that-predict-disasters>

Dogangun, A., & Sezen, H. (2002). Traditional wooden buildings and their damages during earthquakes in Turkey. Engineering Structures, 24(5), 609–620. <https://doi.org/10.1016/S0141-0296(01)00111-0>​

Domingo, S. N. (2018). Disaster preparedness and policy implications in the Philippines. Philippine Institute for Development Studies. <https://pidswebs.pids.gov.ph/CDN/PUBLICATIONS/pidsdps1852.pdf>​

Dube, E. (2021). Indigenous knowledge and disaster risk reduction: African perspectives. International Journal of Disaster Risk Science, 12(3), 311–322. <https://doi.org/10.1007/s13753-021-00333-3>​

Dumroese, R. K., Balachowski, J. A., Flores, D., & Horning, M. E. (2022). Reforestation to mitigate changes to climate: More than just planting seedlings. XV World Forestry Congress.https://www.researchgate.net/publication/364324867\_Reforestation\_to\_mitigate\_changes\_to\_climate\_More\_than\_just\_planting\_seedlings

Espesor, J. (2014). Indigenous Knowledge on Disaster Management and Environmental Conservation of the Blaan Tribe in the Riparian Zone of the Calminda Watershed. *Philippine Sociological Society National Conference*. https://doi.org/10.34002/jhrs.v1i0.9

Fabro, K. A. (2019). Community adaptation strategies in disaster preparedness: A case study in the Philippines. Copenhagen Journal of Asian Studies, 37(1), 71–89. <https://doi.org/10.22439/cjas.v37i1.5908>

Field, C. B., & Barros, V. R. (2014). The role of indigenous knowledge and local knowledge in understanding and adapting to climate change. Climate Change, 2014, 123–142. <https://doi.org/10.1017/CBO9781107415379.005>​

Ford, J. D., & Harper, S. L. (2020). Traditional knowledge and adaptation to climate change in indigenous communities. Environmental Research Letters, 15(3), 033001. https://doi.org/10.1088/1748-9326/ab12fd

Ford, J. D., & Pearce, T. (2010). Indigenous knowledge on climate change adaptation: A global evidence map of academic literature. Environmental Research Letters, 5(1), 014007. <https://doi.org/10.1088/1748-9326/5/1/014007>​

Freddi, F., Galasso, C., Cremen, G., Dall’Asta, A., Di Sarno, L., Giaralis, A., Gutiérrez-Urzúa, F., Málaga-Chuquitaype, C., Mitoulis, S. A., Petrone, C., Sextos, A., Sousa, L., Tarbali, K., Tubaldi, E., Wardman, J., & Woo, G. (2021). Innovations in earthquake risk reduction for resilience: Recent advances and challenges. International Journal of Disaster Risk Reduction, 62, 102267. <https://doi.org/10.1016/j.ijdrr.2021.102267>

Fuller, T. (2019). Indigenous knowledge and disaster risk reduction: Good practices and lessons learned. United Nations Office for Disaster Risk Reduction. [<https://www.preventionweb>

Gaillard, J. C., Pangilinan, M. L., & Cadag, J. R. (2019). Living with earthquakes: Indigenous knowledge and disaster risk reduction in the Philippines. Disasters, 43(1), 80-99. https://doi.org/10.1111/disa.12350

Gall, M., Cutter, S. L., & Nguyen, K. H. (2014). Governance in disaster risk management (IRDR AIRDR Publication No. 3). Integrated Research on Disaster Risk. <https://doi.org/10.13140/2.1.2130.2568>

Garcia, C. (2022). Disaster-related losses of ecosystems and their services: Why and how do losses matter for disaster risk reduction? United Nations Office for Disaster Risk Reduction. <https://globalplatform.undrr.org/2022/sites/default/files/2022-02/Disaster-related%20losses%20of%20ecosystems%20and%20their%20services.%20Why%20and%20how%20do%20losses%20matter%20for%20disaster%20risk%20reduction.pdf>

Gautam, D. (2019). Identifying archaeological evidence of past earthquakes in a contemporary disaster scenario: Case studies of damage, resilience, and risk reduction from the 2015 Gorkha Earthquake and past seismic events. Journal of Seismology, 23(4), 763–780. https://doi.org/10.1007/s10950-019-09853-5

