Thematic Study: Diverse Knowledge Systems

Disclaimer: This study does not formally represent any indigenous or local communities. Information for this study was gathered through a literature review and expert consultations conducted between November and December 2022, specifically for the purpose of the Sendai Framework Midterm Review.
Acknowledgements

The Midterm Review Sendai Framework thematic study: Diverse Knowledge Systems (MTR SF DKS) consultant would like to thank the experts, indigenous members and scholars who generously gave their time to support the study, participate in the MTR SF DKS interviews and who shared their knowledge and insight on myriad issues including indigenous and local knowledge on disaster risk reduction, often with great passion and candour: Mr. Adessou Kossivi, Ms. Andrea Carmen, Prof. Andrew Spring, Ms. Chanchana Chakma, Ms. Catherine Murupanga-Ikenn, Dr. Douglas Nakashima, Prof. Edward Shizha, Dr. Igor Krupnik, Ms. Jennifer Rubis, Prof. Jennifer Baltzer, Dr. Jessica Dolan, Mr. John Scott, Dr. Joseph Karanja, Mr. Marcus Oxley, Prof. Mark Pelling, Ms. Nora Bateson, Prof. Rajib Shaw, Ms. Regina Jacobs, Dr. Simon Lambert, Prof. Stephen Crawford, Prof. Stuart Kirsch, Dr. Taru. Thank you for patiently answering all our questions and repeated requests for clarification, as well as tracking down answers to follow-up questions we took every opportunity to raise. We are also grateful for the guidance and frank conversations and the unique perspectives of thought leaders. As a result, this report is not really the work of the MTR consultant alone, but rather is a joint effort representing the collective wisdom by all the stakeholders.

Particular thanks is extended to the UNDRR, especially Mr. Marc Gordon, the Senior Coordinator of the MTR SF, for giving guidance and suggestion in framing this study, as well as Aashish Khullar, MTR SF Stocktaking Consultant, Ms. Momoko Nishikawa, programme management officer (Sendai Cooperation Initiative) for supporting administration for contract so that this study can be done.

This study, a component of the midterm review of the Sendai Framework thematic studies, provides a contemporary analysis and forward-looking assessment of the measures that might be needed to better align policy and practice within multilateral governance. Additionally, the study aims to pave the way for building an inclusive framework grounded in the principles of understanding the contextualization and transferability (or non-transferability) of knowledge. It promotes the trust in different forms of knowledge and encourages self-help based on multiple forms of knowledge. It does not presume community homogeneity and strives to develop a system to ensure knowledge exchange.
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<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>DRR</td>
<td>Disaster Risk Reduction</td>
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<tr>
<td>EWS</td>
<td>Early Warning System</td>
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<td>LK</td>
<td>Local Knowledge</td>
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<tr>
<td>LTIK</td>
<td>Local, Traditional, Indigenous Knowledge</td>
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<td>IK</td>
<td>Indigenous Knowledge</td>
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<td>IPCC</td>
<td>Intergovernmental Panel on Climate Change</td>
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<td>IR</td>
<td>Integrative Review</td>
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<td>ISIK</td>
<td>Integrating Scientific and Indigenous Knowledge</td>
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<td>ITU</td>
<td>International Telecommunication Union of the United Nations</td>
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<td>MTR SF</td>
<td>Midterm Review of the Sendai Framework</td>
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<td>SF</td>
<td>Sendai Framework</td>
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<td>SFDRR</td>
<td>Sendai Framework of Disaster Risk Reduction</td>
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<td>UNDRR</td>
<td>United Nations Office for Disaster Risk Reduction</td>
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<tr>
<td>UNDP</td>
<td>United Nations Development Programme</td>
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<tr>
<td>UNESCO</td>
<td>The United Nations Educational, Scientific and Cultural Organization</td>
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<tr>
<td>UNISDR</td>
<td>United Nations International Strategy for Disaster Reduction</td>
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<tr>
<td>UNOCHA</td>
<td>United Nations Office for the Coordination of Humanitarian Affairs</td>
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Capacity is “the combination of all the strengths, attributes and resources available within an organisation, community or society to manage and reduce disaster risks and strengthen resilience. Capacity may include infrastructure, institutions, human knowledge and skills, and collective attributes such as social relationships, leadership and management.” (UNDRR, 2022b).

Digital inequality is the disparities in knowledge and ability of using digital and information technology among individuals with different demographics, socioeconomic backgrounds, and digital and information technology experience and competencies. Currently there are 2.9 billion people who are excluded in the digital technology, and they are facing poverty, illiteracy and lack of access to electricity (ITU, 2021; UNDP Sri Lanka, 2021).

Disaster is “a serious disruption of the functioning of a community or a society at any scale due to hazardous events interacting with conditions of exposure, vulnerability and capacity, leading to one or more of the following: human, material, economic and environmental losses and impacts.” (UNDRR, 2022b).

Disaster risk reduction “is aimed at preventing new and reducing existing disaster risk and managing residual risk, all of which contribute to strengthening resilience and therefore to the achievement of sustainable development.” (UNDRR, 2022b).

Diverse knowledge systems are different forms of knowledge systems including scientific, traditional, local and indigenous knowledge that are connected and bring a potential to jointly addressing risk and building resilience (UNDRR, 2022a).

Explicit knowledge is a form of a formal knowledge that can be described, written down and documented. It is largely acquired in formal educational settings. Explicit knowledge includes behavioural rules, agricultural calendars, curative treatments and scientific theories (Nakanishi & Black, 2018).

Hazard is “a process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation. Hazards may be natural, anthropogenic or socionatural in origin.” (UNDRR, 2022b).

Natural hazards “are predominantly associated with natural processes and phenomena. Anthropogenic hazards, or human-induced hazards, are induced entirely or predominantly by human activities and choices.” (UNDRR, 2022b).
Socionatural hazards “are associated with a combination of natural and anthropogenic factors, including environmental degradation and climate change.” (UNDRR, 2022b).

Implicit Knowledge is “acquired through enculturation and experiences in a socio-cultural environment. Implicit knowledge is complex, logical and value laden but often unconsciously acquired and learned. Therefore, it is difficult to explain to an outsider who does not belong to the same social group. Due to its implicit characteristics it also is difficult to document.” (Nakanishi & Black, 2018, p. 3). Implicit knowledge including local and traditional knowledge.

Local, traditional, indigenous knowledge is an understanding and experiences developed from observation of natural phenomena throughout generations, resulting capability of communities to understand the behaviour patterns of natural hazard specific to their local environment (de Silva et al., 2021; Trogrlić et al., 2019). The knowledge is accumulated across generations of local, traditional and indigenous communities which guide interactions between people and environment (Pierro et al., 2022; Ford et al. 2020; Kniveton et al., 2020). This knowledge enables indigenous communities to act and adjust to environmental challenges and change (Mclean and Nakashima, 2012). Indigenous knowledge is neither singular nor universal and homogenous. It is diverse and vastly localised knowledge (Makondo and Thomas, 2018).

Marginalized groups. The Sendai Framework identifies the following groupings: women (or gender more broadly); children and youth; older people; people with disabilities; migrants; ethnic minorities and indigenous peoples; sexual minorities (UNISDR, 2017). People who live in poverty and lack access of electricity are also categorized as marginalized groups in this study.

Mitigation is “the lessening or minimizing of the adverse impacts of a hazardous event. The adverse impacts of hazards, in particular natural hazards, often cannot be prevented fully, but their scale or severity can be substantially lessened by various strategies and actions. Mitigation measures include engineering techniques and hazard-resistant construction as well as improved environmental and social policies and public awareness. It should be noted that, in climate change policy, “mitigation” is defined differently, and is the term used for the reduction of greenhouse gas emissions that are the source of climate change.” (UNDRR, 2022b).

Resilience is “The ability of a system, community or society exposed to hazards to resist, absorb, accommodate, adapt to, transform and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions through risk management.” (UNDRR, 2022b).

Risk is “the probability of harmful consequences, or expected losses (deaths, injuries, property, livelihoods, economic activity disrupted or environmental damaged) resulting from interactions between natural or human-induced hazards and vulnerable conditions. Conventionally risk is
expressed by the notation Risk = Hazards x Vulnerability. Some disciplines also include the concept of exposure to refer particularly to the physical aspects of vulnerability. A disaster is a function of the risk process. It results from the combination of hazards, conditions of vulnerability and insufficient capacity or measures to reduce the potential negative consequences of risk” (Dekens, 2007 based on UN/ISDR, 2004).

*Vulnerability* is “the conditions determined by physical, social, economic and environmental factors or processes which increase the susceptibility of an individual, a community, assets or systems to the impacts of hazards.” (UNDRR, 2022b).
I. Introduction

Background

1. We are in an era of rapid advancements in knowledge and technology; however, concurrently, vulnerability and risk are increasing exponentially in all parts of the world. The recently published Global Risk Report (Franco et al., 2022) reveals that environmental risks (e.g., climate action failure, extreme weather, biodiversity loss) and societal risks (e.g., erosion of social cohesion, livelihood crises, infectious diseases), followed by debt crises and geoeconomic confrontations, are the most severe risks we are projected to face in the upcoming decades. Digital inequality is also emerging as a significant threat worldwide. Over the past two years, erosion of social cohesion, livelihood crises, and mental health deterioration have worsened since the inception of the COVID-19 pandemic. The UNDRR Global Assessment Report (2022, p. xiii) adds, “Despite progress, risk creation is outstripping disaster risk reduction. Disasters, economic loss and underlying vulnerabilities that drive risk, such as poverty and inequality, are increasing just as ecosystems and biospheres are at risk of collapse. Global systems are becoming more connected and therefore more vulnerable in an uncertain risk landscape… By 2030, global disasters to increase by 40%.” UNOCHA (2022) mentions another record for humanitarian aid as much as $51.5 billion for 339 million in 69 countries in 2023.

2. The Sendai Framework was ratified in 2015, the same year a devastating earthquake in Nepal claimed the lives of over 8,000 individuals. The following year, another quake wreaked havoc in various parts of Ecuador. In 2017, Puerto Rico was hit by Hurricane Maria, resulting in an uncertain death toll. The year 2018 saw wildfires causing substantial damage in various parts of Greece, while an earthquake decimated the Indonesian region of Lombok. That same year, severe drought conditions in Australia led to the deaths of millions of animals. Forest fires in the Amazon and Australia obliterated millions of hectares of forest, leading to an unknown number of animal deaths and impacting endangered species. In 2019, Hurricane Dorian devastated the northern Bahamas Islands and parts of the United States. The same year, Texas was battered by Tropical Storm Imelda, and California suffered from intense wildfires. The Caribbean faced widespread destruction due to Hurricane Iota in 2020. The years 2020 and 2021 were marked by the global health and economic crises caused by the COVID-19 pandemic. In 2021, a winter storm in Texas and other regions of the United States led to power outages and a variety of other disruptions. Another crisis unfolded in 2022 when Russia invaded and occupied parts of Ukraine, significantly escalating the Russo-Ukrainian War.
3. As the UNDRR has been advocating for some time, we must fully understand and embrace the concept of "living with uncertainties". The significance of this idea cannot be overstated. Consequently, the role of adaptive governance becomes critically important. We cannot depend solely on traditional governance systems, particularly as new, potentially complex or cascading risks continue to emerge. A novel governance approach - adaptive governance - is needed, and it intertwines local, traditional, and indigenous knowledge (LTIK) with contemporary scientific knowledge, framing it within the term "diverse knowledge systems" (Expert consultation, 11 November 2022). Merging all these knowledge systems can help generate novel solutions, especially in instances where contemporary scientific knowledge does not have all the answers (Expert consultation, 16 November 2022).

