

## ABSTRACT

Cyclone Pam was one of the strongest cyclones to hit the south-west Pacific. In 2015 it struck some of the most populated parts of Vanuatu, resulting in extensive damage. Remarkably, only 11 deaths related to the cyclone were recorded. There has been some media attention to this good news and the logical questions are: why was the death toll low, and are there lessons for other countries? This paper examines the cyclone effects and explores possible reasons for the relatively low loss of life. Considerations include effective warnings and the high degree of self-reliance within communities, as well as aspects of the cyclone, in particular, the absence of a storm surge and major flooding in the area.

# Cyclone Pam in Vanuatu: learning from the low death toll

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## Introduction

The south-west Pacific island nation of Vanuatu is ranked as the world's most vulnerable to natural disasters in the *World Risk Report 2014* (United Nations University 2014). This assessment was based on the country's location in the South Pacific and its exposure to natural hazards, along with its susceptibility and limited coping and adaptive capacities. Given this, it would seem reasonable to expect that Vanuatu would be seriously impacted when, in April 2015, one of the strongest cyclones on record hit some of the most populated parts of the country. As expected, there were significant impacts on most sectors of the economy. This included food crops, infrastructure and buildings. Estimates were that about 80 per cent of the national housing stock was damaged or destroyed (Secretariat of the Pacific Community 2015). Telecommunications ceased functioning in most areas. Infrastructure and food crops were badly damaged, with many tree crops lost. Water supplies were damaged or contaminated with salt water leaving nearly half the population (110,000) in need of clean drinking water (OCHA 2015). There was much speculation by government, non-government organisations (NGO) and the media that the death toll would be high. Vanuatu President, Baldwin Lonsdale, described the storm as 'a monster that has devastated our country' (News.com 2015). The United Nations had unconfirmed reports of 44 people killed in one province alone. 'A disaster of this magnitude has not been experienced by Vanuatu in recent history—particularly in terms of the reach of the potential damage and the ferocity of the storm' (Sune Gudnitz in UN-OCHA 2015).

However, the actual death toll was much lower than expected. Eleven deaths were attributed to the cyclone, with four of these being people in or attempting to move their boats. The reasons for this are important as low death tolls during major disasters are much desired but often elusive. The Vanuatu experience of Cyclone Pam could offer valuable insights.

## Vanuatu

The Melanesian island nation of Vanuatu consists of a chain of about 80 islands spread over 1300km of the south-west Pacific Ocean. The island chain lies in the cyclone belt and is threatened by an average of two cyclones a year. There are active volcanoes in the area and major earthquakes are frequent. This exposure underlies the nation's number one ranking in the *World Risk Report 2014*. Infrastructure is very limited and transport logistics and communications are challenging. Most wastewater is unmanaged and food and water security pose more challenges. An exception to this general pattern is the recently established successful mobile phone network.

The population of the country is about 253,000. Most Ni-Vanuatu (people of Vanuatu) live in rural areas and most (90 per cent) are engaged in subsistence food production and fishing. Languages of Bislama, English and French are widely spoken in addition to about 100 local languages. There are two major towns: Port Vila the capital with about 50,000 people and Luganville with some 15,000 people. Port Vila has large informal settlements with many squatters. These informal settlements do not have official sanction and are generally based on agreements with local land owners. Faith-based organisations and NGOs play key roles especially in disaster recovery and, to some extent, in preparedness. The formal economy is narrowly based and largely dependent on tourism, international aid programs and some agricultural exports. Vanuatu's Human Development Index ranking in 2015 was 134 out of 187 countries and territories. The United Nations lists it as a 'least developed country' (United Nations 2015).

## Cyclone Pam hits Vanuatu

Category 5 Cyclone Pam was the most intense tropical cyclone in the southern hemisphere in 2015 and the second most intense tropical cyclone ever in the South Pacific basin. Cyclone Pam was second after Cyclone Zoe in 2002 with a central pressure of 896hPa on March 14, and high wind speeds at one minute of 270km/h, ten minute 250km/h (similar to cyclones Orsen and Monica). A maximum gust of 320km an hour was reported. The previous most damaging cyclone to hit Vanuatu was the Category 3 Cyclone Uma in 1987.

