



INDIGENOUS KNOWLEDGE FOR DISASTER RISK REDUCTION

DOCUMENTING COMMUNITY PRACTICES IN PAPUA NEW GUINEA



International Organization for Migration (IOM)



NATIONAL DISASTER CENTRE

The opinions expressed in the report are those of the authors and do not necessarily reflect the views of the International Organization for Migration (IOM). The designations employed and the presentation of material throughout the report do not imply the expression of any opinion whatsoever on the part of IOM concerning the legal status of any country, territory, city or area, or of its authorities, or concerning its frontiers or boundaries.

IOM is committed to the principle that humane and orderly migration benefits migrants and society. As an intergovernmental organization, IOM acts with its partners in the international community to: assist in meeting the operational challenges of migration; advance understanding of migration issues; encourage social and economic development through migration; and uphold the human dignity and well-being of migrants.

International Organization for Migration, Papua New Guinea
P.O. Box 1876
Port Moresby, NCD
Papua New Guinea
+6753213655

International Organization for Migration, Transition and Recovery Division
17, Route des Morillons
P.O. Box 17
1211 Geneva 19
Switzerland
trd@iom.int
www.iom.int/migration-disaster-risk-reduction-and-resilience

© 2015 International Organization for Migration (IOM)

CONTRIBUTORS

Wonesai W Sithole
Mostafa M Naser
Lorenzo Guadagno

PHOTO CREDITS

all photos: IOM/Nic Dunlop

This publication has not undergone professional editing by IOM

IN COLLABORATION WITH



NATIONAL DISASTER CENTRE

Dept. of Provincial & Local Level Government Affairs

P. O Box 4970, Boroko, NCD

Phone: 3014700 - Fax: 3014747

www.pngndc.gov.pg - info@pngndc.gov.pg



USAID
FROM THE AMERICAN PEOPLE

The study is made possible by the support of the American people through the United States Agency for International Development (USAID) Office of Foreign Disaster Assistance Agreement No. AID-OFDA-IO-12-00027. The opinions expressed herein are those of the author(s) and do not necessarily reflect the views of USAID.

TABLE OF CONTENTS

Introduction	1
Vulnerability, resilience and indigenous knowledge	3
Rationale of this study	3
Research methodology	4
Definition and nature of indigenous knowledge	5
Importance of indigenous knowledge	6
Papua New Guinea: identifying indigenous knowledge	7
Hazard forecasting and monitoring	9
Observation of wind, waves, clouds and celestial bodies	9
Observation of animals and plants	10
Disaster prevention, mitigation and preparedness	10
Risk-sensitive housing construction	10
Food and water security strategies	10
Early warning and preparedness systems	11
Environment conservation practices	13
Mutual support mechanisms for relief and recovery	13
Integrating local knowledge in policies and programmes	15
National level	15
National summit	15
Indigenous knowledge education	15
Dissemination of IEC materials	15
Local level	15
Strengthen DRR and CCA efforts	15
Develop and disseminate effective information	16
Hold community forums	16
Conduct community training sessions	16
Include indigenous knowledge in school curricula	16
Conclusions	17
Challenges	17
Concluding remarks	17
References	19



INTRODUCTION

The Independent State of Papua New Guinea (PNG) is exposed to a variety of natural hazards, such as earthquakes, tsunamis, volcanic eruptions, cyclones, droughts, landslides, and floods. Occurrence and intensity of many of these hazards are exacerbated by environmental degradation processes such as deforestation, desertification, biodiversity loss, pollution and soil erosion. In combination with social factors such as poverty, conflict and inequality, these events and processes result in frequent disasters.

Every year, the country experiences an average of two to three disasters requiring the activation of the national emergency response system, and numerous smaller events requiring more local responses. In the past 15 years alone, it has been hit by 7 major disasters (see table 1), triggered by flooding, volcanic eruption, tsunami, landslide, and drought (IOM, 2015). In addition, the country is at high risk of industrial accidents (in particular oil spills) and industrial pollution.

Unregulated and destructive land use practices and infrastructural development, as well as rapid growth in population, compound such risks (NDC, 2005). Several low lying small islands of PNG are also experiencing more frequent storm surges due to sea level rise, and about one fifth of the land in PNG is subject to inundation (Australian Bureau of Meteorology and CSIRO, 2014).

At the same time, the country hosts a remarkable ethnic and cultural diversity, with over 800 spoken languages. This translates in a rich body of cultural traditions, mostly undocumented, which has been transmitted orally from one generation to the other and constitutes the country's indigenous knowledge heritage. Indigenous customs, knowledge systems and governance structures are numerous and diverse.