4. The current global agreement on Disaster Risk Reduction (DRR), namely the Sendai Framework, emphasizes the importance of LTIK (UNDRR, 2015). Several studies have demonstrated LTIK's significant contribution to effective DRR in diverse contexts (de Silva et al., 2021). The preliminary results of the midterm review of the Sendai Framework (MTR SF) (UNDRR, 2022) also indicate a growing recognition of the crucial role LTIK plays in addressing risk and building resilience. Furthermore, several governments have begun to incorporate LTIK into their discussions.

5. Despite the demonstrated effectiveness of Local, Traditional, and Indigenous Knowledge (LTIK) in managing disaster risks and its potential to contribute to more efficient disaster risk reduction, various types of knowledge are still underutilized (Trogrlić et al., 2022). There is a lack of consensus within the scientific community about the role of LTIK in Disaster Risk Reduction (DRR) (Trogrlić et al., 2022). An increase in the engagement of scholars and practitioners through comprehensive studies and applications of indigenous resilience is necessary (Berkes et al., 2021).

6. This study, as part of MTR SF thematic studies covers a contemporary analysis and a prospective assessment on what measures may be needed to align policy and practice based on diverse knowledge systems in multilateral governance to work towards reducing risk and building resilience, aligned with the priorities for action of the Sendai Framework. This study is also trying to gather principles to build an inclusive framework with principles of understanding contextualization and transferability or non-transferability of knowledges; promoting trust of different knowledge forms and self-help based on multiple knowledge forms; not assuming community homogeneity and developing a system for ensuring knowledge exchange.
7. Thus, this study explores (a) role of LTIK in supporting communities in understanding risk, (b) role of LTIK in strengthening risk governance to manage disaster risk, (c) role of LTIK in investing in DRR for resilience, (d) role of LTIK in enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation, and reconstruction. In the last discussion, we try to find out how to weave diverse knowledge systems by finding gaps and closing the gaps of braiding diverse knowledge systems, and prospective assessment on what measures may be needed to align policy and practice based on diverse knowledge systems in multilateral governance.

**Diverse knowledge systems definition scope in this study**

8. This research narrows its scope to concentrate on local, traditional, and indigenous knowledge (LTIK), which is a part of diverse knowledge systems. The goal is to provide an adequate information to intertwine LTIK with contemporary scientific knowledge.

9. Local, traditional, and indigenous knowledge (LTIK) are all forms of knowledge systems distinct from mainstream contemporary scientific knowledge. It is rooted in a specific culture and community. However, they each have distinct aspects:

- **Local Knowledge:** This type of knowledge refers to the understandings, skills, and philosophies developed by societies with long histories of interaction with their natural surroundings. It is usually oral and tactile, passed down through generations and closely intertwined with cultural traditions and worldviews. Local knowledge is context-specific and can greatly differ from one community or society to another. According to Sillitoe (1998), local knowledge is a "complete system of concepts, techniques, and practices developed by societies with long histories of managing their natural surroundings.”

  This is knowledge that is specific to a particular area or community, usually gained through long-term interaction with the local environment. It's not limited to indigenous or traditional communities and can evolve quickly in response to changes in the local environment. Local knowledge is considered practical and context-specific. It includes adaptations to local conditions, such as understanding of local ecosystems, species, and climate patterns (Sillitoe, 1998).

- **Traditional Knowledge:** Traditional knowledge is cumulative and transmitted from generation to generation. It includes a society’s worldview and teachings about the human relationship with the natural environment. Warren (1991) describes traditional knowledge as "the long-standing traditions and practices of certain regional, indigenous, or local communities. Traditional knowledge is often passed down from generation to generation, usually by word of mouth and cultural rituals, and has been the basis for agriculture, food preparation, health care, education, conservation and a wide range of other activities at the community level.”

9
This type of knowledge refers to the long-standing traditions and practices of certain indigenous or local communities, which are passed down from generation to generation. Traditional knowledge is typically cumulative, building upon the experiences of previous generations and adapting to the present. It includes aspects like traditional practices, rituals, folk wisdom, and skills (Warren, 1991).

- **Indigenous Knowledge**: Indigenous knowledge is a subset of traditional knowledge, specifically held by indigenous communities, which have a unique cultural identity and a deep-rooted relationship with their ancestral lands. Indigenous knowledge is typically holistic, reflecting an understanding of the world as interconnected. It includes not just practical skills and know-how, but also cultural values, rituals, and worldviews. Importantly, indigenous knowledge often carries a spiritual or sacred dimension, with nature being seen not just as a resource, but as a living entity to be respected. It is unique to a culture or society and forms the basis for decision-making in many areas of life including, but not limited to, agriculture, health, education, and natural resource management. Indigenous people have a long of experience dealing with all kinds of environmental changes, including disruptions and disasters. They have mechanism to access risk to respond to disasters. Indigenous knowledge is derived from empirical evidence that is gathered over generations, tested, assimilated, and transferred through culturally frame processes that is filtered, and that filter comprised of custom belief and values through past and present experiences is processed. It is a highly context-dependent knowledge system and highly specific to certain places. There is no static indigenous knowledge. It is a living body of experience that takes into consideration, the custom on the community and their beliefs and values, but also their present and past experiences, whether it is story telling or written documentation, whether uses science and technology, and how technology is adapted by the community. It is a highly context-dependent knowledge system and there are no homogenous indigenous groups (Nakashima et al., 2000; Expert consultation, 11, 25 November 2022).

10. Whilst we understand that local, traditional and indigenous knowledge systems have their own important element to distinguish and they are highly context-dependent knowledge system, while there are no homogenous indigenous groups and local communities, it is not our intention to arrange all different knowledge systems in one oversimplified and generalisation definition. We are here trying to highlight similarity, commonality in world view of LTIK and its approaches to contribute to development of better solution mechanisms in DRR. Therefore, for the purpose this study we use LTIK term in the discussion. When there is a purpose to create a designated platform for LTIK, it is
suggested to separate local communities and indigenous peoples to respect their difference and standpoint.

11. LTIK needs to be better understood by decision makers and contemporary scientific knowledge holders because there is a gap between what community knows and what a global decision-makers and contemporary scientific community aware of and acknowledge. This gap preventing better process for natural disaster assessment or adaptation processes. Decision makers commonly are only asking answers from contemporary science but the contemporary scientific knowledge does not have all the answer (Expert consultation, 16 November 2022).

12. Braiding, instead of integrating is suggested word to avoid devalued other knowledge systems. When we integrate, there are some things to compromise to be able to co-exist with scientific knowledge, in fact both knowledge systems work differently and cannot be compared. It is clearly politically important to give recognition to indigenous knowledge and to aware marginalisation of indigenous knowledge holder and their different world view than modern world view (Expert consultation, 4, 9 November 2022).
II. Methods

**Methods**

13. This study employs ‘integrative review’ method (Torraco, 2016) combined with expert consultation on diverse knowledge systems. The integrative review is a specific type of literature review method that allows for the inclusion of both experimental and non-experimental research in order to more fully understand a particular phenomenon. “Integrative review is the most comprehensive methodological approach of reviews, and it allows to include experimental and non-experimental studies to fully understand the phenomenon analyzed. It also combines data from theoretical and empirical literature, and has a wide range of purposes, such as definition of concepts, review of theories and evidence, and analysis of methodological problems of a particular topic” (Souza et al., 2010, p. 103).

![Figure 1. Steps in conducting the study](image)

14. Integrative review consists of the following steps:

1. Problem identification. Problems were identified based on preliminary MTR SF study where later guiding questions were developed. The study is guided by six following questions, which some are falling under each theme of SF priorities:
   i. What is the role of LTIK to help communities in understanding risk?
   ii. What is the role of LTIK in strengthening risk governance?
   iii. What is the role of LTIK in investing in disaster risk reduction for resilience?
   iv. What is the role of LTIK in enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation, and reconstruction?
   v. What are the gaps in braiding diverse knowledge systems?
   vi. How can we close the gaps of braiding diverse knowledge systems?
The search term should be included but not limited to “local knowledge”, “traditional knowledge”, “indigenous knowledge”, “community-based knowledge”, “communities in understanding risk”, “disaster risk reduction”, “hazard impact management”, “risk management”, “risk governance”, “investment in disaster risk reduction”, “indigenous knowledge in build back better”, “community resilience”, and so on.

2. Literature search: the search will go through Google Scholar, Web of Science, and EBSCOhost and Directory of Open Access Journals, the four frequently used databases by researchers across various disciplines. The publication date is limited to 2015 until 2022. Then number of findings based on the search and screening for inclusion will be updated in the methodology section after the study is concluded.

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<td>• Peer-reviewed journal articles, grey and white literatures;</td>
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<tr>
<td>• Term/ terms related to the topic and guiding questions in the title;</td>
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<tr>
<td>• Literature in English;</td>
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<tr>
<td>• Literature related to one or more domains of disaster management and</td>
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<tr>
<td>indigenous knowledge;</td>
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<tr>
<td>• Published in 2015 until 2022 (exception for established theories and</td>
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<tr>
<td>supporting evidence of LTIK application).</td>
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<td>• Non-scientific reviews;</td>
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<td>• Commentaries;</td>
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<td>• Non-English literature.</td>
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Result on the literature search:

Around 90% of the peer-reviewed journal articles are coming from primary data. Geographical area of the articles found are dominated by research studies in Asia, Africa and Latin America.

3. Data evaluation: data evaluation and critical analysis of the study will be conducted through quality appraisal criteria such as inclusion criteria, identifying methodological rigor, source of bias, validity and utilization some critical appraisal tools. The analysis of the data is integrated using the finding table and thematic synthesis. Table finding is used to assure collection of all relevant data, to minimize the risk of errors in transcription and to guarantee precision when checking information.

4. Data analysis: analyzing the data involves extracting and synthesizing the findings from the individual studies to identify patterns, themes, or relationships.

5. Discussion of the result would be based on the review findings, including recommendation and implications for policy and or others when applicable. The conclusion will include a concise summary of the major findings and key contributions to the overall objective of the study.
6. Presentation of integrative review. The study result was discussed within internal team of MTR SF and then composed to a brief to present key messages to be consulted to relevant stakeholders (this part was conducted by UNDRR team without the consultant).

7. Expert identification then was done to facilitate validation of result found in the integrative review. Expert was selected based on their expertise related to LTIK and/or DRR. There were seventy two LTIK and DRR experts and indigenous leaders from across the regions (except for Arab States) identified and contacted for this study during the period of late October to November 2022. There were only twenty one LTIK and DRR experts and indigenous leaders participated in the expert interview, cover expertise in Africa, Asia, America and Global. Some experts responded to not able to have contact due limited time available from their sides while some of the experts did not response the invitation email. The author was also participated in the Swiss NGO DRR Platform: Annual Event 2022: Integrating uncertainty – risk-informed and climate-resilient programming in international cooperation, to engage with the experts especially in the topic of LTIK and DRR.

