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“*Even if it doesn’t come, you should be prepared*”: tropical cyclone perceptions, remoteness and, implications for disaster risk reduction in rural Fiji

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**Abstract**

We examine disaster risk reduction among *iTaukei* living in Nawairuku village, in the highlands of Ra Province, Fiji through a case study of Tropical Cyclone (TC) Winston in February 2016 and a major flood event in December 2016. An analysis of 30 semi-structured interviews with villagers reveals that perceptions of risk influenced the ways in which people prepared for and experienced disaster impacts. Past experiences with less severe cyclones and floods made some people complacent and ill-prepared for the intensity of TC Winston and flooding. Consequently, everyone in the village sustained some degree of damage to their houses and farms with different capacities to recover. Rebuilding efforts mostly replicated previous building techniques due to the cost and availability of materials and some homes were rebuilt away from high-risk areas. We conclude that preparation is key to surviving a disaster and minimising harm, that accurate and timely information is needed to cue preparation, and that climate-proofing housing drawing upon modern and traditional construction methods, is needed to lessen the impact of future disasters.

**Keywords** (6 max): adaptation, climate change, natural hazard, Pacific Islands region, resilience, vulnerability

## 1. Introduction

The Pacific Islands region (PIR), including Fiji, is geographically exposed to a suite of natural hazards, including cyclones, floods, droughts, earthquakes, volcanic eruptions, landslides, and tsunamis (Campbell 2010). These hazards, except droughts, are considered episodic events with rapid onset (Sidle et al. 2017). In Fiji, hazards like cyclones and floods disrupt societal functions and cause widespread human, material, economic, and environmental losses (Nolet 2016). In recent decades, climate change has exacerbated existing natural hazards resulting in new risks to human livelihoods (Gallina and Sidle 2018). These changes are projected to continue, and in some cases worsen, in the future (Nurse et al. 2014). Pacific Islanders will have to adapt (de Coninck et al. 2018), and this is reflected in the increasing urgency with which adaptation is being considered in the PIR (Robinson and Dornan 2017).

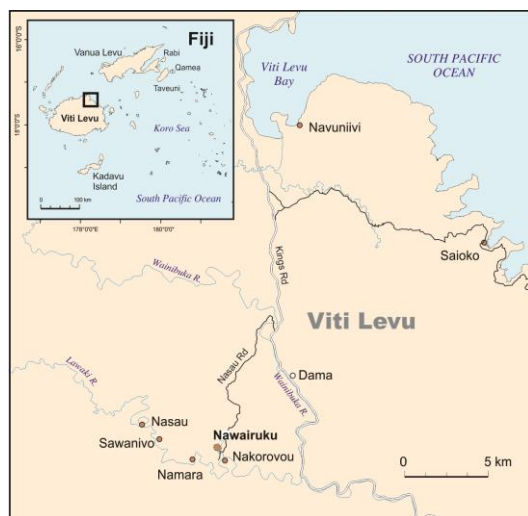
To initiate adaptation actions, decision makers and local peoples need to understand the nature of vulnerability to natural hazards in terms of who and what are vulnerable, to what stresses, in what way, and why, and also what is the capacity to adapt? This knowledge is particularly salient given the volume of climate change adaptation aid to the PIR (Donner et al. 2016). Community scale disaster risk reduction and climate change adaptation overlap and there is a need to combine efforts to enhance effectiveness and reduce confusion for communities (Gero et al. 2011). This involves understanding the cultural context of disasters and human-environment interactions (Mercer et al. 2012) as well as traditional coping strategies and their effectiveness to deal with emerging risks (Fletcher et al. 2013).

In this article, we examine aspects of disaster risk reduction among *iTaukei*, Indigenous Fijians, living in Nawairuku village, in the highlands of Ra Province, Fiji. Our examination focuses on how people prepared for, experienced and responded to Tropical Cyclone (TC) Winston in February 2016 and a subsequent major flood event in December 2016. The following sections provide a brief background on Nawairuku village, TC Winston and the extreme flooding event, and the research approach and methods used. We then turn to the results and examine how people prepared for, experienced, and responded to the disasters. The article is distinct from other disasters scholarship in Fiji in that it focuses on an inland village whereas most other scholarship has reported on the experiences of peoples living in the coastal zone (McCubbin et al. 2015; Nolet, 2016; Giardano et al. 2018; Walshe and Nunn 2012). The data presented in this article were collected as part of larger climate change adaptation project in the village (Currenti et al. 2019).

