Cyclone Harold and the role of traditional knowledge in fostering resilience in Vanuatu

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Abstract

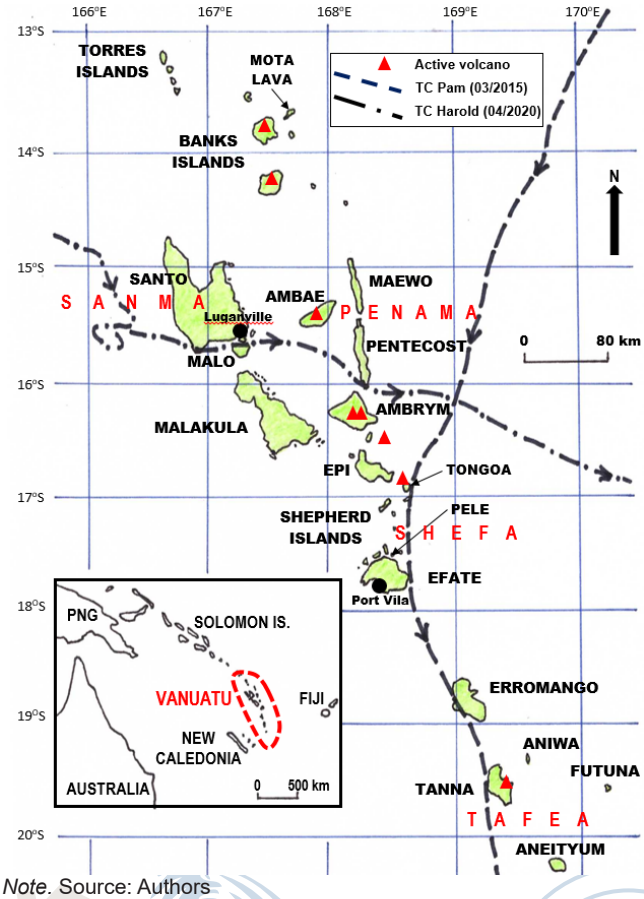
This article examines the role of traditional knowledge, skills, and values in fostering resilience in Vanuatu, the world's most at-risk country from natural hazards. We study responses to severe Tropical Cyclone (TC) Harold, which devastated the nation's northern islands in April 2020 just as a state of emergency had been declared in response to COVID-19. This necessitated severe restrictions on the delivery of relief supplies and a ban on the arrival of overseas humanitarian workers, forcing remote communities to adopt local responses to the emergency and cope with food insecurity through traditional resilience strategies and values that promote resource-sharing and cooperation. We use a mixed methods approach to analyse the content, extent, and transmission of traditional knowledge in Vanuatu and link this to evidence of its usefulness during TC Harold. Quantitative data from field surveys with two groups of respondents are combined with reports on responses to TC Harold both nationally and along the remote western coast of Santo Island. We also review the extent of traditional knowledge in current educational curricula in Vanuatu. Results illustrate how traditional ecological knowledge and social capital played a key role in disaster response and recovery, but such knowledge is mainly held by older people, and its use by younger generations is declining. We conclude that with rising global temperatures predicted to generate more extreme weather events, and external funds for disaster relief likely to decline, there is a need to build greater adaptive capacity at the local level through the revival of centuries-old informal transmission pathways of knowledge and values.

Keywords: *Vanuatu, resilience, tropical cyclone, traditional knowledge (TK), TK transmission, food security*

Resilience and Traditional Knowledge

As a small island developing state in the South Pacific, Vanuatu (Figure 1) is highly vulnerable to the impacts of natural hazard-related disasters and climate change (Connell, 2013; Le Dé et al., 2018). The 2021 World Risk Report (Bündnis Entwicklung Hilft, 2021) calculated disaster risk for 181 countries based on the dimensions of exposure to a range of hazards, vulnerability, susceptibility, and coping and adaptive capacities. Vanuatu's position along the Pacific "Ring of Fire" exposes it to earthquakes, volcanic eruptions, and tsunami, while its location as an archipelago in the tropical south-west Pacific makes it susceptible to cyclones, floods, droughts, landslides, and sea level rise.

Figure 1
Map of Vanuatu Showing Active Volcanoes and the Tracks of Category 5 Cyclones Pam (2015) and Harold (2020)



Note. Source: Authors

Vanuatu's risk index for 2021 was 47.73, considerably higher than that of the next two countries, the Solomon Islands (31.16) and Tonga (30.51). However, ni-Vanuatu, like other Pacific Islanders, have extensive experience in building adaptive capacity to extreme weather events, particularly cyclones and droughts, through their indigenous and local knowledge and traditional values of mutual support and community cohesion (Granderson, 2017; McMillen et al., 2014).

Traditional knowledge (TK) refers to knowledge that has been transmitted inter-generationally within a particular cultural community, primarily through oral means: stories, songs, rituals, memories, experiences, and skills (Rai & Khawas, 2019), including practical demonstration of agricultural practices. Traditional knowledge is also known as traditional wisdom, traditional environmental knowledge (TEK), and indigenous and local knowledge (ILK). It is a key factor in sustainable development, especially when integrated with non-indigenous information sources (Nakamura & Kanemasu, 2020; Walshe & Nunn, 2012). Numerous articles emphasise its role in building resilience through the sustainable management of natural ecosystems and resources (Berkes et al., 2000; Thaman, 2000), and more recently, its capacity for helping communities to mitigate the effects of climate change and extreme weather conditions, especially cyclones (Lefale, 2010; Leonard et al., 2013). In the Pacific Islands, McMillen et al. (2014) point out that ILK systems are critical to understanding resilience and adaptation because of the islands' long exposure to environmental variability. Over thousands of years, islanders have developed adaptive responses to living in marginal habitats for food production that face periodic severe disturbances from drought, cyclones, tsunami, and volcanic eruptions.

In Vanuatu, there is a clear role for traditional values, ecological knowledge, and skills in building resilience (or adaptive capacity). This is emphasized in the Vanuatu Climate Change and Disaster Risk Reduction Policy 2016-2030 (VCCDRRP), which stresses the need to build on, share, and expand existing TK of early warning and coping mechanisms (Government of Vanuatu, 2015). These needs are illustrated by case studies drawn from various islands across the archipelago.

Campbell (1990) found that in the Banks Islands prior to the mid-1800s, food security in the aftermath of cyclones was maintained through the use of resilient crops, agricultural diversity, "famine" and forest foods, and inter-island exchange, whereby customary networks and friendships ensured assistance in terms of surplus crops. However, European contact, colonialism, and independence have led to changing patterns of land-use, involvement in the cash economy, a decline in food surpluses and inter-island trade, and an expectation that external relief will be supplied through the government and overseas donors. In the remote Torres Group, Mondragon (2018) documented how islanders have generated their own environmental and indigenous knowledge in response to risk, that such knowledge is intimately linked to culture, and that it is modified through interactions with external agents and interventions. Pascht (2019) found a similar situation in Siviri, North Efate, stating that climate change is perceived by villagers as occurring within a combined environmental and socio-cultural context. On Tongoa Island, Granderson's research (2017) indicates that five aspects of *kastom save* (TK) are important for building adaptive capacity to climate change: observing and predicting weather and climate, careful management of local resource use, maintaining networks of relations and reciprocity, customary governance and leadership, and cultural beliefs and values such as cooperation and forward planning.

However, such aspects are declining in the face of Western education, a capitalist economy, and urban migration, so that opportunities for transmission to younger generations are much reduced. This sentiment is echoed by McNamara and Prasad (2014) from their work on Tanna and North Efate and supported by Nakamura and Kanemasu (2020) in their research into the resilience of four Fijian communities to the devastation caused by Cyclone Winston in 2016. Similarly, McCarter and Gavin (2011) found that TEK had eroded on Malekula and identified the formal school system as the driver. They proposed the inclusion of certain domains in formal curricula, specifically ethnomedical and agricultural knowledge and practice, and the reinforcement of respect for traditional authority and values.

The central role of traditional and local mechanisms in responding to Cyclone Pam in 2015 has been highlighted by Le Dé et al. (2018), who conducted research in two villages in North Tanna directly in the cyclone's track. Local knowledge of shelter and food, intra- and inter-community cooperation, traditional social security systems, and livelihood diversification were as significant in recovery as the external, top-down assistance to provide medical supplies and repair water systems and schools that followed. On the other hand, Webb's (2020) research in three Tannese villages found that

people were ill-prepared for Cyclone Pam compared with villagers on the neighbouring islands of Erromango and Aniwa, also on the track of the cyclone, because they had not engaged in disaster risk reduction programmes conducted by a non-government organisation during the preceding 3 years. These programmes focussed on modern techniques and fostered the participation of women and other vulnerable groups. The research, however, did not attempt to address the role of indigenous knowledge or values.

