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Tourism destinations' vulnerability to climate change: Nature-based tourism in Vava'u, the Kingdom of Tonga

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Abstract
Tourism plays an important role in economic and human development in the Pacific. These benefits are at risk from the impacts of climate change, threatening the sustainability of the Pacific tourism sector. We assess the vulnerability and resilience of nature-based tourism in Vava'u, Tonga, using the Destination Sustainability Framework of Calgaro (2014) modified for a climate change focus. Our empirical assessment indicates that the following factors increase vulnerability levels in Vava'u: strong seasonality, dependency on air access, remoteness, limited connectivity of Vava'u from national decision makers and limited human and financial resources. Resilience levels in Vava'u are heightened by a high awareness of climate change, the resilient nature of Tongans and strong family and social networks. In conclusion, we recommend a set of adaptation strategies to further improve resilience levels, namely improving climate change education, increasing product and market diversification, strengthening institutional capacities and mainstreaming adaptation in national policies.

Keywords
Vulnerability assessment, climate change, adaptation, Vava'u, Tonga, nature-based tourism, resilience, island tourism

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Introduction

The tourism industry is particularly sensitive to climate variability and change (Richardson and Witkowski, 2010). Tourism destinations will increasingly be affected both directly (e.g. travel behaviour, capacity to travel, destination perceptions, destination attractiveness) and indirectly (e.g. mitigation policies, physical environmental, economic and socio-political change) by these changes (Scott et al., 2011). The resulting complex system of interrelated drivers and uncertainties leaves decision makers with the difficult task of finding solutions adapt to climate change.

This issue is of great concern to Small Island Developing States (SIDS) that rely heavily on tourism to drive economic growth and employment (Burns and Vishan, 2010; Scheyvens and Momsen, 2008). Remote and developing populations often have few livelihood alternatives (Bankoff, 2003; Scheyvens and Momsen, 2008). The Intergovernmental Panel on Climate Change (IPCC) (2007) predicts that SIDS are especially vulnerable to the effects of climate change, sea-level rise, and extreme events. Climatic changes are expected to place greater strain on populations, like SIDS, that are already dealing with the impacts of multiple and often compounding natural hazard events (Kelman and West, 2009; Mercer, 2010). Key identified risks for small islands include the loss of livelihoods, coastal settlements, infrastructure, ecosystem services, and economic stability (IPCC, 2014).

Climate change is threatening the sustainability of many island destinations in the Caribbean, Mediterranean, Indian Ocean and the Pacific Ocean due to greater climate variability and the possible increase in extreme events (Becken and Hay, 2007; Gössling et al., 2009; Scott et al., 2008). The decline of coastal zone conditions will damage local resources, infrastructure, and negatively affect tourism (Burns and Vishan, 2010; United Nations Framework Convention on Climate Change (UNFCCC), 2005). The threat posed by climate change to tourism destinations in the Bahamas, Maldives and Tuvalu is well known (Gössling et al., 2009). In the Caribbean, for example, a one meter rise in sea level would likely result in losses of over 50% of coastal properties in five countries, three of which are highly dependent on tourism (Anguilla, British Virgin Islands and Turks and Caicos Islands). Scott et al. (2012) observe that this same threat will challenge the sustainability of SIDS destinations worldwide.

Like many SIDS, those in the Pacific face multiple challenges that are linked to development issues and the compounding impacts of natural hazards and climate change. Development options in Pacific SIDS are often constrained by their small size and populations, limited natural resources, poor accessibility, lack of skilled staff and local capital, and sensitivity to global developments and environmental changes (Harrison, 2004; Klint et al., 2015; Mercer et al., 2007; Scheyvens and Momsen, 2008). Consequently, many Pacific Island countries have identified tourism as a priority area for their social and economic development (Jiang and DeLacy, 2014). The Pacific is also one of the most disaster prone regions in the world. Pacific SIDS are regularly exposed to hydro meteorological (floods, cyclones, storm surges, and droughts) and geophysical (earthquakes, volcanic eruptions, and tsunamis) events, which collectively interrupt the development trajectories and goals of the affected countries (Asian Development Bank, 2013). Climate changes are expected to further exacerbate these existing vulnerabilities (Calgaro et al., 2014a; Scott et al., 2008).

