

# The Application of Indigenous Knowledge for Disaster Risk Management and Sustainable Development: Insights from Developing Countries



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**Abstract** This chapter interrogates the nexus between indigenous knowledge (IK), disaster risk management (DRM) and sustainable development. The central argument is that IK has been internalised by local communities over millennia for DRM with enormous potential to inform the Sustainable Development Goals (SDGs). Although IK has been time-tested and shown to be effective in mitigating community vulnerability to disaster risks, its application to contemporary DRM frameworks has been dismally insufficient in developing countries. This has implications for achieving the SDGs. Through an analysis of the relationship between IK, DRM, and the SDGs from various perspectives, this chapter has established that IK is a valued model of endurance in the history of DRM that contributes to achieving the SDGs. With this realisation, the chapter argues for the need to integrate IK with modern and/or scientific technology for optimal DRM performance, which will also accelerate accomplishing the SDGs. Hence, mainstreaming IK into DRM strategies to tackle the growing disaster risks in developing countries will also address impediments to achieving the SDGs. Arguably, this will be most beneficial to local communities that suffer the most from disaster risks and face the greatest challenges in achieving the SDGs. This chapter enhances knowledge on the relationship between IK, DRM and the SDGs and also contributes to literature in the field. Nevertheless, more research is required to better understand how merging indigenous and modern/scientific DRM approaches can be more beneficial to sustainable development particularly in local communities.

**Keywords** Indigenous knowledge · Disaster risk management · Sustainable development goals · Developing countries · Local communities · Natural hazards

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# 1 Introduction

Developing countries host remote, isolated, and disadvantaged communities living in some of the most inhospitable and fragile habitats in the world. These communities are especially vulnerable to several types of hazards, which continue to cause significant damages and pain to the destitute populace, with the hardest hit residing in local communities.

If we consent to the popular expression within the disaster management (DM) community that “*all disasters are local*”, then there is a rational argument that local, native, or indigenous knowledge (IK) should be instrumental in managing local disaster risks. Over generations, local communities survived all the challenges posed by nature, albeit not without difficulties using local strategies whose roots have been traced to IK.

Indigenous people’s knowledge encompasses a vast repertoire of knowledge and practices that has evolved in specific communities over several millennia of tackling livelihood and environmental challenges (Valez, 2020). This unique knowledge has evolved in various areas incorporating traditional environmental knowledge, local technical knowledge or referred to as “*science of the local people*” in some circles (Iloka, 2016).

Even prior to technological innovations in various approaches to disaster risk reduction (DRR) or standard operating procedures for disaster response, numerous indigenous people around the world have mitigated, prepared for, cope with and responded to natural hazards and/or disasters using local knowledge and cultural practices. The survival of IK to this day depicts a success story of adaptation and overcoming natural and human-induced hazards/disasters. Consequently, the DM skillsets of local people cannot be undermined.

The experience garnered by indigenous people to mitigate disaster risks plaguing local communities has implications for achieving the sustainable development goals (SDGs). Indeed, effective risk reduction and prevention using local knowledge is essential for local level sustainable development. Deprived of valuable resources, this chapter argues that the DRM practices of indigenous people in developing countries already contribute to sustainable development and should be recognised as invaluable in achieving the SDGs. Indeed, the application of DRR is implicit in several SDGs goals particularly in reducing vulnerabilities and enhancing resilience to disaster risks. That is why several global frameworks have been articulating the relationship between DRR and socio-economic development (UN, 2005, 2012, 2015).

Despite its potential, the integration of IK into DRR activities has been dismally insufficient in developing countries (Gaillard & Mercer, 2012; Rist & Dahdouh-Guebas, 2006; Shaw et al., 2009). Consequently, national policies that ignore local traditions/practices have often left indigenous people vulnerable to natural hazards with implications for attaining the SDGs. This chapter attempts to close this gap by highlighting the nexus between IK, DRR and sustainable development. This is a worthwhile exercise to create awareness in developing country governments

that inculcating IK systems into disaster risk aversion policies/plans also benefits in achieving the SDGs.