8. Expert Consultation. After integrated literature review, consultation through semi-structured interview was done with experts and indigenous leaders on the LTIK and DRR topic area to cross-check data. Cross-checking data was done using some method such as ‘member checking’ and ‘peer debriefing’. ‘Member checking’ involves taking the findings of the study to the experts to confirm their accuracy and ‘Peer Debriefing’ involves discussing the findings and interpretations with the experts who can provide an outside perspective and help identify potential biases or errors.

9. Information from expert consultation was gathered and combined into the report. Revision was made based on this validation process.

**Organisation of the Report**

15. The report section on result and discussion focus to provide evidence and applicability of LTIK in understanding risk; role of LTIK in strengthening risk governance; role of LTIK in investing in DRR for resilience planning; role of LTIK in enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation, and reconstruction. In the last discussion, we try to find out how to weave diverse
knowledge systems by finding gaps and closing the gaps of braiding diverse knowledge systems.

Scope and Limitation of the Study

16. This study focuses to provide evidence and applicability of LTIK connection to the four main priorities of Sendai Framework.

17. This study does not explore detailed LTIK practices as many scientists have reported various practices and to prevent repeated study. This study focuses on exploration of LTIK role in the four main priorities of Sendai Framework by highlighting relevant practical examples and assess gaps and potential ways in braiding LTIK and contemporary science for better DRR management strategy.

18. The views and opinions expressed in this study do not represent any indigenous and local communities and there was no field study conducted for this study.

19. Experts consultations were done in an online communication platform and there was no clarification process on what is written in the study due to limited time for this study.

III. Result and Discussion

The Role of Local, Traditional, Indigenous Knowledge in Supporting Communities in Understanding Disaster Risk

20. Local, traditional, and indigenous knowledge (LTIK) provides a vital perspective on understanding disaster risk, encompassing wisdom, practices, and beliefs that communities have developed over generations from interacting with their environment. Rooted in local context, this knowledge offers a nuanced understanding of hazards, vulnerabilities, and resilience strategies (Berkes & Folke, 2003).

21. LTIK holders’ deep-seated connections with their environment inform their understanding of acceptable risks, and their livelihoods are often intricately entwined with these surroundings. This relationship informs their cultural practices and provides a robust basis for disaster preparedness (Expert consultation, 11, 16 November 2022 and 16 December
22. Their understanding of risk is derived from first-hand experience with local hazards, and their localized knowledge systems have shown an impressive capacity to recognize natural patterns predictive of approaching hazards (Hadlos et al., 2022).

23. The risk perception within LTIK communities is often rooted in complex knowledge systems that integrate social, cultural, environmental, and spiritual elements. The following paragraphs will delve deeper into how these communities interpret disaster risks.

23. **Experience-based risk understanding:**

   i. Local, traditional, and indigenous knowledge (LTIK) holders possess a rich understanding of local hazards, drawing from past experiences. This understanding encompasses weather patterns linked to natural disasters and areas prone to specific types of disasters. Observations of wildlife migration, cloud formation, and sun intensity often provide crucial information about potential hazards (Kurnio et al., 2021; de Silva et al., 2021; Hilshort et al., 2015; Ankrah et al., 2021; Wang et al., 2019; Guoping et al., 2021; expert consultation, 16 November 2022).

   ii. Numerous instances further illustrate the valuable insights of LTIK holders. These include communities along the Mekong River who gauge risks through observing climatic patterns, or Mapuche people in Chile who used their cultural and spatial understanding to survive an enormous earthquake in 1960 and sociopolitical hazards like decolonization (Atallah, 2016; Pauli et al., 2022; Ponce de Leon, 2021; UNISDR, 2008; Atallah, 2016; Bwambale et al., 2021).

   iii. Several studies confirm the reliability of LTIK in predicting weather and adapting farming practices related to weather and climate changes, demonstrating that it can be as dependable as scientific knowledge. Some experts believe that LTIK can help communities anticipate risks before hazards occur and can supplement the limitations of modern technology (Ankrah et al., 2021; Malone et al., 2021; Makondo and Thomas, 2018; Dube and Munsaka, 2018; Expert consultation, 11 November 2022a, 16 November 2022; 27 December 2022).

   iv. The Covid-19 pandemic further highlighted the resilience of LTIK holders. Indigenous Arctic communities, for instance, developed strategies that corresponded with their cultural memory of the 1918 influenza pandemic. These strategies included practicing traditional subsistence activities, emotional and physical support, and retreating to traditional subsistence areas such as tundra, rivers, lakes, and forests. These efforts resulted in lower infection rates, despite the limited healthcare support in these regions (Elliott-Groves, 2020; Petrov et al., 2021; Expert consultation, 2 November 2022).

24. **Cultural beliefs and practices-based risk understanding:**

   i. Cultural norms, beliefs, and practices can also shape understanding of risk. For example, certain events or phenomena might be seen as signs or omens of impending disaster. For an instance, cultural burning, also known as indigenous fire management, is a practice used by many indigenous
communities worldwide, particularly by those in Australia, North America, and parts of Africa (The Firesticks Alliance, n.d.; Yibarbuk, et al., 2001; Huffman, 2013). This practice involves the deliberate setting of small, controlled fires as a way to manage the land and it is based on a set of beliefs and understandings rooted in centuries of experience and cultural traditions. The core beliefs behind cultural burning are based on:

1. Respect for nature and interconnectedness: Many Indigenous cultures view themselves as an integral part of the natural world, not as separate or superior to it. All life forms are interconnected and respected.

2. Stewardship and responsibility: Indigenous peoples often see themselves as caretakers or stewards of the land. Cultural burning is a part of this stewardship, used to maintain the health and balance of ecosystems.

3. Reciprocity: There is a belief in the principle of give-and-take with the land. If people take resources from the land, they have an obligation to give back and maintain the health of the land.

4. Knowledge and wisdom from ancestors: Cultural burning practices are based on generations of accumulated knowledge and wisdom. These practices are often passed down through oral traditions and ceremonies.

5. Adaptation and survival: Cultural burning is also recognized as a survival strategy. By managing the land and resources carefully, Indigenous communities ensure their own survival and the survival of future generations.

ii. In Canadian Northwest Territories, the Canadian government allocated funds to construct a fire break in the communal territories, allowing the community to participate in the design process, particularly to bolster their food production systems. The community proposed original and innovative solutions to ensure their resilience against potential fires (Expert consultation, 9 November 2022b).

iii. Cultural burning is also an important practice among many Indigenous Australian communities, often referred to as Aboriginal and Torres Strait Islander peoples. The basic beliefs behind cultural burning in these communities share some similarities with those of Indigenous communities in North America, but also have their unique aspects influenced by the distinct cultural and ecological context of Australia (Bird et al., 2012; The Firesticks Alliance, n.d.; Yibarbuk, et al., 2001; Huffman, 2013):
6. Interconnectedness and respect for country: Indigenous Australians often hold a belief in the deep interconnectedness of all elements of the natural world, which is often referred to as "Country". Country is a term that signifies the living, spiritual entity that is the earth, encompassing all life forms, landforms, and elements.

7. Caring for country: Indigenous Australians often perceive themselves as having a deep responsibility to care for and maintain the health and balance of Country. Cultural burning is an integral part of this stewardship.

8. Knowledge transmission: The knowledge and practices of cultural burning are often passed down through generations. This traditional knowledge encompasses precise understandings of local ecologies, fire behaviors, and the right timing and techniques for burning.

9. Cultural and spiritual significance: Fire and cultural burning practices also have significant cultural and spiritual dimensions. Fire is often considered a tool for communication with the ancestral beings of the Dreaming (or Dreamtime), the Aboriginal spiritual belief system.

10. Resource management and biodiversity: Cultural burning practices are used to manage resources, enhance the productivity of plant and animal species important for food and materials, and maintain biodiversity.

11. Protection and safety: By carefully applying fire in a controlled manner, Indigenous Australians reduce the fuel load in the environment and decrease the risk of larger, uncontrolled wildfires, thereby protecting communities and Country.

iv. In the aftermath of the catastrophic "Black Summer" between 2019 and 2020, these practices are being integrated into broader wildfire risk reduction initiatives. There has been growing interest from government agencies, fire services, and land management organizations in Australia to learn from indigenous communities and integrate cultural burning practices into their fire management strategies since it has been increasingly recognized for their potential to mitigate bushfire risks, for several reasons (The Firestick Alliance, n.d.):

12. Reducing fuel loads: Cultural burning, often carried out as low-intensity 'cool' fires, can reduce the amount of fuel (like undergrowth, leaf litter, and dead wood) available for potential bushfires, thereby reducing their intensity and spread.
13. Creating firebreaks: The patchwork or 'mosaic' pattern of cultural burns can create natural firebreaks in the landscape that can slow the progress of bushfires and help contain them.

14. Promoting healthy ecosystems: By preserving larger trees and important habitats, and by promoting the growth of certain plant species, cultural burning can contribute to healthier, more resilient ecosystems that are better able to recover from fires.

15. Reinvigorating local knowledge and engagement: The resurgence of cultural burning can reinvigorate local and Indigenous engagement in land management, bringing valuable traditional knowledge into bushfire management strategies.

16. Adapting to climate change: As climate change increases the risk of severe bushfires, integrating cultural burning into broader fire management strategies can be a part of adapting to these changing conditions.

25. Knowledge transmission-based risk understanding:

i. Risk mitigation knowledge is often passed down through generations within LTIK communities, utilizing oral traditions, storytelling, ceremonies, and practical demonstrations. For instance, the Moken community in Thailand relies on inherited knowledge of wave patterns, handed down through storytelling. This enabled them to recognize abnormal wave sequences as a signal of an impending tsunami, leading to a successful evacuation before the tsunami struck, thereby saving lives within their community (Expert consultation, 16 November 2022).

ii. Similarly, the Simeulue indigenous community in Aceh, Indonesia, were able to predict the 2004 Asian tsunami based on environmental changes and other variables. This information was passed down in the form of stories, songs, poems, and lullabies, allowing them to develop an effective early warning system (Suciani et al., 2018; Rahman et al., 2017). As a result, they suffered only seven casualties out of 86,735 inhabitants, in stark contrast to the 167,000 victims overall in Aceh.

iii. Likewise, the Solomon Islanders utilized ancestral stories to understand and mitigate tsunami risks, allowing them to preserve lives during such events (UNISDR, 2008). These examples underline the importance and effectiveness of LTIK in disaster risk reduction.

26. Local adaptation and resilience-based risk understanding:

i. LTIK communities possess sophisticated strategies for risk management, including unique agricultural practices, building techniques, and resource
management strategies, which help mitigate disaster impacts. Studies highlight that communities across regions like Asia and Africa effectively prevent and manage hazards using locally derived adaptation strategies (Guoping, 2021; Hilshort et al., 2015; Pierro et al., 2022; Suciani et al., 2018).

ii. These communities are adept at observing environmental changes and exhibit resiliency and creativity when adapting to their shifting environments. LTIK can enhance the effectiveness of local adaptation strategies, helping communities contextualize progressive or escalating climate changes (Sultana and Luetz, 2022). Their frequent interaction with the environment enables them to recognize unusual animal behaviors or environmental changes often before scientific studies can (Expert consultation, 30 November 2022b).

iii. Traditional solutions for water supply, such as various methods of water extraction and storage, can prove useful, particularly in water-scarce regions (Expert consultation, 30 November 2022b). For instance, the traditional irrigation system known as Karez in Xinjiang, China, has effectively mitigated drought risks and circumvented food insecurity. Karez is sustainable, resistant to natural disasters, and can efficiently transport water over long distances without significant evaporation (UNESCO, 2016). Currently, the Karez system is being integrated with modern technology to enhance its efficiency (UNISDR, 2008).

iv. It's essential to recognize the varying impacts of climate change across different regions and avoid one-size-fits-all solutions. Indigenous communities, with their deep understanding of their environment, can contribute valuable insights for climate change adaptation. Collaborating with these communities can lead to the development of context-specific, culturally-sensitive solutions to environmental challenges (Expert consultation, 2 November 2022).

