

A framework to integrate indigenous knowledge into disaster risk reduction to build disaster resilience: insights from rural South Africa

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Abstract

Purpose – For millennia, indigenous or local knowledge (IK) has empowered rural communities particularly the most vulnerable and disadvantaged groups to prepare for, cope with and survive disasters instead of relying on external help only. However, this knowledge has been ignored by practitioners and policymakers in favour of Western science and technology-based methods of disaster risk reduction (DRR) and response. This paper proposes a framework for integrating IK into DRR because we believe the simultaneous use of IK and modern DRR measures could increase the resilience of rural communities.

Design/methodology/approach – The study finds solace in the pragmatism research philosophy which places emphasis on practical solutions and outcomes. The study followed a phenomenological approach of qualitative research with a total of 109 respondents participating in the study. The collected data were analysed thematically.

Findings – Participants in the study provided key insights into areas of interventions for improved integration of IK into DRR and these include, trust-building initiatives, recording and systematise traditional practices, developing localised, context-specific approaches to DRR planning and engaging traditional leaders, and increasing their participation in decision-making forums. We submit that the blending of modern and traditional techniques has the potential to create robust, adaptive systems for disaster preparedness, response and recovery, leading to safer and more resilient communities.

Originality/value – Pursuing an integrated approach to the use of IK and modern expert knowledge on DRR would be a step forward in addressing the fragmentation of the two knowledge systems.

Keywords Indigenous knowledge (IK), Disaster risk reduction (DRR), Community disaster resilience, Framework, Integration

Paper type Research paper

1. Introduction

Indigenous people around the globe have relied upon their traditional knowledge to prepare for, cope with, and survive disasters for millennia (Scott *et al.*, 2013; Kelman and Næss, 2013). Scott *et al.* (2013) further argue that until recently, policymakers have ignored this vast body of knowledge in favour of Western science and technology-based Disaster Risk Reduction (DRR) and response methods. Rumbach and Foley (2014) are even franker, stating that mainstream disaster science and policy has marginalised indigenous and traditional forms of knowledge and practice, especially in Western industrialised countries. As a result, Indigenous Knowledge (IK) has been slow to worm its way into Disaster Risk Reduction (McAdoo *et al.*, 2009). However, the 2004 Indian Ocean earthquake and tsunami and the 2007 Solomon Islands tsunami, amongst others, have catalysed the acknowledgement of the role played by



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local knowledge and practices in reducing disaster risk and improving disaster preparedness for local people (Hawasaki *et al.*, 2014; McAdoo *et al.*, 2009). As Zulfadrim *et al.* (2019) argue, the knowledge that helped local communities facing the 2004 tsunami demonstrates the importance of local or Indigenous Knowledge (IK) for Disaster Risk Reduction (DRR). For example, the Simeulue community in Indonesia's survival during the 2004 Indian Ocean tsunami, with only seven fatalities compared to the devastating 230,000 deaths in mainland Aceh, is attributed to their Indigenous Knowledge of smong—an oral tradition passed down since 1907 (Sutton *et al.*, 2020). This narrative warned of the signs of an impending tsunami, teaching the community to immediately flee to higher ground after an earthquake and demonstrating the life-saving power of traditional knowledge in Disaster Risk Reduction.

Disaster Risk Reduction involves the process of identifying, assessing, and reducing the risks of hazardous events (Scott *et al.*, 2013). Kusumasari and Alam (2012) are of the opinion that successful DRR requires a considerable degree of adaptability to context-specific factors, as well as a deep understanding of the cultural backgrounds of the affected communities. This is mainly because the impacts of disasters are severely felt at the local level. Meanwhile, Indigenous people are communities that maintain a deep understanding of nature and possess a specific way of thinking that enables them to survive in a changing environment (Mikulecky *et al.*, 2023). As Pelling and Wisner (2009), local people initiate their own response efforts when disasters strike, prioritising their safety and survival (Pelling and Wisner, 2009). Not only that, but they also use knowledge of the local environment to anticipate and prepare for disasters. Local people act as frontiers during disasters, and they capitalise on their own capacities, as Molina and Neef (2016) argue, this highlights the role of IK as an important resource for protecting lives, livelihoods, and properties against hazards. Indigenous Knowledge has the potential to provide solutions for reducing disasters at many levels, and in rural areas, survival during disasters mostly relies on IK (Lodhi and Mikulecky, 2010). Bruchac (2014, p. 3814) defines traditional or IK as a network of knowledge, beliefs, and traditions intended to preserve, communicate, and contextualise Indigenous relationships with culture and landscape over time.