## 2. Case study

Nawairuku village is in the rural interior of Ra Province, Fiji at an elevation of 51 meters and 24 kilometres (km) from the coast (17°38'15.52"S, 178°12'51.66"E) (Figure 1). Ra Province covers an area of 1340 km<sup>2</sup> and has one major town, Rakiraki, which is located 43.6 km from the village via Kings Road. The village is situated within a riverine valley between the Tavunikoko and Namolaca

mountain ranges surrounded by steep forested and cultivated hills with slopes that are 30° in places. The village is adjacent to an upper-catchment tributary of the Lawaki River which, in turn, is a tributary of the Wainibuka and Rewa Rivers, all within the Rewa Basin. The village population is approximately 320, 100% *iTaukei*, living in 65 households. In Nawairuku, as is the case in most villages in Fiji, traditional *bures* (traditional Fijian house made of locally sourced natural materials) were mostly replaced with houses constructed from imported materials like iron roofing and walls, and treated pine framing timbers in the latter half of the 20<sup>th</sup> century (Fujieda and Kobayashi 2013). All families in Nawairuku rely on agriculture for subsistence and income.



**Figure 1** Location of Nawairuku village in Ra Province, Viti Levu, Fiji (Currenti et al. 2019)

### 2.1 Tropical Cyclone Winston and extreme flooding

Nawairuku endured two record-breaking events in 2016. First, TC Winston in February causing damage due to cyclonic winds and flooding; and second, a Tropical Depression (TD04F) causing extensive flood damage. Both events delivered a high volume of rainfall, but the flood event associated with TD04F resulted in a higher flood peak than during TC Winston.

TC Winston is the first-ever recorded Category 5 cyclone to make landfall in Fiji and the most intense tropical cyclone in the Southern Hemisphere on record (Di Liberto 2016). Winston crossed the northeast coast of Viti Levu and tracked westward leaving a trail of destruction, including 44 lives lost, some 131,000 people left homeless and an estimated FJD\$2.852b<sup>4</sup> (USD\$1.326b) worth of damage and losses (Government of Fiji 2016a). The Fiji Government estimates that 62% of the population (about 540,000 people) were directly affected by TC Winston (Miyaji et al. 2017). TC Winston passed directly over Nawairuku at approximately 2100 on 20 February 2016, severely affecting local agriculture, physical infrastructure, and human health and well-being with ongoing effects some two years later.

Nawairuku also endured a record-breaking flood associated with a slow-moving tropical depression approximately 10 months after TC Winston, (Tropical Depression 04F, or TD04F)

(ReliefWeb 2016). Floodwaters rose rapidly on 17 December 2016 at a time when the village was still recovering from TC Winston (i.e. rebuilding homes and re-establishing farmlands), causing widespread damage to infrastructure and cultivated land. People in Nawairuku reported the flooding to be larger and more severe than anyone could remember. While there was no monitoring instrument on the river that flows through Nawairuku, rain data from Nausori (54.6 km away) can be used to make comparisons between TC Winston and TD04F. Nausori received 147 mm of rain in the 24-hour period on 20-21 February 2016 (Davies, 2016), and 226 mm in the 24-hour period of 15-16 December 2016 (ReliefWeb 2016). Both 24-hour periods coincided with the major rainfall periods of the two events and thus the data backs up participants' observations that rainfall and consequent flood flows were greater in the December. Floodwaters forced businesses in Rakiraki town to close, and the area downstream of Nausori town was threatened by flood waters from the Rewa River, which peaked at more than four metres.

### 3. Research Approach and Methods

The research took a grassroots, bottom up approach to data collection that enabled participants to share their knowledge, experience and perspectives on disasters in their own ways without presupposing what conditions were relevant and important to them. This approach is consistent with others working on climate adaptation in the PIR (McCubbin et al. 2015; Pearce et al. 2018). Here, vulnerability is conceptualized as a function of *exposure* to biophysical changes, *sensitivity* to these exposures and *adaptive capacity* to deal with exposure-sensitivities (Smit and Wandel 2006). It is thus important to understand the biophysical nature of the disaster as well as the societal conditions that influence how people prepare for, experience and respond to disasters (Sidle et al. 2013).