Despite this growing concern, little is known about the complex factors and processes that influence the vulnerability and resilience of SIDS destinations in the Pacific to climate related hazards (Jiang and DeLacy, 2014). Given the potential threat climate change impacts pose to tourism-dependant Pacific Island communities, the next critical question is: how might such destinations adapt to future climate change? We address this by looking at the Vava'u Island group in Tonga as a case study for examining the vulnerability to climate change in the tourism sector. Tonga is a SIDS nation in the South Pacific (Figure 1). The island archipelago of Vava'u is heavily reliant on nature-based tourism activities and predictions suggest that these types of activities may be particularly vulnerable to climate change (UNWTO, UNEP and WMO, 2008).

We begin with a brief overview of Pacific SIDS, and the challenges the tourism sector faces in responding to climate change. This is followed by an examination of the concepts of vulnerability and resilience and what is already known about the drivers of tourism vulnerability. We then turn our attention to Tonga and use Vava'u's nature-based tourism industry as a platform for examining tourism vulnerability levels to climate change in SIDS in more depth. We identify the various shocks and stressors that Vava'u is vulnerable to (with a particular focus on climate-related events) and the causal factors and processes that determine the vulnerability and resilience levels of the destination to these risks. Drawing upon these findings, we conclude by offering a set of adaptation strategies and policy recommendations that may help build the resilience of the destination to future climate change.

Pacific SIDS, tourism and climate change

Of the 22 Pacific Island Countries, 20 are classified by the United Nations as SIDS. On a global scale the economic