27. Holistic perspective-based risk understanding:
   i. LTIK holders often perceive risk holistically, recognizing the interconnectedness of humans, the environment, and the spiritual world. This integrated viewpoint promotes comprehensive risk management strategies. Indigenous peoples' close relationship with nature forms the backbone of their resilience against natural hazards. Strong social networks and a tradition of mutual aid further equip these communities to understand and manage risk, providing crucial support in times of crisis.
ii. Integrating LTIK with the knowledge of DRR practitioners can help reveal community vulnerabilities and aid in disaster anticipation. A study by Dube and Munsaka (2018) found that 60% of interviewed DRR practitioners believe indigenous knowledge can support the creation of effective prevention, mitigation, and preparedness plans. As primary risk bearers, indigenous and local communities live with, address, and learn from these risks, creating a 'living risk knowledge.

iii. Dube and Munsaka (2018) also suggest that communities rich in indigenous disaster risk reduction knowledge can cope with disasters with minimal external support. Leveraging their indigenous knowledge, these communities can anticipate and manage various hazards before a disaster strikes. They understand their local hazards, risks, capacities, vulnerabilities, and acceptable risk levels. This understanding forms the basis of local knowledge, which is vital for devising local solutions (Expert consultation, 16 December 2022). Therefore, to understand risk as a key pillar of SF, we must consider the perspectives of primary risk bearers (LTIK holders) who understand their vulnerabilities and capacities.

THE ROLE OF LOCAL, TRADITIONAL, INDIGENOUS KNOWLEDGE IN STRENGTHENING RISK GOVERNANCE TO MANAGE DISASTER RISK

28. LTIK plays a vital role in strengthening risk governance to manage disaster risk since LTIK contributes to:

29. An understanding of local hazards and risks:
   i. Indigenous and local communities often possess profound insights into local hazards and risks, derived from lived experiences and oral histories. This knowledge, as discussed earlier, can offer invaluable context and aid in formulating disaster risk reduction strategies. In regions where government adaptation programs are inadequate, employing LTIK can promote more effective long-term adaptation, enhance trust and transparency in governance, support social networks, and ensure job stability and income flow (Islam et al., 2018, p. 18). A study indicates that increased use of LTIK can significantly enhance adaptation capacity in Bangladesh.

30. Promoting sustainable practices:
   i. Indigenous and traditional practices, such as those related to land and water management, often embody sustainability and can bolster environmental resilience against disasters. For example, Native Americans adhere to a principle considering the seven generations preceding them and the seven that will follow, in all their activities. This philosophy allows them to
incorporate the wisdom and experiences of their ancestors while ensuring future generations' well-being, access to sustainable natural resources, and disaster safety. This principle, firmly ingrained within Native American communities, offers a sustainable perspective towards risk governance (Expert consultation, 14 December 2022).

31. **Advantage in cultural relevance and acceptance (including informing early warning systems and response):**

i. Risk reduction measures derived from local, traditional, and indigenous knowledge are more likely to be culturally acceptable and thus readily embraced by the community. As Mohanty et al. (2019) state, involving local communities is crucial for establishing sustainable, functional early warning systems (EWS).

ii. A study conducted by Mohanty et al. (2019) in Afghanistan demonstrates the preference for EWS rooted in indigenous practices. For instance, communities found loudspeakers and traditional drums more familiar and effective than electronic EWS such as mobile short messaging service (SMS) or modern foreign technologies.

iii. The Mentawai indigenous community in Indonesia exemplifies the effectiveness of implementing a preparedness plan based on indigenous wisdom. This approach resulted in minimal casualties during the 2004 Asian tsunami (Suciani et al., 2018; Rahman et al., 2017). The InaTEWS, an early warning system developed by the Indonesian government with international support, failed due to internet connection loss, leaving the population uninformed about the impending tsunami.

iv. Traditional technologies proved reliable as modern methods faltered. Cell phones were non-functional due to adverse weather, while tropical cyclones and high waves obstructed victim evacuation. The indigenous community relied on 'Tuddukat,' a traditional early warning system utilizing a wooden drum to signal impending events and disseminate news, similar to Bali's 'kul kul' system. The community was familiar with the sound patterns and signals produced by the Tuddukat, which can transmit sound over long distances. This system enabled effective warnings, bypassing the need for modern technology like mobile phones and the internet (Zulfadrim et al., 2019).

v. A case study by Sari and Prayoga (2018) reported a successful collaboration between local government and a flood-prone community in Semarang City, Indonesia. They integrated LTIK and social networks with modern
technology to create a flood early warning system. This collaborative approach led to heightened hazard awareness, thereby improving community and government preparedness.

32. **Enhancing community participation:**
   
   i. The recognition and appreciation of local, traditional, and indigenous knowledge (LTIK) can foster active community participation in risk governance, leading to more effective and inclusive solutions. In some instances, LTIK can fill gaps in scientific understanding, especially in local-level phenomena. Here are some supporting cases:

   1. The community-led evacuation process during a natural hazard event in Sinabung, Indonesia, demonstrates how effective social interaction can manage evacuations efficiently. Andreastuti et al. (2019) observed that the self-organization of local communities enhanced the local government's risk management. The community was proactive in executing evacuation strategies such as preparing shelters and meals and arranging communal prayers, even without government instruction. However, Andreastuti et al. (2019) also noted that external intervention, such as support from foreign volunteers, disrupted the community's customary self-organized evacuation process, creating hesitancy among community members and leading to dependency on foreign aid.

   2. Nakanishi and Black (2018) found that explicit knowledge (knowledge disseminated by formal/state government) is beneficial when a community has an existing level of education and preparedness, as it originates from educational and scientific environments. However, in societies where explicit knowledge may be difficult to comprehend, implicit knowledge (like LTIK) plays a vital role in enhancing local participation and preparedness. Communities with low literacy levels may struggle with technical concepts rooted in scientific principles, often turning to customary knowledge (Trogrlić, 2022). This suggests LTIK holders can assist governments in disseminating relevant information to strengthen disaster risk governance. For instance, in Takamatsu, Japan, implicit knowledge of historical typhoon and coastal inundation events was found to be more trusted and useful for future preparedness compared to explicit knowledge.

33. **Building resilience:**
   
   i. Many indigenous and local communities have developed their own strategies for coping with and recovering from disasters, thus contributing
to community resilience. An example of this can be seen in Canaan, Haiti, where local knowledge and capacities independently transformed an unproductive landscape into a self-functioning city, without the intervention of the government or NGOs. In contrast, a two-million-dollar resilience city project, funded and executed by international institutions, was unsuccessful. The project misjudged the feasibility of building residential housing in a flood-prone area and failed to support necessary urban ecosystems, such as public transportation. Only after the community successfully built a functioning city did international NGOs intervene, but they ultimately left the project unfinished (Lizarralde et al., 2022).

34. **Examples of LTIK contribution in strengthening risk governance:**

i. Over the last twenty-five years, there has been increasing recognition of indigenous knowledge in governmental systems at both national and sub-national levels across various countries, in both the Global North and South. For the last ten years, countries in the Global North have begun to understand the importance of indigenous knowledge (Expert consultation, 11 November 2022). Countries like China, Indonesia, Namibia, Nepal, Pakistan, the Philippines, and Taiwan, for instance, have recognized the value of LTIK, integrating it into national policies and local risk management strategies, along with contemporary technology. While no formal efforts have been made to combine these two knowledge spheres in Malawi, Zimbabwe, Fiji, and Tonga, these regions have informally been doing so (Hadlos et al., 2022). The Vanuatu government has established a national climate change and disaster risk reduction policy for 2016-2030 that safeguards traditional knowledge, providing guidelines for its collection, storage, and use for climate change adaptation and disaster risk reduction (Government of Vanuatu, 2015). Australia has also increased recognition of LTIK within its federal and state policy framework, although evidence of engagement and application remains limited (Spurway, 2018).

ii. Governments in South Africa, Mozambique, and Zambia take indigenous knowledge seriously, seeking to communicate with communities. Indigenous chiefs are appointed to governmental positions, and when projects are proposed, they consult with indigenous communities (Expert consultation, 11 November 2022).

iii. In Canada, indigenous chiefs and their cultures are respected by the Canadian government, and their expertise is sought after for project implementation (Expert consultation, 11 November 2022b).
iv. Japan's social and DRR governmental systems have seen changes, moving away from exclusive reliance on governmental and scientific knowledge approaches (Expert consultation, 11 November 2022a). Despite significant investments in DRR, Japan has experienced repeated disasters and human losses. Recognizing that the government alone cannot create an effective DRR strategy, over the last fifteen years, they have been developing DRR strategies in a more participatory way, involving local communities that hold indigenous or local knowledge, particularly regarding landslides.

v. The Taiwanese government has acknowledged the typhoon mitigation strategies of their indigenous communities, particularly in response to Typhoon Herb in 1996, Typhoon Mindulle in 2004, and Typhoon Morakot in 2009 (Berkes et al., 2021).

vi. The flood warning system in Dagupan City, Philippines, allows the government to combine indigenous and modern scientific knowledge, resulting in an effective response to the city's perennial flooding problem (UNISDR, 2008).

35. Bringing LTIK into risk governance requires respectful dialogue and partnership with local, traditional and indigenous communities, recognition of their rights, and efforts to bridge the gap between this knowledge and contemporary scientific approaches. It is also important to remind that LTIK is dynamic and evolving, not static, and must be understood in its cultural, ecological, and historical contexts.

THE ROLE OF LOCAL, TRADITIONAL AND INDIGENOUS KNOWLEDGE IN INVESTING IN DISASTER RISK REDUCTION FOR RESILIENCE

36. Despite recent progress, there's a pressing need for increased investment and commitment to enhance disaster risk reduction and resilience, particularly in regions of the Global South and North where indigenous communities reside (Expert consultation, 22 November 2022; Martins et al., 2022). As discussions about investment planning, especially in the wake of the COP 27 outcome, highlight the need "to establish a fund for responding to loss and damage" (UNFCCC, 2022), it's crucial to seize this momentum. This is an opportune time to consider how investments in disaster risk reduction for resilience can be made more effective and sustainable.

37. Local, traditional, and indigenous knowledge significantly contribute to investments in disaster risk reduction (DRR) for resilience. This knowledge can provide invaluable insights that guide investment decisions and actions in various ways:
38. **Sustainable practices:** Numerous indigenous and traditional practices demonstrate inherent sustainability and resilience, including particular farming or land management practices that decrease vulnerability to certain hazards. Investing in the safeguarding and promotion of these practices can form an effective disaster risk reduction strategy (Berkes et al., 1994; Ford et al., 2020; Mistry et al., 2016).