It is therefore not surprising that various forms of local and indigenous knowledge were identified in the three provinces selected for this study. Such knowledge is key to the security and well-being of communities before, during and after disasters.

Many communities in PNG, in particular along the coasts, are highly exposed and vulnerable to both natural and man-made hazards, as well as to the impacts of environmental and climate change. However, well before the development of technologically advanced early warning systems, or the establishment of standard operating procedures for response, such communities had developed methods to forecast hazards, issue and disseminate warnings, reduce disaster risk and respond to and cope with emergencies. Such knowledge, passed on from one generation to the next, includes the observation of animals, celestial bodies and other environmental features, as well as the use of local technologies and materials for hazard prevention

Table 1. Recent disasters in PNG

Event	Year	Deaths	Injured	Displaced	Affected
Flood	1998	2,182			10,000
Earthquake and tsunami	1998	2,200; 500 missing	700	10,000	10,000
Volcanic eruption	2004			10,000	10,000
Cyclone Guba	2007	149		9,500	162,000
Flood	2008				20,000
Landslide	2012	60			35,000
Sea-level rise	2013			3,200	14,000

Sources: IFRC, 2009; IRIN, 2009 and 2010; UNHCR, 2010; The Guardian, 2012; US Geological Survey, n.d.; World Bank, 2011 (cited in IOM, 2015).

and mitigation. When threatened by a hazard, indigenous communities respond by making use of all this knowledge and practices, which has evolved over generations, and will continue to adapt to future changes.

These traditional, often faith-based, beliefs and practices that are embedded in their day-to-day lives are key to their resilience in the face of natural hazards. However, many communities are concerned that this knowledge might be lost as the elderly die without transferring it to younger members of the community. Rapid environmental changes also challenge the communities' capacity to use and adapt it to achieve security.

Indigenous and traditional knowledge is a precious national resource that can support the process of disaster prevention, preparedness and response in cost-effective, participatory and sustainable ways (Jha and Jha, 2011). In order to better leverage it, it is necessary to understand, acknowledge and respect it as a valuable source of information for reducing disaster risks in PNG. Achieving this requires making an inventory of existing practices, validating them to establish their scientific basis, and promoting and integrating them into education, policies, programs and projects for disaster risk reduction (DRR) and climate change adaptation (CCA). This study attempts to contribute to this objective.



VULNERABILITY, RESILIENCE AND INDIGENOUS KNOWLEDGE

Efforts to mitigate the impacts of hazards and climate change often tend to focus on infrastructural development such as building sea walls, or on high-tech solutions such as sophisticated early warning systems based on scientific data and models. These solutions save lives when hazards affect communities; however, they need to be complemented by actions to address the underlying components of vulnerability — the interrelated human, social and cultural factors that influence risk and contribute to turning a hazard into a disaster (Wisner et al., 2004).

An important component that addresses such factors and that can increase the resilience of communities is their local knowledge. Such knowledge is often disregarded or denied by modern disaster management efforts, and more in general by recent development policies. However, it has proved to be a useful resource for communities to manage crises of all kinds, and, in conjunction with other sources of knowledge, can be key to better preventing, responding to and recovering from shocks (Ellen, 2007).

Evidence that local knowledge and practices can reduce disaster risk has grown since the 1970s (Dekens, 2007). This has been clearly reflected in the Hyogo Framework for Action 2005–2015 (HFA) and, more recently, in the Sendai Framework for Disaster Risk Reduction 2015–2030 (SFDRR). The latter clearly acknowledges traditional and indigenous knowledge and cultural heritage as a fundamental resource to build a culture of safety and resilience at all levels. The document stresses the need to ensure the use of traditional, indigenous and local knowledge and practices to complement

scientific knowledge in disaster risk assessment and the development and implementation of policies, strategies, plans and programmes of specific sectors (Paragraphs 24(i), 27(h) and 36 (1-v)) (UN, 2015).

Leveraging existing indigenous knowledge in disaster risk reduction work is not only essential to its immediate success, but also to its sustainability in the longer term. Participation and integration of communities in all Disaster Risk Reduction (DRR) processes is necessary in pursuing the objectives of the Sendai Framework for DRR and in promoting sustainable development through better disaster risk reduction policies and practices.

RATIONALE OF THE STUDY

Indigenous knowledge can be a useful resource in the endeavour to face the challenges posed by natural hazards and disasters. However, it is being lost at a rapid pace as traditions such as story-telling are disappearing, which makes their documentation particularly crucial.