This paper finds solace in the definition of IK by Lodhi and Mikulecky (2010, p. 94), who defines IK as “a complete body of knowledge, know-how, and practices maintained and developed by peoples through generations, generally in rural areas”. The knowledge is unique to a given culture or society (Warren, 1991). Bruchac (2014) shares similar views and indicates that individual ethnic and tribal communities in different regions of the world have preserved different versions of IK, which do not comprise a single tool kit. IK forms the basis for local-level decision-making in different sectors of life and a host of other activities in rural communities (Lodhi and Mikulecky, 2010). This knowledge has empowered communities, particularly the most vulnerable and disadvantaged groups, to take action instead of relying on external help only for millennia (Lodhi and Mikulecky, 2010). Direct experiences with disasters have taught many rural communities the duration, location, time, frequency, intensity, and predictability of hazardous events (Scott *et al.*, 2013). Many different examples are cited in the literature wherein IK has saved lives and protected livelihoods in the face of disasters (McAdoo *et al.*, 2009), and therefore, the importance of its integration with modern and expert knowledge cannot be overemphasised.

Scott *et al.* (2013) opine that the relationship between the two knowledge systems is complimentary, with clear advantages in their intertwining. Warren (1991) argues for the identification of beneficial aspects of the IKS as well as those that can be improved through modern science-based technologies. This, as Warren (1991) argues, will scientifically test the validity and cost-effectiveness of indigenous practices. For Gaillard and Mercer (2013), beneficial local knowledge, when combined with relevant modern scientific approaches, offers a blend of effective and applicable knowledge which could enhance DRR. However, despite the obvious value of integrating IK with contemporary science-dominated DRRM

interventions at all levels, its use remains peripheral in many countries throughout the world (Shaw *et al.*, 2008). Lodhi and Mikulecky (2010) contend that failure to retain traditional knowledge exacerbates most communities' vulnerability to disasters and makes it harder for the community to recover and bounce back to normality (Hallegatte *et al.*, 2016) or even to bounce forward (Manyena *et al.*, 2011; Walsh, 2002). Scott *et al.* (2013) share similar views and state that the imposition of Western models in societies that have lived, adapted to and coped with hazards for millennia can result in the loss of IK, which may contribute to an increase in vulnerability of Indigenous communities. Importantly, Indigenous people themselves are not afforded adequate opportunities to participate in the design, implementation, monitoring, and evaluation of DRR activities (Scott *et al.*, 2013). Gaillard and Mercer (2013) documented in detail the challenges of integrating knowledge and actions in DRR.

Whereas there is hyped advocacy on the imperative need to integrate IK and modern knowledge on DRR, there is a dearth of normative frameworks or models that are informed by empirical data. This paper proposes a novel framework for integrating IK into DRR because we believe that certain elements of IK and modern knowledge of DRR are reinforcing, and therefore, integration could increase the resilience of rural communities. In suggesting the framework, the paper is inspired by Kelman *et al.*, who state that no single knowledge form can be a panacea for DRR and that IK has the potential to contribute far more than is usually believed to contribute. Also, integration provides an avenue for local people to take on the role of development agents, shaping the outcomes of the next disaster event rather than acting as mere subjects of intervention (Molina and Neef, 2016). Drawing from Mercer *et al.* (2010), this paper contends that the integration of IK and modern scientific knowledge in DRR will facilitate effective risk reduction, particularly for local communities.

2. Methodology

2.1 Study area

The study was conducted in the Northern Cape Province of South Africa, which is made up of five district municipalities and 27 local municipalities. Specifically, the study was carried out in five villages of Bendell, Bothithong, Dithakong, Gasese, and Tsineng, all situated in the Joe Morolong local municipality in the John Taolo Gaetsewe district. The sites were selected based on their isolated locations and the potential of the rural communities to still rely on traditional knowledge in their daily lives.