Data were collected through semi-structured interviews using open-ended questions (n=30) over a 10-week period between June and August 2017 in Nawairuku. Participants were recruited using purposive (key informant) and snowball sampling techniques to achieve a demographically representative (age and gender) sample of the adult population (18+ years of age) (Table 1).

**Table 1.** Demographic characteristics of interview participants

Age	Male	Female
18-24	1	0
25-34	2	4
35-44	2	3
45-54	2	2
55-64	5	2
65-74	3	2
75+	1	1
<b>Total</b>	16	14
	30	

Interviews were usually held in or outside the participant's house, and conducted as a *talanoa*-style<sup>2</sup> conversation in the chosen language of the participant (English or Fijian (Ra dialect)). *Talanoa* is a process in which two or more people talk together, or where one person tells a story while the others listen (Nabobo-Baba 2006). The interviews conducted in Fijian were translated during the interview and transcripts were later verified by the local research partner, who is university educated and lives in Nawairuku. Interview questions concentrated on participant's experiences with TC Winston and the recent flood. We were particularly interested in preparations made before the onset of the events, impacts on lives and livelihoods, and immediate responses and longer-term recovery. Data were analysed following the principles of latent content analysis, which involved identifying recurring or common themes related to the broad categories of interview guide listed above (Bernard, 2012).

## 4. Results

### 4.1 Preparing for TC Winston and flooding

Participants' perception of the approaching TC Winston and TD04F was that these events would be no different to cyclones and heavy rain events experienced in the past. Older participants (>50 years) expected TC Winston to be like past cyclones (Table 2) and prepared accordingly (Table 3). Having heard radio warnings of cyclones and other extreme weather events in the past and in the end not being directly impacted by them also dissuaded people from over-preparing due to a false sense of security.

**Table 2.** Characteristics of Cyclones Bebe, Kina and Winston (Krishna, 1981; Prasad, 1993; Kuleshov et al., 2013)

Cyclone	Date	Category	10-min sustained wind speed (km h <sup>-1</sup> )	1-min sustained wind speed (km h <sup>-1</sup> )	No. of fatalities	Estimated damages (FJD)
Bebe	Oct 1972	3	155	205	24	\$20m
Kina	Dec 1992	3	150	220	26	\$170m (USD 110m)
Winston	Feb 2016	5	280	285	44	\$2.852b (USD\$1.326b)

Confusion in how to interpret warnings and the unexpected track of TC Winston also influenced how the village prepared for the cyclone. An initial warning was issued by the Fiji Meteorological Service on February 14, but as TC Winston tracked away from Fiji the warning was cancelled two days later (Fiji Meteorological Service 2016a; 2016b). When the cyclone doubled back towards Fiji, warnings were again issued on February 18 and continued until the system passed (Fiji Meteorological Service 2016c). General unfamiliarity with meteorological terminology such as 'Category 5', meant that many people were unaware of the intensity of the approaching cyclone and did not prepare for it.

Similar circumstances resulted in minimal preparations being made ahead of the major flood in December 2016. The Fiji Meteorological Service issued a flood alert and a press release relaying

information about Tropical Depression 04F (TD04F) on December 14, 2016 (Government of Fiji 2016b) but all participants said that no flood warnings were received in Nawairuku. Consequently, people were ill-prepared and caught-off guard. As the water levels in the river rose, many people resorted to hope and prayer to try to stop floodwaters from inundating their houses. Some people moved their belongings to higher ground ahead of time, but many waited until it was too late.

**Table 3.** Different methods of preparation for natural hazards described by participants in Nawairuku

Purpose	Method
Protect physical infrastructure	<ul style="list-style-type: none"> <li>• Dismantle <i>bolabolas</i> (temporary structures)</li> <li>• Cover windows with iron sheets</li> <li>• Secure roofs with iron rods or heavy stones</li> <li>• Hang gallon water containers from eaves to secure roof bracing</li> <li>• Trim fruit trees nearby houses</li> </ul>
Protect personal belongings	<ul style="list-style-type: none"> <li>• Move household belongings to higher ground</li> </ul>
Secure livestock	<ul style="list-style-type: none"> <li>• Untether livestock so they can instinctively seek shelter</li> </ul>
Increase food security	<ul style="list-style-type: none"> <li>• Cut cassava stems short to avoid wind damage</li> <li>• Keep an emergency stockpile of non-perishable foods</li> <li>• Plant <i>kumala</i> (sweet potato) in October/November so yield is ready for harvest in cyclone season</li> </ul>
Human well-being	<ul style="list-style-type: none"> <li>• Have phone with you to keep updated by warnings</li> <li>• Share warning updates with others</li> <li>• Plan evacuation route and emergency shelter</li> </ul>

#### 4.2 Experiencing TC Winston and flooding

No human lives were directly lost in the village due to TC Winston or the flooding, but the disasters had severe impacts on agricultural lands, built infrastructure and human health and well-being.