The discourse in this chapter has been arranged systematically in the following order: after this chapter, chapter two and three provides insights into the conceptualisations of IK and DRM respectively. The global recognition of the linkages between IK, DRM and sustainable development is the objective of chapter four. The fifth chapter attempts to examine the SDGs through the lens of DRM and IK. Next in Sect. 6, is the application of IK to DRM for sustainable development with examples from developing countries. Section 7 deals with the integration of IK into DRM measures to achieve the SDGs. There is a discussion section in Sect. 8 while Sect. 9 is the conclusion.

## 2 Conceptualising Indigenous Knowledge

The term IK defies a consensus on its usage and has been conceptualised in many ways: the knowledge that local people use to make a living in a specific environment (Warren, 1991); knowledge held collectively by a defined community (Williams & Muchena, 1991); a stock of knowledge developed by communities through generations of living in close proximity with nature (Johnson, 1992); an integrative system of knowledge that comprises of perceptions, concepts, values, and beliefs that occurs naturally amongst communities living in a rural environment (Sillitoe et al., 1998); a body of knowledge that originates from a specific geographical area (Ranasinghe, 2008); local, traditional and unique knowledge that exists within and evolved around certain circumstances of people indigenous to a certain geographic region (Grenier, 1998); and the functional knowledge of native people inhabiting a particular ethno-cultural and agro-ecological location or region (Haque, 2013).

Although these definitions may appear to be straight forward and simple, this unique knowledge has been described in several ways including phrases like “*traditional knowledge*,” “*local knowledge*,” “*indigenous technical knowledge*,” “*rural knowledge*,” “*traditional ecological knowledge*,” “*indigenous traditional knowledge*,” and “*traditional environmental knowledge*” (UNEP, 2008).

An analysis of the definitions shows that they emphasise key aspects such as the specificity of the knowledge in particular communities; its accumulation over several years and unwritten nature; its uniqueness in specific regions; its development under peculiar circumstances of local people; includes skills, beliefs, perceptions, concepts; achieved via experience or information transmitted over centuries; its relevance in the everyday life of people and application during disasters/crises.

By living in harmony with their environment, our ancestors developed exceptional strategies to cope with natural hazards, water and ecosystem management, climate change/variations, and especially agricultural practices that has sustained their livelihoods for centuries. The mode of IK acquisition and transmission has implications for theoretical and operational DRM.

### 3 Disaster Risk Management (DRM)

The term DRM warrants clarification to set the context of the discourse. DRM is defined by the United Nations as “*the application of DRR policies and strategies to prevent new disaster risk, reduce existing disaster risk and manage residual risk, contributing to the strengthening of resilience and reduction of disaster losses*” (UN, 2016; p. 16).

From this definition it can be deduced that DRM encompasses DRR (pre-emptive strategies and processes to lessen prevailing disaster risks) and DM processes (preparing for disasters, response to disasters, and recovery after disasters) including any DRR regulations, laws, policies, institutional, administrative, and crises management instruments that has been established for coordinated and systematic DRM (Bang, 2021). Therefore, use of the term DRM in this chapter encompasses DM or DRR or both. In some instances, however, DM or DRR will be used to be more specific about the DRM activity.

The conceptualisation of DRM in this chapter aligns with the UN definition and seeks to interrogate the seemingly wide application of IK to DRM practices predominant in local communities in developing countries. As revealed later in the chapter, DRM activities that has been embedded in IK helps local communities to mitigate natural hazards and disaster risks, thereby increasing human security, enhancing livelihoods and well-being, which also contribute to accomplish the 2030 agenda for sustainable development. The linkages between IK, DRM and sustainable development have been acknowledged by the international community.

### 4 Global Recognition of the Linkages Between Indigenous Knowledge (IK), Disaster Risk Management (DRM) and Sustainable Development

Several global documents have recognised that IK systems can enhance DRR, and that DRM is an essential part of socio-economic development that is vital for sustainable development. The Rio de Janeiro Earth Summit (Agenda 21) demanded that international agencies and nation states should record and incorporate IK systems into research and development activities (UNCED, 1992). The first major international framework to address the mitigation of disaster risks, the Yokohama Strategy and Plan of Action for a Safer World (1994) acknowledged the nexus between DRR and sustainable development. Issues of DRM and vulnerability reduction were addressed in the UN Commission on Sustainable Development (UNCSD) in its 2004–2005 cycle in relation to human settlements, water management and sanitation. Similarly, the 2006–2007 cycle also addressed drought and desertification in reference to vulnerability and risk reduction (UN, 2013). In 2007, the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) underscored respect for indigenous peoples’ rights, their culture, IK, traditional practices and the contribution they make