By improving the understanding of indigenous knowledge in PNG and providing concrete examples of how it can be effectively used, this study aims to build practitioners' and policy makers' awareness of indigenous knowledge as DRR resource. This will hopefully lead to better integrating it into future DRR work, thereby contributing to reduced vulnerability and increased resilience for at-risk communities. Thus, the goal of the study is to reduce the risk and enhance the resilience to hydro-meteorological hazards and climate change impacts of communities living in disaster prone areas. To achieve the goals, it sets the following aims and objectives:

1. Identifying and documenting local indigenous knowledge related to disaster risk reduction and climate change adaptation in PNG;

“Traditionally, we used to have plenty of resources. As time passes, resources are diminishing”.

Yaling Andrew, Bulolo village

2. Better understanding the value of indigenous knowledge for reducing disaster risk for different types of hazards and in different environmental and cultural settings in PNG;
3. Increasing the participation of stakeholders at the community level in efforts towards prevention and mitigation of, and preparedness for, the impacts of hazards and environmental change;
4. Raising awareness on the risk reduction potential of indigenous knowledge among DRR practitioners and decision-makers and help develop ways for this knowledge to be further integrated into mainstream disaster risk reduction policy and practice;
5. Enabling governments and communities to develop policies, community action plans and other actions to reduce risks linked with hazards and climate change impacts, integrating local and indigenous knowledge with science; and
6. Strengthening learning relationships through sharing of lessons learned and good practices in dealing with hazards and climate change impacts among communities in PNG.

RESEARCH METHODOLOGY

This publication presents a collection of indigenous practices that were developed over time by communities in PNG, in response to a variety of hazards including earthquakes, volcanic eruptions, cyclones, floods, droughts, landslides and tsunamis.

The study is based on general observations, data collection, literature reviews and participatory surveys. Primary data was collected from local communities and stakeholders in three Provinces in PNG. Three workshops were held in Kimbe, West New Britain WNB (20 July 2015), Bulolo Village, Morobe (21 and 22 July 2015) and Oro (24 July 2015). The events were attended by disaster officers and government employees, representatives of NGOs and community members.

The researchers used structured and unstructured interviews, mostly composed of open-ended questions and discussion-oriented. The interviews were conducted in English or in a local language, depending on the preference of the interviewees. At times, local interpreters also helped. Photographs were also used to document visible practices existing in the communities.

Figure 1. Map of research locations





DEFINITION AND NATURE OF INDIGENOUS KNOWLEDGE

Indigenous knowledge is often referred to in different terms such as local knowledge, traditional knowledge, peasants' knowledge, traditional environmental knowledge, traditional ecological knowledge, indigenous technical knowledge, endogenous knowledge and folk knowledge (Sillitoe, 1998; Mercer et al., 2009).

Indigenous knowledge refers to the methods and practices developed by a group of people from an advanced understanding of the local environment, which has formed over numerous generations of habitation in a certain location. This knowledge differs from other types of knowledge as it originates within the community, is transferred through informal means of dissemination, is collectively owned, developed over several generations and subject to adaptation, and is embedded in a community's way of life as a means of survival and well-being.

Matsika (2012, 209-210) defines indigenous knowledge as:

"The traditional and local knowledge that exists and is developed through the experiences of the local community in the process of managing the conditions or context that challenge the people's everyday life"

and lists the main characteristics of indigenous knowledge as:

- home-grown, derived from the solution of everyday life problems;
- part and parcel of a community's cultural practices and ways of life;
- often undocumented, passed on orally from one generation to another;
- used in solving the immediate problems faced by the community;
- dynamic, changing in parallel with events that may be taking place in a society; and
- always under scrutiny, as it is valued for its ability to solve prevailing problems.

Indigenous knowledge is therefore a body of knowledge existing within or acquired by local people over a period of time through accumulation of experiences, society–nature relationships and community practices and institutions and passed down through generations (Sillitoe, 2000; Mercer et al., 2009).

This study focuses specifically on the various forms of knowledge related to early warning systems, disaster risk reduction and disaster risk management, which fit within the following categories:

- perceptions and interpretations of meteorological, climatic and other environmental patterns and phenomena (e.g. prediction of storms based on observations of the sky, sea and wind);
- livelihood sustainability and coping practices (e.g. livelihood diversification before/after shocks);

- prevention, mitigation and survival strategies (e.g. temporary evacuation to higher ground, construction of houses using local materials, short and long-term migration); and
- individual and collective recovery mechanisms based on social, cultural and belief systems (e.g. rituals and ceremonies).

This study looks at complex bodies of knowledge, skills and technology, belonging to specific, geographically-defined communities. Such knowledge is based on practical experience and can be preserved and harnessed for the benefit of present and future generations.