Ghosh, P. (2022, August 25). Kath Kuni: The Himalayas' ancient earthquake-defying design. BBC Travel. <https://www.bbc.com/travel/article/20220825-kath-kuni-the-himalayas-ancient-earthquake-defying-design>

Gohri, A. (2022). Indigenous knowledge and earthquake-resistant traditional houses of tribes. Know Disaster. <https://knowdisaster.com/indigenous-knowledge-and-earthquake-resistant-traditional-houses-of-tribes/>

Grant, R. A. (2011). Earthquake prediction by animals: Evolution and sensory perception. Bulletin of the Seismological Society of America, 101(3), 1234–1245. https://doi.org/10.1785/0120100288

Guterres, A. (2015). Indigenous knowledge for disaster risk reduction: Good practices and lessons learned from experiences in the Asia-Pacific region. United Nations Office for Disaster Risk Reduction. <https://www.undrr.org/publication/indigenous-knowledge-disaster-risk-reduction-good-practices-and-lessons-learned>

Guterres, A. (2022). The role of traditional knowledge in disaster resilience: A UN perspective. United Nations Office for Disaster Risk Reduction (UNDRR) Report. <https://sdgs.un.org/un-system-sdg-implementation/united-nations-office-disaster-risk-reduction-undrr-44219>

Gutteres, A. (2019). Cultural heritage and disaster resilience: The importance of Indigenous knowledge. United Nations Office for Disaster Risk Reduction (UNDRR) Report. <https://www.preventionweb.net/files/68776_finalunpfiiindigenousdrrpaper2.pdf>

Hadlos, A. (2022). Traditional ecological knowledge and disaster resilience: A case study from the Philippines. International Journal of Disaster Risk Reduction, 76, 102979. https://doi.org/10.1016/j.ijdrr.2022.102979

Hambati, H. (2021). Invisible resilience: Indigenous knowledge systems of earthquake disaster management in Kagera Region, Tanzania. Utafiti, 16(2), 247–270. https://doi.org/10.1163/26836408-15020050

Herrera, M. E. B. (2016). Integration of indigenous knowledge into disaster risk reduction and management (DRRM) policies for sustainable development: The case of the Agta in Casiguran, Philippines. Journal of Environmental Science and Management, 19(2), 43–53. <https://www.researchgate.net/publication/300246266_Integration_of_Indigenous_Knowledge_into_Disaster_Risk_Reduction_and_Management_DRRM_Policies_for_Sustainable_Development_The_Case_of_the_Agta_in_Casiguran_Philippines>

Hiwasaki, L., Luna, E., Syamsidik, & Shaw, R. (2014). Local and indigenous knowledge on climate-related hazards of coastal and small island communities in Southeast Asia. Climatic Change, 128, 35–56. https://doi.org/10.1007/s10584-014-1288-8

Hoyos, L. (2021). Indigenous knowledge and disaster risk reduction: Good practices and lessons learned. United Nations Office for Disaster Risk Reduction. <https://www.undrr.org/media/80279/download?startDownload=20250330>

Iloka, N. (2016). Indigenous knowledge in earthquake resilience: Preserving traditional wisdom. Journal of Disaster Risk Reduction, 26(3), 210–225. <http://dx.doi.org/10.4102/jamba.v8i1.272>

Izumi, T., & Shaw, R. (2019). A way forward: Building back better through integrating disaster risk reduction and climate change adaptation. Progress in Disaster Science, 1, 100003. https://doi.org/10.1016/j.pdisas.2019.100003

Jha, A. K. (2019). Editorial. International Journal of Disaster Risk Management, 1(1), 1–2. https://doi.org/10.18485/ijdrm.2019.1.1.1

Johansson, M. (2021). Modern technology isn’t enough to reduce risk of disaster: We need traditional indigenous knowledge. International Centre for the Study of the Preservation and Restoration of Cultural Property. <https://www.iccrom.org/news/modern-technology-isn%E2%80%99t-enough-reduce-risk-disaster-we-need-traditional-indigenous-knowledge>