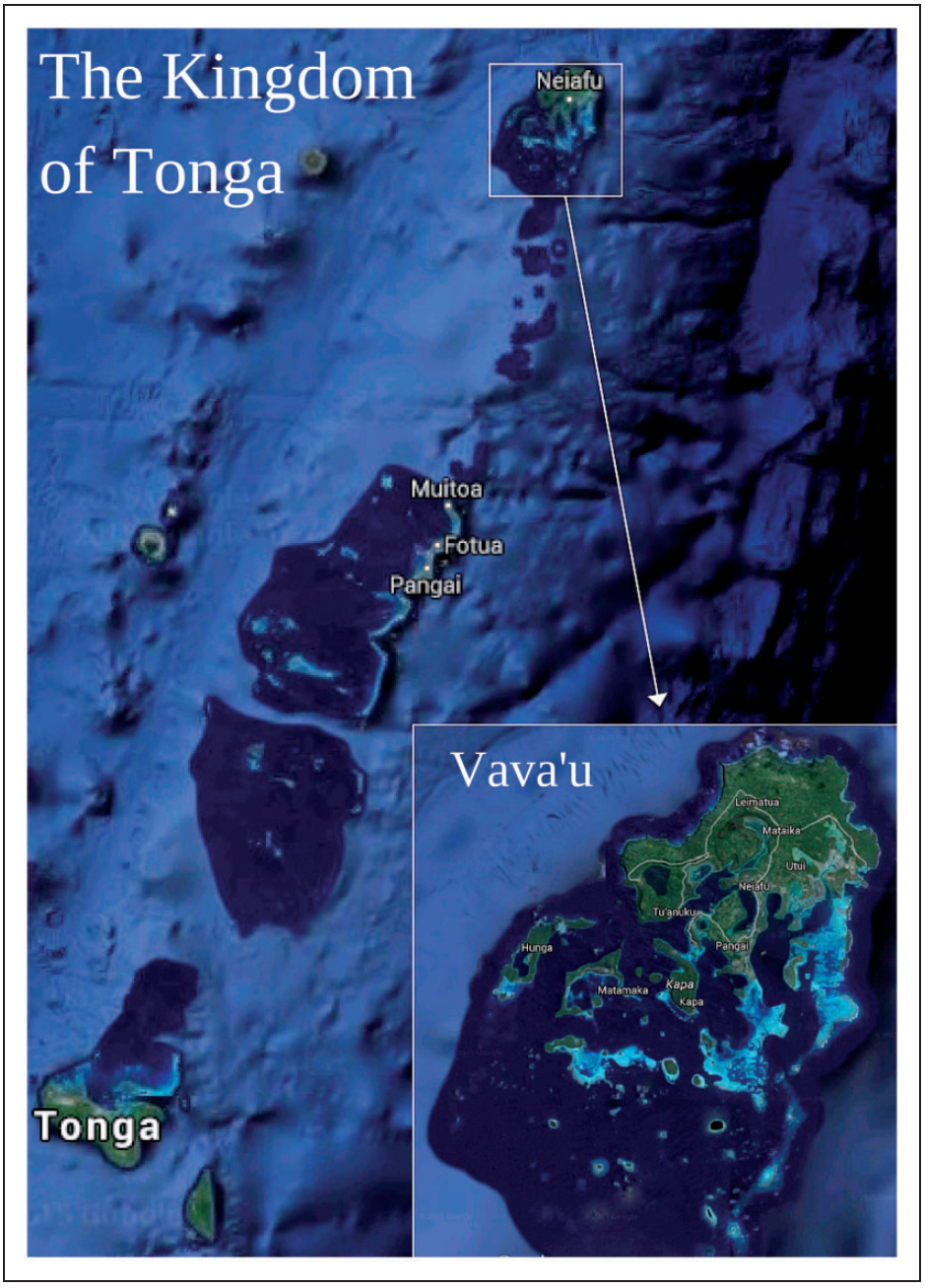


Figure 1. Map of the Kingdom of Tonga and the island group Vava'u.
Source: Google map with drawings by author.

significance of tourism in the Pacific is small. However on a local scale it is significant (Commonwealth of Australia, 2009). With the observed changes in the climate and the predicted changes to the climate and environment for the remainder of the 21st century, tourism destinations in the Pacific region are among those most at risk to the effects of climate change (Klint et al., 2015; Scott et al., 2008). Consequently, the success and viability of tourism as a livelihood option, along with subsequent advancements in development, are threatened by extreme events and climate change.

The tourism sector contributes significantly to the gross domestic product of Pacific island countries (Becken and Hay, 2007). The sector is the largest source of income and the fastest growing industry in the region, providing opportunities for economic growth, employment and sustainable development in places (Crocombe, 2008; Harrison, 2004). In the Pacific, tourism is the only sector to have seen sustained growth in recent years, whilst the real value of primary export products has declined (Scheyvens and Russel, 2009). With the positive effects of tourism,

many countries in the South Pacific have welcomed tourism as a tool to alleviate poverty and improve economic growth (Harrison, 2004; Jiang et al., 2010). However, the Pacific tourism sector will continue to face several challenges including to climate change.

Throughout the Pacific region, frequent and more intense tropical cyclones were experienced during the 1990s (UNFCCC, 2005). Small size, remoteness, and fragile biodiversity of Pacific SIDS greatly decrease their capacity to effectively manage these collective risks (Asian Development Bank, 2013). These same characteristics also leave Pacific SIDS highly vulnerable to climate variability and change (Becken and Hay, 2007; IPCC, 2012).

Projected climate change manifestations for the Pacific region include sea-level rise, annual rainfall increases, higher temperatures, the incidence of extremely hot days, sea surface temperature changes and associated storms, to the El Niño-Southern Oscillation, and more intense tropical cyclones (CAWCR, 2011; IPCC, 2012). Impacts of climate change are potentially disastrous to the region. These involve inundation of land because of storm and sea-level rise, extensive coastal erosion, coral bleaching, salinization of groundwater, persistent alternations of regional weather patterns, decreased productivity in fisheries and agriculture, and increases in the distribution and frequency of mosquito-borne diseases (UNWTO, UNEP and WMO, 2008).

These changes are expected to negatively impact tourism development (Becken and Hay, 2007). Impacts most likely to affect tourism destinations include damage to infrastructure, beach erosion, a decrease in destination values and attractiveness, stress on marine environments (especially coral bleaching) and increasing carbon taxes resulting in a decline in tourism flows (Garrod and Gössling, 2008). Together, these impacts have the propensity to diminish the viability of tourism operations in Pacific destinations and the businesses that support tourism activity. This is of great concern considering that tourism plays an important role in alleviating poverty and achieving the Millenium Development Goals for Pacific SIDS (Jiang et al., 2015).

Pacific island communities have demonstrated their resilience to past and present risks (Barnett and Campbell, 2010; Campbell, 2009). Traditional risk management centred on maintaining food security, inter- and intra-community cooperation, and building in such a way that protected settlements from coastal hazards (Campbell, 2009). Still, developmental challenges restrict their capacity to adapt to climate change impacts, leaving Pacific SIDS among the most vulnerable in the world to these impacts, and presents them with another unquantifiable challenge (Becken and Hay, 2007; UNWTO, UNEP and WMO, 2008). Additionally, the IPCC (2014) expects that efficacy of traditional community coping strategies will be substantially reduced in the future.