In summary, there is a body of research in Vanuatu that demonstrates how resilience to climate change and disasters at a local level is generated not only through close observations of and interactions with the local environment, traditional agricultural techniques, and oral transmission of past experiences, but also through traditional social resources or *social capital*: resources and support created through networks and relationships among and between families, friends, and communities which can be used to help actions such as disaster response and recovery (Adler & Kwoon, 2002). A community's *adaptive capacity* (the ability to adjust and respond and take advantage of opportunities) is best achieved when it is locally led and owned by the community itself, guided by local institutions and taking a more flexible, "whole of island" approach, rather than through being sponsored or driven by an external agency (Westoby et al., 2020a,b). At the same time, rural communities are ready to combine traditional resilience strategies with modern techniques such as cyclone warnings transmitted by text to mobile phones and crop breeds that can withstand extreme weather. While traditional strategies are important in planning for disasters, they may not be so effective in the future, when climate change increases the severity of extreme weather events (McNamara & Prasad, 2014; Nakamura & Kanemasu, 2020).

The current article seeks to contribute to the existing literature on the role of traditional and local knowledge and social capital in building resilience to hazards and climate change in Vanuatu. Data from a survey of holders and recipients of TK on its extent and transmission was linked to a case study on how communities in a remote coastal area benefited from traditional knowledge and values in response to TC Harold, the most recent Category 5 cyclone to strike the country in April 2020. We will demonstrate that the role of traditional knowledge and values in post-TC Harold experiences is an indicator of their future importance, as external aid continues to decline.

We take *resilience* to be broadly synonymous with adaptive capacity (as explained above) and make use of the terms *traditional knowledge* (TK) interchangeably with traditional ecological knowledge (TEK) and indigenous knowledge (IK), as outlined above. *Local knowledge*, however, refers to the fusion of traditional knowledge with other knowledge gained through people's changing interactions with their immediate material, non-material, and social environments (Pascht, 2019).

Vanuatu's Extreme Vulnerability to Hazards and Climate Change

Vanuatu has a high exposure to extreme natural events and current and future sea level rise. This can be explained by its location along the junction of the Pacific and Indo-Australian tectonic plates, with eight active volcanoes (see Figure 1), frequent earthquakes (Walshe & Nunn, 2012), occasional tsunami and landslides, its position in the heart of the cyclone belt of the south-west Pacific, lengthy droughts during El Niño periods, and the concentration of its inhabitants in coastal areas. In the August 2020 national census, Vanuatu had a population of 301,695 (Vanuatu National Statistics Office, 2021), of whom 67,590 (22%) were living in the two main urban areas of Port Vila and Luganville.

Recent impacts of geological hazards include the eruption of Mt Lombenben (Manaro Voui) on Ambae in September 2017, resulting in severe ashfalls over the next 13 months that destroyed food gardens, contaminated water supplies, caused the collapse of homes, and damaged the health of people and animals. This eruption culminated in the evacuation of the island's entire population of over 11,000 to other islands in October 2017 and then again from July to October in 2018, when the eruption ceased (Global Shelter Cluster, 2018; Rovins et al., 2020). The two volcanoes on Ambrym and Mount Yasur on Tanna are continuously degassing. Mount Yasur also ejects intermittent moderate ashfalls, with the latest episode in early 2020.

In Vanuatu, climate change can be viewed as a slow-onset disaster. One of its major impacts is sea level rise and the concomitant coastal erosion that occurs during storms (see Figure 2). Projections of sea level rise for 2015-2090 range from 25 to 59 cm for a very low emissions scenario and 42 to 89 cm for a very high emissions scenario (Pacific Climate Change Science and Adaptation Planning Programme [PACCSAPP], 2015). A warmer atmosphere and oceans are expected to result in the increased intensity, but decreased frequency, of tropical cyclones. Other observed and expected

Figure 2
Coastal Erosion of a Village Graveyard on Pele Island, Vanuatu

Note. Source: Author

environmental impacts include more very hot days and extreme rainfall events, an increase in ocean acidification and decline in the health of reef ecosystems, and reduced terrestrial biodiversity (Taylor & Kumar, 2016).

Two Recent Hydro-Meteorological Disasters: Cyclones Pam and Harold

During the 41-year period between 1969 and 2010, the islands of Vanuatu experienced an average of two to three tropical cyclones per annum, although this figure varied between zero and six (PACCSAPP, 2015). However, between 2015 and 2020, the country suffered from two of the most intense cyclones in recorded history: TC Pam in March 2015 and TC Harold in April 2020, both Category 5 (Food and Agricultural Organisation [FAO], 2020; Secretariat of the Pacific Community [SPC], 2016). Cyclone Pam struck the central and southern islands on the 13th and 14th of March 2015. Sustained winds of 250 kilometres per hour flattened homes, schools, and villages, affecting an estimated 188,000 people and leading to 15 deaths, many injuries, and the displacement of some 65,000 from their homes. In SHEFA and TAFEA provinces, 96% of agricultural crops were destroyed and 81% of homes sustained some level of damage (SPC, 2016). Costs of the damage were almost US$600 million (Mcdonald, 2020). The immediate response was an outpouring of aid from the United Nations Office for the Coordination of Humanitarian Affairs (OCHA) and from bilateral donors such as Australia, New Zealand, France, the United Kingdom, Israel, Germany, the European Union, China, and Japan to assist local efforts spearheaded by the National Disaster Management Office (NDMO). One positive outcome of TC Pam was the establishment of the national "cluster" system for managing future disasters. This enables government and humanitarian agencies to develop and implement disaster preparedness activities during non-disaster time, with each cluster led by a government agency and co-led by a humanitarian partner. The eight clusters are: Education; Emergency Telecommunications; Food Security and Agriculture; Gender and Protection; Health and Nutrition; Logistics; Shelter; and Water, Sanitation and Hygiene (NDMO, 2021).

Cyclone Harold, also of Category 5 intensity, was smaller in size than TC Pam, but its passage was slower and with winds gusting up to 294 km per hour, its destructive impacts very similar. It lingered off the west coast of Santo from 4th to 6th April before moving along the south of that island and across to Pentecost (Figure 3), finally leaving Vanuatu waters on the 7th of April. Eighty to 90% of homes and 60% of schools in SANMA province were destroyed, as were up to 95% of homes on Pentecost (where most housing is traditional buildings constructed of leaves and branches), thus displacing an estimated 80,000 people (Ober & Bakumenko, 2020). Many communities were cut off from support due to flooding and destruction of roads. The United Nations estimates that over 160,000 people, or more than half of Vanuatu's population, were affected (OCHA, 2020), and some 17,500 hectares of cropland were damaged, including root crops and other staples that were almost ready for harvesting (FAO, 2020).

TC Harold arrived in Vanuatu shortly after a state of emergency had been declared due to COVID-19 and while the NDMO was already struggling to cope with major ashfalls afflicting Tanna. Despite the severity of

Figure 3
Village of Melsisi, Central Pentecost, Three Weeks After the Impact of TC Harold

Note. The building on the left is the largest church in Vanuatu. Image credit: Ginny Stein (Kenni & Wijewickrama, 2020)

the damage, the NDMO banned foreign aid workers from entering the country because of the pandemic, saying that the response to Harold would be "localised". In terms of foreign aid, $2.5 million was provided from the United Nations Emergency Humanitarian Fund, and $8 million worth of supplies came from Australia, New Zealand, France, and China; however, distribution to communities in need was hampered by strict decontamination and quarantine measures, damage to inter-island vessels, erosion of roads, and the remoteness of many villages (Mcdonald, 2020). In general, there was a significantly weaker external humanitarian response to TC Harold than for TC Pam (Ober & Bakumenko, 2020). Therefore, communities were compelled to adopt local responses to the emergency, such as managing food security through traditional resilience strategies and values.