2.2 Design, population, sampling methods, and sample size

This study is grounded in the philosophical assumptions of pragmatism and adopted a phenomenological approach. According to Saunders *et al.* (2019), pragmatism asserts that concepts are only relevant where they support action. As such, pragmatism starts with the identification of a problem and aims to contribute practical solutions that inform future practice (Saunders *et al.*, 2019). Given that the study aimed to get real-life insights and experiences about IK practices and suggest solutions to the challenge of integrating IK into DRR within their localities, a phenomenological study was considered the best-suited approach as it explores the lived experiences of participants (Frechette *et al.*, 2020). Phenomenology allows for the unearthing of phenomena from the perspective of how people interpret and attribute meaning to their existence (Frechette *et al.*, 2020).

A multistage sampling technique was adopted to select the study sites and the respondents who participated in the study (Singh *et al.*, 1996). Firstly, the Northern Cape Province of South Africa was chosen conveniently as the main researcher who resided and worked in the province during the time of the research. Convenience sampling allows the researcher to choose study sites and participants based on accessibility and practical assumptions that align

with the research requirements (Golzar *et al.*, 2022). Secondly, purposeful sampling was used to select John Taolo Gaetsewe as a study site from the five districts in the Northern Cape based on the ruralness of the district. Also, Joe Morolong, the local municipality, and the five villages were selected purposefully. A convenience sampling technique based on participants' availability at the time of the research was used to select participants from the five villages. Convenience sampling is a type of non-probability sampling where members of the target population that meet certain practical criteria such as easy accessibility, geographical proximity, availability at a given time, or the willingness to participate are included for the purpose of the study (Etikan *et al.*, 2016). The study sample included 100 participants from the communities of the five villages, who participated in 20 focus groups (FGDs) comprising of 5 participants each.

Finally, nine (9) key informants from the following institutions namely: Tribal authority – Chief and Induna from Bahurutshe Traditional House, Tsineng Community Integrated Development Structure responsible which assisted with the selection of the sampled villages, National Disaster Management Centre (NDMC), Provincial Disaster Management Centre (PDMC), District Disaster Management Centre (DDMC), Municipal IDP, an independent facilitator for IKS in the rural community, and an independent Facilitator in Community and Organisation Development, whose work was relevant to the study topic, were purposefully chosen, and information from them was acquired using virtual platforms such as Microsoft Teams and Zoom. This virtual option for key informants was chosen because it offered flexibility, cost-effectiveness, and time efficiency as an alternative to in-person interviews (Sah *et al.*, 2020). The total number of participants from both the community members and the key informants were affected by the limitations posed by the COVID-19 pandemic.

2.3 Data collection and analysis

A total of 20 FGDs, each with five participants, were guided by a structured discussion guide. Focus group was chosen for their guided, interactive discussion to generate rich data. A thematic data analysis methodology was used to extract important themes from all of the acquired data (Riger and Sigurvinsdottir, 2016). Thematic analysis is a method for identifying, analysing and interpreting patterns of meaning in qualitative data (Terry *et al.*, 2017). Specifically, a deductive approach (Bingham, 2023) or concept-driven coding was adopted wherein broad themes were preconceived during the development of data collection tools mainly informed by the literature and the researchers' interests. Table 1 summarises the broad themes considered in the analysis.

2.4 Ethical clearance for the study

The research received ethical approval from the North West University's Faculty of Natural and Agricultural Science ethics committee. The ethical clearance number is NWU-FNAS REC (NWU-01721-20-A9). Also, during data collection, participants were verbally consulted and provided consent concerning voluntary participation, anonymity and confidentiality, and these were maintained throughout the research processes.

Table 1. Themes used for presentation and development of the framework

#	Themes
Theme 1	The importance of Indigenous Knowledge in Disaster Risk Reduction
Theme 2	Respondent's perception of the need to integrate IK and DRR
Theme 3	Respondents' suggestions on how to integrate IK and DRR
Theme 4	Challenges of inclusion of Indigenous Knowledge in Disaster Risk Reduction
Source(s): Authors' own work	

3. Findings

This section below presents the overall findings from all participants involved in the study.

3.1 The importance of Indigenous Knowledge in Disaster Risk Reduction

Focus group discussions revealed that community members who participated in the study value IK as a fundamental part of their way of life. Throughout the discussions, participants consistently highlighted the practical benefits of IK across various domains of their lives. As one of the participants from the Bothithong FGD stated, *“It is embedded in our ways of life”*. For healthcare-related issues, participants indicated that they relied on indigenous healthcare-related practices to address health challenges, including the recent COVID-19 pandemic. As one participant noted, *“a majority of us have a rich awareness and wealth of experience regarding our surroundings, particularly the use of local resources and herbs in health-related concerns”* Gases Village FGD. The study also revealed that in some areas, traditional healers played a critical role in treating COVID-19 symptoms.