IMPORTANCE OF INDIGENOUS KNOWLEDGE

The local and traditional knowledge of nature and natural phenomena still plays a key role for many people and communities in this era of technological advancement. Since time immemorial indigenous knowledge has developed as part of communities' relationship with their environment, and has therefore the potential to enrich current environmental research on and policy and operations on DRR and CCA (Jha and Jha, 2011). According to Shaw et al. (2008), "inhabitants of coastal areas have been developing mechanisms to survive and to adapt to such hazards for centuries. They are rich in indigenous knowledge relating to the environment and how to live in harmony with it, much of which is manifested in survival and

livelihood strategies". Indigenous knowledge has allowed communities at risk to mitigate, prepare for, respond to and recover from disasters well before the establishment of high technology-based early warning systems and standard operating procedures for response.

According to Shaw et al. (2008), the four primary arguments for including local and indigenous knowledge in disaster risk reduction policies are the following:

- Indigenous knowledge can be transferred and adapted to other communities in similar situations;
- Incorporating indigenous knowledge can empower communities by encouraging their participation to DRR efforts;
- Indigenous knowledge can provide invaluable information about the local context; and
- The non-formal means of disseminating indigenous knowledge can serve as a model for DRR education.

The interest for the use of indigenous knowledge for DRR (and in particular for disaster education and early warning) has grown in recent years, and has been enshrined in global policy documents such as the HFA and more recently the SFDRR. Taking local knowledge into consideration can be key to improving understanding of local environmental contexts or to identify effective risk reduction practices. A blend of scientifically or technologically-advanced methods and traditional knowledge opens avenues towards better disaster prevention and mitigation, preparedness, response and recovery (Jha and Jha, 2011).



PAPUA NEW GUINEA

IDENTIFYING INDIGENOUS KNOWLEDGE

Indigenous communities in PNG have experienced a range of disasters since immemorial times. Disasters have detrimental effects on people's lives, livelihoods, property and assets and can damage infrastructure and disrupt community functioning. It is therefore natural for every community to take measures to prevent and mitigate losses they might be facing when hazards strike.

At-risk communities in PNG have a long history of observing changes in the environment and have amassed a wealth of knowledge and practices closely related to these changes. Their knowledge systems include elements of disaster prevention, risk awareness and preparedness. Communities also employ complex strategies to respond to, cope with and recover from the impacts of hazards. This type of traditions and practices have influenced the way local communities anticipate, and adapt to, extreme weather events and other hazards.

There is a wealth of indigenous knowledge related to DRR and early warning in the three areas where the field research was conducted. Documented practices range from the observation of animals, celestial bodies and other environmental features for forecasting hazards, to the use of specific local resources for building hazard-resistant structures and for coping with scarcity in times of disaster, and the reliance on traditional and faith-based beliefs and practices to overcome traumatic events. There is, however, knowledge that cannot be explained scientifically or empirically.

Many communities are able to forecast weather by observing the sky, or to predict incoming rain and storms by observing the behaviour of certain animals. In other villages it is believed that elderly people receive signs and knowledge regarding upcoming hazardous events in dreams. When people are sure a storm is coming, they disseminate alerts and warnings using conch shells, they reinforce their houses, and preserve food that will enable them to eat without cooking during a storm. People affected by the storm resort to mutual help mechanisms for material and emotional support.

Faith and religious rituals help them endure losses, build inner resilience and give them hope that they will be able to recover.

This body of measures and strategies helps anticipate and reduce the impacts of disasters. However, traditional knowledge and practices are being lost at a rapid pace – something that was noted by the elderly in all surveyed communities. Traditions such as story telling are disappearing, while the advent of modern knowledge and new belief systems and religions are gradually challenging the authority of traditional knowledge. Accumulated through generations, local legends, know-how and practices are currently at risk of being lost.





HAZARD FORECASTING AND MONITORING

A key insight from the research across the sites was the ability of local people to closely observe and monitor changes in their environment (sea, clouds, animal behaviour, plants) and celestial bodies (the moon, sun and stars) and interpret them to predict hazards. For an overview of observed environmental features, refer to Table 2.

These observations allow communities to predict storms, heavy rainfall, floods, droughts, volcanic eruptions and landslides, and have enabled them to prepare for such hazards and mitigate their impacts. However, communities also highlighted how, with hazard patterns changing, traditional observation methods are becoming increasingly unreliable. In Popondetta, cyclone forecasting based on cloud observation is now no longer possible.

Observation of wind, waves, clouds, celestial bodies

Various meteorological and astronomical phenomena are observed to forecast hazards. For instance, in Popondetta cold breeze or thunder roars coming from the mountains are signals for a cyclone or heavy flood approaching. In Bulolo, cyclones are announced by the appearance of a rainbow, while wave noises are associated with tsunamis.