Theoretical Framework

The definition of resilience provided by the Intergovernmental Panel on Climate Change (IPCC) is used throughout this study:

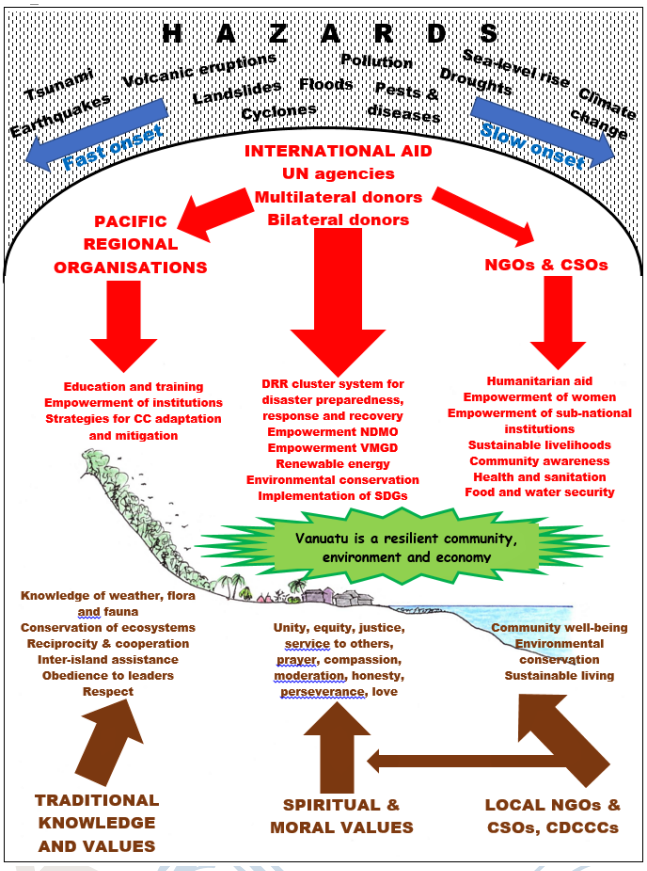
> The capacity of social, economic and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity and structure, while also maintaining the capacity for adaptation, learning and transformation. (IPCC, 2014, p. 127)

Thus, education to foster resilience, whether in formal school environments, non-formal, community-based settings, or through traditional, informal mechanisms, will help people to learn how to face, cope with, and recover from the impacts of disasters and climate change (McMillen et al., 2014). Traditional knowledge, skills, and values can be seen as informal ways of learning to promote resilience. However, for such wisdom to be effective in the future, this study examines whether and how it is being passed to younger generations and identifies the obstacles to such transmission and use. We also evaluate the extent to which traditional wisdom is contributing to community resilience as compared with other internal and external factors.

The vision of Vanuatu's Climate Change and Disaster Risk Reduction Policy (VCCDRRP) 2016-2030 is that "Vanuatu is a resilient community, environment and economy" (Government of Vanuatu, 2015, p. 2). We have produced a hypothetical model (Figure 4) to suggest how that resilience might be achieved, considering external and internal "drivers" that are involved. The principal hydro-meteorological, geological, and biological hazards are symbolised by torrential rain at the top. Protection is offered through an umbrella of foreign aid (in red), representing financial and technical flows coherent with the UN's 17 Sustainable Development Goals. The stated aim of this top-down assistance is the empowerment of communities in building resilience to natural hazards by reducing disaster risk and adapting to climate change impacts, both direct and indirect, such as sea level rise, loss of food and water security and biodiversity, coastal erosion, and urban migration. However, we further postulate that resilience is also nurtured through bottom-up, largely voluntary processes within civil society (in brown): ordinary people, environmental groups, and faith-based organisations seeking the well-being of communities and building on millennia of experience. We argue that external financial assistance may come and go, but it is ultimately the fostering of self-supporting dynamic and equitable communities that use ecosystem services sustainably which will ensure enduring resilience to environmental change.

What seems to have happened through TC Harold is that external assistance, historically so significant for resilience and recovery in Vanuatu, has weakened at the same time as internal local efforts have strengthened. Response structures established by the NDMO, such as

Figure 4
Model of the Drivers of Resilience in Vanuatu



Provincial Emergency Operation Centres and Community Climate Change and Disaster Committees (CCCDCs), have coordinated response efforts, while traditional structures such as the *Malvatumauri* (National Council of Chiefs) mobilised communities to raise funds and collect relief items (Kenni & Wijewickrama, 2020). The Vanuatu Association of Non-Government Organisations and other NGOs and civil society groups have stepped up their activities. According to interview responses and media reporting, ni-Vanuatu have been inspired by their spiritual, moral, and/or traditional values to demonstrate their willingness to offer food, clothing, building materials, and support to the tens of thousands severely affected.

Within the context of this framework, we aim to examine whether traditional skills, values, and knowledge that provide strategies for mitigation and adaptation are indeed contributing factors in making Vanuatu a "resilient community, economy and environment".

Method

This research uses a mixed methods approach, including a review of literature on TK and Vanuatu's vulnerability to hazards and recent cyclones, field interviews and questionnaires with providers and recipients of TK from seven islands of Vanuatu, questionnaires with ni-Vanuatu students at the University of the South Pacific (USP) in Fiji, a case study of experiences of Cyclone Harold in Santo, and analysis of current formal school curricula in Vanuatu.

Ethical approval for the investigation was granted to the lead author by Bishop Grosseteste University UK and the Vanuatu Cultural Centre as part of his on-going PhD research, and no further permits were required for conducting interviews. The structured interview questions/questionnaire are provided in the appendix.

The selection of known holders of TK, as well as recipients of such knowledge, was through convenience sampling. The aim was to interview participants from as many islands and age groups as possible, based on separate questionnaires for providers and receivers, but acknowledging that providers are also recipients and may wish to complete both sets of questions. Thirty-three structured interviews were conducted in Bislama, the lingua franca of Vanuatu, or else translated into one of the 106 indigenous languages used in the country. Interviewers, comprising the lead author and his research assistants, were known to the interviewees and not regarded as "outsiders" from whom information would be withheld; the lead author had been a permanent resident of Vanuatu for 42 years. The 74 respondents at USP were ni-Vanuatu who volunteered to complete the questionnaires under the supervision of a research assistant. Interviews and surveys were undertaken between March and August 2020. A thematic analysis of the data was carried out, assigning preliminary codes to ascertain the kinds of TK, values, and transmission pathways uncovered and exploring patterns that emerged.

Several limitations to the collection of data through interviews and questionnaires must be acknowledged:

1) Questionnaire completion in Vanuatu was carried out in a slightly different way to that by respondents at USP in Fiji. In Vanuatu, questionnaires were completed face-to-face, with 28 of the 33 participants interviewed in their home village, and five who live in Port Vila or Luganville but have a close connection with their home island. In all cases, the interviewers already had family or friendship ties with the respondents, and it is assumed that information would have been shared freely. In Fiji, questionnaires for a minority of respondents were completed through face-to-face interviews with the research assistant, but most students preferred to complete the questionnaires on their own. It is not thought that such respondents deliberately concealed TK of weather signs or coping strategies, nor of traditional values, but questions may not have been understood in a uniform manner and there may have been misconceptions. This difference between the two groups in the method of questionnaire completion may have influenced the responses.
2) Because convenience sampling was used, and since the majority of the USP sample were young people who have reached a university level of education (Table 1), we cannot say that either sample is representative of all old or young people in Vanuatu. Instead, the findings are more indicative of how young adults who have spent most of their lives exposed to education at secondary and tertiary level in spaces remote from their home villages may not have the same knowledge, skills, or values as those who remained in a rural setting.
3) There is not an even representation of the 33 Vanuatu respondents by geographic area, with almost half of them coming from the one island of Santo, and the majority of those from its west coast. Similarly, 28 of the respondents were male, and only five were female. This skewed representation may have distorted the results, especially since among

the 74 USP respondents, the research assistant endeavoured to ensure an equitable gender balance (Table 2).

Information on the internal and external responses to TC Harold comes from a variety of sources such as ReliefWeb (a service provided by UN OCHA), media outlets, Vanuatu's NDMO, and personal communications with people living along the western coast of Espiritu Santo, one of the most inaccessible areas of Vanuatu. The use of primary quantitative and qualitative data to corroborate information from secondary sources has enabled a more reliable analysis of the role of TK and values in building resilience.

Table 1
Age of Respondents, Split by Sex

Age group (years)	Vanuatu adults			USP respondents		
	Male	Female	Total	Male	Female	Total
10-19	-	-	-	-	1	1
20-29	1	-	1	28	32	60
30-39	1	2	3	3	4	7
40-49	3	-	3	1	2	3
50-59	5	1	6	-	-	-
60-69	7	1	8	-	-	-
70-79	7	1	8	-	-	-
80 +	4	-	4	-	-	-
Not stated	-	-	-	3	-	3
TOTAL	28	5	33	35	39	74

Table 2
Home Island of Respondents, Split by Sex

Home island	Vanuatu adults			USP respondents		
	Male	Female	Total	Male	Female	Total
Banks	1	-	1	1	-	1
Santo (west coast)	11	1	12	-	-	-
Santo (other)	4	1	5	9	6	15
Malo	-	-	-	4	-	4
Maewo	-	-	-	2	2	4
Ambae	2	-	2	6	9	15
Pentecost	-	1	1	2	4	6
Malakula + offshore	-	-	-	8	8	16
Ambrym	-	-	-	1	1	2
Paama	-	-	-	-	1	1
Epi	-	-	-	-	-	-
Shepherds	-	-	-	-	1	1
Efate + offshore	6	-	6	1	3	4
Erromango	-	-	-	-	1	1
Tanna	4	1	5	1	1	2
Aniwa	-	-	-	-	-	-
Futuna	-	-	-	-	1	1
Aneityum	-	1	1	-	-	-
Not stated	-	-	-	-	1	1
TOTAL	28	5	33	35	39	74

Results

Extent and Transmission of Traditional Knowledge and Values

Participating groups. Vanuatu-based participants consisted of 33 respondents from the islands of Mota, Santo, Ambae, Pentecost, Efate, Tanna, and Aneityum, with half of them coming from Santo (Table 2). Nearly all (97%) were aged 30 and over, with 61% aged 60 years and over. All but five were male. Twenty respondents classified themselves as providers, 11 as receivers, and 2 as both providers and receivers. Every person was interviewed in the field, using structured questions in Bislama or his/her own language posed by the researcher or a trained assistant.