to sustainable development and environmental management (UN, 2007). Shortly afterwards, the United Nations Environment Programme (UNEP) recognised and endorsed the use of IK in managing natural hazards/disasters and natural resource conservation practices (UNEP, 2008). The Rio de Janeiro UN Conference on Sustainable Development acknowledged the linkages between DRR and sustainable development (UN, 2012). Other global agreements like the 2030 Agenda for Sustainable Development, the Johannesburg Plan of Implementation (UN, 2005) and the Millennium Development Goals also reaffirmed the close interrelation between sustainable development and DRR by recognising the urgent need to mitigate disaster risks (UN, 2015).

Furthermore, the relevance of IK for DRM has been highlighted in international disaster management frameworks. Priority 3 of the Hyogo Framework for Action 2005–2015 underscored the application of IK into DRM policies and practices (UNISDR, 2005). The 2015 Sendai Framework for Disaster Risk Reduction highlighted that SDGs can be attained via DRR, for instance, by lessening vulnerability and exposure of local communities prone to disasters or building resilient infrastructures (UNISDR, 2015).

The United Nations Office for DRR (UNDRR) publication entitled “*Indigenous knowledge for disaster risk reduction: good practices and lessons learned from experiences in the Asia–pacific region*” underscores the need to develop consciousness for IK as a valuable tool for lessening disaster risks, particularly from natural hazards. A key objective of the publication is to motivate DRM administrators, policy makers and practitioners to integrate the wealth of local knowledge held by native/indigenous communities into contemporary and future disaster resilient projects (Shaw et al., 2009).

The seventh high-level meeting of the African Regional Platform for DRR that held in Kenya on the 19th of November 2021 acknowledged the role of IK in DRR in Africa. The document states “...encourage the adoption of a whole-of-society approach that integrates...indigenous and local knowledge systems and practices, age and cultural perspectives into the design and implementation of DRR” (ARPD RR, 2021, p. 5).

While outlining the vital role of IK to DRM, these international stakeholders underline its application in managing or mitigation community vulnerability to disaster risks. That also contributes to development and helps in achieving the SDGs.

## **5 Viewing the Sustainable Development Goals (SDGs) Through the Lens of Disaster Risk Management (DRM) and Indigenous Knowledge (IK)**

The application of DRR is implicit in several SDGs and targets particularly in reducing vulnerabilities and enhancing resilience to disaster risks. Since disasters can cause and/or exacerbate poverty or set back development gains, effective DRM has

implications for poverty reduction. Hence, its relevance to (SDG1) “*End poverty...*”. The relationship of SDG1 with IK is easily established since local knowledge are also aimed at boosting agricultural practices/food production to enhance rural incomes fundamental to poverty reduction at the local level. Indeed, hunger and extreme poverty are principally rural (UN, 2020a), posing grave threat to local agrarian livelihoods.

SDG number 2, with regards to achieving food security and promoting sustainable agriculture is a viable DRR strategy against hazardous incidents like droughts that often cause food shortages or climate risks such as flooding that may damage farms or agricultural products. Ensuring food security and sustainable agricultural practices are also enshrined in IK practices.

Targets of SDG number 4 in relation to “*Ensure inclusive...education and promote lifelong learning...*” have relevance in both practical and theoretical education and sensitization to the populace on DRR measures or early warning for natural hazard-induced disasters.

“*Ensure availability and sustainable management of water...*”, SDG 6 is a vital DRR measure to preserve or responsibly manage water resources for use during drought conditions and/or store water due to water scarcity in dryland environments. Climate risks like flooding, famine and pollution pose grave threats to the range of invaluable services and livelihood needs sustained by water resources.

Although not explicit in SDG 9 (*building resilient infrastructure*), there is direct correlation to DRR in ensuring that structures/buildings can withstand natural hazards like earthquakes, hurricanes and/or floods.

SDG 11, which broadens the scope of resilience (and safety) to cities and human settlements, can be achieved through various DRM strategies. Examples are focus on dealing with anticipated disaster risks through better land-use planning/practices and/or water systems management; measures to mitigate disaster risks already present like retrofitting existing infrastructure or relocating vulnerable assets or populace and measures to enhance resilience to residual risks—preparedness, response, and recovery. These measures reaffirm the relation between DRM and sustainable development and have their roots in IK.