Damage was extensive especially on the islands of Efate, around Port Vila and on the southern islands of Tanna and Eromango.

Despite its severity, some of Cyclone Pam's attributes reduced the risk:

- The cyclone moved relatively slowly as it headed towards Vanuatu giving time for warnings and preparation.
- The cyclone hit the populated areas in the islands of Tanna and Eromango during daylight hours (Port Vila was hit at night). This allowed people on the islands to monitor the direction of the cyclone and shelter accordingly.
- Populated areas were not subject to significant damaging storm surges, landslides or flooding.

The first two factors were highlighted by local people as important contributors to the low death toll. This research also showed that the absence of major flooding was important. The majority of deaths from tropical cyclones (including typhoons and hurricanes) are the result of flooding either from the sea or heavy rain and landslides. While it is beyond the scope of this paper to examine why the storm surge was small in this case, it should be noted that damage was limited because any surge that did occur was not near heavily populated areas (the cyclone made landfall on Efate island on the opposite side to the location of Port Vila).

Many factors influence surge size including storm intensity, cyclone central pressure, size (measured by

the 'radius of maximum wind'), angle of approach to land and the quadrant involved (with the left front quadrant of the cyclone having the strongest onshore winds in the southern hemisphere) and the characteristics of coastal and near shore features such as bays and reefs. Offshore bathymetry is also important and the state of the tide can be critical. Deep water nearshore, a wide bay protected by reefs, a cyclone approach coinciding with low tide and with the right hand quadrant making landfall first, would all contribute to a low storm surge.

## The research approach

A desktop study was conducted of the cyclone and the factors related to the reported fatalities. This was supplemented with information from contacts in Vanuatu. The desktop work was primarily based on internet searches and included Vanuatu print media. In addition to a wide range of government, individual and NGO website posts, blogs, media stories and interviews, there were formal reports on the cyclone and its immediate aftermath by NGOs. A news report by Bolitho (2015) identified text warnings, traditional building styles and preparedness as key factors in the low death toll.

A field visit to Vanuatu was undertaken in August 2015, five months after the cyclone. Discussions were held with local contacts including the Prime Minister and government ministers at the time of the cyclone, people running the emergency management office, officials working in the emergency management effort, representatives from the telecommunications authority, local business operators and major NGOs. In all there were about 15 discussions. Participants were fully informed about this study and the associated research on the role of digital volunteers in emergency management (see Acknowledgements). Apart from senior politicians and agency staff, people talked under an assurance of confidentiality. The original intent was to visit the affected areas of Tanna. However, logistic and other problems meant researchers stayed on the island of Efate. A Tanna perspective was provided through discussions with people from Tanna held in Port Vila and via media and online sources. A visit to the worst affected areas would have added confidence in the results, as would detailed community surveys about the warning messages, preparedness, shelter and attitudes and actions. Time, resources and practicalities mean that the research was limited and results need to be interpreted with this in mind.

## Low death toll

Factors important in the low death toll were identified as:

- effective warnings
- self-reliance and traditional knowledge and preparation
- training and evacuation
- shelter and housing.

These factors are in addition to the cyclone attributes identified earlier.

## Effective warnings

The effectiveness of Vanuatu’s early warning system was universally recognised as a key factor influencing the low death toll, especially when comparing the impacts to previous cyclones where phone network coverage and mobile accessibility were very limited. Initial warnings were issued days ahead of the cyclone reaching Vanuatu (refer Figure 1, Figure 2). Warnings took the form of advice on preparations and safety. These messages were broadcast via radio and especially text messages; the latter reaching most of the at-risk population (World Bank 2015). There are about 66 mobile phone subscriptions per 100 people and 90 per cent of the country is covered (World Bank 2015). Warnings were also broadcast by radio but there was evidence that some areas were not reached by this medium. In a review of modern communication across the Pacific, Noske-Turner and colleagues (2014) state that there were no formal agreements for the use of SMS in emergencies in Vanuatu. The National Disaster Office has been working on putting this in place for some time (Volunteer Service Abroad 2014).