Overseas ni-Vanuatu participants comprised 74 respondents at USP in Suva, Fiji, of whom 66 were full-time students. Most islands of Vanuatu were represented in this sample, with most respondents coming from Santo, Ambae, and Malekula. Unlike the first sample, 82% of USP participants were under 30 years old, with a more equitable balance between males (47%) and females (53%). Sixty-six classified themselves as both providers and receivers of traditional knowledge. Most respondents preferred not to be interviewed but to complete the questionnaires by themselves, responding in either English or Bislama.

The purpose in having two distinct participant groups was to distinguish between older respondents who have lived entirely or for long periods in a rural setting, and younger respondents who have spent much of their school lives undergoing formal education in secondary and tertiary establishments removed from the village[1], having little contact with natural

1 After primary school (Year 6), nearly all students must leave their village to continue education at secondary level in another location. In 2019, there were 479 primary schools (Years 1-6) and 111 secondary schools (Years 7-14) in Vanuatu (Ministry of Education and Training, 2020). Of those who complete junior secondary school (Years 7-10), approximately half move to a senior secondary school in an urban or non-village rural location, and only one third complete Year 13, the entry point for university. We estimate that the average 20-year-old student who arrives at USP is likely to have spent at least 7 years (one third of their life) away from home influences. For a student who has been born in Port Vila or Luganville and completed primary and secondary education in an urban school, estimated at 25% of all students, it is likely that they have had little direct exposure to their cultural roots in the parents' village(s) of origin.

ecosystems and the possibility of alienation from their cultural roots, a practice dating back for more than 50 years. However, the limitations of the survey mean that results cannot be considered as representative of Vanuatu society as a whole.

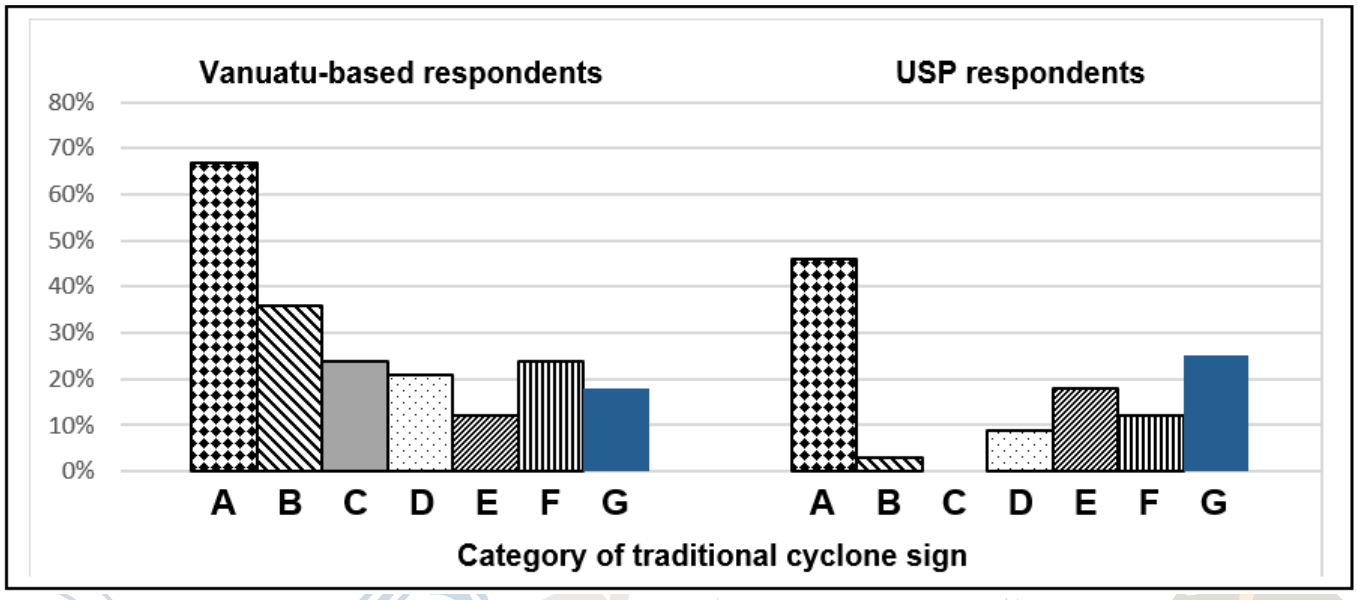
Traditional signs, strategies, and values. A key finding of the research relates to whether respondents could state any traditional environmental signs of approaching disasters and describe any traditional strategies for being resilient to such disasters. Table 3 and Figure 5 show results for traditional cyclone signs, while Table 4 and Figure 6 provide data for traditional cyclone resilience strategies. These signs and strategies were offered by the respondents themselves, without interviewers having to use checklists or prompts.

As expected, Vanuatu-based respondents demonstrated a greater knowledge of traditional cyclone signs than those in the USP sample. Thus 67% of the Vanuatu group stated one or more atmospheric signs, compared to 46% of the USP group. The contrast was particularly marked for observed changes in flora, with 36% of the Vanuatu group identifying an abnormally high output on fruit trees and 24% noting other changes in crops and plants, compared with 3% and 0% respectively for the USP group. For fauna, 21% of the Vanuatu sample knew that cyclones are likely when hornets and birds build their hives/nests close to the ground, compared

Table 3
Traditional Cyclone Signs Stated by Number of Respondents

Traditional cyclone sign	Vanuatu-based respondents			USP respondents		
	M (28)	F (5)	T (33)	M (35)	F (39)	T (74)
A. Atmospheric signs: unusual cloud formations, increasing wind speed, heavy rainfall, unusually hot days and nights, halo around moon, etc.	20	2	22	17	17	34
B. Changes in flora: abnormally high production of flowers and fruit on fruit trees – breadfruit, nakatambol, navel, mango.	9	3	12	0	2	2
C. Other changes in flora: yam vines coil back down the yam stake, new banana shoots remain closed but leaves fall to ground, withering of windiwindi grass, red yam grows under nabanga tree, nalumlum (algal bloom) on sea surface, etc.	8	0	8	0	0	0
D. Changes in fauna: hornets/birds build nests close to the ground, fowl roost under houses, turtles lay eggs in bush, mangrove crabs leave habitat, unusual movements of animals/insects.	6	1	7	4	3	7
E. Changes in fauna: bird flight: frigate birds fly in from the sea, birds fly in unusual patterns/movements.	2	2	4	6	7	13
F. Other environmental signs: rough seas, dirty seas, use of traditional calendar, etc.	6	2	8	2	7	9
G. No traditional signs stated.	5	1	6	13	13	26

Figure 5
Percentage of Total Respondents Identifying Each Category of Cyclone Signs