Meanwhile, the study revealed that agricultural and food security practices included cultivating drought-resistant crops and employing techniques like mixed and rotational planting. A good example of this cited by the participants is the planting of groundnuts after maize to recycle nutrients. Participants also revealed practices for preserving and storing food for sustained food security. Participants identified traditional, time-tested methods of food preservation such as sun-drying, wind-drying, and dry-salting. This is important because of the seasonal availability and perishability of most food items, including crops, vegetables, and fruits. In semi-arid areas like the study sites, where rainfall is limited, food preservation is even more vital to sustain household food security. Additionally, participants reported using local knowledge to predict hazardous events, such as observing animal behaviours, celestial events, and plant indicators. For example, the presence of black swallows signals the onset of heavy rainfall. Furthermore, these communities have developed unique survival strategies in response to disasters, reflected in their settlement patterns and house construction techniques. Common materials include stones and cow/donkey dung, which are mixed with soil to create brick and plaster. The traditional process involves creating mud bricks by combining mud, water, and small stones or straw, then drying them for hardening. The orientation of the house and the roof structure are some of the aspects identified by the communities to be important. Such practices enable communities to prepare for disasters in advance, thus improving their resilience. Indeed, IK has been integral to the survival of communities facing disasters for centuries.

3.2 Respondents’ perspectives on the need to integrate IK and DRR

“You can not mix oil with water, but you can use compatible elements of modern DRR measures and IK,” quipped one participant at Bothithong FGD. Such statements signify the notion that IK cannot be integrated into DRR, but rather compatible elements of IK and modern scientific knowledge can both be used simultaneously in DRR. It also indicates that most participants in the study support the use of IK in DRR. Both FGD participants and Key Informants acknowledged the value of using IK and modern DRR interventions complementarily. They believe that this complimentary use would create more effective and context-specific disaster risk management strategies. This converges with the assertion of [Rai and Khawas \(2019\)](#) that while not all indigenous strategies are suitable for DRR, some offer valuable insights that can complement scientific approaches.

Besides, a large majority of FGD participants were of the view that traditional knowledge must be used in all sectors of life and not in DRR interventions only. They believe that for them, the traditional way of living is the way of life that must be embraced by all. *“If we integrate traditional knowledge in everything that we do, we will be able to preserve our cultural heritage which is quickly disappearing”* FGD Dithakong. Another participant at Bendell FGD said, *“As Africans we need to protect our IK, otherwise, we will become strangers in our own*

world. We need it to survive and to know who we are. The way we are built as people we are connected to our spirituality and our environment and therefore, we would rather have our traditional knowledge together with westernised ways of doing things than in isolation.” Such sentiments support the continued use of IK by these communities.

The findings reveal a strong sentiment among participants regarding the disconnect between older and younger generations, particularly in the preservation of traditional ways of doing things. Many participants were of the view that the younger generations have abandoned traditional ways of living, leading to a loss of intergenerational wisdom. This loss is seen as detrimental to DRR efforts as IK plays a crucial role in managing local hazards and mitigating the impacts of disasters. Additionally, participants were of the view that their deep understanding of the environment and historical knowledge of hazards should be integrated into government-led DRR initiatives. As one participant at Bothithong FGD commented, “we have relied on this knowledge during COVID-19, and we have successfully defeated the disease”. FGD participants not only emphasised the effectiveness of IK in mitigating disasters and disease outbreaks but also viewed it as cost-effective. A minority of participants mentioned that if the government were to formally recognise the role of IK in DRR, it could open other opportunities, including job creation for the youth. The key informants, largely practitioners, shared similar views reinforcing the simultaneous use of IK and modern knowledge in DRR interventions. They acknowledged that DRR efforts are dominated by modern, scientific knowledge, but integrating IK would empower communities by fostering decision-making and a sense of ownership, which will ultimately improve DRR outcomes. One Key informant from the National Disaster Management Centre (NDMC) said, “being intimately familiar with their respective areas, communities possess valuable knowledge that must be acknowledged and used because ultimately effective DRR initiatives will always originate from the grassroots level.”