The following variables have been associated to potential hazard occurrence:

For clouds:

- changes in texture (thin/thick)
- color (white, dark, yellow, orange or red)
- location (over the mountains or the sea)
- speed (fast)
- direction (vertical/horizontal, to/from the coast)

Table 2. Indigenous hazard forecasting methods in the three research sites

Hazard	Bulolo and Labu, Morobe	Popondetta, Oro	Kimbe, WNB
Cyclone	Appearance of rainbow	Strong wind blows through Mount Kokada Pigs move inland Certain colour of cloud	Dogs bark continuously
Strong wind		Leaves fall from a certain tree	
Flood	Change in animal behaviour Too much rain	Cold breeze coming from the mountains Thunder roars in the mountains	
Drought/dry spells	<i>Malepa</i> flowers blossom When the leaves of the <i>Xuc</i> tree start falling, clouds and dark come, but no rain. It usually happens between November and December, also signals Christmas	Flowers bloom in a certain colour and/or flower fall from trees Very cold nights	
Heavy rain	<i>Mend</i> trees blossom with yellow flower		
Volcanic eruption		Dead fish in the river Bats, snakes and other animals move away from the volcano	Unusual behaviour of animals (e.g. bats' flying patterns) Continuous rain Thunder storms, Particular direction of rain Sun darker and/or red Trees drying around the volcano Continuous tremors for 7 days.
Tsunami	Whistling and jet sound from the sea	Seagulls move inland	Dogs bark continuously
Any hazard		Bats shriek continuously	Unusual behaviour of animals Dead fish in the sea Dogs bark continuously Elderly receive signs in dreams

DISASTER PREVENTION, MITIGATION AND PREPAREDNESS

For waves:

- changes in color (white crests)
- direction
- size (higher than usual)

For winds:

- direction (usually eastward or westward)
- temperature (cold or warm)

For celestial bodies:

- position of the sun and moon (high/low)
- size of the sun (large or small)
- visibility of constellations (many or absent).

These observations allow communities in PNG to predict storms, heavy rainfall, floods, droughts, volcanic eruptions and landslides, and are key to improved preparedness and mitigation actions. However, communities also highlighted how, with hazard patterns changing, traditional observation methods are becoming increasingly unreliable. It is for instance the case of cyclone forecasts through cloud observation in Popondetta.

Observation of animals and plants

Observation of animals and plants can also help forecast hazards. In Bulolo, the appearance of bats is associated with incoming storms. Birds, in particular migratory species, indicate seasonal cycles, and potential, future heavy rains, storms, or droughts. The movement of sea snakes and hermit crabs fleeing inland or climbing up trees all forewarn storms and typhoons. When banana tree leaves and branches of other trees fall to the ground without strong winds, people prepare for storms or typhoons. These observations are also considered indicators of other hazards such as landslides and flooding, since they often take place in conjunction with heavy rainfall episodes and strong winds.

In Popondetta, seagulls have been observed to move inland before tsunamis. Bats, snakes and other animals fleeing away from the volcano can signal volcanic eruptions – such as before the Mount Lamington eruption in 1951 and in a number of occurrences at Mount Pago. Pigs moved inland, and stayed safe, when Cyclone Guba struck.

Customary practices play a key role in reducing risk for traditional communities in PNG. Beliefs, rituals and rules related to conservation of the environment and management of natural resources are instrumental to preventing and mitigating landslides and floods, by engendering and reinforcing respect for the environment. Knowledge and use of a variety of natural resources supports resilience by allowing for hazard-resistant construction, improved food security and by underpinning people's coping strategies in the face of disasters. Table 3 summarises the practices gathered through the fieldwork.

Risk-sensitive housing construction

Local knowledge accumulated through generations is the foundation of the design of traditional building forms. Traditional designs are adapted to local hazard patterns and help minimize their impacts on households and communities.

Coastal communities in Oro build their houses on stilts, which reduces the impact of flooding and sea tide. The houses' corner posts are made of quail tree, while palm bark is used for walls and palm leaves for the roof. The result is strong, lightweight housing that can resist wind but causes limited damage in case of collapse.

Food and water security strategies

All villages have developed a variety of strategies to increase their food and water security in times of hardship and disaster. The cultivation of hazard-resistant crops is widespread. In Kimbe, villagers plant different varieties of crops to increase the chance to have some food in case they face drought or frost. In Bulolo, people use bananas and taro, a hardy crop that survives in floodwater, as disaster crops. Villagers wrap the bananas in leaves to protect them from water and birds. Taro is cultivated in drains dug in the flooded soil. Taro, cassava and bananas are also the main staple in times of drought. Yam and taro are also grown further away from the village, in elevated areas on the mountainside, to be used in times of shortage or when the village is affected by a hazard and villagers have to temporarily seek shelter on higher ground. Cultivation, in particular of taro, in lakes,

swamps and wetlands is also undertaken in times of drought. Traditionally, in particularly dry periods, villagers used to survive on meat of Wembel (also called Wewag), a wild bird found in grassland.