Due to their close interaction with natural and climate systems, local communities are highly vulnerable to climate risks. Hence, they can use their traditional knowledge to develop innovative means of responding to climate crises. Consequently, there is an intimate connection between IK and SDG13 on climate action.

SDG 16 has relevance in indigenous practices since it creates social harmony through the joined planning, organisation and implementation of DRM measures or natural resource management. Continues interaction amongst communities mitigates conflict and creates more inclusive societies.

Examples of IK practices with application in DRM that can foster the realization of the SDGs have been analysed in the next section.

## **6 Application of Indigenous Knowledge (IK) to Disaster Risk Management (DRM) for Sustainable Development: Examples/Cases from Developing Countries**

This section highlights IK-induced DRM practices or case studies that have been carried out in various parts of the developing world that have implications for the SDGs. These have been obtained from contemporary practices, case studies, folk law and stories in various rural/indigenous communities.

### *Agricultural Practices that Mitigate Poverty (SDG1) and for Food Security (SDG2) During Natural Hazards*

In the Lubombo regions of Swaziland, the local inhabitants are known to cultivate crops that can withstand dry conditions. Examples of such drought tolerant crops are jugo beans, cassava, bambara groundnuts, sweet potatoes, and sorghum. Cassava is also the preferred hazard (drought) resistant crop in Tanzania. Cassava can also remain unharvested for years on end without getting bad, hence providing food security during famine. Other drought resilient crops are pigeon peas, cocoyam, sorghum, millet, sweet potatoes, and cowpeas. Farming practices like mixed cropping ensures the availability of other food types when some crop species have poor yields. This is practiced by the Bunyore people in the western province of Kenya. They cultivate crops like cassava, potatoes, and millet etcetera, although their staple food is maize. When maize yields are poor, other crops are available as substitute for consumption (UNEP, 2008).

Furthermore, the success of livestock rearing has also relied on the indigenous medicinal skills of communities. A unique means of treating animals or preserving their health through immunity to specific diseases has been demonstrated by the Maasai in Kenya. During the outbreak of the rinderpest virus that posed a grave threat to cattle in the region, the Maasai took blood from the already infected animals in neighbouring villages and rubbed on the nostrils of the animals owned by them. This helped to build immunity in the animals that survived the disease (UNEP, 2008). These strategies help to fight poverty (SDG1), reduces the likelihood of famine, and enhances food security (SDG2).

### *Learning Through DRR Practices (SDG4)*

Several examples abound of indigenous practices for DRR that have been sustained over generations due to the application of observational learning theories (Fryling et al., 2011). By observing how their elders/ancestors have applied structural and non-structural DRR measures, local people have used similar strategies to fight natural and environmental hazards. For instance, residents of Kashmir (India) have learned traditional construction techniques resilient to earthquakes (Dar & Ahmad, 2015). Through observations, people in Africa and Asia have learned to use local materials in constructing flood preventive structures (Stephen et al., 2008). Likewise, local people in Bangladesh, Thailand, Zimbabwe, Uganda, and Tanzania have learned to use animal behaviour and breeding trends to forecast the weather, seasonal changes, and

natural hazards (Arunotai, 2008; Mafongoya et al., 2021; Mondal, 2012; Okonya & Kroschel, 2013).

In addition, to survive cyclones, which are often associated with floods, local people have learnt to construct floating structures using locally sourced indigenous materials. Haque (2019) described how coastal communities of Bangladesh have developed indigenous survival strategies for cyclones that threaten the region annually by building floating items like straw piles, timber, bunches of coconuts, and thatched roof. To survive the strong cyclonic winds, they hold onto permanent structures and/or bind themselves to trees. Fostering environmental management and other attitudes through observational behaviour using IK (Morse et al., 2019) is a strategy to achieve SDG4.

Furthermore, the mode of community dissemination of IK could serve as an educational model for DRM. IK can be used to educate local communities to understand environmental change and threats. This enhances their ability to cooperate in tackling environmental hazards and disaster risks. For this to happen, stakeholders need basic education/training on IK.