Some key informants noted that government institutions, such as Disaster Management Centres at the national, provincial, and local levels, often lack adequate resources to implement. To address this issue, they suggested incorporating IK to fill this gap. This group of participants are of the view that certain communities that depend on IK tend to be self-sufficient and possess a strong ability to endure disasters by utilising resources in their vicinity. They believe that this helps communities weather disastrous events before external help arrives. As such, they believe that the government could leverage these local resources to strengthen its DRR efforts.

The findings of this theme demonstrate a shared belief among both community members and key informants that integrating traditional knowledge with modern scientific approaches is critical for effective DRR. This convergence of views aligns with the literature advocating for the integration of IK into DRR frameworks (Mercer *et al.*, 2010; Molina and Neef, 2016; Zulfadrim *et al.*, 2019). These studies suggest that top-down strategies often fail because they are not tailored to the local context, whereas culturally sensitive, bottom-up approaches rooted in both IK and modern scientific knowledge can improve disaster preparedness and enhance community resilience against disasters.

3.3 Respondents' suggestions on how to integrate IK and DRR

Participants in this study offered several practical suggestions on how to integrate IK into DRR, emphasising collaboration between local communities and DRR experts. Most participants in the FGDs agreed that integration should begin with DRR professionals acknowledging the vital role that IK plays in local communities. They stressed the importance of experts participating in community-led initiatives, where they can listen to local perspectives and share experiences. This approach, they believe, would allow for an exchange of knowledge, enabling experts to gain a deeper understanding of the community's traditional preparedness, mitigation, and response strategies. One key point raised was the need for education and training on emerging challenges, such as shifting weather patterns and

“abnormal” disasters. Respondents expressed a desire for this education to be delivered through traditional leadership structures, such as the chief system, as this would ensure better engagement and understanding within the community.

Participants expressed frustration over being excluded from DRR planning. They were of the firm belief that local communities must be actively included and consulted during the development of disaster management strategies so that their traditional practices can be included. They argued that their participation would provide avenues for them to articulate their traditional DRR practices, which can complement expert knowledge. The statement by one of the FGD participants in Bendell captures the essence of this. *“Government never include us when they plan interventions to address disasters; actually, we have never seen any disaster management official in our area.”* FGD participants believe that engaging with communities will help ensure that DRR interventions reflect their needs, priorities, and aspirations and leverage their unique, culturally sensitive and context-specific strategies to build resilience. Also, they believe that collaborative planning between experts and communities would allow synergistic learning wherein experts can gain valuable insights from traditional knowledge while local communities benefit from expert guidance. According to one participant from the Gaseke FGD, *“we have our own indicators to identify hazards, and these are so precise that they can complement the unreliable disaster warning system from the government.”* This highlights the communities’ belief that their knowledge can enhance formal disaster warning systems.

Several participants advocated for the systemic inclusion of traditional knowledge in disaster risk assessments, particularly at the grassroots level. FGD participants firmly believed that by incorporating IK in assessments, DRR strategies would be more contextually relevant and effective. They also said that community-based assessments can provide platforms where experts and community members can exchange knowledge. A recurring theme was the challenge communities face in understanding DRR initiatives, largely due to language barriers. In this regard, participants emphasised the importance of delivering DRR communications in vernacular languages to enhance community comprehension. They are of the view that when communities understand DRR measures, they are less likely to reject government interventions.

Some key informants who participated in the study suggested identifying and involving community champions who can support DRR experts when implementing DRR initiatives. These can include religious leaders, community leaders, traditional healers, and elders within the communities who have institutional memory on the use of IK within their communities. Moreover, some key informants called for the formal inclusion of representatives from the houses of traditional leaders in decision-making forums. They believe that their participation would help guarantee that the voices of those holding IK are heard and represented.

Both Focus Group Discussions (FGDs) and Key Informant Interviews (KIIs) revealed potential strategies for integrating Indigenous Knowledge into DRR, including collaborative platforms for knowledge exchange between experts and local communities, involvement of traditional leaders in consultative meetings, and use of local languages to ensure community engagement and understanding. By involving communities, traditional leaders, and language considerations in DRR interventions, the integration of Indigenous Knowledge can significantly increase local ownership of DRR strategies. Also, Utilising IK not only bridges the gap between modern and traditional approaches but also ensures that interventions are culturally relevant. Additionally, engaging communities offers mutual capacity building—experts gain context-specific insights while communities become better equipped with formal disaster risk management practices.