Prior to the rainy season and potential flooding, food is preserved in traditional clay pots to ensure food availability when people cannot leave their houses. Food is also sun-dried: bananas, sweet potato flour and sago powder, when preserved this way, can last up to 6 months in clay pots and remain edible. Seeds are also dried and saved for the following year's planting season.

Bamboo is used to store water and for cooking. Rainwater collected during the rainy season and

stored properly represents a clean supply to avoid drinking potentially contaminated floodwater.

Early warning and preparedness systems

Active involvement of communities is a key element of all early warning systems, but represent the foundation of community-based warning and preparedness systems. Since the surveyed communities depend on the environment for their livelihoods, they have all developed a vast amount of knowledge on potential hazards and present high levels of risk awareness. They have devised a variety of ways to disseminate warnings and react swiftly when a hazard is approaching.

Table 3. Traditional measures for disaster prevention, mitigation, preparedness and recovery

Type of measure	Bulolo, Morobe	Popondetta, Oro	Kimbe, WNB
Early warning	Shouting from high ground and imitation by the warning recipients Blowing big conch shells House-to-house dissemination of warnings	Blowing big conch shells Shouting House-to-house dissemination of warnings	Blowing big conch shells Shouting House-to-house dissemination of warnings Beating <i>garamut</i> drums Fire and smoke signals Producing quick, fast noises
Preparedness	Growing and protecting disaster foods such as banana and taro around evacuation sites <i>Malepa</i> flowers blossoming indicate the time when the bush fowl (<i>Siang</i>) lays eggs, collected in anticipation of the dry season	Traditional dances are used as a drill, indicating what is needed in preparation for various hazards Traditional art forms (e.g. songs, theater, dressing) indicate how people survived past disasters	
Prevention and mitigation	When there is a drought, a stone (<i>Lun</i>) is put into the river so that heavy rainfall comes The use of <i>Sago</i> palm leaves for roofing reduces damage in case of collapse		Suspending the toilet pit 1 meter above ground minimizes the impact of flooding. Tree planting to stabilize slopes Flood resistant design of houses, care centre and bamboo emergency shelter in Lagui
Food security	Storing crops and food Used to cope with food scarcity by eating <i>Wewag</i> , a wild grass-land bird. Today they use taro, cassava and banana (<i>wair</i>) Family and social support	Crop diversification	Crop diversification
Rescue, reconstruction and recovery	Can build in 5 hours a bamboo emergency shelter that can last up to 5 years Members of high-altitude communities migrate to the valley to cope with frost and drought Material and psychosocial support from the extended family through the <i>wantok</i> system during and after disasters		Small glasses are used to produce signals to attract ships



If members of the community see signs of heavy rain in the hills they start to prepare for an impending flood by packing belongings and ensuring food supplies are plentiful. Spotters are sent upstream to determine the river's level and behaviour; markers are used to determine the changes in water level. They then report back by passing messages passed from person to person to quickly reach the village. Villagers downstream are constantly on alert with adequate plans in place in case flooding occurs. Oral traditions passed down through generations in the form of legends, visions and stories are plentiful and people rely on them for guidance as to what to do in the face of a hazard.

Various types of dissemination methods have traditionally been used within indigenous communities to warn the people about impending disasters. In all three surveyed villages villagers blow a conch shell as a sign of alert. In some provinces, including WNB and Morobe, warnings are conveyed by playing a garamut drum. Lighting fires, shouting and producing loud noises is also used. In the village of Labu Tale, shouting from elevated ground (a hill or mountain top) in order to take advantage of echoes was indicated as an effective early warning practice.

Environment conservation practices

Sustainable management of natural resources is a precondition for the well-being and resilience of all surveyed communities, and a core element of traditional livelihood practices. Communities also rely on traditional ceremonies and rituals based on respect for nature are practiced to stop heavy rainfall and storms. The elderly in Labu visit a scared place in the mountain and offer meditation to their gods, pleading for mercy. Traditionally, villages also define sacred sites and areas in which no human presence is allowed and entrance is punished. This results in the conservation of pristine forest and land.