*Water Preservation and Extraction that Ensures the Availability and Sustainable Management of Water Resources (SDG 6)*

Indigenous communities residing in arid environments have used local/traditional practices to preserve and extract water resources for centuries. To combat water shortage, locals have used traditional water management strategies (extraction and transportation) for centuries, especially in dryland environments. Such practices, locally known as “*Qanat*”, is a method of developing underground networks for transporting fresh water from deep wells on elevated or higher areas to planes (Beshah et al., 2016). *Qanat* have been used particularly in arid regions with low rainfall as the main method of getting water for irrigation and domestic purposes (Mohsen, 2013). In semi-arid environments that have average rainfall, rainwater collection practices (allowing subsurface percolation of runoff into aquifers and constructing ponds) have been used to collect and preserve water (Ferrand & Cecunjanin, 2014). These strategies are commonly applied in Morocco, Ethiopia, and some Central and Eastern Asian countries (Canavas, 2014). Notable, is the unique water conservation skills of the Konso tribe in Ethiopia that use terraces to channel runoff from catchments into ponds (Beshah et al., 2016). Unquestionably, these traditional practices contribute to achieving SDG6.

*Traditional Architectural Designs Resilient to Natural Hazards (SDG9)*

Traditional indigenous architecture has been used to mitigate contemporary risks and safe lives during natural hazards. For instance, the traditional vernacular residential architecture in India is known to have adapted to the climate and importantly to the region’s fragile/soft soils and vulnerability to earthquake risks for thousands of years. Traditional architectural techniques locally known as the “*Taq*” and “*Dhajji-Dewari*” in the State of Kashmir saved the life of thousands of people during the 2005 Kashmir Earthquake. The “*Taq*” technique involves inserting timber horizontally into stonewalls, which prevents the structure from cracking and collapsing during earth

tremors. The “Dhajji-Dewari” construction system entails placing timbers vertically, horizontally and crossed, which keeps the house firmer and more balanced. Indeed, the Kashmir earthquake confirmed that the application of indigenous architectural heritage in earthquake prone regions could be safer than modern techniques (Dar & Ahmad, 2015).

Likewise, the indigenes of Nias (Indonesia) build their wooden houses by slotting wooden beams vertically, horizontally, and diagonally that function as pillars and longitudinal and lateral bracing. The construction of the roof is similar to the underlying/supporting structure of the house. This traditional architectural design is resistant to earthquakes. During the devastating impact of the 2005 earthquake on Nias island’s population and infrastructure, most of the few wooden structures on the Island survived the earthquake while the dominantly modern masonry buildings were destroyed (Meyers & Watson, 2008). These indigenous DRM construction practices could be emulated to achieve SDG9.

#### *Dredging Rivers and Building/Planting Flood Preventive Structures to Make Human Settlements Safe and Resilient (SDG11)*

Indigenous communities have learnt over centuries that riverine flooding is exacerbated by the deposition of sediments on riverbeds, thereby, reducing its volume. To reduce sedimentation on their riverbeds and prevent their rivers overflowing their banks and flooding nearby areas, IK has required local people to desilt riverbeds. Through communal work, local residents in the Nandeswar village of Goalpara District India, remove silt and sand from rivers on a regular basis (Stephen et al., 2008) in order to keep their village safe from riverine inundation.

By the same token, building flood preventive structures using local materials and/or planting of flood resistant shrubs have been done in Asia and Africa. Local communities in both continents have mitigated the impact of riverine bank erosion and surface gully erosion using locally sourced indigenous plants like bamboo. The people of Nandeswar village in Goalpara District, India used silt and mud from rivers beds to build bunds along the sides of river channels. Then grass and bamboo are grown on the bunds to bind their surfaces in order to prevent erosion (ibid).

In the Niger Delta region of Nigeria, locals have grown bamboo and raffia-palm along riverbanks and areas susceptible to gully erosion. These served as water current breakers to prevent soil erosion in those areas. They have also planted bamboo on slopes, elevated areas, or hills to prevent landslides that often happens especially during the rainy/wet season when the soil becomes saturated with water and losses its binding capacity. The roots of the indigenous plants bond the soil together, reinforcing its strength. The soil then becomes more hardened and more resistant to soil erosion (Zhou et al., 2005; Iloka, 2016). These measures help to make their settlements safer and more resilient to natural hazards, aligning with SDG 11.