The then Prime Minister, Mr Joe Natuman, commented that the cyclone moved slowly giving enough time for warnings. There was a view that many of the fatalities in previous cyclones resulted from people moving their boats to safety at the last minute. The longer warning time available for Cyclone Pam meant that many owners were able to move their boats in safety, although four people died in or while moving boats.

The two national mobile phone providers (Telecom Vanuatu and Digicel) made the official SMS cyclone warnings and all text messages free following a request from the Prime Minister. It was widely believed this was the most

effective way to contact the majority of people quickly both before (with details of the cyclone’s progress) and after impact (with health information and details of food distribution) (Arbon 2016). The emergency text messages included the threat level and the direction and location of the cyclone. The text-based warnings were widely re-distributed reaching much of the population. This is based on estimates of the number of people receiving pre-cyclone advice by text and the widespread ownership of phones. SMS messaging on cyclone preparedness sent several weeks before Cyclone Pam reached an estimated 120,000 people in all provinces. A media article by Willie (2015) describes the approach in more detail and a World Meteorological Organization (2015) report details these warnings.

There is no certainty as to what action people took when warned, but reports confirm people were not taken by surprise. Cyclone tracking maps are a useful part of early warning systems. They allowed people to track the progression of the cyclone via coordinates sent by SMS and radio messages. Maps also detail information on cyclone intensity and other attributes broadcast by radio and mobile phone messages (Tafea PDC 2015).

Although pre-cyclone warnings via emergency SMS messages appear to have been effective, post-cyclone effectiveness was limited by the number of mobile towers left standing. Cyclone Pam destroyed all but one of the mobile towers in Port Vila resulting in no communication with other provinces. The two telecommunications companies were encouraged to share the available resources while repairs were undertaken. The first repairs to damaged towers were made within days. A number of satellite phones were also distributed across the provinces and islands for official communication.