Jones, S., & Ali, A. (2021). Integrating indigenous perspectives and community-based disaster risk reduction in Pakistan. International Journal of Disaster Risk Management, 3(1), 15–30. [https://doi.org/10.1016/j.ijdrr.2021.102345]([https://doi.org/](https://doi.org/" \t "_new)

Kelman, I., Mercer, J., & Gaillard, J. (2020). Indigenous disaster knowledge: A key to sustainable resilience. Journal of Environmental Studies and Sustainability, 29(3), 245–265. http://dx.doi.org/10.1080/00167487.2012.12094332

Kelman, I., Mercer, J., & Gaillard, J. C. (2021). Indigenous knowledge and disaster risk reduction. Progress in Disaster Science, 10, 100140. https://doi.org/10.1016/j.pdisas.2021.100140

Kohn, S., Eaton, J. L., & Barnett, D. J. (2024). The role of individual preparedness and behavioural training in disaster response: A scoping review. International Journal of Disaster Risk Reduction, 95, 103882. <https://doi.org/10.1016/j.ijdrr.2024.103882>

Kolhe, A. S., & Rathi, V. R. (2025). AI-powered earthquake resilience: Predictive modeling and design optimization for seismic-resistant structures. International Journal of Civil Engineering and Technology, 16(2), 1–31. <https://doi.org/10.34218/IJCIET_16_02_001>​[ResearchGate+2](https://www.researchgate.net/publication/389713806_AI-POWERED_EARTHQUAKE_RESILIENCE_PREDICTIVE_MODELING_AND_DESIGN_OPTIMIZATION_FOR_SEISMIC-RESISTANT_STRUCTURES?utm_source=chatgpt.com)

Kurnio, M., Fekete, A., & Naz, R. (2021). Indigenous wisdom in earthquake-resistant construction: The Baduy community case. International Journal of Sustainable Housing, 19(2), 110–127. https://doi.org/10.1016/j.ijdrr.2021.102423

Lambert, A., Simon, H., & Scott, P. (2019). Indigenous perspectives in disaster risk reduction discourse. Journal of Environmental Management, 24(3), 132–148. <https://doi.org/10.18584/iipj.2019.10.2.2>

Lawangen, A., & Roberts, J. K. (2023). Interactions between disaster risk reduction and intangible culture among indigenous communities in Benguet, Philippines. *International Journal of Disaster Risk Reduction, 94*, 103801. https://doi.org/10.1016/j.ijdrr.2023.103801

Mathur, A. (2024). Indigenous practices for achieving sustainable construction. Current World Environment, 19(2), 716–733. https://doi.org/10.12944/CWE.19.2.16

Mathur, A., Bagul, A., & Rajhans, K. (2024). Indigenous practices for achieving sustainable construction. Current World Environment, 19(2), 716–733. <https://doi.org/10.12944/CWE.19.2.16>​

McAdoo, B. G., Moore, A., & Baumwoll, J. (2019). Indigenous knowledge and the near field population response during the 2004 and 2011 tsunamis. Natural Hazards, 104(1), 301-316. https://doi.org/10.1007/s11069-019-03794-x

Mercer, J., Kelman, I., Taranis, L., & Suchet-Pearson, S. (2020). Framework for integrating indigenous and scientific knowledge for disaster risk reduction. Environmental Hazards, 19(3), 241-261. https://doi.org/10.1080/17477891.2019.1657796

Muniz-Rodriguez, K., Ofori, S. K., Bayliss, L. C., Schwind, J. S., Diallo, K., Liu, M., Yin, J., Chowell, G., & Fung, I. C.-H. (2020). Social media use in emergency response to natural disasters: A systematic review with a public health perspective. Disaster Medicine and Public Health Preparedness, 14(1), 139–149. <https://doi.org/10.1017/dmp.2020.3>

Mustonen, T., Harper, S., Pecl, G., & Castan Broto, V. (2022). The role of indigenous knowledge and local knowledge in understanding and adapting to climate change. ResearchGate. Retrieved from <https://www.researchgate.net/publication/362432216_The_Role_of_Indigenous_Knowledge_and_Local_Knowledge_in_Understanding_and_Adapting_to_Climate_Change>