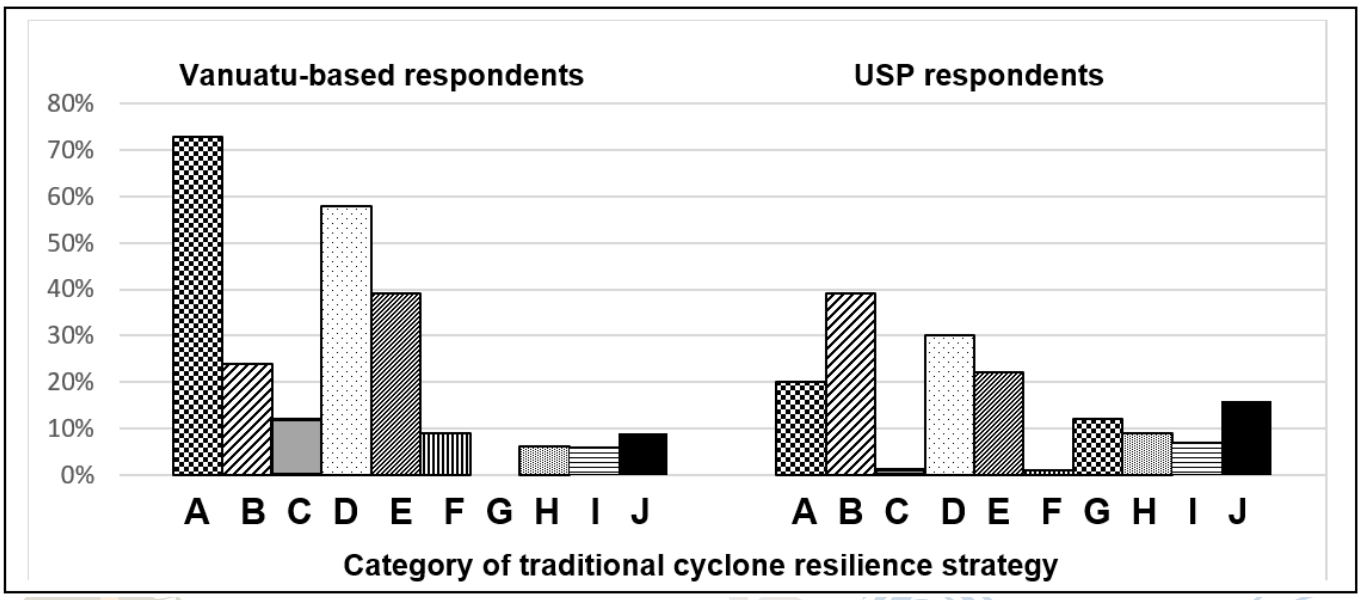
with 9% of the USP group, but a higher proportion of the latter (18% compared to 12%) mentioned the arrival of frigate birds or unusual bird movement. The proportion of USP respondents who could not state any traditional cyclone signs (35%) was almost double that of the Vanuatu-based group (18%). Table 3 suggests that the different responses for the two groups were due to age and experience rather than to sex, demonstrated by the near-identical number of males and females among the USP group identifying atmospheric signs, as well as no signs at all.

Similarly, and without any prompting, a much greater proportion of the Vanuatu-based respondents could demonstrate knowledge of traditional cyclone resilience strategies, particularly those of long-term duration. For example, 73% of the Vanuatu group stated traditional

Table 4
Traditional Cyclone Resilience Strategies by Number of Respondents

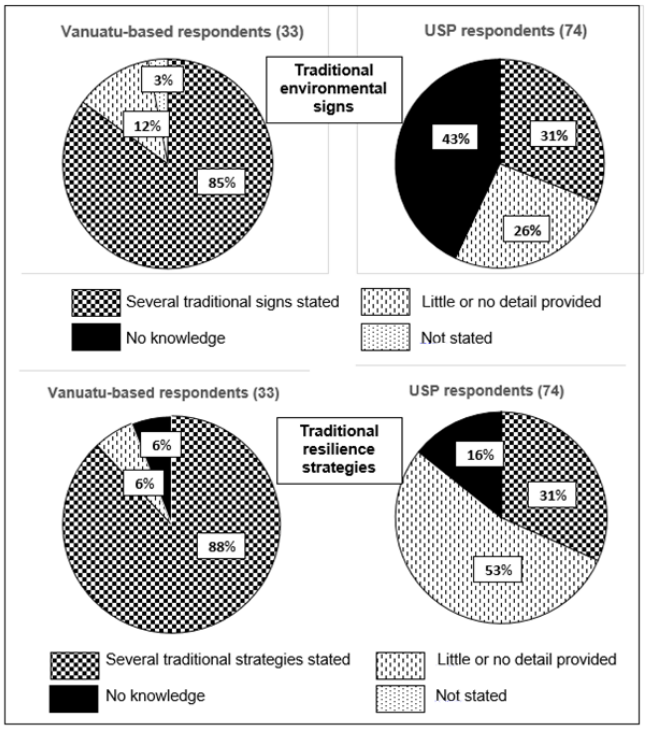
Traditional cyclone strategy	Vanuatu-based respondents			USP respondents		
	M (28)	F (5)	T (33)	M (35)	F (39)	T (74)
A. Traditional house construction and maintenance (long-term): style, shape, site. Construction of permanent houses.	20	4	24	11	4	15
B. House maintenance and preparation (short-term), just before arrival of cyclone: ensuring roof is properly tied down, tying extra coconut leaves to roof, cutting branches of trees close to house, etc.	7	1	8	10	19	29
C. Strengthening of community solidarity/unity (long-term). Maintenance of kastom networks and reciprocal relationships. Obedience to chief.	2	2	4	0	1	1
D. Improving food security (long-term): planting and storing long-life tubers; clearing and planting traditional food gardens; following seasonal planting calendar; traditional food preservation techniques, including burial.	14	5	19	12	10	22
E. Improving food security (short-term): harvesting of manioc, bananas, and other vulnerable crops before cyclone arrives; using wild crops as emergency foods after cyclone passes; storing food in home, etc.	11	2	13	6	10	16
F. Improving water security (long-term), e.g., by finding new sources, cleaning springs.	3	0	3	1	0	1
G. Improving water security (short-term), e.g., by covering water sources/collecting water just before cyclone arrives.	0	0	0	4	5	9
H. Traditional ways of diverting or stopping a cyclone or reducing destruction of home (short-term), e.g., by using special leaves/magic.	2	0	2	2	5	7
I. Other strategies, e.g., trapping crabs and fish, sheltering in caves, clearing path to caves, planting trees on slopes, planting windbreaks.	1	1	2	1	4	5
J. No traditional cyclone strategies stated.	3	0	3	6	6	12

Figure 6
Percentage of Total Respondents Identifying Each Category of Cyclone Resilience Strategies



house construction and maintenance (A) as a key factor in resilience, compared with just 20% of the USP group; common features of such traditional homes include low or no walls, a triangular or semi-circular profile, and use of *natangura* (sago palm) thatch. The Vanuatu group also had much higher proportions stating the strengthening of community solidarity (12% vs. 1%), long-term food security and traditional food preservation (58% vs. 30%), and short-term food security just before and just after the passage of a cyclone (39% vs 22%). However, the USP group had higher percentages for short-term maintenance and preparation of houses (39% vs. 24%) and short-term improvement of water security (12% vs. 0%), possibly reflecting the role of young people in last-minute preparations before a cyclone arrives. Traditional short-term ways of calling upon the spirits or using special leaves or sacred stones to divert a cyclone away from an island or reduce damage to the home were mentioned by 6% of the Vanuatu group and 9% of the USP group. A larger percentage indicated no knowledge of traditional cyclone resilience strategies in the USP sample than in the Vanuatu-based sample (16% vs. 9%), with males and females equally represented among the students.

Figure 7
Knowledge of Traditional Environmental Signs and Resilience Strategies



When examining responses to traditional environmental signs and resilience strategies for *all* hazards (cyclones, droughts, ashfalls, tsunami), the contrast between the two cohorts is reinforced (Figure 7). For example, 85% of the Vanuatu group demonstrated detailed knowledge of several traditional signs, while another 12% made generalised statements. However, only 31% of the USP cohort had detailed information, 26% gave generalised statements, and 43% had no knowledge. For traditional resilience strategies, 88% of the Vanuatu group gave detailed descriptions, 6% had generalised knowledge, and 6% had no knowledge, compared with 31%, 53%, and 16% respectively for the USP cohort. The younger USP cohort appear to have a better knowledge of traditional strategies for disaster resilience than they do of traditional signs of impending disasters, perhaps because they have greater trust in modern alerts

Table 5
Knowledge of Traditional Values and Attitudes That Build Resilience

	Category	Vanuatu-based respondents		USP respondents		Total	
A.	Social capital: unity and solidarity, cooperation, working together, showing respect and obedience to leaders, strong leadership and governance, reciprocity, family bonds, trusted social networks, togetherness.	16	48%	64	86%	80	75%
B.	Personal qualities: integrity, strong work ethic, caring, friendship, love, kindness, hospitality, orderliness.	5	15%	6	8%	11	10%
C.	Traditional resilience strategies: traditional disaster mitigation unspecified; using/passing traditional knowledge, values, and advice; ensuring food supplies through traditional farming, food storage, and food preservation; traditional housing; conserving trees and using traditional ways of promoting crop growth; traditional hazard signs and warnings, including cyclone signs and observation of animal behaviour; sharing food, knowledge, and communications; preparation and planning; valuing caves.	27	82%	37	50%	64	60%
D.	Environmental attitudes: benefits of cyclones, pleasing the spirits.	3	9%	-	-	3	3%
E.	Not stated	3	9%	8	11%	11	10%
	TOTAL number of values mentioned	54		115		169	
	TOTAL persons completing survey	33	100%	74	100%	107	100%

available through mobile phones, the Internet, radio, and television.

When asked to list one or more traditional values and attitudes that build resilience, responses from the older cohort interviewed in Vanuatu were different to those of the USP cohort (Table 5).