##### 4.2.1 Impacts on agriculture

Winds up to 300km h<sup>-1</sup>, heavy rainfall, and flash flooding associated with TC Winston caused physical damage to agricultural land, including landslides and waterlogging, which destroyed most crops. Participants reported losing whole harvests of *dalo* (taro), cassava, *vudi* (plantain), and the expected income they would have earned by selling the produce.

“Yes, many crops damaged in Winston. One year I didn’t get anything from the crops, one year no income. Just stay and try to rebuild to restart to earn the living. Replant everything and start planting again because Winston take it away.” (Male participant, Penisimani Rabenawa no. 2, 25 years, July 2017)

Some slopes that had been recently cleared for agriculture failed triggering landslides, something that villagers were not accustomed to seeing.

“I just see how forefathers do things. Before they didn’t plough the land, they only use fork and spade. That’s one thing that is different this time. This time, many places doing the farming have landslides because of spraying the land, because there’s no trees. Big trees were taken away. (Male participant, Epeli Raisevu, 58 years, July 2017)

Some agricultural plots were completely lost in landslides and fertile soil was stripped from the hillside within the landslide scars and runout zone. Loss of agricultural produce resulted in financial

hardships for some people. Similarly, during the December 2016 flood, some villagers lost whole plots of agricultural land that were washed away by floodwaters. The fertile, moist soils near the river are an attractive location to plant short-term crops and *dalo*, but plots located here and near the village drainage systems were particularly exposed to flooding.

#### 4.2.2 Impacts on built infrastructure

Participants described the impact of TC Winston on village infrastructure, including houses, community dwellings, [water and power distribution systems](#), and roads and bridges. One participant shared how his “*iron roof was torn away like paper*” (Male participant, 58 years, July 2017). 62 of the 65 houses in the village sustained damage significant enough to qualify for government funds for rebuilding. The Fiji Government offered vouchers of different values to purchase construction materials. Table 4 gives the breakdown of the three categories of damage and the respective amount of funding received. This dataset was obtained from records kept by the *turaga-ni-koro* (village headman) who recorded the damage to submit claims to authorities for recovery compensation. Many villagers were in the final stages of rebuilding their houses when the floodwaters associated with TD04F arrived further complicating re-building efforts. Layers of mud up to 0.6 m thick in some places carpeted the inside of houses, smothering woven mats, bedding, clothes, and other household belongings.

**Table 4.** House damage by TC Winston and "Help for Homes" recovery funds received

Category of damage	Number of households	Recovery funds allocated per house (FJD\$)	Total (FJD\$)
“Fully destroyed”	42	7000 (USD\$3256)	294,000 (USD\$136,744)
“Full roof damage”	9	3000 (USD\$1395)	27,000 (USD\$12,558)
“Partial roof damage”	11	1500 (USD\$698)	16,500 (USD\$7,674)
<b>Total</b>	62		337,500 (USD\$156,977)

Note: FJD\$2.15 = USD\$1.00

There is one unsealed road (Nasau Road, 11.7 km) that connects the village to Fiji’s “Ring Road” (Kings Road). The bridge (Savusavu crossing) on Nasau Road was destroyed by flood waters disrupting peoples' ability to access markets to buy and sell produce. The alternative route to Rakiraki town (markets, services) takes three additional hours and additional transport costs like time and fuel, limiting who can travel. It is notable that after TC Winston, a temporary bridge was constructed at the Savusavu crossing by the Fiji Roads Authority, which was again destroyed by floodwaters associated with Cyclone Josie and Keni both in early April 2018. At the time of writing, construction is underway on a permanent causeway to the value of FJD\$2,749,513 (Fiji Roads Authority 2018).

#### 4.2.3 Effects on human health and well-being

TC Winston and flooding had indirect effects on human health and well-being. Following TC Winston, one participant fell sick and was bedridden for a week with boils rising on her skin due to



unsanitary conditions, constantly being wet while cleaning, poor nutritional intake, and lack of clean drinking water. She believed the main reason that she, and other people, got sick was because of the damaged pipes and lack of access to clean drinking water. She further noted that the clean water from the school borehole and the hundreds of fallen coconuts were a blessing for Nawairuku, as sources of some hydration and nutrition.