Despite the significance of tourism in the Pacific and its vulnerability to climate change impacts, adaptation of the Pacific tourism sector to climate change has not been addressed in any systematic way (Jiang et al., 2015). Climate change research that focuses on developing countries is still limited and the current knowledge-base is yet to provide a solid understanding of how adaptive capacity and resilience translates into effective responses to climate change (Barnett and Campbell, 2010; Becken, 2013). Additionally not all climate change impacts are felt or experienced equally across different tourist destinations so the focus of policy making is likely to differ accordingly (Becken and Clapcott, 2011). This research adds to the current knowledge-base of climate change vulnerability in the island destinations by identifying the different types of climate change impacts and extreme events that Tonga faces, determining those factors that influence patterns of vulnerability and resilience, and present actions that the destination community and its supporting institutions can take to better improve their resilience and adaptive capacity to future events. By developing a better understanding of the adaptive capacity of destinations, steps can be taken to address climate change in the Pacific tourism sector.

Vulnerability and resilience in the context of tourism

The last decade has seen the emergence of strong interest in understanding the drivers of vulnerability and resilience in the tourism system and individual destinations and examining how these risks might affect long-term sustainability (Becken, 2013; UNWTO, UNEP, and WMO, 2008). Identifying and redressing the drivers of destination vulnerability allow for the development of targeted and effective adaptation strategies (Calgaro and Lloyd, 2008). Tourism-specific enquiries build upon wider insights from vulnerability research, resilience thinking and sustainability science (see Calgaro et al., 2014a). Drawing upon this broader work, we define vulnerability as 'the degree to which an exposure unit [individuals, households, human groups, communities] is susceptible to harm due to exposure to a perturbation or stress, and the ability of the exposure unit to cope, recover, or fundamentally adapt (Kasperson et al., 2001: 7). Vulnerability is closely aligned with resilience but they are not antonyms or the flip-side of one another (IPCC, 2001). Instead, these dynamic properties of the coupled human–environment system are co-constituted and co-exist in the same communities, environments and economies (Calgaro et al., 2014a;