Overall, the 107 respondents mentioned a total of 169 values. For both groups, the two most frequently mentioned categories were social capital (A) and traditional resilience strategies (C), with the latter more important for the Vanuatu-based group and the former more important for the younger USP cohort. Regarding specific values, the most common for Vanuatu respondents was identified as "following traditional weather signs", mentioned by 11 out of 33 respondents (33%), while the most common for USP respondents was "working together", mentioned by 23 out of 74 respondents (31%), and "obedience to/ respect for leaders", stated by 17 respondents (23%). The importance of traditional resilience strategies and social capital demonstrated by these findings supports earlier research in Vanuatu and Fiji by Campbell (1990), Granderson (2017), Le Dé et al. (2018), McNamara and Prasad (2014), and Nakamura and Kanemasu (2020).

These findings imply that despite a period of estrangement from their cultural roots, the majority of USP respondents still recognise the importance of social capital and, to a lesser extent, traditional resilience strategies. However, a different picture emerges when we look at responses to a question that was only asked of receivers: they had to recall any basic attitudes or beliefs that the transmitter of TK had passed to them. Of the 71 USP respondents identifying themselves as TK receivers, 45 (63%) remembered traditional resilience strategies but only two (3%) could recall attitudes relating to social capital, or social aspects of community life; a further 18 (25%) could not remember any basic attitudes at all.

Respondents were asked to state whether they had used any of their received TK in their own lives, and to provide a specific example of when or where this had happened (Table 6).

Table 6
Extent to Which Respondents Have Used Traditional Knowledge in Their Own Lives

Category	Vanuatu-based respondents		USP respondents		Total	
Yes, with a specific example	12	36%	37	50%	49	46%
Yes, but no example	21	64%	23	31%	44	41%
Not used	-	-	13	18%	13	12%
Not stated	-	-	1	1%	1	1%
TOTAL	33	100%	74	100%	107	100%

All Vanuatu respondents confirmed that they have used their received TK in their own lives, but only one third (36%) could provide a specific example of this. For the USP respondents, half (50%) could provide a specific example, but 18% said that they had not used any of the TK received; this aligns with the large proportion of USP respondents (69%) who could demonstrate little or no knowledge of traditional hazard signs or of traditional resilience strategies.

Traditional Knowledge (TK) Transmission

Both samples were asked to state the person(s) from whom they had received their TK on weather, climate, and environmental change. Of all 107 respondents, 29 (27%) said that they had received their TK from their fathers, 14 (13%) from their grandfathers, and the remaining 64 (60%) from a variety of family members or other adults. A much larger percentage of the Vanuatu adults said that they had received TK from their fathers (45%) than the USP respondents (19%). Grandparents seem to be more significant for the younger cohort of USP respondents (30%) than they are for the Vanuatu adults (6%). Another important difference is that while none of the Vanuatu adults received their TK from outside their extended families, 15% of USP respondents did so through the Internet or teachers.

Respondents were also asked to indicate the person(s) to whom they would, or have already, transmitted their TK, selecting only one option from several to avoid double counting. One third of the USP respondents (34%) said that their TK should be passed to their children, with the next highest response (12%) for transmission to the first-born son. For Vanuatu adults, on the other hand, the highest response (39%) was for "not stated", followed by 12% each for transmission to the first-born son, to children, and no transmission at all. The common explanation for this non-transmission is that their children, or those around them, are not interested.

A distinction was made between transmission of knowledge and the transmission of skills: TK receivers were asked how much they remembered of each on a scale of 1 to 4, with 4 being everything and 1 very little. The majority of recipients in both cohorts said that they recalled "a lot" or "a little" knowledge and skills (the middle values of the scale). Average scores for memories of knowledge were higher for the USP students than for the

Vanuatu adults (2.9 compared to 2.6), but slightly lower for memories of skills (2.7 compared to 2.8). A surprising 25% of the USP receivers claimed that they remembered all the TK transmitted; however, they could have been thinking of modern knowledge about weather and climate rather than traditional environmental knowledge.

Finally, in response to the question on frequency of TK transmission, a majority of Vanuatu adults and USP respondents stated that the person transmitting TK to them did so repeatedly. Among the USP respondents, however, 16 (22%) said that this person transmitted their knowledge only once, possibly because they have had limited contact with that person since leaving their village to pursue secondary and tertiary education.

Reasons for the Decline of Traditional Knowledge

Providers were asked to discuss whether the transmission of TK is changing, and if so, why. Most respondents felt that there is less transmission today than in the past, and hence there is a general decline in the amount of TK currently available. Among reasons for this decrease offered by the older cohort were that their children were no longer with them, are no longer interested in TK, or that young people have lost respect for their elders. Other, more specific, reasons were that knowledge of traditional house design is perceived as no longer relevant because permanent building materials offer better protection from cyclones; that urban living precludes the demonstration of many traditional environmental signs to others; and that when children go away for education, they are removed from home influences and gain preferences for processed rather than traditional foods. Among the younger cohort, however, 28 out of 74 (38%) stated that the decline in TK is because of their use of modern technology, citing the Internet, social media, cell phones, and hazard warnings transmitted through the media. Other factors mentioned were the influence of urbanisation, education, Western culture and lifestyle, and the fact that young people are no longer spending time with their elders.

Analysis and Implications

Evidence of TK Transmission

Results from the survey indicate that older people in rural areas of Vanuatu hold considerable knowledge of traditional weather signs and resilience strategies that they wish to transmit to younger generations, but that the out-migration of their descendants to schools and urban areas means that much of this wisdom is not being transferred. The majority of tertiary students interviewed (69%) confirm that they have little or no knowledge of traditional environmental signs or resilience strategies, but 86% have nevertheless retained awareness of key traditional values relating to social capital - working together, sharing, respect, and preparation - that are important for community well-being and disaster risk reduction. These young people also point out that TK is now being submerged under a tide of digital technology and social media - a trend that is only likely to increase.

Contribution of Traditional Knowledge, Skills, and Values to Resilience during Cyclone Harold

The external response to Cyclone Harold was less than during the previous cyclone of similar intensity, largely because Vanuatu was already in a state of emergency due to the COVID-19 pandemic and there were fears that arriving humanitarian personnel and supplies would carry the virus. Foreign aid workers were banned, and all imported relief supplies (including hygiene kits, tents, and tarpaulins) were delivered under strict quarantine protocols. According to Ober and Bakumenko (2020) of Refugees International, sources on the ground in Vanuatu noted a significantly inferior international humanitarian response to TC Harold as compared to TC Pam in 2015, despite the former's greater destruction on some islands; three weeks after the cyclone, one such source reported that there are "no personnel, no military aircraft, no helicopters---and it's been logistically very challenging. Financially we've received very little." (Ober & Bakumenko, 2020, par. 31). In addition to lower levels of financial assistance, support came from fewer donors than with TC Pam. The FAO's request for US$3 million for seeds, tools, and capacity-building to address food insecurity was underfunded by more than $2.5 million, while UNICEF's appeal for US$7.7 million to support humanitarian operations fell short by more than $6 million (Ober & Bakumenko, 2020).

In contrast to this decline in aid, a significant development was the forced localisation of responses to TC Harold. The NDMO insisted that response efforts would be "internally run" (Kenni & Wijewickrama, 2020); thus, greater responsibility for recovery operations was assumed by national and sub-national institutions. The *Malvatumauri* (National Council of Chiefs) mobilised communities to raise funds and collect relief items. Little external food aid was received, but during the months after TC Harold and under the coordination of the NDMO's Food Security and Agriculture Cluster, communities in central and southern islands donated boatloads of root and fruit crops to affected populations on Pentecost and in SANMA Province (Figure 8).

Figure 8
Root Crops from Central and Southern Islands of Vanuatu Arriving in Pentecost on 31st May 2020

Note. Image credit: Alain Siméon. Reproduced with permission

For example, villages from Tongariki and Buninga contributed 2.3 tonnes of yams and 142 farmers from Emae supplied 11 tonnes of quality yams, while root and fruit crops were also shipped from Erromango, Malakula, Paama, and Tanna (R. Tigona, personal communication, 2020). Such contributions testify to the importance of social capital - traditional values of sharing, cooperation, togetherness, and mutual assistance - together with traditional leadership structures at national, island, and community level. They also confirm the significance of traditional subsistence agriculture, with its emphasis on root crops, bananas, and fruit trees grown through a bush-fallow system.

A major advantage of this sharing of locally grown food is that cyclone victims receive much healthier and more diverse food than would otherwise come through donations of rice, noodles, tinned meat, and fish in food packages from overseas (Kenni & Wijewickrama, 2020). Another benefit is that a proportion of the root crops can be used for replanting in damaged food gardens, strengthening future food security. These initiatives confirm that traditional knowledge and values give Vanuatu the potential to contribute to its own food security during future disasters, reducing its need for overseas aid. Indeed, the role of overseas aid ought to be re-assessed.