#### *Coping and Adaptation Measures to Fight Climate Change and Its Effects (SDG13)*

IK systems have been critical in adapting to various climate risks or natural hazards. Use of IK for climate change adaptation exists across regions through

practice, planning and behavioural measures. This include measures like the cultivation of climate-resilient crops, land management techniques, mobility/migration, warning/observation, and physical infrastructure measures, which have been used in Africa and Asia (Petzold et al., 2020).

For example, African pastoralists are known to adapt to drought conditions via various ways. Intra-African pastoralist migration is one of the most ancient and drought adaptation method used by nomadic pastoralist to continuously search for greener pastures in other regions particularly during droughts (Awinia, 2020). Another strategy is to rear a varieties of cattle with different degrees of resistance to environmental conditions. To ensure their herd have food always, they store fodder for later use. During drought conditions, local people eat cattle meat. They use fodder to feed sheep and goats, which are reserved for other purposes (Oba, 2013).

Furthermore, indigenous coping strategies have been employed for biodiversity preservation in local communities. Prior to the introduction of western methods for pest control, Africans used plant derivatives to fend off pests from damaging crops. These local pesticides have been found to have unique properties such as containing substances that hinder insects from developing resistance to them and having biodegradable plant derivatives that are innocuous to animals (Domfeh, 2007). The coping strategies of local Bangladeshi people following disasters have been applauded. One area is that of appropriate food preservation for use when crops are damaged by natural hazards. Before external assistance arrives after disasters, they drink rainwater or coconut water, eat the roots/stems of edible plants, and rely on local first aid for treating illnesses like fever, diarrhoea, and injuries (Haque, 2019). These practices demonstrate the vital role of IK to agriculture and livestock production, hence, enhancing food security in drought prone areas.

Another dimension is the abundance of greenery (forest, shrubs, indigenous plants, and other biodiversity) in indigenous habitats that helps to regulate carbon levels in the atmosphere (IFAD, 2019). Although indigenous people are amongst the most vulnerable to Climate Change, paradoxically, they are not culpable for the unsustainable emission of greenhouse gasses responsible for increasing the earth's temperature.

*Strong Local Social Structures are Relevant for Peaceful and Inclusive Communities/Society (SDG16)*

One of the largest contemporary indigenous community based natural resource management (CBNRM) programme in Africa is in Namibia. The CBNRM allows local communities to manage the forest resources in their lands through issuing community forest-use permits, control over farming and grazing land and the use of forest/wood and non-forest/wood products for commercial purposes (FAO, 2020). CBNRM creates inclusiveness amongst local people.

Another example in Nepal suffices. Though not fully recovered from the effects of the 2015 earthquake in Nepal, the local communities organised themselves and worked to repair key community infrastructures (shrines and community buildings). They also restarted important festivals and rituals integral to their spiritual well-being (Jigyasu, 2020).

Inclusiveness has also been demonstrated in community water management. The Borana community in Ethiopia have a traditional administration system (Gedaa) for water system management enshrined in participatory customary laws that impose responsibilities to all members. The local administrative system has a general assembly that meets regularly (8-year interval) to evaluate, review, and modify rules for the management of the local water resources (wells excavation and maintenance,) enacted in previous years. The entire community are responsible for the management of the water resources and failure to comply have consequences (Beshah et al., 2016).

As shown in this section, the manner in which the traditions/systems of indigenous people contribute to social/community organisations and inclusive societies cannot be undermined in a world where disunity, civil strife, conflicts, and social inequality are impediments to sustainable development. Community organisation and participation creates strong bonding/networks and social harmony relevant for peaceful and inclusive communities/society as prescribed by SDG16.

The examples and/or cases outlined in this section, underscores the importance of traditional wisdom in various DRM measures that foster the SDGs. Merging them would be of immense benefit for sustainable development.

## **7 Integration of Indigenous Knowledge (IK) into Disaster Risk Management (DRM) Measures to Achieve the Sustainable Development Goals (SDGs)**

There is overwhelming evidence that the application of IK in DRM practices can contribute to the SDGs as revealed in the previous sections of this chapter. Yet, the application of IK for resilience against the vagaries of nature that also target the SDGs has been dismally insufficient in the plans and programmes of many developing countries. Indeed, indigenous ideas that facilitate risk aversion are rarely adequately addressed in DRM frameworks. Consequently, DRM decision-making processes that ignore local traditions/practices have often left local/indigenous people vulnerable to natural hazards. Therefore, it is relevant to involve indigenous communities in the public and private DRM planning processes.