The Bulolo community felt that the main changes in their surrounding landscape had occurred as a result of changes in their agricultural practices. Community elders remembered "times of plenty" when land was abundant and the river flowed gently along a narrow riverbed. There is no recollection of flooding events during these times. The villagers felt that the present-day situation of heavy erosion and resulting destruction caused by floods and landslides resulted from loss of

indigenous practices as the community moved from subsistence gardening to cash cropping. Traditional land management strategies, which involved limited burning and respect of specific boundaries for cultivation, are increasingly being disregarded in favour of extensive use of land for cash cropping. Population levels also increased as monetary incomes went up and, while life was made easier as a result of money, it was around this time that the community felt that hazard incidence increased. Despite the availability of money, life on the land became increasingly harder with gardens destroyed by floods and village access increasingly difficult. This, in turn, has resulted in limited opportunities for education for the young members of the community.

Mutual support mechanisms for relief and recovery

Communities share strong traditional bonds, and everyone is used to help one another during disaster. Family, extended family, religious organizations, clans, villages and local governments provide particularly important coping and recovery mechanisms through material and emotional support. A traditional system specific to PNG is the *wantok*, voluntary collective actions through which villagers assist their peers in need in normal times, such as by helping build or move a hut or plant crops. In times of disaster, the *wantok* system is leveraged to support with relief and recovery needs, including psychosocial support.



INTEGRATING LOCAL KNOWLEDGE IN POLICIES AND PROGRAMMES

The Hyogo and Sendai Frameworks give high consideration to the integration of local and indigenous knowledge in DRR policy. Given the wealth of indigenous knowledge PNG hosts, it is key for national and local institutions to make the best use of it for the design and implementation of DRR and CCA programmes. The following are examples of concrete activities that could be implemented.

NATIONAL LEVEL

National summit

A national summit could be organized to disseminate indigenous knowledge on DRR and climate change adaptation (CCA), and to discuss its integration into national and local policies and programs. The summit would involve national and local institutions, practitioners, academics and community representatives, such as members of the councils of elders. It could consist of an event where resource persons would speak on key topics, followed by segments on formulation of policies, programmes and advocacy efforts.

Indigenous knowledge education

The National Disaster Centre and the Department of Education could collaborate to promote the integration of indigenous knowledge in school curricula through the development of national-level policies mandating schools to integrate indigenous knowledge into appropriate subject areas. At the tertiary level, this could be done by creating curricula on indigenous knowledge, or, perhaps more feasibly, integrating indigenous knowledge topics in courses on DRR and CCA.

Dissemination of IEC materials

A variety of Information, Education and Communication (IEC) materials can help convey

messages to the general public, including indigenous communities, and support policy and education efforts. Audiovisual productions could be broadcasted by local televisions and radios. Posters would be an effective way of conveying messages to communities, especially those without electricity. Poster submissions could be sought from students through a country-wide competition, and would help increase awareness of the importance of indigenous knowledge and promote its use for disaster risk reduction and climate change adaptation programmes, planning and activities.

LOCAL LEVEL

Provincial Administrations are mandated for disaster prevention, preparedness, response and recovery, and are responsible for public awareness and information, food security, dissemination of early warning and emergency communications, logistics and transportation, evacuation, reconstruction and rehabilitation. District administrations and local governments are responsible for developing, implementing and coordinating DRR programs at community level. Council of elders and local community organizations can also be mobilized to promote their community's indigenous knowledge. The following are examples of concrete activities that could be implemented.

Strengthen DRR and CCA efforts

Community-based DRR can be a good entry point for enhancing DRR and CCA activities through the integration of local and indigenous practices with scientific and technological knowledge. Local SOPs and preparedness plans, for instance, can integrate traditional forecasting or early warning methods, such as the use of conch shells and garamut drums. This can be supported by research efforts investigating the effectiveness of traditional practices.

Develop and disseminate effective information

Indigenous knowledge could be integrated in the development of simple education and communication materials that are culturally-appropriate and relevant to various aspects of the day-to-day life of local communities (e.g. construction of housing and infrastructure, water and sanitation, food and agriculture).

Hold community forums

It is important to raise community awareness on indigenous knowledge, its use and potential improvements among community members themselves. This might be done in dedicated events through the presentation of audiovisual productions or community theater. Open-floor discussions could allow the community to comment and raise questions. Posters may be posted in key places in the community.

Conduct community training sessions

Training sessions could be organized for community leaders and teachers who will be trained on:

- impacts of natural hazards and climate change
- DRR and CCA strategies
- use of indigenous knowledge for DRR and CCA
- use of IEC materials.

Include indigenous knowledge in school curricula

School-level policies can effectively support integration of indigenous knowledge in education. Schools can provide guidelines to assist teachers in integrating indigenous knowledge into appropriate subject areas such as science, social studies and arts. This would not require curriculum revision, which can be complicated and lengthy, but might have a limited impact because the scope would be an individual school.