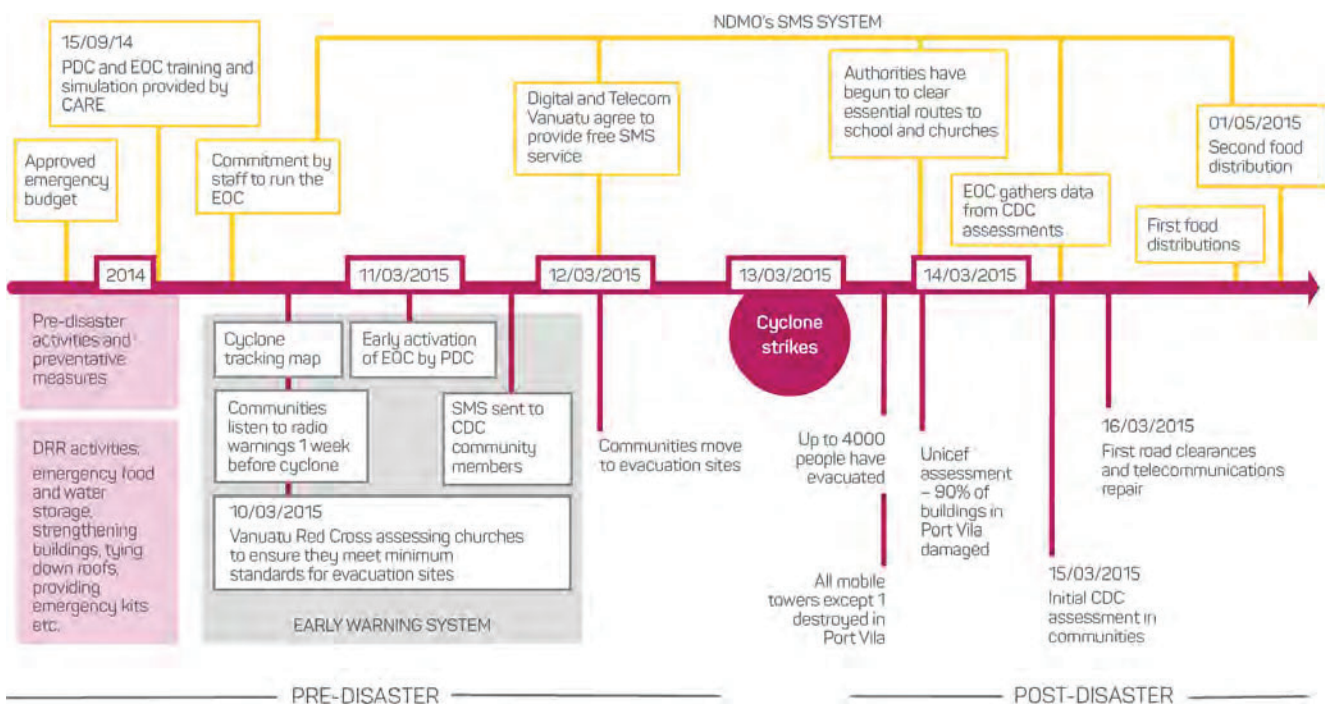


Figure 1: Cyclone Pam timeline.

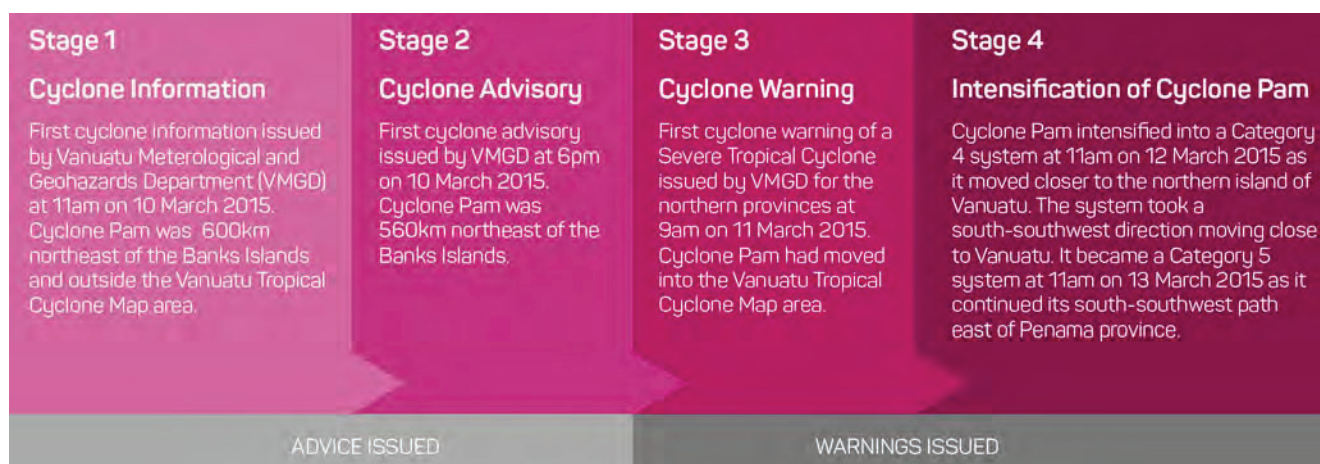


Figure 2: The four stages in the tropical cyclone early warning system in Vanuatu for Cyclone Pam. Advice was issued during stages one and two. Warnings were issued in stages three and four.

## Self-reliance and the use of traditional knowledge and preparation

Vanuatu's exposure to, and considerable experience with, cyclones means that the people are accustomed to these events and have developed coping mechanisms. These include a mix of traditional preparedness activities and self-reliance. Two main areas of traditional knowledge were emphasised: knowledge of traditional indicators of an approaching cyclone and traditional building styles including the use of traditional 'cyclone houses'. Preparedness and post-cyclone coping mechanisms were also contributors to recovery following the cyclone.

Although SMS warnings proved effective, some people do not have phones or live in areas without mobile phone coverage. As a result people on remote islands use traditional knowledge to detect the onset of a cyclone. For example, the abundance of a particular plant or the flight of a particular bird is thought to indicate the approach of a cyclone. These signs traditionally trigger activities such as cutting down the leaves of banana plants to prevent the trees from collapsing, tying down roofs, and storing food and water.