There was a food shortage following TC Winston due to crop damage. A schoolteacher recalled children from Nawairuku and two other nearby villages bringing no lunch for school or not attending school due to having nothing to eat. Government-supplied rations were delivered by helicopter a month after TC Winston supplying flour, rice, sugar, cooking oil, canned food, and in the meantime, households depended on each other to share whatever food supplies they had on hand.

The disasters affected people's mental health. A female participant recalled her psychological struggle to comprehend and deal with the onset of another disaster, flooding, threatening to damage her house after recovering from TC Winston.

“Kini just got all the boys to take all the stuff up. The clothes, like that, Jo’s suitcase. Some other things. I don’t want to go and take anything up. Like I’m growling or what? I was thinking of the cleaning up, it’s very hard. Only Kini and the boys take the things, I don’t want to, I just sit here and look at them. Big job, big job.” (Female participant, Viniana Salabogi, 52 years, July 2017)

An elderly man suffered a stroke the day after the flood when visiting his house and seeing the intense damage throughout. He sadly passed away in April 2017, two months after his first stroke.

#### *4.4 Responding to TC Winston and flooding*

The post-disaster response and recovery effort involved months of rebuilding houses and re-establishing farmland. Immediate responses to TC Winston included clearing and burning vegetation and salvaging damaged construction materials to rebuild temporary housing (*bolabolas*). Villagers cleared mud and debris from Nasau Road to improve access for when help would eventually arrive, undertook repairs on the water reservoir and distribution pipes to restore access to drinking water, and cleaned household goods such as floor mats and bedding that were wet during the storm. Activity commenced the morning after the disaster and was continuing at the time of this research, 18 months after the event. TC Winston struck on a Saturday night and the following day, Sunday, was a religious day of rest, but villagers continued to work and instead sought God’s forgiveness.

Recovery efforts involved internal village labour and external financial and material support. External assistance was provided, including by CARE Australia (water, sanitation and hygiene (WASH) kits and shelter kits), Australian Defence Force (food rations dropped by helicopters), Habitat for Humanity Fiji (‘Build Back Safer’ awareness session), and the People’s Republic of China (temporary housing tents). As part of the Fiji Government’s coordinated plan to rebuild from TC Winston, the *Help for Homes* initiative was designed to assist people rebuild damaged homes and make them more resilient to future cyclones. 62 households applied for and were issued electronic cards that could be used at selected hardware retailers to purchase materials to rebuild. The amount of

funding was based on the extent of damage (Table 4). However, for some people, the amount of funding received was not enough to rebuild their house or use newly learned skills to improve structural integrity. As a result, these people chose to rebuild their house the same way it had been built previously, and some opted to purchase roofing iron and a chainsaw with the funds and venture into nearby forests to collect fallen logs and mill their own lumber. Participants acknowledged, however, that self-milled lumber would not match the longevity of purchased treated pine timber, potentially rotting and needing replacement sooner. The use of more robust building materials such as concrete in housing designs was ruled out by high prices and transportation costs.

Despite financial challenges, some participants acknowledged the need to decrease the sensitivity of their houses to disasters. Several people rebuilt their houses on higher ground, positioned them to avoid wind tunnels, and constructed houses with the narrow side of the house facing windward to reduce wind resistance. Having seen the ability of strong winds to peel iron roofing away from rafters, carpenters purchased and installed as many tie-downs and bracing rods as possible to reduce lift in future events.

## **5. Discussion**

We noted earlier that other disaster risks reduction scholarship in the PIR has mostly focused on the experiences of peoples living in the coastal zone. We cannot directly compare the experiences of people living in the coastal zone with those in Nawairuku, but our data suggest some important social conditions in interior villages that have implications for disaster risk reduction and response.