3.4 Challenges of integrating Indigenous and Western knowledge systems

In their paper “From Knowledge to Action: Bridging Gaps in Disaster Risk Reduction”, [Gaillard and Mercer \(2013\)](#) asked a pertinent question – *“why is it so difficult to integrate*

knowledge and actions in DRR?”. They (Gaillard and Mercer, 2013) argue that it is difficult because of the lack of trust between stakeholders, which often interact in autonomy at different levels. Thus, lack of trust is highlighted by both the participants and previous studies as a major challenge inhibiting the integration of IK and modern knowledge systems. This is mainly rooted in mutual perceptions and a disconnect between the two groups. Often, experts view IK as anecdotal and lacking empirical validation, making it less reliable compared to scientific knowledge. This perception fosters an environment where local communities feel disregarded and disrespected. Participants in FGDs feel disdained by experts who tend to dismiss their knowledge due to their lack of formal education. This contributes to a sense of alienation during DRR planning processes. Meanwhile, Key informants emphasised that experts frequently dismiss IK because of its lack of formal documentation or scientific backing, which aligns with concerns expressed by community members during FGDs. The study also revealed internal tensions within communities that make the integration of Indigenous and Western knowledge more challenging. Elders tend to prefer traditional practices, while younger people often favour Western approaches. This generational divide complicates efforts to find common ground for DRR interventions, as both sides are resistant to compromise.

Another significant barrier identified is the lack of documentation for IK. Unlike modern DRR practices, which are systematically documented in policies and strategies, IK is often passed down orally through generations and remains undocumented. KII respondents pointed out that the absence of formal records makes it difficult to integrate IK into modern DRR frameworks. Furthermore, much of the traditional knowledge is shrouded in secrecy and superstition, as highlighted by some KIIs who reported that communities are often reluctant to share their practices openly with outsiders. For instance, one KII respondent mentioned, “*These people are very superstitious and do not want to talk about their practices,*” which further complicates engagement. Another one from the PDMC said: “*we have tried on several occasions to engage with the communities, but when it comes to issues that relates to their traditional knowledge, these people do not open up*”.

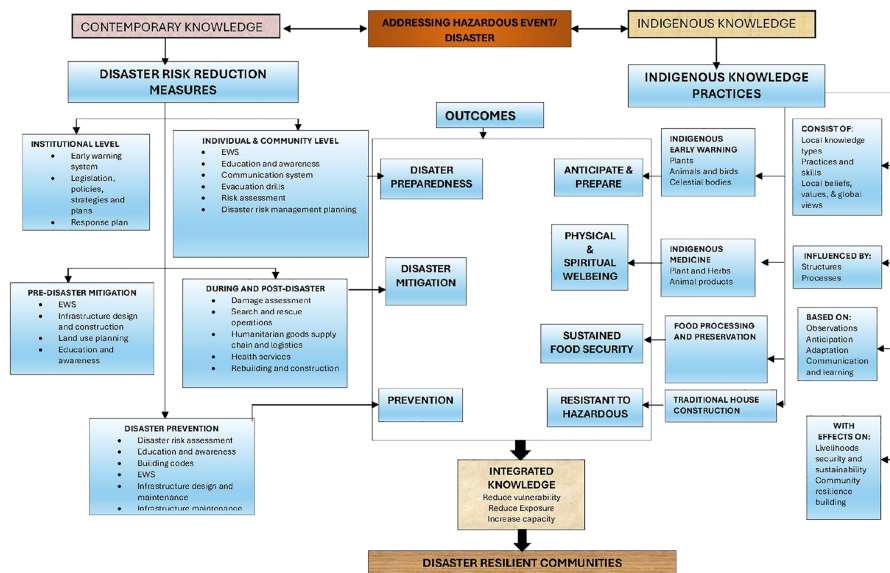
Additionally, IK is a highly localised, with its effectiveness often tied to specific geographical and cultural contexts. KII participants stressed that IK is context-specific, making it difficult to standardise and apply across different regions in a uniform manner. One key informant noted, “*IK is context-specific and localised and therefore would be very difficult to standardise and integrate into modern scientific practices.*” Thus, the contexts-specificity of IK limits its scalability in broader DRR interventions, requiring tailor-made approaches for each community. Furthermore, the limited involvement of traditional leaders and traditional healers in formal DRR discussions is cited as a hindrance to integration. KII respondents noted that traditional leaders and healers rarely attend consultative meetings despite holding valuable knowledge and influence within their communities. One key informant emphasised that local decision-makers are often absent from DRR advisory forums, further hindering the integration of IK into formal planning processes.