39. **Community ownership and participation:** LTIK holders are often adept at addressing the core of issues due to their familiarity with the relevant context, culture, and the language of the people involved. Their involvement manifests in varying degrees, accompanied by capacity building and accountability. Additionally, LTIK holders are instrumental; they inhabit and experience these areas on a daily basis, providing them with a deep understanding that outsiders cannot achieve. They possess the authority, knowledge, skills, and personal motivation to ensure their environment thrives for their benefit and that of their future generations. Therefore, to include them in any process is essential, and their insights should be valued and respected. To successfully accomplish any task, it's crucial to engage those who will actually be carrying it out - the people who are the caretakers of that place (Expert consultation, 9 December 2022). Some scientists advised that investing in DRR for resilience should not limited to post recovery efforts, it should be framed for a long-term sustainability. Communities that are empowered have the ability to make knowledgeable decisions that distance them from potential hazards. The difficulty lies in establishing a disaster risk reduction approach that continues to prioritize people (Lusterio et al., 2022).

40. **Context-specific solutions:** LTIK can provide valuable insight into local hazards, vulnerabilities, and capacities. This can guide investment in context-specific DRR solutions that are tailored to the local environment and culture. Synergy is required for integrating DRR investments at local, national, and global levels. One way to move forward with investment in DRR for resilience can be evaluating what knowledge that is already exist in the targeted area while understanding socio-political drivers that can create risks. It could save investment funds and allocate and result more sustainable impacts from investments. For an instance, a lot of funding can be minimized while applying certain indigenous knowledge systems such as Karez irrigation system for dry land in Afghanistan and China (Expert consultation, 11 November 2022). There are substantial opportunities in various sectors such as health, water, and agriculture, all of which are connected to disaster risk reduction (DRR). In Japan, when government posed a dyke protection system in coastal area there was no comprehensive aspects on ecology and livelihood. Only because of local communities’ input, the government could get a bigger picture of system changing thus resulting a better solution for the ecosystem and the community who relies their livelihood on the coastal area (Expert consultation, 11 November 2022).
THE ROLE OF LOCAL, TRADITIONAL, INDIGENOUS KNOWLEDGE IN ENHANCING DISASTER PREPAREDNESS FOR EFFECTIVE RESPONSE AND TO "BUILD BACK BETTER" IN RECOVERY, REHABILITATION, AND RECONSTRUCTION

41. Local, traditional, and indigenous knowledge (LTIK) plays an important role in enhancing disaster preparedness and building resilience, particularly in the context of recovery, rehabilitation, and reconstruction for several reasons:

42. **Understanding risk and vulnerability:** LTIK provides a deep understanding of local environments, their risks, and vulnerabilities. This knowledge can be used to assess disaster risks accurately and to develop more effective preparedness measures (Expert consultation, 16 November 2022; 16 December 2022).

43. **Effective disaster preparedness and response:** LTIK practices often contain proven strategies for disaster preparedness and response. These strategies, which have been developed and refined over generations, can be integrated into contemporary disaster management approaches. Despite indigenous communities limited resources, they have devised the most impressive solutions (Expert consultation, 14 December 2022).

44. **Resilience building:** The intimate relationship between indigenous peoples and nature provides the foundation of indigenous people’s resilience in the face of natural hazards. Some scholars, especially anthropologists conclude that local, traditional, indigenous people’s survival is a result from their LTIK that passed down from generation to generation, which prepared them to deal with natural disasters (Budjeryn, 2005 in Hilhorst, 2015). There has been a lot of experience in using LTIK, which brought tremendous capacities because communities facing hazards on the first hand and have no option other than to deal with it. This forces them to use their own initiative and their own knowledge, because small, localized event often times do not get the attention at national level, thus no resources allocated (Expert consultation, 16 December 2022). A study conducted by Dube and Munsaka (2018) discover testimonies of their study respondents and 70% of them mentioned the crucial role of indigenous knowledge for a better response and recovery in disaster if it is combined with contemporary science. Additionally, several African countries are starting to come back to their indigenous knowledge to sustain their livelihoods when disasters approaching, especially on agriculture sector where farmers are planning crops varieties that are resistant to drought. Communities in Zimbabwe also have some ways to preserve food in case droughts arrived (expert consultation, 11 November 2022).

45. **Sustainable recovery and reconstruction:** Many indigenous communities have faced and adapted to environmental changes and hazards over generations, developing unique strategies of resilience and left them place-based knowledge. The place-based knowledge is context-specific knowledge that can greatly contribute to the development of sustainable solutions that can guide where and how reconstruction should happen (Kurnio et al., 2021;
Furthermore, LTIK holders often have strong community bonds and structures that can be mobilized for recovery and reconstruction efforts. Their social capital can be leveraged for collective action, providing manpower and resources (Hilhorst et al., 2015; (Kharis et al., 2019).

46. **Cultural continuity and community engagement:** The recognition and integration of LTIK encourages a sense of ownership and participation in disaster management processes among local communities. This improves the chances of successful implementation and long-term sustainability. This spirit is embodied in the culture of social organization, specifically the system of mutual assistance, where people help each other. For instance, this is referred to as 'bayanihan' in Tagalog, and 'nguopin' in Balinese, both terms carrying a strong value of community and 'otherness'. In the Philippines, there is a common perspective among the people of the Cordillera, where they construct a counter-image about the lowlands. In their view, the spirit of 'bayanihan' seems to have disappeared in these lowland areas. During disaster management situations, there have been cases of intense competition among people, leading to food riots and complaints about government services. In contrast, in the highland areas, people patiently wait for their food, organize themselves, and tolerate the situation. As a teacher interviewed by Hilhorst et al. (2015, p.33) put it, "there is no community spirit; it is every man for himself. They don’t care about the rest." A similar phenomenon has been observed in Bali, where the local government has used the indigenous concept of 'nguopin' (helping each other) during the recovery and rehabilitation processes following disasters in earthquake and volcanic eruption-prone areas (Kharis et al., 2019).

49. Additionally, an indigenous member and expert stated during an expert consultation on 2nd December 2022, “When the crisis hits, we're going to rely on our relationships and our communities' relationships. Relationships are most important.” A similar culture is observed in the First Nations indigenous communities in the US and Canada: regardless of long-standing disputes or disagreements among community members, they form unity and lend a hand to one another in times of crisis. Scholars note that the strength of indigenous communities often lies in their collectivism, a trait seldom found in more individualistic societies (Expert consultation, 2nd November 2022).

50. **Biodiversity and ecosystems management:** Indigenous knowledge often includes sustainable management of local ecosystems and biodiversity, which can contribute to reducing disaster risk and enhancing overall community resilience (Fort et al., 2020).

51. **Climate change adaptation:** Indigenous knowledge often encompasses practices that can help communities adapt to climate change, a factor increasingly recognized as significant in disaster risk (Petzold et al., 2020). There is a general perception that holders of Local Traditional Indigenous Knowledge (LTIK), being small communities without resources and exposed to significant risks, are vulnerable. However, according to some expert works, it is revealed that while LTIK holders indeed face high risks and are deeply concerned
about climate change, they also possess a sense of socio-cultural strength (Expert consultation, 2 November 2022).

**Gaps in braiding diverse knowledge systems for DRR**

52. Braiding diverse knowledge systems with contemporary scientific knowledge can provide a more comprehensive understanding of complex issues and enhance DRR strategies. However, there are several gaps and challenges to effectively integrate these knowledge systems:

53. **Lack of understanding in knowledge systems epistemological differences:**

i. Diverse knowledge systems such as Local Traditional Indigenous Knowledge (LTIK) and contemporary scientific knowledge often stem from different assumptions, values, and methodologies. Bridging these epistemological differences involves recognizing and respecting the value and validity of each system. For example, while contemporary science often values objectivity, controlled experiments, quantifiable evidence, and replicability, indigenous epistemologies may place more emphasis on generations of experience, holistic understanding, qualitative evidence, and oral traditions (Expert consultation, 4, 16, 25 November 2022).

ii. Integrating LTIK and contemporary science brings these distinct values into play. LTIK's experiential knowledge and observational insights often complement contemporary scientific data and systematized information in Disaster Risk Reduction (DRR) management (Hadlos et al., 2022). Scholars suggest that while LTIK may not be sufficient on its own to reduce disaster risk, contemporary science often lacks understanding of local vulnerabilities, missing a holistic view of DRR. Recognizing the value of each system involves appreciating different epistemologies, ways of knowing, and cultural contexts. There may be challenges in validating indigenous knowledge by scientific standards, not suggesting LTIK's inferiority, but acknowledging different knowledge frameworks (Nakashima & Roué, 2002).

iii. There has been extensive debate on integrating diverse knowledge systems, but the actual interaction between knowledge holders needs further examination (Expert consultation, 9 November 2022c; 7 December 2022). The prevalent contemporary scientific knowledge can unintentionally impose biases on indigenous knowledge, leading to skepticism about its validity and contribution to DRR. Despite evolving attitudes, the dominance of scientific knowledge over indigenous knowledge remains significant (Hadlos et al., 2022).
iv. LTIK holders often face marginalization, and their knowledge and perspectives can be overlooked in formal DRR processes, leading to ineffective DRR strategies (Cadag & Gaillard, 2012). For example, even when the Mentawai people in Indonesia effectively used their indigenous knowledge during the 2010 tsunami, this knowledge was considered "invisible" due to its societal embeddedness (Zulfadrim et al., 2019). In regions where scientific knowledge dominates risk management, local communities are often excluded from dialogues and decision-making processes, undermining the significance of LTIK (Nakanishi and Black, 2018).

v. Recognizing these epistemological differences is crucial for effective integration of diverse knowledge systems, as misunderstandings or conflicts can arise if these differences are not adequately addressed (Expert consultation, 4 November 2022; 25 November 2022; 2 December 2022a).

54. **Language and communication barriers:** Different knowledge systems often use distinct languages and terminologies, which can obstruct effective communication and collaboration. Developing a shared language or employing translators and cultural mediators can alleviate these issues (Expert consultation, 25 November 2022). For instance, disaster risk reduction (DRR) terms like "vulnerability," "risk," and "hazard" are not always readily understood by a wide audience, specifically within some indigenous cultures (Expert consultation, 30 November 2022a; 19 December 2022). Take the Māori people's view of volcanoes, which differs from the Western perspective as they perceive them as part of a broader human experience, not specifically as hazards (Expert consultation, 25 November 2022). The UNDRR (2015) has underscored the need to adjust DRR terminology to foster a shared understanding while respecting and acknowledging national and cultural specificities.