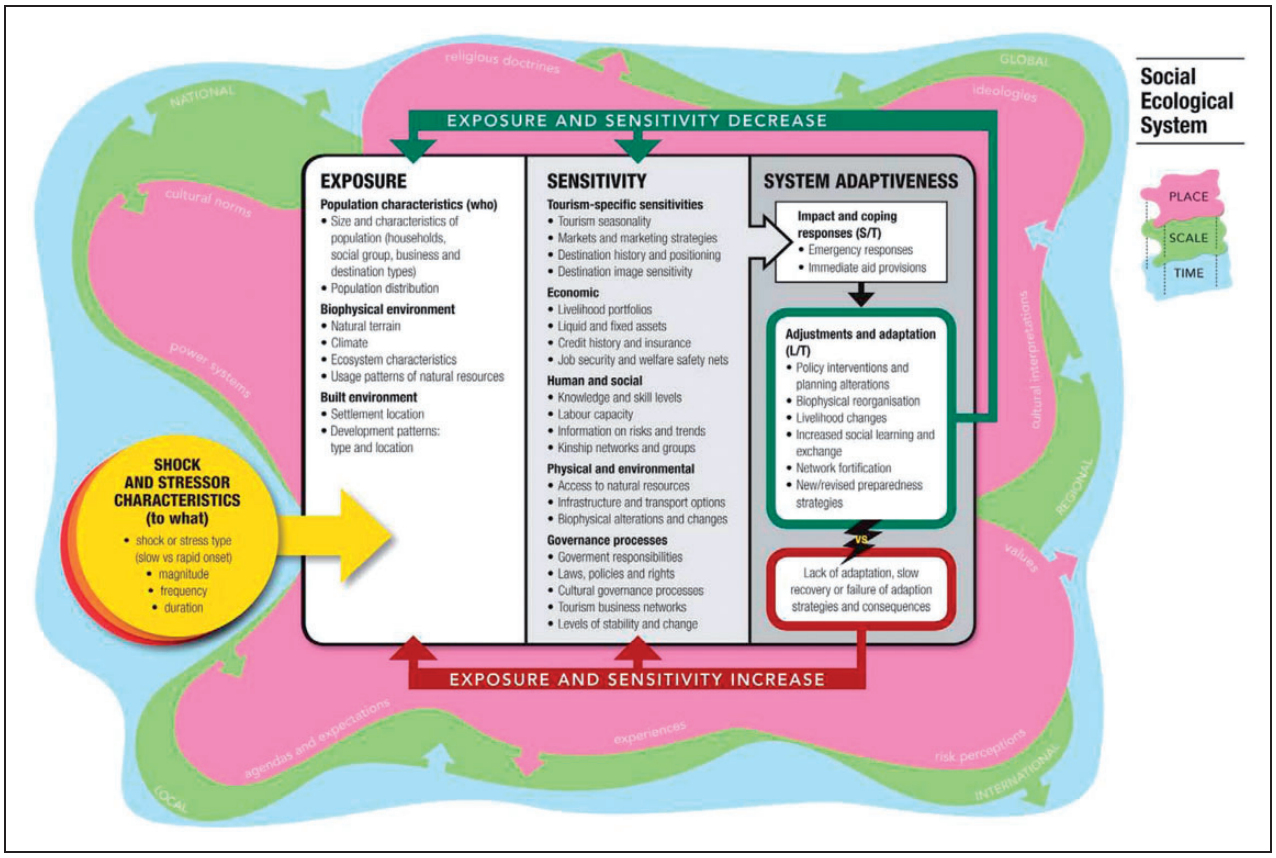


Figure 2. Destination Sustainability Framework (DSF).
Source: Calgaro et al. 2014a.

Scheyvens and Momsen, 2008). Resilience is the ability to absorb changes in climatic conditions and is associated with resistance and readiness (Walker et al., 2004). Resistance reduces the number of impacts that are likely to affect tourism, whilst readiness is the ability of the destination to deal with changes and seize on opportunities that arise (Sivell et al., 2008). Together, fluctuations in vulnerability and resilience levels within a given system will influence the extent to which society can cope with and effectively respond to changes over time and space (Tompkins, 2005).

Vulnerability is place- and system-specific, contextualised, highly scaled, dynamic, and differential (Adger, 2006; Calgaro et al., 2014a; O'Brien et al., 2008; Turner et al., 2003). Vulnerability is largely determined by an individual's or group's ability to access socio-political, economic and environmental resources, which in turn is regulated by power systems, formal and informal governance structures and processes, social norms, culture and human agency (Adger, 2006). Narrowing the focus to the tourism context, research suggests that destination vulnerability and resilience levels are influenced by a combination of multiple, dynamic and interacting factors including geographical exposure, tourism sensitivities (seasonality, markets and marketing strategies, destination image sensitivity levels), destination-specific development characteristics (destination history and positioning), unequal access to resources (socio-political, economic, physical), social norms and structures, and governance processes (Calgaro and Lloyd, 2008; Calgaro et al., 2014a, 2014b; Klint et al., 2012a; Lambert et al., 2010; Nyaupane and Chhetri, 2009; Turton et al., 2010).

The Destination Sustainability Framework (DSF) shown in Figure 2 captures how these factors and processes influence vulnerability levels to risk in the coupled human–environment system (Calgaro et al., 2014a). Vulnerability assessments begin by identifying what people are vulnerable to – depicted as the trigger *shock* or *stressor* that destabilises the system in the DSF – and determining the pre-existing physical attributes (listed under *exposure*) and social characteristics (grouped under *sensitivity*) of the system that influence its ability to withstand the impacts of the shock. It also charts how resources (listed under the sub-categories of economic, *human and social*, *physical and environmental*) are used to cope post-event (depicted by the

arrow linking the resources listed under *sensitivity* to *system adaptiveness*), and the outcomes of response actions on future vulnerability levels (depicted via the *feedback arrows*). Finally, the DSF acknowledges the dynamism of vulnerability and the deep-rooted contextual factors (shown in *place*) that shape all social actions and processes (including vulnerability creation and perpetuation) across multiple *scales* of social organisation over *time*.