The finding that there were limited preparations made in response to disaster warnings shows that there is room for improvement on the disaster communication front. It is vital that accurate weather information is communicated in locally relevant ways, including terminology and modes of communication, to ensure that people take warnings seriously and act accordingly. Preparation is key to surviving a disaster and minimising damage, and adequate and accurate information is essential to cue preparation. *“Even if it doesn’t come, you should be prepared”* was the attitude adopted by some Nawairuku villagers after learning from the mistake of being underprepared for TC Winston (Male participant, 58 years, July 2017). This finding supports Ellis et al.’s notion that “experience is a central factor in motivation, and the more recent the experience the better” (2004, p. 42). Becker et al. (2017) note that people who have directly experienced a disaster can recall information better, which they can in turn use to inform future decisions for disaster preparedness. Given that prior to TC Winston the most relatable experience was Cyclone Kina in 1992, few people would have had the vivid recollection of the associated impacts. The fresh memory of the extensive damage inflicted by TC Winston and the flood has encouraged people, for the time being, to think proactively and implement damage mitigation measures. The question remains as to how long this ‘fresh memory’ of disaster will remain?

The finding that rebuilding efforts included the reconstruction of houses like those that were destroyed, suggests that some village infrastructure remains susceptible to harm from future natural hazard, especially those houses rebuilt in high-risk locations such as near the river. While some people are incorporating more bracing in the design of new houses, the typical iron-walled, iron-roofed structures with pine bracing are still vulnerable to cyclonic winds. Lack of essential resources like supplies, knowledge, expertise, building codes and financial capital confine people to building what they know (Aquino et al., 2019). Lack of financial support has also prevented people from rebuilding their houses to disaster-resilient standards (Magee et al. 2016). If another high category cyclone hits Nawairuku, the chances of which will be increased with climate change (Hartmann et al., 2013; Nurse et al. 2014), the village will be faced with the same structural inadequacies. Building designs must be climate-proofed for longevity and constraints overcome to promote resilient housing standards (Miyaji et al. 2017).

Climate-proofing infrastructure could involve returning to some traditional construction methods, which has not happened to date in Nawairuku. The traditional one-roomed, thatched roof, earth floor *bure* proved its ability to withstand the elements of extreme weather events, such as high velocity winds and heavy rainfall (Fujieda and Kobayashi, 2013). Traditional *bures* began to be replaced with contemporary houses constructed from newly introduced materials (iron roofing and walls, treated pine framing timbers) in the latter half of the 20<sup>th</sup> century (Fujieda and Kobayashi, 2013). This transition saw the loss of *bures* and with it, the comfortable and climate-resilient designs. While it may not be feasible or desirable for all buildings to be constructed as *bures*, because of access to building materials, changing motivations, and absence of knowledgeable *bure*-building teachers, some traditional building techniques could be used in modern construction. Furthermore, construction of storm water drains in the village could help alleviate uncontrolled runoff and erosion.

In Nawairuku, generations of exposure to natural hazards should provide the population with a knowledge platform for effective decision-making. However, in the wake of TC Winston and subsequent flooding, it is apparent that previous knowledge is not always useful when a larger event strikes if people are accustomed to smaller events (Sidle et al. 2017). Similarly, existing knowledge of climate risks may be insufficient to deal with the types and scales of risks that are yet to be experienced (Mercer et al. 2010). Participants explained that because of their lack of preparation for TC Winston and the consequential damage sustained, the village is more likely to prepare better for future cyclones. It was noted that several weeks after TC Winston, a warning was issued for another cyclone and villagers were far more responsive than before, indicating that some degree of social learning had taken place.

## **6. Conclusion**

In this article, we examined how people living in Nawairuku village prepared for, experienced, and responded to TC Winston and a major flood event. The findings of this research

provide insights into how natural hazards are experienced and responded to by people living in an interior village in Fiji and raise questions about the ability of current disaster risk reduction efforts to cope with expected future hazards. First, local perceptions of risk influence the ways in which people respond to warnings and prepare for disaster impacts. People's understated perception of risk from TC Winston resulted in inadequate preparation for its impact. Second, level of preparation affects the amount of damage sustained by disasters. Early and ongoing preparations are vital to ensure the best chances for survival and reduced harm. Thirdly, while experience with past disasters can contribute to resilience, people's historic knowledge of, and familiarity with, less-severe events can contribute to some degree of complacency in the face of new hazards. Finally, the speed of onset and intensity of hazard events like TC Winston and flooding, challenge local knowledge of weather forecasting. This raises the question of how long it will take for local knowledge systems to adapt to new conditions. Taken together, these findings provide the basis for a renewed conversation on disaster risk management in Fiji under changing climatic conditions. Future work in Nawairuku and elsewhere in Fiji should attend to these important social factors if we are to better understand natural hazards and what they mean for people in the PIR.

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