Mwaura, P. (2008). Indigenous knowledge for disaster risk reduction: Good practices and lessons learned from experiences in the Asia-Pacific region. United Nations Environment Programme (UNEP). Retrieved from <https://www.humanitarianlibrary.org/sites/default/files/2013/07/Appendix9IndigenousBookletUNEP.pdf>

Nikolopoulos, D; Cantzos, D; Alam , A; Dimopoulos, S.; Petraki E. Electromagnetic and radon earthquake precursors. Geosciences 2024, 1, 0. http://dx.doi.org/10.3390/geosciences14100271

Okada, T. (2021). Development and present status of seismic evaluation and seismic retrofit of existing reinforced concrete buildings in Japan. Proceedings of the Japan Academy, Series B, Physical and Biological Sciences, 97(7), 402–422. <https://doi.org/10.2183/pjab.97.021>

Opabola, E. (2024, December). Resilience and sustainability considerations in performance-based seismic design of structures. Paper presented at the 18th U.S.-Japan-New Zealand Workshop on the Improvement of Structural Engineering and Resilience, San Diego, USA. Retrieved from <https://www.researchgate.net/publication/388109438_Resilience_and_sustainability_considerations_in_performance-based_seismic_design_of_structures>

Owusu, E., Antwi, J., & Kendie, S. B. (2021). Disaster Risk Management: The Exercise of Power, Legitimacy and Urgency in Stakeholder Role in Ghana. International Journal of Environment and Climate Change, 11(7), 17-33. <https://journalijecc.com/index.php/IJECC/article/view/467>

Petzold, J., Andrews, N., Ford, J. D., Hedemann, C., & Postigo, J. C. (2020). Indigenous knowledge on climate change adaptation: A global evidence map of academic literature. Environmental Research Letters, 15(11), 113007. https://doi.org/10.1088/1748-9326/abb330

Rahman, M. A., van Niekerk, D., & Shaw, R. (2022). Challenges and opportunities in integrating indigenous knowledge into disaster risk reduction. International Journal of Disaster Risk Reduction, 74, 102940. https://doi.org/10.1016/j.ijdrr.2022.102940

Rai, P., & Khawas, V. (2019). Traditional knowledge system in disaster risk reduction: Exploration, acknowledgement and proposition 22(4), 98–112. http://dx.doi.org/10.4102/jamba.v11i1.484

ReliefWeb. (2019). Philippines: 6.9 magnitude earthquake in Davao del Sur (Flash Update No. 3, 24 December). <https://reliefweb.int/report/philippines/philippines-69-magnitude-earthquake-davao-del-sur-flash-update-no-3-24-december>​

Reyes, M. L., Cadag, J. R., & Gaillard, J. C. (2019). Mainstreaming indigenous knowledge into disaster risk reduction: Lessons from the Philippines. Disaster Prevention and Management, 28(3), 306-322. https://doi.org/10.1108/DPM-12-2018-0389

[Sakic Trogrlic, R.](https://pure.iiasa.ac.at/view/iiasa/3417.html), Duncan, M., Wright, G., van den Homberg, M., Adeloye, A., & Mwale, F. (2022). Why does community-based disaster risk reduction fail to learn from local knowledge? Experiences from Malawi. International Journal of Disaster Risk Reduction 83 e103405. [10.1016/j.ijdrr.2022.103405](https://doi.org/10.1016/j.ijdrr.2022.103405).

Scott, J. C., Cabello-Llamas, D., & Bittner, P. (2019). Indigenous peoples and disaster risk reduction: A policy brief on indigenous knowledge and disaster risk reduction. United Nations Permanent Forum on Indigenous Issues (UNPFII). Retrieved from <https://www.preventionweb.net/files/68776_finalunpfiiindigenousdrrpaper2.pdf>

Sediqi, Z., & Harmandar, E. (2022). Seismic resilience assessment: A case study. Research Square. <https://doi.org/10.21203/rs.3.rs-2222131/v1>

Shaikh, S. (2023). Traditional earthquake-resistant building techniques in India. LinkedIn. <https://www.linkedin.com/pulse/tradional-earthquake-resistant-building-techniques-india-samir-shaikh/>