55. **Power dynamics and marginalization (underlying drivers that create risks):**

   i. Historically, contemporary scientific knowledge systems have often been privileged over LTIK, leading to the marginalization of indigenous and local communities. For centuries, indigenous people in the US, Canada, and Australia have lost their lands due to colonization, leading to a cultural and linguistic shift towards modernization. The loss of indigenous lands often signals the decline of resilience knowledge towards environmental changes. Long-standing knowledge and local understanding derived from generations of observation and past hazard experiences become irrelevant, weakening indigenous people's capacity to address risk (Hooli, 2015; Zulfadrim et al., 2019).

   ii. Land holds significant meaning for LTIK holders, many of whom do not see migration as an option. Relocation often results in significant cultural
erosion, disrupting the two crucial pillars – attachment to land and community love – that have historically enabled these communities to withstand or minimize the impacts of disasters (Expert consultation, 2 November 2022). Additionally, policy often bans traditional cultural practices and rituals in indigenous communities despite their sustainable aspects. This unsupportive policy significantly contributes to the decline of disaster-related resilience and normalizing strategies within society, without considering indigenous knowledge (Zulfadrim et al., 2019).

iii. The consequences of prolonged colonization in North American communities include a sense of anomie, loss of identity, and serious repercussions, especially among the youth, leading to issues like suicide (Expert consultation, 30 November 2022b).

iv. Furthermore, poverty within the indigenous community is also one of the challenges to maintaining LTIK and DRR strategies. Indigenous peoples, often displaced from their territories, are among the most marginalized groups. Forced to focus on basic survival needs, especially in settings where natural resources have been depleted, they are the most likely to suffer the serious impacts of natural disasters. Without addressing certain rights and conditions, LTIK holders may lose their knowledge in the struggle for survival, exacerbating their disadvantaged position (UNDRR, 2017b; Expert consultation, 2 December 2022a).

56. Access and ownership of LTIK: The accessibility and ownership of Local and Traditional Indigenous Knowledge (LTIK) can significantly bolster local resilience in disaster risk reduction (DRR). However, challenges persist: a significant concern is the potential misappropriation and exploitation of LTIK without appropriate recognition or benefits reciprocated to indigenous communities (Simpson, 2004 in Hudlos et al., 2022). Furthermore, those unfamiliar with LTIK may struggle to understand its cultural context and significance, leading to misunderstandings and misinterpretations. Such inaccuracies can then translate into the improper application of this knowledge in disaster risk reduction initiatives (Agrawal, 1995 in Hudlos, 2022).

57. Transmission and preservation: The transmission of LTIK typically relies on oral traditions and intergenerational learning, making it vulnerable in the face of globalization and cultural assimilation. It is crucial to undertake measures to preserve, document, and transmit this knowledge to future generations. Another challenge is accessing indigenous knowledge, as it's often passed down through generations without formal documentation. Therefore, it's important to organize and document this knowledge systematically (Expert consultation, 11 November 2022b).

58. Institutional and policy frameworks:
i. Few international frameworks, including the Sendai Framework, comprehensively address LTIK and promote meaningful engagement with LTIK holders. Despite the occasional mention of indigenous knowledge in these frameworks, it's often not explored in depth. National governments, during policy-making processes, usually draw information primarily from contemporary scientific knowledge, frequently neglecting the importance of LTIK (Expert consultation, 11 November 2022b; Expert consultation 25 November 2011). This oversight often reduces the attention given to this issue (Expert consultation, 25 November 2022).

ii. The development of inclusive policies and institutions that recognize and incorporate multiple knowledge systems is crucial for effective integration. However, their tangible impact on policy and global negotiations is yet to be seen. For instance, while paragraph 135 of the Paris Agreement emphasizes the need to bolster LTIK and practices on adaptation and mitigation, the specifics of its implementation remain unclear (Expert consultation, 22 November 2022).

59. Capacity and education:

i. Modern education is predominantly Eurocentric, with minimal emphasis on LTIK. Where it is taught, it is often cursory or confined to indigenous language instruction, with few indigenous knowledge systems integrated into the curriculum (Expert consultation, 11 November 2022b). The public education system, including schools, has limited exposure to LTIK. Rarely is LTIK introduced to non-LTIK holders in public schools. Effective collaboration necessitates an understanding of LTIK by both LTIK and non-LTIK holders (Expert consultation, 11 November 2022b).

ii. Additionally, LTIK holders often lack the resources to participate in national and international negotiations (Expert consultation, 2 December 2022a). It's vital to provide capacity building and education to empower LTIK communities to participate in decision-making processes and to foster understanding and appreciation of diverse knowledge systems among policymakers and practitioners.

60. LTIK in informed investment decisions:

i. A considerable disconnect exists between Local and Traditional Indigenous Knowledge (LTIK) and contemporary scientific knowledge in terms of disaster risk reduction (DRR) investment for resilience. Effective development planning necessitates identifying key investments that are both informed by potential risks and resilient to future disruptions. Given the increasingly extreme shocks and stresses shaping our world, the importance
of local knowledge in disaster risk management becomes evident (Expert consultation, 16 December 2022).

ii. Investments can be ineffective without LTIK and local collaboration, and may even create additional problems. There are numerous instances where international interventions have overlooked local conditions, leading to inappropriate and problematic outcomes that do not enhance community resilience (Martin et al., 2022). For instance, international DRR policy, urban planning, and other disciplines proved ineffective in rebuilding and enhancing resilience in Haiti after the 2010 earthquake. International intervention failed due to an inability to understand the local situation in Haiti (Lizarralde et al., 2022).

iii. There is a tendency, particularly among thinkers from the Global North, to seek a one-size-fits-all solution. However, given the complexity of the issues we face, this approach is inadequate. The challenges are multifaceted, therefore, solutions must be comprehensive, not merely quick fixes. It's crucial to incorporate a diverse range of perspectives when considering solutions (Expert consultation, 2 December 2022).

iv. Surtiari et al. (2022) provide an example from Jakarta, where the transition from informal to formal structures intended to build resilience only increased local community vulnerability. Strict formal rules can threaten community livelihood sustainability. There are concerns about housing sustainability, the weakening of socio-cultural networks, and the potential loss of flexible payment mechanisms based on understanding and mutual trust. Surtiari et al. (2022) emphasize the importance of acknowledging the positive contributions of informality in effective formal adaptation, indicating the necessity of urban dwellers' involvement in adaptation planning and implementation.

61. **Limited meaningful LTIK holders participation:**

i. Unfortunately, the focus of many international institutions' interventions has been on a participatory approach that functions more as a formality rather than aiming for meaningful participation. Participation is often quantified merely by counting the number of people attending meetings, and workshops can simply be tokenistic without truly addressing community aspirations (Martins et al., 2022). Frequently, local leaders or politicians, guided by their own interests, dominate the discussions, while voices not captured during meetings remain unheard. A comprehensive
understanding of power dynamics is critical when implementing a participatory approach (Lusterio et al., 2022).

ii. Indigenous peoples show willingness to participate in international negotiations, but they often find themselves sidelined in these discussions. The actual decision-making process is often separate from the recognition of indigenous knowledge (Expert consultation, 2, 22 November 2022).

**Potential ways in closing the gaps of braiding diverse knowledge systems for DRR**

62. Closing the gaps in braiding diverse knowledge systems requires a multifaceted and inclusive approach. Here are some potential ways that could help in addressing the gaps:

63. **Building mutual respect and understanding:**

i. Given uncertainties, no knowledge system can predict every potential occurrence, as it exceeds anyone's lived experience. Contemporary scientific knowledge doesn't have all the answers either (Expert consultation 2 December 2022). LTIK can contribute to contemporary scientific efforts in anticipating hazards, and there's a growing consensus that we need to listen to indigenous peoples (Expert consultation, 16 November 2022). Indigenous knowledge and scientific knowledge should converge to foster innovation and tackle emergent issues beyond the reach of either knowledge system thus far (Expert consultation, 11 November 2022; 16 November 2022). The synthesis of these two knowledge systems could provide supplementary information, leading to co-created innovative knowledge. Introducing varied concepts, understandings, and worldviews can foster unique knowledge, sparking new innovations (Expert consultation, 4 November 2022).

ii. Recognizing the value and validity of each knowledge system demands a respect for different epistemologies, ways of knowing, and cultural contexts. Challenges can emerge when verifying and validating indigenous knowledge based on scientific standards. This isn't to suggest that LTIK is inferior to contemporary scientific knowledge, but rather to recognize that the two knowledge systems operate and validate under different paradigms (Nakashima et al., 2000; Expert consultation 4 November 2022; 19 December 2022).

iii. Indigenous peoples should be given opportunities to fully represent their knowledge, moving beyond a dichotomous framing of science versus indigenous knowledge (Expert consultation, 25 November 2022).
Comparing and ranking the two knowledge systems is counterproductive; instead, they should be acknowledged as equally valuable (Expert consultation, 4, 9 November 2022; 11 November 2022). Addressing inequalities between scientific and indigenous knowledge systems first requires acknowledging indigenous and local knowledge as robust sources of knowledge with their own validation methods (Nakashima & Roué, 2002; Expert consultation, 4, 25 November 2022).

iv. Acknowledging LTIK is inextricably tied to recognizing indigenous peoples' rights and their land rights. Land rights are fundamental for LTIK holders, serving as the venue for social, economic, cultural, and environmental activities. These activities generate sustainable production and consumption practices, along with resource conservation and management techniques rooted in traditional knowledge and customary governance systems (Magni, 2017). It's challenging for LTIK holders to utilize LTIK when grappling with poverty, relocation, and forced migration, which impede their understanding of local environments and risk judgement based on familiarity and past experiences. A national legal framework protecting LTIK holders, their land rights, and LTIK is thus essential. Acknowledging heterogeneity, recognizing that differences exist within communities, is also important (Expert consultation, 16 November 2022; 25 November 2022). Recognizing indigenous land rights and the validity of indigenous knowledge is key for effective collaboration (Expert consultation, 30 November 2022b).

v. Unless the issue of contemporary scientific knowledge's cultural dominance is addressed, engagement between knowledge holders will remain limited (Expert consultation, 9 November 2022c, 16 November 2022, 25 November 2022).

vi. A significant divide exists between the social and natural sciences, often leading to difficulties in mutual understanding among scientists from these fields. Resolving this internal discord within the contemporary scientific community is essential before initiating dialogue with LTIK holders, and the same applies to LTIK holders (Expert consultation, 9 November 2022c).

vii. Adopting a multiple evidence-based approach and a 'warm data' approach could offer potential insights into LTIK (Expert consultation, 4 November 2022) and enhance

64. Building trust and collaboration:
    i. Establishing sustainable collaboration between diverse knowledge systems and contemporary scientific knowledge holders necessitates building trust,
respect, and equity. Trust can be fostered through long-term engagement, mutual respect for cultural contexts and practices, equitable partnerships, and education (Expert consultation, 25 November 2022). Initiatives such as co-creation of knowledge, where scientists and indigenous knowledge holders collaboratively develop insights, have proven effective in establishing a foundation of mutual respect and understanding (Tengö et al., 2017; Smith et al., 2016; Reid et al., 2016, Expert consultation, 30 November 2022). Contemporary scientists, especially those in rural areas, have demonstrated a greater willingness to engage with indigenous communities, leading to mutual learning and more effective DRR systems (Expert consultation, 30 November 2022b).

ii. Effective disaster risk reduction (DRR) involves international cooperation, global partnerships, and respectful integration of local competencies. Often, international agencies excessively invest in reports, diagnostics, and frameworks that neglect local contexts and expertise (Lizarralde et al., 2022). Effective DRR must also consider the role of national governments in legalizing policy recommendations from Local and Traditional Knowledge (LTIK) and in balancing top-down and bottom-up disaster management approaches (UNDRR, 2017; Khalil et al., 2016). Furthermore, governments and development projects should engage local communities consultatively, steering clear of imposed, pre-designed programs. LTIK holders should play an active role in shaping actions that impact their communities, thereby reclaiming their knowledge, cultural practices, and livelihoods (Expert consultation, November & December 2022). Furthermore, collaboration among LTIK holders with public and private sectors, academia, and civil society organizations is crucial for effective disaster risk reduction and resilience building.

iii. Additionally, civil society organizations play a particularly important role in supporting LTIK holders, especially in regions where local governments have a history of violence. A case from Jharkhand, India, during the COVID-19 pandemic exemplifies the systematic and collaborative potential of civil society organizations in supporting indigenous communities (Expert consultation, 2 December 2022c).