With the likelihood of an increasing number of Category 5 cyclones affecting not just Vanuatu but other areas of the world (Carbon Brief, 2015; IPCC, 2014), aid agencies are going to be increasingly hard-pressed to fund reconstruction after such disasters. The reaction to TC Harold and the findings from this survey suggest that effective responses to, and recovery from, disasters lie in building greater capacity for preparedness at household, community, area council, and provincial levels, processes that benefit from the use of traditional resilience strategies combined with on-going education and training on modern coping mechanisms. Building such local capacity can reduce the high cost of accessing the outer islands of Vanuatu, which regularly drains the already stretched annual budget of the NDMO and enables humanitarian aid to reach affected areas more rapidly (Ober & Bakumenko, 2020).

The role of TK in this development is stressed by a senior research officer in Vanuatu's NDMO:

Traditional knowledge definitely needs to be emphasised. Our forefathers have well survived the past disasters and we are proof of that. Traditional knowledge saves lives when modern knowledge is slow or lacking. Studies have shown that Vanuatu will experience more frequent and intense natural disasters. While waiting for modern knowledge to save us from a certain death, let's make use of our traditional knowledge. It is not a simple task, because traditional knowledge is slowly disappearing in the face of rising technology and change of focus from our youths. National leaders should encourage revival of traditional knowledge to ensure best practices are kept and applied when there is a potential disaster occurring.

(NDMO research officer, personal communication, 7 September 2020)

Case Study on the Use of TK in West Coast Santo

The implications of relying on traditional knowledge and values in resilience responses is demonstrated by this case study of events in communities along the remote west coast of Santo Island. This was one of the areas to suffer most from the impacts of TC Harold when it remained offshore for almost 3 days.

This case study draws on an in-depth interview with a young graduate of the first-ever certificate courses on Resilience (Climate Change Adaptation and Disaster Risk Reduction) held in Vanuatu during 2017-2018 as part of a Technical and Vocational Education and Training (TVET) programme. After training, he returned to his home village of Kerepua in western Santo, and was instrumental in promoting awareness of resilience strategies, including traditional techniques, as well as the creation of a local marine and land conservation area that extends from the reef at Kerepua to high montane forests around Mt Tabwemasana, Vanuatu's highest mountain. He co-founded the Santo Sunset Environment Network (SSEN), whose goal is to ensure the protection and conservation of ecosystems and biodiversity through traditional knowledge and customary practices in the 25 villages along the West Coast. For response to and recovery from TC Harold, he reports

that impact assessments were conducted for the whole west coast area, a detailed report was sent to the NDMO, and a locally-constituted team established and trained CDCCCs in 14 villages ready for the coordination of future disaster preparedness, response, and recovery. Community awareness was carried out on health, hygiene, forestry, and environmental conservation, and people were encouraged to plant quick-growing ("three months") crops such as kumala. When asked how TK helped the community to be resilient during the passage of TC Harold, the respondent said:

> We relied on traditional weather indicators. When clouds were moving rapidly across the sky, the *manuinalane* [cyclone birds] were flying in from the sea and our poultry stopped making a noise when roosting in the late afternoon, my father predicted that the cyclone would be very strong, and he was right. We undertook traditional preparations such as lashing down our houses, baking taro and *laplap* [national dish of Vanuatu] in underground ovens ready for food shortages after the cyclone, and moving the family to the safety of the kitchen, which has low roofing. We also knew that if there was fine weather in the middle of the cyclone, then winds would return with even more force."
>
> (Respondent, personal communication, 8 August 2020)

According to the report submitted to the NDMO (Bartlett, 2020), TC Harold completely destroyed over 600 homes, badly damaged nearly all infrastructure and wiped out the agricultural and productive sector livelihoods of over 2,590 people across 25 communities. All primary and junior secondary schools were either totally destroyed or rendered completely inoperable, leaving more than 500 students with no educational opportunity in the foreseeable future. Even before TC Harold struck, West Coast Santo was highly food insecure, largely due to a severe drought which lasted for most of 2019 and into 2020. Planting was delayed by 4 months and only commenced in February 2020. Staple crops like manioc, taro, and sweet potato were not yet ready when the cyclone struck. Banana, the other staple food, was completely decimated and was not available for at least 8 months. Livestock that broke out of their fences ate much of the remaining food, as no fencing materials were available for repairs. The cyclone damaged many existing water systems, breaking pipes, burying source springs, and shattering storage tanks. Because of slow and insufficient external relief, emergency operations were managed by a team of volunteers from the SSEN, Edenhope Foundation, and the Area Council, who helped communities to self-organise and begin their own response and recovery work using their inherent resilience and a wealth of TK practices. Some of these traditional practices include: constructing cyclone-resilient homes from wild cane and black palm, with low roofs supported by posts dug deeply into the ground, held together with strong bush ropes (lianas) and protected by large logs placed on roofs at the start of the cyclone season, and the house aligned north-south so that the long side is facing strong westerly winds; observing environmental signs of forthcoming cyclones and taking the necessary precautions - cloud movements, formations and colours, abundance of fruit, abnormal animal behaviour; collecting and preserving food before a cyclone arrives; using wild yams as disaster food; making home-made salt through the evaporation of sea water for preserving meat and fish; and accessing fresh water through storage in dry bamboo segments and knowledge of perennial upland springs.

The report also suggests that much of this traditional knowledge is confined to older people, with younger people no longer spending time with their elders to absorb this wisdom. Therefore, most communities along the west coast of Santo no longer contain many traditional cyclone-proof houses, and as a result of TC Harold, which was described by older people as being much stronger than anything they had previously experienced during their lifetimes, there is widespread interest to revive, re-learn, and put into practice such traditional resilience and coping strategies (Bartlett, 2020).

Although these two communications from western Santo on the role of TK in building resilience to cyclones cannot be considered as representative of Vanuatu as a whole, they do support two major findings from our survey. Firstly, the traditional cyclone indicators (weather observations, changes in flora, abnormal animal behaviour, cyclone birds) and traditional coping measures for cyclones (distinctive houses, long-term and short-term ways of assuring food and water security) are the same as those identified by both cohorts of survey respondents and correspond to those identified by other authors (e.g., Granderson, 2017; Le Dé et al., 2018; McNamara & Prasad, 2014; Mondragon, 2018; Nakamura & Kanemasu, 2020). Secondly, much of this TK is held by older people, who are unable to pass it on inter-generationally because young people are either not there or not interested, an observation made by some of the older Vanuatu-based survey sample; additionally, over one third of the USP sample said that young

people's use of efficient modern technology (especially mobile phones and the Internet) leads to a reluctance to rely on traditional warning signs or strategies.

Traditional Knowledge in Formal and Non-Formal Education

Primary and secondary educational curricula have been in the process of major revision since 2010, ensuring that both English- and French-medium schools offer common content from Years 1 to 13. The revised curriculum for primary schools includes aspects of resilience in Environmental Studies and Basic Science, with acknowledgement of the role of TK. Revised curricula for the junior cycle of secondary education (Years 9 and 10) are still being developed, so that as of 2020, schools were still reliant on pre-2010 content. This content has limited coverage of climate change and disasters through Basic Science and Social Science, with no inclusion of TK. New syllabi for the senior cycle of education (Years 11 to 13) were followed for the first time in 2020, although education at this level is no longer compulsory and most students have dropped out. In 2019, for example, just 1,064 students were enrolled in Year 13, compared with 8,150 when these same students were in Year 1 during 2007: an 87% attrition rate (Ministry of Education and Training, 2020; Ministry of Education, Youth Development and Training, 2007). In the senior cycle, resilience issues feature in curricula for Geography, Earth Science, and Development Studies, but these are optional subjects and TK is only covered in Development Studies. Since most learning about climate change and disaster risk reduction takes place in the senior cycle and is restricted to three optional subjects, we can conclude that the majority of young people in Vanuatu are not benefiting from formal exposure to resilience education and are not learning about traditional resilience strategies. This contrasts with the VCCDRRP's statement that TK should be "included in formal and informal school curricula" (Government of Vanuatu, 2015, p. 14).

At tertiary level, accredited courses on resilience have been offered through the Certificates I and III TVET programmes at the Vanuatu Institute of Technology since 2017, but the total number of graduates to complete both courses to date is less than 50. Unlike most other programmes, these two courses do contain explicit content on traditional environmental signs of approaching hazards and traditional coping strategies. The University of the South Pacific offers on-line courses that cover climate change and disasters and make reference to TK, but again, the number of participants is limited.