With developing countries facing incredible challenges in mitigating disaster risks at the local level (Bang et al., 2019), there is need to recognise that community DRR measures anchored in IK systems have the potential to alleviate the well-being of local communities and achieve the SDGs. Therefore, bringing indigenous communities on board will facilitate the development of mutually beneficial cooperation and/or collaboration with their communities and stakeholders, which would foster the attainment of the SDGs.

This chapter endorses and advocates for an integrative perspective on IK and DRM to achieve the relevant SDGs. Arguably, since the livelihoods of indigenous communities and their cultures/traditions rely heavily on the tenets of social and

environmental sustainability, environmental and ecosystem management by indigenous people tend to be far better than those of other communities. For instance, the deforestation rate in indigenous people's territories in the Brazilian Amazon is less than 10% that of other regions (IFAD, 2019).

Developing a holistic approach to DRM that considers both indigenous and modern strategies is vital in rural communities of developing countries where risk reduction and development is often minimal. That is partly why the UN has recommended a holistic approach to sustainable agricultural practices (UN, 2020b), which will also facilitate response to natural hazards and intend, enhance the SDGs.

Advancements in technological innovations and modern DRM methods is one of the main reasons for the minimal application of indigenous wisdom and skills in many developing countries (Langill, 1999). As IK is abandoned in favour of contemporary practices, local communities can be more vulnerable to disaster risks. This calls for the need to integrate IK or local community approaches with modern DRM strategies. Two examples suffice to illustrate this assertion.

First, the traditional construction practices in some regions of India where houses are built with mud walls and thatch roofs could sustain some, but not all natural hazards in the region. During the 2006 unprecedented storms and floods in western India that seriously affected the drought stricken Barmer District of Rajasthan, most of the local houses were seriously damaged. Although the houses could withstand earthquakes and sandstorms, they easily succumbed to flooding. Consequently, the houses needed reinforcement in order to be resilient to flooding. That was provided by SEED, a national NGO that liaised with other regional and local stakeholders to integrate the indigenous construction practices and modern technology to build houses in the region that were resistant to multiple hazards including climate risks like flooding (Sharma & Joshi, 2008).

Second, a study carried out by CARE Kenya (NGO) noted that although 90% of the residents in the Luo community in Kenya's Nyanza province used clay pots, only 34% could access safe drinking water. In addition, the children had a high incidence of diarrhoea (47%). It was noted that the diarrhoeal diseases were caused by water contamination and storage when the inhabitants removed water from the wide-mouth clay pots using their hands, cups or calabashes that may be contaminated. Using the indigenous skills of local potters, the clay pots were modified (fitted with a flat base for easy extraction of water, a spigot, narrow mouth, and lid) with technical assistance from CARE Kenya. The water is treated, stored, and accessed via the spigot (UNEP, 2008). Thus, the modified pots are more hygienic, resilient, and environmentally friendly to the drought hazards in the region. These two examples demonstrate the benefits of merging traditional and modern technics.

## 8 Discussion: Critical Analysis of the Application of Indigenous Knowledge (IK) to Disaster Risk Management (DRM)

Despite continuous failures in western/modern strategies to effectively mitigate disaster risks in many developing countries, their DRM frameworks have either omitted or not sufficiently considered IK systems in their policies, plans and programmes. Continuous reliance on imported DM strategies and modern technology minimizes local people's resilience to hazards and disasters. This is disturbing especially considering that many developing countries have limited access to the prescribed modern/western DRR technologies. Even when available, such technologies are prioritised for use in urban settings to the detriment of local communities. Inefficiencies in addressing local risks underscores the relevance of sustaining IK in local communities that are often marginalised in DRM considerations.

DRR measures embedded in IK/practices are invaluable in mitigating disaster risks in local communities and the relevance of IK for DRM had been recognised by local communities centuries ago. Although IK systems have had little scientific inputs or tests, their suitability/ability to mitigate community vulnerabilities to disaster risks has been demonstrated as revealed in this chapter. This implies that IK can benefit DRM in identifying and proffering indigenous solutions to the growing disaster risks plaguing local communities.