65. Providing cultural mediators and interpreters:

i. Cultural mediators and interpreters who understand both knowledge systems and can bridge language and communication barriers are crucial. These individuals ensure that when LTIK holders elucidate their knowledge
transmission methods via folklore, songs, dances, etc., those who uphold scientific knowledge are prepared and open-minded to comprehend the core concepts involved (Expert consultation, 9 November 2022c).

ii. It is important that indigenous individuals undertake the translation process. There are numerous indigenous experts worldwide who can assist in developing the post-Sendai Framework. These experts will not only contribute to the approaches of the post-Sendai Framework but will also influence its written style. Therefore, their contribution will be seamlessly integrated into the text (Expert consultation, 25 November 2022).

iii. Moreover, there is a need for greater attention to cultural and linguistic relevance in DRR discussions. The UN translates all of its documentation into eight languages, but these are literal translations, not cultural translations (Expert consultation, 25 November 2022). It is suggested that the post-Sendai Framework should be devised and drafted to be more applicable and meaningful to LTIK holders. In this way, it will also become more relevant to LTIK holders, as the language used will be less technical and more accessible to communities from different cultures and informal sectors. It could be beneficial to have two distinct documents for the post-Sendai Framework: one composed by professionals and a companion piece that presents the same content in culturally sensitive and linguistically accessible terms for LTIK holders (Expert consultation, 25 November 2022).

66. Protection of LTIK access and ownership:
   i. Ensuring that LTIK holders retain ownership of their knowledge and are included in decision-making processes is essential. This involves addressing issues related to intellectual property rights, benefit-sharing, and informed consent. There is also a need to legally protect LTIK to avoid intellectual property misconduct and to avoid marginalisation of indigenous people will continue (Hadlos et al., 2022; Zulfadrim et al., 2019; Hilhorst et al., 2015).

   ii. While accessing LTIK for DRR is crucial, it is also important to respect the rights of indigenous communities to their knowledge and to involve them as equal partners in the process. This means obtaining their free, prior, and informed consent, acknowledging their ownership of their knowledge, and providing them with benefits from its use. This will not only ensure the ethical use of LTIK but also enhance the effectiveness of DRR efforts (Nakashima et al., 2000).
iii. Multilateral institutions can support the development of guidelines for benefit-sharing when indigenous knowledge is used. This can ensure that any benefits (financial or otherwise) derived from the use of indigenous knowledge in DRR are shared with the communities that possess this knowledge (Laird and Wynberg, 2018). Multilateral organizations can advocate for and facilitate greater representation of indigenous peoples in DRR planning and decision-making processes. This allows indigenous communities to directly influence policies and strategies that affect them (UNDRR, 2019).

67. **Respecting LTIK validation system and credibility:**

   i. Contemporary scientific knowledge systems often prioritize quantitative and empirical evidence, while LTIK may rely more on qualitative, experiential and oral knowledge. To reduce inequalities between the scientific knowledge and indigenous knowledge system is first acknowledging that LTIK is a rigid source of knowledge and it has its own validation (Expert consultation, 4 November 2022). LTIK has the validation process that is much longer through experimentation adaptation or evolution. It would be unproductive to compare the two knowledge systems and try to rank one as more important than the other; they should instead be recognized as equally valuable (Expert consultation, 4, 9 November 2022; 11 November 2022).

68. **Giving efforts on LTIK preservation and transmission:**

   i. It is important to support efforts to preserve and transmit local and indigenous knowledge. This can include documenting oral histories, supporting intergenerational learning, and incorporating indigenous and local knowledge into formal education systems. If people want to know what is happening about the indigenous issues, community should have access to the information, therefore a platform should be dedicated to build information center that is accessible for everyone (Expert consultation, 11 November 2022).

   ii. Furthermore, Zulfadrim et al. (2019) recommends to focus documentation on technical knowledge rather than general conclusion of indigenous knowledge to be more applicable. Documentation will help to understand LTIK principles behind practices in specific contexts to be more readily accepted and understood by others. From here, points of leverage to maximise the use and recognition of LTIK can be inferred (Zulfadrim et al., 2019).

   iii. There has been often tendency lies in addressing only a single facet of disaster management, such as highlighting just one aspect of indigenous
knowledge, such as early warning system, which is merely a part of the overall preparedness phase. It is important to realize that indigenous and local knowledge is far more complex and plays a significant role across all stages of disaster management. Often, we only concentrate on the results of indigenous knowledge in the face of certain disasters (Expert consultation, 4 November 2022).

iv. There is a growing consensus among scholars to document the knowledge and practices of indigenous knowledge on DRR along with many findings that LTIK are proven to saved lives during hazard. Some scholars tested LTIK hazard and forecast data are aligned with contemporary science forecast, and LTIK coexist with local DRR management systems and be acknowledged in its importance and preservation (Hadlos et al., 2022).

69. **Building inclusive governmental policy and institutional frameworks:**

i. Building inclusive governmental policies and institutional frameworks to support the integration of diverse knowledge systems involves a multi-step process:

ii. **Respect for diversity:** Recognize and value the richness of different knowledge systems, including those from indigenous and local communities as well as scientific understanding (Nakashima, D., Prott, L., & Bridgewater, P., 2000).

iii. **Inclusion of diverse voices:** Create policies that actively seek the participation and input of various knowledge holders, ensuring they have a place in decision-making processes (Zimmerer, K. S., 2006). This could entail participatory policymaking and specific strategies to empower marginalized or underrepresented groups.

iv. **Investment in cultural competence:** Strengthen cultural competence among government staff, which involves understanding, appreciating, and respecting different cultural backgrounds and values. This is essential for meaningful engagement with diverse knowledge systems (Purnell, L., 2012).

i. **Creating Accessible Platforms:** Develop platforms that enable the sharing and co-production of knowledge, fostering a dialogue between diverse knowledge systems. This would entail not just the exchange of information, but the co-creation of new understandings and solutions (Cornell, S., Berkhout, F., Tuinstra, W., Tábara, J. D., Jäger, J., Chabay, I., ... & van Kerkhoff, L., 2013). In the outcome of COP 27 on the agreement of the loss and damage fund for vulnerable countries missed the inclusion of indigenous people especially in least vulnerable countries. It is important to
note that indigenous people are spread throughout the globe, including in the Global North and they are still struggling. Indigenous people need to be included in such mechanism, especially in DRR (Expert consultation, 22 November 2022).

v. **Legislation and Policies**: Implement legislation and policies that protect and promote diverse knowledge systems. For example, intellectual property rights should be adjusted to acknowledge the communal and generational nature of indigenous knowledge (WIPO, 2016).

vi. **Incorporation in Education Systems**: Incorporate diverse knowledge systems into formal education. This helps to validate these systems and promote their understanding among broader society (Battiste, M., 2002).

vii. **Participatory Monitoring and Evaluation**: Establish monitoring and evaluation systems that include the perspectives of diverse knowledge holders. This ensures the ongoing relevance and effectiveness of policies and actions (Estrella, M., & Gaventa, J., 1998).

ii. **Fostering Collaboration**: Encourage collaborative research projects between traditional knowledge holders and scientists. These projects can help blend different knowledge systems and generate innovative solutions (Tengö, M., Hill, R., Malmer, P., Raymond, C. M., Spierenburg, M., Danielsen, F., ... & Folke, C., 2017).

iii. Additionally, policies and systems established at the global, regional, or national levels must be meaningful and applicable at the local level for them to work effectively (Martins et al., 2022; Expert consultation, 16 November 2022). An initiative is needed to shift from a top-down style of policy-making or decision-making processes to one that fosters equality; local communities should also be allowed to devise how these policies can be executed (Expert consultation, 11 November 2022). Thus, there is a need to integrate top-down (government-driven) with bottom-up (community-based) approaches in responding to disasters, striking a balance between inputs from administrative authorities and insights from communities (Khalil et al., 2016). It is important to note that when government-initiated disaster management lacks sensitivity to local-level conditions, affected communities transform policies to respond to disasters better suited to their own circumstances (Valance, 2015) (Expert consultation, 25; 30 November; 2 December 2022).

iv. To let integration of top-down and bottom-top decision making approach exist, this might involve creating spaces for LTIK holders within existing institutions or developing new, more inclusive institutions. In the regional and global forum, LTIK holders are crucial to be involved in all plenary sessions and parts of the process in writing down the documentation such
as Sendai Framework or post Sendai Framework (not only given a space at side events, but at the actual negotiations).

70. **Improve capacity building and education:**

   i. Establishing environments where the importance of Local and Traditional Indigenous Knowledge (LTIK) is recognized and can be implemented requires the participation of indigenous elders in the dissemination of information. As many LTIK holders reside in post-colonial environments, they often face challenges in acknowledging indigenous knowledge and bolstering its intergenerational transmission within these communities due to being educated in systems and languages that are foreign to them. This challenge necessitates working with the educational system, creating educational resources in indigenous languages, and fostering pride in indigenous knowledge and the wisdom of their elders (Expert interview, 16, 25 November 2022).

   ii. Besides recognition of indigenous people in political and decision-making processes, supporting their involvement in national and international negotiation processes is crucial and requires preparation, including education and funding (Expert consultation, 30 November 2022a). Many indigenous people, especially youth, are still struggling with basic necessities and sometimes cannot afford to get a good education to perform effectively at negotiation processes (Expert consultation, 22 November 2022; 25 November 2022).

   iii. They need training in modern DRR methods, negotiation skills, and leadership development (Expert consultation, 25 November 2022; 2 December 2022a; Gillard et al., 2016). Additionally, collaboration with educational institutions is crucial to work in tandem with indigenous communities and invite community members or elders to convey indigenous knowledge (Expert consultation, 11 November 2022).

   iv. LTIK education in non-LTIK educational institutions is also crucial to educate non-LTIK younger generations. This early understanding of indigenous knowledge can foster collaboration later in life (Expert consultation, 2 December 2022).