CONCLUSIONS

CHALLENGES

Indigenous knowledge is culture-specific, and represents people's lifestyle. Thus, the dissemination and use of knowledge beyond the boundary of the community that has developed it is often a challenging issue. However, indigenous knowledge measures can be applicable to different locations, provided they are adequately calibrated to local cultural and environmental features. Application is a process and needs stakeholder participation as well as policy support, and shall be one of the key focuses of future efforts in this domain.

Despite the recognition of the important role that local and indigenous knowledge can play in disaster risk reduction, such knowledge has yet to feature prominently in environment, climate change and disaster-related policies in PNG. The increasing number of local and indigenous practices documented on the topic of disasters and environmental change has not been systematically integrated in efforts to increase communities' resilience to their impacts.

CONCLUDING REMARKS

Local and indigenous knowledge is key to increasing the resilience of communities facing the potential impacts of natural hazards and environmental change. It represents a key local resource which can complement science and technology in building effective DRR and CCA policies and actions. However, it has yet to be fully harnessed by scientists, practitioners, and policymakers.

The codification of indigenous knowledge is particularly important considering the cultural and linguistic diversity of PNG and the fact that much of this cultural diversity is increasingly under threat by environmental change, the intrusion of religion,

particularly Christianity and of mainstream development and culture, which undermine its authority. For instance, the community in Bulolo reported that during past droughts the elderly could bring rain with their traditional knowledge; this is now no longer possible. As a consequence, traditions and local knowledge are not passed through to younger generations. Helping communities adapt their knowledge to changing environmental and social circumstances is particularly important as many smaller, isolated communities are unlikely to receive effective government assistance when disasters strike: local means of forecasting and dealing with hazards, disasters, and climate change impacts are among the only resources available for risk reduction and effective recovery.

This study particularly emphasizes the need for creating mechanisms that can promote and popularize indigenous knowledge through public awareness-raising materials, educational activities, mainstreaming indigenous knowledge in policies, programs and services at national, local and community levels. Indigenous knowledge can effectively be integrated in hazard forecasting and monitoring, early warning systems and disaster response and recovery mechanisms. It can also be a key resource to the redesign of agricultural and fishing practices, as well as for ecosystem conservation work and a number of other resilience-building activities. Identifying traditional practices, and validating and adapting them, will be key to preserve and increase the resilience of communities facing natural hazards and environmental changes over the next years and decades.



REFERENCES

Australian Bureau of Meteorology and Commonwealth Scientific and Industrial Research Organisation (CSIRO)

2014 Climate Variability, Extremes and Change in the Western Tropical Pacific: New Science and Updated Country Reports, Pacific-Australia Climate Change Science and Adaptation Planning Program Technical Report. Melbourne, Australia.

Dekens, J.

2007 Local Knowledge for Disaster Preparedness: A Literature Review. Kathmandu: International Centre for Integrated Mountain Development (ICIMOD).

Ellen, R.

2007 Modern Crises and Traditional Strategies: Local Ecological Knowledge in Island Southeast Asia. Oxford, Barghahn Books.

Jha, V. and A. Jha

2011 Traditional Knowledge on Disaster Management: A Preliminary Study of the Lepcha Community of Sikkim, India. Indian Knowledge of Traditional Knowledge. Vol. 10 (1) p. 173.

International Organization for Migration (IOM)

2015 Assessing the Evidence: Migration, Environment and Climate Change in Papua New Guinea. International Organization for Migration (IOM). Available at: <https://publications.iom.int/books/assessing-evidence-migration-environment-and-climate-change-papua-new-guinea>

Matsika, C.

2015 Traditional African Education: Its Significance to Current Education Practices with Special Reference to Zimbabwe, Mambo Press, Gweru.

Mercer, J. et al.

2009 Integrating Indigenous and Scientific Knowledge Bases for Disaster Risk Reduction in Papua New Guinea. Swedish Society for Anthropology and Geography, pp. 157–183.

National Disaster Centre (NDC)

2005 The Papua New Guinea Disaster Risk Reduction and Disaster Management National Framework for Action (2005–2015).

Shaw, R. et al.

2008 Indigenous Knowledge: Disaster Risk Reduction, Policy Note. Bangkok: UNISDR Asia and the Pacific.

Sillitoe, P.

2014 The development of indigenous knowledge: a new applied anthropology. *Current Anthropology* 39 (2), 223–252.

United Nations

2015 Sendai Framework for Disaster Risk Reduction (2015–2030).

Wisner, B. et al.

2004 *At Risk: Natural Hazards, People's Vulnerability and Disasters*, 2nd edition. Routledge.

www.iom.int/migration-disaster-risk-reduction-and-resilience



International Organization for Migration (IOM)



NATIONAL DISASTER CENTRE



USAID
FROM THE AMERICAN PEOPLE