The challenges identified by both KIIs and FGDs present significant obstacles to integrating Indigenous and Western knowledge systems. However, they also offer key insights into areas where interventions can be improved, and these include trust-building initiatives, which are crucial for addressing the perception gap between experts and communities. We believe that mutual respect for both knowledge systems will foster better collaboration. Furthermore, the lack of documentation of IK underscores the need for efforts to record and systematise traditional practices. However, this should be done with community consent and in a culturally sensitive manner. Additionally, localised, context-specific approaches to DRR planning must be developed, as IK cannot be easily generalised. Tailored strategies are necessary for different communities. Also, engaging traditional leaders and increasing their participation in decision-making forums will ensure that Indigenous voices are represented in DRR planning.

4. Discussion

The findings of this study, along with the existing literature, highlight the critical role of IK in DRR. Numerous studies, including [Scott *et al.* \(2013\)](#), stress the need for acknowledging the positive relationship between indigenous practices and modern scientific methods to successfully incorporate IK into DRR. Similarly, [Gaillard and Mercer \(2013\)](#), citing Anstiss (2001) and Dods (2004), emphasised the need to bridge the gap and reconcile scientific and local knowledge to enhance disaster preparedness and resilience. To bridge the gap between modern scientific and traditional knowledge, this study proposes a framework for integrating IK into DRR ([Figure 1](#)). The development of this framework is inspired by the views of [Warren \(1991\)](#), who argues that IK has value not only for the culture from which it originates but also for scientists and planners working to improve rural communities' conditions. The framework draws from existing models including models by [Mercer *et al.* \(2010\)](#) and [Molina and Neef \(2016\)](#). The framework is designed to combine effective local practices with contemporary DRR measures, ensuring both knowledge systems complement each other to improve disaster resilience.

The proposed framework incorporates contemporary DRR measures aimed at disaster preparedness, mitigation, and prevention. These measures are identified at both the institutional and community levels. At the institutional level, preparedness includes establishing early warning systems (EWS) as per UNDRR's multi-hazard Early Warning for All (EW4A) initiative. For maximum effectiveness, EWS must include key elements such as risk knowledge, communication, dissemination, and response capability. Early warning messages should be communicated in local languages to ensure communities can act appropriately. Institutions must also develop and implement legislative frameworks, policies, strategies, and response plans with community involvement to ensure that traditional knowledge is included. At the community level, preparedness measures identified include education and awareness campaigns, evacuation drills, risk assessments, and community-based DRR planning, all of which were regarded by study participants as crucial for integrating IK into DRR.



Source(s): Authors' own work

Figure 1. Framework to integrate disaster risk reduction and indigenous knowledge

Mitigation efforts are divided into pre-disaster and post-disaster activities. Pre-disaster measures include the establishment of early warning systems, infrastructure design and construction, land-use planning, and education. Post-disaster measures focus on activities such as damage assessments, search and rescue operations, humanitarian aid logistics, and health services. These measures ensure that communities can recover quickly and efficiently after disasters. Prevention measures outlined in the framework include periodic disaster risk assessments, education, and adherence to building codes. Proper infrastructure design and maintenance were also identified as essential components of prevention efforts.

The framework emphasises the importance of integrating IK into each stage of DRR, particularly in disaster preparedness and prevention. These include community involvement in planning. Participants in the study highlighted the importance of involving communities in the development of DRR policies and strategies so that their traditional knowledge and practices can be incorporated. Education and Awareness wherein IK can be integrated into education campaigns to raise awareness about local practices that help reduce disaster risks alongside modern DRR practices and localised practices: The framework recognises that IK is often location-specific, meaning that disaster management strategies must be tailored to the specific cultural and geographical contexts of communities. For successful integration, community participation is vital in all stages of disaster planning, from preparedness to prevention and mitigation. Both policy-makers and scientists must prioritise trust-building with communities, ensure IK is documented, and adapt DRR strategies to local contexts to ensure the full potential of Indigenous Knowledge is realised in Disaster Risk Reduction efforts.