Knowledge and activity ascribed to tradition is useful in reducing cyclone impact and improving safety. The Vanuatu government promotes the use of such methods as a form of self-reliance and preparedness (McNamara & Prasad 2014). In a study of a 1999 tsunami, Walshe and Nunn (2012) found that both traditional knowledge and a recent tsunami-awareness program were important factors in the low death toll. However, traditional knowledge and beliefs have long faced challenges from missionaries, colonial authorities, modernity and, now, from environmental change. There is a view (supported by Walshe and Nunn 2014) that younger Ni-Vanuatu are more interested in modernity than tradition. This has major implications for traditional knowledge when nearly 60 per cent of Ni-Vanuatu are under 24 years old. Traditional knowledge and beliefs exist, but education in this area is declining and has a diminished role. Cyclone Pam highlighted the decrease in traditional famine crop gardens and storage of emergency food rations. In addition, the increasing incidences of crop diseases and theft and a rise in

preference for imported food provide new challenges (Warrick 2012).

Cyclone recovery tradition has been largely replaced with a reliance on government, NGOs and international aid. This is not necessarily a recent phenomenon. Barr (1992) made a similar observation in his review of disaster planning in Vanuatu, Warrick (2012) cites studies of food relief after cyclones in 1939 and 1972. Schreider (1957) comments on food aid dependency in his study of typhoons on the Micronesian island of Yap.

## Training and evacuation

Experience from previous cyclones is a factor in improving safety, however, training and evacuation are vital to survival. Many of those whose houses collapsed moved to a variety of shelters including roots of banyan trees, pig trenches, thick bush and caves. The effectiveness of evacuation in Tanna was helped by the fact that the cyclone hit during daylight hours.

Efforts were made by NGOs and government to evacuate people prior to the cyclone considered particularly vulnerable to flooding around Port Vila. The evacuation targeted both formal and informal settlements deemed at-risk based on local hazard maps. However, Save the Children found that the evacuation was hampered due to people's resistance to leave their homes and the government's reluctance to issue a code red alert. Although people were aware of the onset of the cyclone they weren't fully aware of the possible magnitude of what was about to hit. About 4000 people were evacuated, 1000 of whom were in Port Vila (Humanity Road 2015).

Evacuation centres were established to be somewhere people slept at night, while daylight hours were spent salvaging and rebuilding their homes. It was noted that although the rebuilding process was very quick, rebuild was to pre-existing standards and vulnerabilities. People rebuilt in the same locations with exactly the same materials as before (Shelter Cluster 2015, Barber 2015). Given the circumstances and the absence of alternatives, rapid rebuilding probably makes good sense: with many people on the edge of the cash economy with little alternative housing or livelihoods, with rebuilding

being straightforward and low cost, and with Category 5 cyclones being historically very rare. At the time of writing, some remote villages are still not rebuilt.

Area councillors noted that previous training by the Community Disaster Committee (CDC) and Provincial Disaster Committee, simulation exercises conducted by CARE in 2014 and the Vanuatu Humanitarian Team (an inclusive group with NGO and government representatives) in 2013, had been important. This training ensures that key provincial and local government representatives had some training in what to do during a large scale emergency response. Disaster response materials and kits were distributed to CDC members by aid organisations prior to the cyclone. The kits included solar power radios, containers for emergency water storage and information on water and sewage hygiene. The Red Cross helped identify 'safe houses' for evacuation. CARE was able to reach 4060 people with intensive help and follow-up. Vanuatu is so widely spread that this task is very challenging and, to date, programs have only reached approximately two per cent of the population.

## Shelter and housing – traditional and modern

Most construction in Vanuatu is informal and unregulated, apart from the central areas of Port Vila and Luganville. Traditional building materials dominate the more remote villages, while in other areas construction uses a mixture of materials as in the low-cost housing around Port Vila. This low-cost housing is constructed of a mix of 'modern' materials (cement, iron roofing etc.) but not built to building standards or codes. This makes communities more vulnerable to building damage and injury during natural events (Shelter Cluster 2015).

Local people believe that a factor in the low death toll and serious injuries was the widespread use of lightweight materials, in particular thatch, used in traditional houses. This meant injuries from falling masonry or flying metal cladding were rare. Similarly, post-cyclone injuries from dislodged traditional building materials were low. A report following Cyclone Pam by the Vanuatu Shelter Cluster found that buildings in the traditional style survived better than houses with cement sheeting and iron roofing and houses built using traditional materials but in modern styles (Shelter Cluster 2015). The research suggested that traditional roofing materials either survived the winds better, or if not, were easily repaired.