71. **Increasing LTIK holders participation:**

   i. Local and Traditional Indigenous Knowledge (LTIK) holders must be involved in all negotiation processes, including the design, implementation, and evaluation of disaster risk reduction (DRR) strategies. This ensures the incorporation of their unique perspectives and experiences into the planning and execution process (Mercer et al., 2010). Higher-level decision-makers must be informed by ground realities. Offering communities spaces for action, reflection, and voicing concerns
can help involve them in all decision-making processes as they are the frontliners (Expert consultation, 13 December 2022). It's crucial to always put people at the center of problems and policies, acknowledging their knowledge and cultural practices. As an LTIK expert explains, programs must be designed with a strength-based approach, allowing communities to decide what is best for them (Expert consultation, 11 November 2022b).

ii. Moreover, LTIK holders should have a formal voice in negotiations to maintain their independent contribution. Indigenous people are often sidelined in international negotiations. It is essential that they have the resources and platform necessary for active involvement in strategy development, position formulation, and lobbying. A legal framework at the national level is especially crucial to ensure indigenous people's involvement in all discussions and decision-making processes. Moreover, it is important to acknowledge indigenous peoples' independent governance systems, with their voices counted as separate from the nations within which their territories are located, such as Native Americans in the US and Canada (Expert consultation, 22 November 2022; 25 November 2022). It is also noted that indigenous communities should not be lumped in with local communities. Despite some similarities, there are significant elements that distinguish indigenous communities, warranting their separate recognition (Expert consultation, 25 November 2022).

iii. To facilitate collaboration with LTIK holders, governments can identify local change agents who may not be recognized formally but are very influential in the community, such as tribal leaders or village heads. These local change agents should be included in consultation and planning processes (Expert consultation, 11 November 2022; 13 December 2022). The role of informality in fostering resilience and considerations of social justice must be fully incorporated into adaptation strategies (Surtiari et al., 2022).

iv. Young individuals from LTIK communities are essential participants, not only because they will inherit the consequences of our planet's stewardship but also for their fresh ideas and innovative solutions (Expert consultation, 11 November 2022a; 2 December 2022a). Older generations from LTIK communities are vital for the wisdom and knowledge they can impart to the younger generation (Expert consultation, 25 November 2022).

v. Finally, it is suggested that international frameworks and documents be written or at least reviewed by indigenous experts to ensure language and cultural relevance (Expert consultation, 25 November 2022).

vi. It is recommended to have an inventory within national and international systems detailing opportunities in various organizations and institutions where delegates from indigenous people can participate or lead. This way, indigenous people can be involved in the entire systems of planning and decision-making (Expert consultation, 25 November 2022).
72. While each of these strategies is important, they are also interconnected. Success in one area will likely contribute to success in others, and efforts should be made to pursue these strategies as part of an integrated approach.
IV. Conclusions & Key Messages

Value of local, traditional and indigenous knowledge in disaster risk reduction

73. Local, Traditional, Indigenous Knowledge (LTIK), cultivated through generations of community interaction with the environment, provides a rich resource for understanding risks and formulating effective Disaster Risk Reduction (DRR) strategies (Berkes & Folke, 2003; Expert consultation, November & December 2022). LTIK's application significantly contributes to achieving the four priority targets of the Sendai Framework.

1. **Understanding disaster risk**: LTIK provides a comprehensive understanding of disaster risk, considering ecological, cultural, social, and spiritual aspects. This holistic view is essential for identifying interconnected vulnerabilities and potential cascading effects of disasters, aligning closely with the first Sendai target (Berkes, 2009).

2. **Strengthening disaster risk governance to manage disaster risk**: LTIK enhances disaster risk governance by fostering community participation and ownership, lending to more relevant and effective management strategies. The integration of this knowledge with contemporary science can yield novel, community-specific solutions where other methods fall short (Fletcher et al., 2019).

3. **Investing in disaster risk reduction for resilience**: Utilizing LTIK in DRR investment and resilience planning can lead to more sustainable, culturally-appropriate, and effective strategies. LTIK incorporates early warning systems, traditional practices, and ecosystem management approaches, thus strengthening investments in DRR and aligning with sustainable development goals (Gadgil et al., 2000; Hill et al., 2012).

4. **Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation, and reconstruction**: LTIK can bolster capacities in enhancing disaster preparedness, response, and in "Building Back Better" during recovery, rehabilitation, and reconstruction. This is achieved through its deep understanding of risks and vulnerabilities, effective disaster preparedness and response methods, sustainable recovery strategies, and cultural continuity and community engagement (Adger et al., 2005; Hoffmann et al., 2017).

74. The role of LTIK in DRR has gained wider recognition, starting with the Hyogo Framework for Action, and has become more explicit in the Sendai Framework, which acknowledges the role of indigenous knowledge in DRR. The integration of LTIK with scientific knowledge is instrumental in achieving the Sendai Framework's targets and building a more resilient future.
The need of enabling environment for the local, traditional and indigenous knowledge in disaster risk reduction

75. Local and Traditional Indigenous Knowledge (LTIK) is deeply connected to social, economic, political, and environmental contexts, and leveraging it for Disaster Risk Reduction (DRR) faces key challenges:

1. **Indigenous and Land Rights**: Indigenous communities face issues related to land rights. As lands host various activities and foster sustainable practices, they're vital for LTIK holders (Magni, 2017). Threats like land grabbing, deforestation, and displacement impede the application of LTIK, including DRR. Additionally, poverty and marginalization make indigenous communities more vulnerable to disasters. Therefore, legal frameworks securing rights of LTIK holders are necessary.

2. **Epistemological Differences**: There's a contrast between LTIK and contemporary scientific knowledge, with the former emphasizing experiential, holistic, and qualitative understanding, and the latter focusing on objectivity, quantifiable evidence, and replicability (Nakashima et al., 2000; Nakashima & Roué, 2002). Recognizing these differences is crucial for integrating diverse knowledge systems.

3. **Language and Communication Differences**: Unique languages and terminologies within each knowledge system can hinder collaboration. DRR terms might carry different meanings for LTIK holders (UNDRR technical review 2015). Therefore, creating a shared language, employing translators, cultural mediators, and revising policy documents for cultural and linguistic accessibility are needed (Expert consultation, 25 November 2022).

4. **Access and Ownership of LTIK**: LTIK can enhance local resilience but is prone to misuse and exploitation without due credit to indigenous communities (Simpson, 2004). Misunderstandings due to lack of cultural insight can lead to incorrect applications of LTIK in DRR initiatives (Agrawal, 1995).

76. To address these challenges, an inclusive approach is recommended, involving respect, collaboration, LTIK protection, cultural mediators, and LTIK holders' active participation in decision-making processes.

The importance of braiding diverse knowledge systems for disaster risk reduction

77. In an era of escalating risks outpacing mitigation efforts, exacerbated by economic downturns, increasing poverty and inequality, and ecosystems teetering on the brink of failure, we need to embrace the concept of "living with uncertainties" (Ravan, 2022). A
shift towards adaptive governance is required to manage these complex, interconnected risks (Expert consultation, 11 November 2022).

78. To do this, braiding diverse knowledge systems, including local and traditional indigenous knowledge (LTIK) and contemporary scientific knowledge, is crucial. Key reports and frameworks such as the IPCC's AR5, the Hyogo Framework, and the Sendai Framework for DRR highlight this integration's importance in climate change adaptation and disaster risk reduction (IPCC, 2014; UNISDR, 2005; UNDRR, 2015; Hilhorst et al., 2015). This synthesis of knowledge systems fosters innovation, offering new insights and understandings (Expert consultation, 4 November 2022).

79. Rather than integration, a "braiding" of knowledge systems is suggested to avoid devaluing either one. Such an approach requires mutual respect, trust, and understanding, with LTIK holders given a platform to share their knowledge without a science-versus-indigenous-knowledge dichotomy (Expert consultation, 4, 9, 25 November 2022). Further, it is important to acknowledge and protect the rights of indigenous people, including land rights, and to challenge the cultural dominance of contemporary scientific knowledge (Magni, 2017; Expert consultation, 9, 16, 25 November 2022).

80. Trust-building and collaboration form the bedrock of successful knowledge braiding. Through the co-creation of knowledge, where scientists and LTIK holders collaborate, we can foster an environment of mutual respect, leading to richer insights (Tengö et al., 2017, Expert consultation, 30 November 2022b). Long-term engagement, respect for cultural contexts, equitable partnership, and representation in decision-making processes are also key to this process (Reid et al., 2016; UNDRR, 2019; Expert consultation, 2, 9, 11, 25 November 2022; 2, 13 December 2022).

81. Education and awareness for both scientific communities about LTIK and for indigenous communities about science are crucial. This includes fostering indigenous languages and promoting pride in indigenous knowledge (Expert consultation, 16, 25 November 2022).

82. Cultural mediators and interpreters who can bridge language and communication barriers are vital, helping to translate indigenous knowledge into a format digestible for the scientific community (Expert consultation, 9, 25 November 2022).

83. Preservation and transmission of LTIK, inclusive governmental policies, and institutional frameworks to support diverse knowledge systems are other essential elements. These include valuing different knowledge systems, fostering inclusivity in decision-making processes, developing cultural competence, and promoting collaborative research between
traditional knowledge holders and scientists (Nakashima et al., 2000; Zimmerer, 2006; Cornell et al., 2013; WIPO, 2016; Battiste, 2002; Tengö et al., 2017).

84. Finally, capacity building and education should focus on enabling indigenous communities' effective participation in DRR decision-making processes, while fostering intergenerational transmission of LTIK and ensuring its continued relevance in a changing world (Expert consultation, 11, 16, 25 November 2022; 2 December 2022).

**The Importance of Involving Local Traditional Indigenous Knowledge (LTIK) Holders in Negotiation Processes**

85. Local Traditional Indigenous Knowledge (LTIK) is increasingly recognized for its significance, particularly in understanding and responding to environmental challenges. However, a disconnection remains between this recognition and the inclusion of Indigenous people, as LTIK holders, in United Nations (UN) negotiation processes. Indigenous communities have expressed willingness to contribute to these international dialogues but often experience exclusion from decision-making processes (Expert consultation, 22 November 2022).

86. To overcome this discrepancy, the participation of Indigenous experts should be elevated in drafting international frameworks and documents. Ensuring their input guarantees cultural and linguistic relevance, and while logistical challenges may arise, the benefits of their inclusion significantly outweigh any obstacles (Expert consultation, 25 November 2022).

87. Indigenous communities offer unique insights grounded in cultural practices and longstanding connections to their natural environments. Their perspectives enhance strategies for tackling global challenges like climate change and biodiversity loss (Mercer et al., 2010, Expert consultation, 16 November 2022). Additionally, their deep understanding of local ecosystems greatly contributes to sustainable resource management and conservation efforts (Berkes, 1999).

88. By involving LTIK holders throughout negotiation processes, their unique insights are better integrated into the design, implementation, and evaluation of Disaster Risk Reduction (DRR) strategies (Mercer et al., 2010). Furthermore, their participation demonstrates respect for their rights to self-determination and assures adequate representation of their concerns on an international level (Expert consultation, 22, 25 November 2022).
89. Despite their critical role, LTIK holders often lack sufficient support and resources to participate in negotiations. There's a need to provide Indigenous communities with the necessary space, funding, and platforms for active engagement. This support should also translate into effective policy implementation, ensuring that their voices are not only heard but also influence outcomes (Expert consultation, 22 November 2022). It is equally important to establish national-level legal frameworks to facilitate Indigenous people's involvement in all discussions and decision-making processes (Expert consultation, 25 November 2022).

90. However, capacity constraints may inhibit LTIK holders from fully participating in national and international negotiations (Expert consultation, 2 December 2022). Therefore, capacity building and education initiatives should be prioritized, empowering LTIK communities to partake in decision-making processes and promoting recognition and respect for diverse knowledge systems among policymakers and practitioners (Expert consultation, 25 November 2022).

91. In conclusion, prioritizing the space, funding, and capacity building for LTIK holders is crucial for their active involvement in UN negotiations and local and national decision-making processes. An appeal is made to member states and stakeholders to provide their full support to this significant cause.


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United Nations Framework Convention on Climate Change (UNFCCC). (2022) Conference of the Parties serving as the meeting of the Parties to the Paris Agreement Fourth session Sharm el-Sheikh, 6–18 November 2022b. Nationally determined contributions under the Paris Agreement Synthesis report by the secretariat. Available at: https://unfccc.int/sites/default/files/resource/cma2022_04.pdf.