The framework proposed in [Figure 1](#) includes several IK practices that help communities enhance their resilience to disasters. It is important to recognise that IK is context-based—not all practices are universally applicable across Indigenous communities globally. However, participants identified key practices (authors' other paper in review) that could be integrated into DRR strategies, including:

- (1) Indigenous early warning indicators which rely on natural indicators like plants, animals, birds, and celestial bodies to predict disasters.
- (2) Traditional medicine for addressing health issues within the community.
- (3) Food processing and preservation techniques that contribute to food security during hazardous events.
- (4) Traditional house construction, using locally sourced materials, is often designed to withstand environmental threats.

The identified IK practices, such as anticipating disasters through natural signs, ensuring physical and spiritual well-being, maintaining food security, and constructing disaster-resistant homes, all contribute to the overall resilience of communities. Therefore, blending these practices with contemporary DRR measures can help build more disaster-resilient communities. Drawing from [Mercer *et al.* \(2010\)](#), these IK practices represent local knowledge types, beliefs, values, and skills that are shaped by community structures and processes. These practices are based on observation, adaptation, communication, and learning and contribute significantly to livelihood security, sustainability, and community resilience.

While the framework offers a promising approach to incorporating IK into DRR, it remains conceptual and has not yet been tested in practical settings. Therefore, we recommend that its implementation begin with pilot projects to assess its effectiveness. Testing the framework will allow for adaptations to be made, ensuring it suits the specific local contexts of various communities. This iterative process will highlight areas where the framework needs to be refined, ensuring that it can deliver the intended outcomes and adequately balance IK with modern DRR methods. As [Scott *et al.* \(2013\)](#) argue, finding a balance between modern science and IK is essential for effectively reducing communities' risks and vulnerabilities. Ultimately,

simultaneous use of both modern and traditional knowledge systems will lead to more effective disaster management strategies. Inspired by Prasad and Nigam (2023), we believe that a balanced approach that combines the strengths of modern science with the insights of traditional knowledge will greatly improve the capacity of rural communities to address disasters and build long-term resilience. The blending of modern and traditional techniques has the potential to create robust, adaptive systems for disaster preparedness, response, and recovery, leading to safer and more resilient communities.

5. Conclusions

Historically, rural and indigenous communities have relied on their own traditional knowledge to manage and recover from disasters long before the introduction of modern scientific methods. Despite its effectiveness, IK has often been overlooked by policymakers, practitioners, and researchers, who have favoured modern knowledge systems. However, recent literature has highlighted numerous examples of how IK has been successfully applied to cope with and adapt to disasters. It is only in the 21st century that the value of IK in DRR has gained renewed attention. The study established that communities in the research areas have traditionally relied on IK to navigate hazards and that they see value in integrating relevant IK practices into modern DRR strategies. Respondents provided valuable suggestions for this integration but also acknowledged the challenges that need to be addressed for successful implementation.

The paper introduces a novel framework for IK-DRR integration, shaped by insights from both the study participants and the literature, based on the belief that combining these two knowledge systems can significantly enhance the resilience of rural communities. While it is recognised that a standardised approach may not suit all indigenous communities affected by disasters, the framework is adaptable to the specific needs and traditions of localities. By proposing this model, we contribute to the growing body of work advocating for the integration of IK and modern DRR practices. However, a limitation of this framework is that it has not yet been tested in real-world scenarios. Therefore, the next step would involve implementing pilot projects to evaluate their practical effectiveness and refine the model to suit various community contexts. We also advocate for the formal recognition and inclusion of IK in national and sub-national disaster risk management policies. Future research could explore innovative methods and tools for systematically documenting and preserving IK in ways that respect community traditions while making it accessible to policymakers and DRR practitioners. This could include exploring the role of digital platforms, oral history archives, or community-based participatory documentation methods. Additionally, given the increasing frequency and complexity of disasters driven by climate change, future research could assess how adaptable IK is to new or evolving hazards. This will involve studying whether traditional practices can be modified to address unprecedented challenges or if new hybrid strategies combining IK and modern science are required.

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