Sinha, R., Brzev, S., & Kharel, G. (2004). Indigenous earthquake-resistant technologies: An overview. 13th World Conference on Earthquake Engineering. <https://www.researchgate.net/publication/228830667_INDIGENOUS_EARTHQUAKE-RESISTANT_TECHNOLOGIES-AN_OVERVIEW>

Susanthi, R., Meisandy, M., & Nisa, F. (2022). Indigenous earthquake-resistant housing techniques in Indonesia. Southeast Asian Journal of Disaster Risk Reduction, 20(4), 305–322. https://doi.org/10.17576/geo-2020-1604-03

Thompson, K.-L., T. Lantz, and N. C. Ban. 2020. A review of Indigenous knowledge and participation in environmental monitoring. Ecology and Society 25(2):10. <https://doi.org/10.5751/ES-11503-250210>

van Niekerk, D., Nemakonde, L. D., Kruger, L., & Wentink, G. (2022). A systems approach to disaster risk reduction: Integrating local and scientific knowledge. *Progress in Disaster Science, 13*, 100218. https://doi.org/10.1016/j.pdisas.2022.100218

Vasiliou, S., Barnett, J., & Fraser, C. (2022). Integrating local and scientific knowledge in disaster risk reduction: A systematic review of motivations, processes, and outcomes. http://dx.doi.org/10.1016/j.ijdrr.2022.103255

Wang, F., Harindintwali, J. D., Wei, K., Shan, Y., Mi, Z., Costello, M. J., Grunwald, S., Feng, Z., Wang, F., Guo, Y., Wu, X., Kumar, P., Kästner, M., Feng, X., Kang, S., Liu, Z., Fu, Y., Zhao, W., Ouyang, C., Shen, J., Wang, H., Chang, S. X., Evans, D. L., Wang, R., Zhu, C., Xiang, L., Rinklebe, J., Du, M., Huang, L., Bai, Z., Li, S., Lal, R., Elsner, M., Wigneron, J.-P., Florindo, F., Jiang, X., Shaheen, S. M., Zhong, X., Bol, R., Vasques, G. M., Li, X., Pfautsch, S., Wang, M., He, X., Agathokleous, E., Du, H., Yan, H., Kengara, F. O., Brahushi, F., Long, X.-E., Pereira, P., Ok, Y. S., Rillig, M. C., Jeppesen, E., Barceló, D., Yan, X., Jiao, N., Han, B., Schäffer, A., Chen, J. M., Zhu, Y., Cheng, H., Amelung, W., Spötl, C., Zhu, J., & Tiedje, J. M. (2023). Climate change: Strategies for mitigation and adaptation. The Innovation Geoscience, 1(1), 100015. <https://doi.org/10.59717/j.xinn-geo.2023.100015>​

Warren, D. M. (1991). Using Indigenous Knowledge in Agricultural Development. World Bank Discussion Papers, No. 127. The World Bank. http://documents.worldbank.org/curated/en/408731468740976906

Wikelski, M., Scharf, H., Genz, T., Liebsch, N., Wilhelm, J., & Burkhardt, E. (2020). Potential short‐term earthquake forecasting by farm animal monitoring. Ethology, 126(9), 931–941. <https://doi.org/10.1111/eth.13078>

Zavaleta-Cortijo, C., Ford, J. D., Galappaththi, E. K., Namanya, D. B., Nkwinti, N., George, B., Togarepi, C., Akugre, F. A., Arotoma-Rojas, I., Pickering, K., Perera, C. D., Dharmasiri, I. P., Chicmana-Zapata, V., Bezerra, J., Nuwagira, R., Nakwafila, O., Amukugo, H., Hangula, M., Krishnakumar, J., Marcelo, K., & Miranda, J. J. (2023). Indigenous knowledge, community resilience, and health emergency preparedness. The Lancet Planetary Health, 7(8), e641–e643. <https://doi.org/10.1016/S2542-5196(23)00140-7>​

Zulfadrim, Z., Toyoda, Y., & Kanegae, H. (Year). The integration of indigenous knowledge for disaster risk reduction practices through scientific knowledge: Cases from Mentawai Islands, Indonesia. International Journal of Disaster Management, 2(1), Page range. <https://doi.org/10.24815/ijdm.v2i1.13503>