A report by Save the Children came to different conclusions:

*'Roofs constructed from natangura leaves and other thatch suffered greater damage than roofs made of corrugated iron, and walls made of bamboo suffered greater damage than walls made of corrugated iron or concrete.'* (Barber 2015)

Barber (2015) also found that in the aftermath of the cyclone, corrugated iron and concrete were significantly easier to access for reconstruction and repairs than natural materials such as thatch and bamboo.

Traditional houses constructed to be cyclone shelters, made entirely of local materials, present another form

of disaster-related traditional knowledge. They were seen by many as an effective form of shelter during Cyclone Pam (Shelter Cluster 2015). These 'cyclone houses' were promoted after Cyclone Innis (February 2009) that destroyed many of the 'normal' thatched houses. These cyclone houses are again being promoted by the government in rural areas after Cyclone Pam. 'This is the type of housing we should be building' stated the then Prime Minister—with the only on-land deaths apparently caused by dislodged heavy building materials. Cyclone houses have thicker thatch (than normal traditional houses) and a roof that extends to ground level. At least one end of the house is rounded to reduce wind resistance, the door is kept as small as possible and the frames are buried in the ground. The building materials are lashed together (rather than nailed) allowing the buildings to flex and bend without breaking up (Barr 1992).

The different views on housing style and materials highlight the limitations of the available studies, and the complexity of vulnerability. Traditional housing materials might not be as resistant as modern materials to high winds, but are less likely to kill or injure people. Informal settlements in Vila used modern materials in construction. There are few places in Vanuatu (Barber 2015) or indeed worldwide where housing is built to withstand Category 5 conditions. It is unclear that it is realistic or even desirable for all housing to be at such a standard; however, emergency shelters can be. One approach to address this is being trialled on Tanna. 'Nev houses' are prefabricated, flat-packed houses designed for extreme winds and for local Vanuatu needs. Thus, both traditional and modern approaches to cyclone-secure housing are being pursued.

## Conclusions

Cyclone Pam was a Category 5 event that passed directly over some of the most populated islands of Vanuatu in March 2015. There was extensive damage. However, far fewer people died than expected for a nation ranked at number one by the World Risk Report.

This study examined the factors identified as contributing to the low toll: effective timely warnings spread via mobile phone texts, self-reliance, preparation and knowledge of appropriate actions from both traditional knowledge and modern sources, training and evacuation, aspects of local housing and, critically, that the cyclone did not result in major flooding or storm surges in populated areas. There was strong endorsement of warnings sent by text, which have, to some extent, replaced warnings broadcast by radio. While texts are regarded as more effective, people also drew on traditional indicators for warnings. These may become less reliable in the context of environmental change. There was evidence that traditional housing fared better but this was disputed by a major NGO report (Barber 2015).

Increased emphasis on tradition is advocated by many, but avoiding modernity and the cash economy is difficult. People need money to pay for school, health care, some food and mobile phones. Without phones warnings cannot be received. The reasons for the low death toll can be viewed as a combination of traditional and modern aspects of community, telecommunications and government and NGO interventions.

It seems evident that a high degree of self-reliance combined with reliable, timely and informative warnings, and knowledge of what to do, saves lives. Critically, warnings and preparation appear to have been taken seriously. While Cyclone Pam was a Category 5 event, it moved slowly enough for warnings to be issued and did not bring on a damaging storm surge. We cannot be sure that the result would have been as good if there had been significant flooding—although government officials argued that they were aware of the possibility and took precautions.

Such extreme and historically rare events are expected to increase in frequency because of both climate change, and increasing exposure of humans and their activities to cyclones and other hazards. The Cyclone Pam experience suggests that the human cost can be minimised, but the destruction highlights the limits of preparations and adaptive capacity. This raises the question of how far a country should, and can, go to prepare for such rare events. However, locally appropriate and timely warnings and maximum message reach and take up, accompanied by preparedness training, is possible for most events. Other factors that underpin effective resilience are the involvement of civil society, government and NGOs in preparedness, strong support from commercial phone service providers and community leadership.

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