Non-formal public education on resilience is fostered by the NDMO and the Vanuatu Meteorological and Geo-Hazards Department but is largely carried out by non-government and civil society organisations such as Red Cross, Care International, Save the Children, World Vision, Oxfam, Live and Learn Environmental Education, Wan Smolbag Theatre, and the Vanuatu Christian Council. These organisations conduct awareness programmes for village communities and sub-national bodies such as Area Councils and CDCCCs, largely focusing on disaster preparedness and response, but recognising the importance of traditional knowledge, values, and resilience strategies. This is in accord with the implementation of the VCCDRRP, which stresses that adaptation and disaster risk reduction should be "owned and driven by communities through working within traditional and local knowledge and values so that these systems become more resilient" (Government of Vanuatu, 2015, p. 18).

In general, therefore, it seems that TK is largely absent from the formal curricula experienced by the entire school population of Vanuatu but is being fostered among a small minority of young people through TVET programmes and short courses offered by government and non-government actors. Thus, if the use of traditional resilience and coping strategies for cyclones and other hazards is to be fostered, we cannot rely on formal education; it must occur primarily through a re-invigoration of traditional transmission pathways.

Conclusion

Evidence from an ongoing survey of older individuals in rural areas of Vanuatu has demonstrated that traditional knowledge, skills, and values help to equip people with the means of reading natural warning signs that prepare them for cyclones and other hazards, with strategies for mitigating the negative effects of disasters, and with attitudes that enable survival and recovery. Reports from West Coast Santo, a remote area severely affected by Tropical Cyclone Harold in April 2020, demonstrate how such traditional strategies and attitudes, together with skills learned through modern courses and awareness programmes on resilience, helped inhabitants support themselves through their own resources, rather than relying on external aid. Further verification is provided by the forced localisation of responses to TC Harold throughout Vanuatu, with traditional leadership, sharing, and mutual assistance able to mobilise movements of root and fruit crops to stricken populations in the northern islands.

On the other hand, a survey of ni-Vanuatu studying at the University of the South Pacific in Fiji, young people who have spent a significant portion of their lives isolated from their cultural roots and sources of traditional wisdom, indicates that although they still acknowledge many of their traditional social values, 69% of them had little or no knowledge of traditional environmental signs or traditional resilience strategies. Generally, the decline in traditional knowledge is acknowledged by both survey groups as being due to reduced transmission from older to younger generations and by younger people's preference for the acquisition of knowledge through the Internet, social media, and cell phones. Further contributing to the decline in the use of traditional knowledge for building adaptive capacity is its near absence from school curricula, despite this being advocated in Vanuatu's National Climate Change and Disaster Reduction Policy.

However, the experience of Cyclone Harold demonstrates that traditional knowledge, skills, and values have a clear role to play in building resilience in Vanuatu, especially when used in conjunction with modern channels of communication and locally owned institutions such as Community Climate Change and Disaster Committees. This article supports the recommendations of other authors (e.g., Granderson, 2017; McCarter & Gavin, 2011; Nakamura & Kanemasu, 2020) that renewed efforts must be made to document, store, and promote the use of traditional knowledge and social capital. Government and non-government agencies at all levels can provide opportunities for older custodians of knowledge to actively engage and share their specialised skills and wisdom with women, youth, children, and other vulnerable groups. Centuries-old informal transmission pathways for building adaptive capacity for hazards and climate change must be revived and supplemented through formal and non-formal education, while at the same time recognising that resilience is at its most effective when both modern and traditional strategies are allowed to complement each other.

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Appendix: Structured interview questions/questionnaire

QTK1 Questions to be asked of a provider of traditional knowledge

NAME: ..... M☐ F☐ VILLAGE: ..... ISLAND .....
AGE: 10-19☐ 20-29☐ 30-39☐ 40-49☐ 50-59☐ 60-69☐ 70-79☐ 80 +☐

INTERVIEWER: ..... DATE: .....

1. **Wanem samfala saen we i soem se weta/klaemet i stap jenis o wan disasta i stap kam (saeklon, drae taem, etkwek, tsunami, volkeno...)?**
   What are some signs that show that our weather or climate is changing or that a disaster is coming (cyclone, drought, earthquake, tsunami, volcanic eruption)

2. **Yu save eni kastom fasin blo stanap strong lo fes blo ol disasta we i kamaot (saeklon, drae taem, etkwek, tsunami) ? (Olsem fasin blo bildim haos, planem kakae mo nara samting olsem)**
   Do you know of any traditional ways of being resilient to disasters such as cyclones, droughts, earthquakes, tsunamis, volcanic eruptions? (House design, cultivating crops, finding fresh water, etc)

3. **Ol save ia yu holem yu wan o yu stap pasem? Mo yu pasem lo huia?**
   Do you hold on to your traditional knowledge about weather and climate, or do you pass it on to others? If so, to whom?

4. **Hao nao yu stap pasem?**
   How do you pass on such knowledge?

5. **Yu save givim wan eksampol blo las taem we yu bin pasem save ia, mo lo hu?**
   Can you give an example of the last time when you transmitted this traditional knowledge, and to whom?

6. **Long kastom blo yu, yu sud pasem ol tradisonal save blo yu lo huia? Fasbon boe blo yu, ol pikinini blo yu, bubu blo yu, o hu?**
   According to your custom, to whom should you transmit your traditional knowledge? Your first-born son, your children, your grandchildren or who?

7. **Tedei, fasin we yu pasem save blo yu lo narafala man i stap jenis, o no? From wanem?**
These days, are there any changes in the way that you are transmitting your knowledge to others? Why?

8. **Wanem nao ol impotan valiu lo kastom we mekem se wan komuniti i save kam risilient (stanap strong) lo fes blo wan disasta?**
   What are some important traditional values that make a community more resilient in the face of a disaster

QTK2 Questions to be asked of a recipient of traditional knowledge

NAME: ..... M☐ F☐ VILLAGE: ..... ISLAND .....
AGE: 10-19☐ 20-29☐ 30-39☐ 40-49☐ 50-59☐ 60-69☐ 70-79☐ 80 +☐
INTERVIEWER: ..... DATE: .....

1. Yu bin kasem eni save abaot ol disasta mo jenis lo weta mo klaemet tru lo ..... (*nem blo man we hem i talem se hem i bin pasem*)?
Did you receive any knowledge about disasters and changes in weather and climate from ..... (*person who says he/she passed it on to you*)?

2. Aot lo man (woman) ia, yu bin kasem eni save abaot hao blo stanap strong lo fes blo ol disasta o jenis lo klaemet we i kam?
Did this person also pass on some knowledge about how to face and overcome the impacts of the disasters and changes in weather and climate?

3. Talemaot sam samting we yu bin lanem aot lo hem. (*Yusum nara saed blo pepa ia*)
Describe some of the things that you learnt from him/her (*You can write your answers overleaf*)

4. Long saed blo ol save ia, hem i bin talem lo yu o hem i bin soemaot lo yu?
Was this knowledge just received just through talking, or through demonstrating how to do things?

5. Yu bin yusum save ia lo laef blo yu? Givim sam eksampol
Have you used any of this knowledge in your own life? Give some examples.

6. Yu rimemba hamas long ol <u>save</u> we man o woman ia i bin traem pasem lo yu? :

- **Mi rimemba evri samting we hem i talem**
- **Mi rimemba fulap samting we hem i talem**
- **Mi rimemba smol lo wanem hem i talem**
- **Mi fogetem fulap samting we hem i talem**

Putum wan sekol raon long wiswan ansa we i stret lo yu

How much do you remember of the knowledge that he/she tried to transmit to you?

- I remember everything he/she told me.
- I remember quite a lot of what he/she told me.
- I remember a little of what he/she told me.
- I've forgotten most of what he/she told me.

7. Yu rimemba hamas long ol <u>skil</u> we man o woman ia i bin traem soem lo yu? :

- **Mi rimemba evri samting we hem i soem**
- **Mi rimemba fulap samting we hem i soem**
- **Mi rimemba smol lo wanem hem i soem**
- **Mi fogetem fulap samting we hem i soem**

Putum wan sekol raon long wiswan ansa we i stret lo yu

How much do you remember of the skills that he/she tried to demonstrate to you?

- I remember everything he/she showed me.
- I remember quite a lot of what he/she showed me.
- I remember a little of what he/she showed me.
- I've forgotten most of what he/she showed me.

8. Yu rimemba eni stamba advaes, tingting o bilif we man o woman ia i bin traem serem wetem yu? Sipos yes, traem talemaot wanem yu rimemba

Do you remember any basic attitudes or beliefs that he/she shared with you? If so, can you tell me what they were?

9. Taem we hem i talem o soem sam samting abaot weta o klaemet, o fasin blo stanap strong lo ol disasta, hem i talem wan taem nomo, o hem i stap ripitim plante taem ?

When he/she told or showed you something about weather, climate or being resilient, did he/she tell you just once, or did he/she repeat things over and over again?