Indeed, specific challenges of indigenous communities at the core of major issues in the SDGs are related to natural hazards, crises and emergencies requiring adequate DRM. The fact that disasters can seriously hamper development means the developmental process must consider DRM measures. IK has been the key to community development planning (Nyong et al., 2007) and coping strategies that has sustained local communities for many centuries. As argued in this chapter, this unique knowledge can significantly contribute to searching and resolving key natural and environmental hazard issues threatening the attainment of the SDGs.

Considering top-down DRM approaches have rarely been successful in many developing countries, IK represents "*bottom up*" approaches developed via a process of local understanding and grassroots participation. This unique knowledge is critical in empowering local/native people take leadership in DRM activities for their own benefit (Tharakan, 2015).

There is a requirement to enhance appropriate coping and resilience strategies in view of the anticipated increasing costs and fatalities from climate risks. IK have much to offer here. While victims of climate risks prefer preventive strategies, they are often left with no option than to adapt in their absence (Berman et al., 2014). Therefore, in planning for DRM, the authorities should prioritise both adaptation and mitigation in its policies and programs to cope with climate change. For instance, flood affected communities in Cameroon have used informal adaptive and coping strategies such as borrowing; consumption smoothing; asset liquidation; and individual, household or community-based actions (Balgah et al., 2019) that originate from IK.

Knowledge and understanding of local perceptions of risk and indigenous strategies to contain them is relevant to all DRM stakeholders at the local, regional, and international levels. Such knowledge will definitely influence the planning, design, and operational aspects of DRM to enhance community resilience to disaster risks while addressing the SDGs. In planning for DRR initiatives, stakeholders should recognize that indigenous people prefer to stay in their ancestral land for generations irrespective of any threats and accept disasters as their fate. In enclaved areas where communities usually have little or no access to modern technology, IK could be the ultimate solution to DRM issues. But merging indigenous and modern DRM strategies, where applicable, is arguably the best option.

The stance of this chapter is that mutually beneficial partnership can be developed around blending technical/scientific DRM knowledge with traditional knowledge from indigenous peoples' communities. This would enhance the involvement of indigenous communities in DRM planning, the realisation of policies, plans and projects, including the SDGs that benefit their communities. Thus, it is imperative to liaise with indigenous people to capture their knowledge and recognise their communities as key players in implementing the SDGs via unique local DRM measures. Considering the realisation of the 2030 sustainable development agenda underscores an overarching framework that promises to leave no-one behind, the argument in this chapter provides scope to incorporate indigenous people or local communities as partners in the realisation of DRM measures that contribute to realising the SDGs.

## 9 Conclusion

In this chapter, IK has been viewed through the lens of DRM as a combination of local or indigenous wisdom, practices, measures, activities, or actions practiced by indigenous/local communities to reduce vulnerabilities to disaster risks, which also contributes to the SDGs.

A review of international frameworks has revealed that indigenous wisdom encompasses most SDG objective and indigenous ideas are unique and valuable in advancing the SDGs including through DRM strategies. This chapter has revealed the repertoire of IK that communities in developing countries draw on to tackle natural hazards/disaster and environmental risks. This has been analysed with case studies or examples regarding SDG 1, 2, 4, 6, 9, 11, 13 and 16.

Although there has been heightened calls for the need to incorporate indigenous knowledge and its practices into DRM resilience planning and operations at all levels (local, regional and national) of the planning process, that objective is yet to be achieved. That poses severe impediment for achieving the SDGs since the invaluable nexus between IK, DRM and the SDGs have been established in this chapter.

Modern DRM techniques and/or innovation should not be a threat to IK. Therefore, this chapter has argued for the need to integrate or complement IK with modern scientific and technical ideologies for optimal performance in the local governance of disaster risks in developing countries. Some entry points to integrate IK with DRM

are mainly in the areas of policies, plans, development, institutional frameworks and response strategies, mapping of disaster risks, early warning, and adaptation.

Considering that natural hazards hit local communities hardest, and can easily be transformed into disasters, applying local/indigenous DRM measures to solve local community problems is a legitimate objective in developing country settings. Through that process, key SDGs will also be achieved as analysed in this chapter.

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