Factors found to influence tourism vulnerability levels to climate change specifically correlate with those identified in broader body of tourism vulnerability and resilience research (Calgaro et al., 2014a). These climate-related factors include:

(i) The place-specific nature of tourist activity (Lambert et al., 2010; Orams, 2013; Scott et al., 2012; Wall, 2007; Moreno and Becken, 2009);
(ii) Ecological fragility (Evans et al., 2013; Nepal and Chipeniuk, 2005);
(iii) Livelihood dependency on tourism often due to restricted options (Jodha, 2001; Kaján, 2012; Wall, 2007);
(iv) Seasonality levels (Lambert et al., 2010; Nyaupane and Chhetri, 2009; Scott et al., 2003; Wall, 2007);
(v) Destination remoteness and inaccessibility (Jodha, 2001; Kaján, 2012; Nepal and Chipeniuk, 2005, Nyaupane and Chhetri, 2009);
(vi) Travel motivations and consumer choices (Becken and Hay, 2007; Gössling et al., 2012; Hopkins et al., 2013);
(vii) Institutional inflexibility (Wall, 2007); and
(viii) Socio-economic and governance settings (Biggs et al., 2015).

Despite sustained research on climate change impacts on island tourism, there is still little information on the breadth of factors and processes that influence vulnerability and resilience levels to climate change in the island destination context (Becken, 2013; Hall, 2008; Jiang and DeLacy, 2014; Jiang et al., 2015). Risk level assessments are not necessarily comparable as potential impacts and adaptation in different physical, biological and human systems across diverse contexts need consideration (Hall, 2008; IPCC, 2014). Therefore, the findings of the vulnerability assessment of nature-based tourism sector in the Vava'u island group of Tonga will provide valuable place-specific evidence of the drivers of destination vulnerability and resilience to climate change in this important and unique geopolitical context. This will also add to the growing knowledge-base on destination vulnerability to risk and our wider understanding of the complexity involved in building a destination's resilience to future events.

Case study focus: Nature-based tourism in Vava'u, Tonga

Located in the Polynesian region of the Pacific, the Kingdom of Tonga is geographically remote, comprising of 176 islands that are spread across 700,000 km^2 of ocean (Figure 1). Tonga's resident population is 101,991 (Central Intelligence Agency (CIA), 2011; Tonga Department of Statistics, 2007). Having never been colonized, core components of the Tongan culture still play an important part in daily life. Tongans are guided by four core values: Fe'apa'apa'aki (mutual respect), Feveitokai'aki (sharing, cooperating and fulfilling mutual obligations), Lototoo (humility and generosity) and Tauhi vaha'a (loyalty and commitment) (Tonga Visitors Bureau (TVB), 2010).

Tourism development is found in 61 of Tonga's islands and the main attractions are nature-based (TVB, 2010). Vava'u – a group of 41 islands – is the focal area of tourism activity in Tonga with 83 registered tourism businesses (TVB, 2010). Tonga's tourism sector is relatively small by regional standards. In 2010, the country received 74,087 visitors – 45,430 by air, 2452 by yacht and 26,205 from cruise-ships (Tourism Visitors Bureau, 2011). Total arrivals are projected to reach approximately 92,700 by 2015 (Tourism Visitors Bureau, 2011). Nonetheless, tourism is the country's largest foreign exchange earner and is a crucial source of employment. As stated by a public stakeholder, "*tourism is really the only industry that Tonga has got that's going to work well into the future and it has got the best growth potential over any other industry by far.*" The World Travel and Tourism Council (WTTC) expect tourism to generate 16% of GDP and 7000 jobs in Tonga (20.7% of total employment) by 2021 (WTTC, 2011).

Nature-based tourism is particularly vulnerable to climate change due to its dependence on a high diversity of natural resources (landscapes, species, ecosystems, outdoor activities relying on specific resources like tides for sailing) (Richardson and Witkowski, 2010; UNWTO, UNEP and WMO, 2008). This has direct implications for tourist flows and demand (Gomez Martin, 2005). Most businesses in Tonga and Vava'u operate tours and activities related to nature-based tourism (TVB, 2010). The humpback whales present in the waters of Vava'u are an extremely valuable tourism resource for Tonga (Orams, 2013). However, "*sea temperature rise seems to have an effect on whale migrations*" as identified by a local tour operator. A tourism association representative stated, "*If this is really happening it would have quite a disastrous effect on the industry as whale watching is our main source of income.*" Vava'u is one of the few places in the world that allows humans to swim with whales (McKinnon et al., 2009).

As most of the tourism products in Tonga are based on natural resources, consideration of climate change's impacts on these resources is crucial. Given the importance of tourism development in the Tongan economy, reducing the sector's vulnerability to climate change risks needs to be a vital component of the country's overall adaptation approach.

Figure 3 provides an overview of Vava'u's nature-based tourism system. The Tourism Generating Region (TGR) box provides an overview of the demand side with the

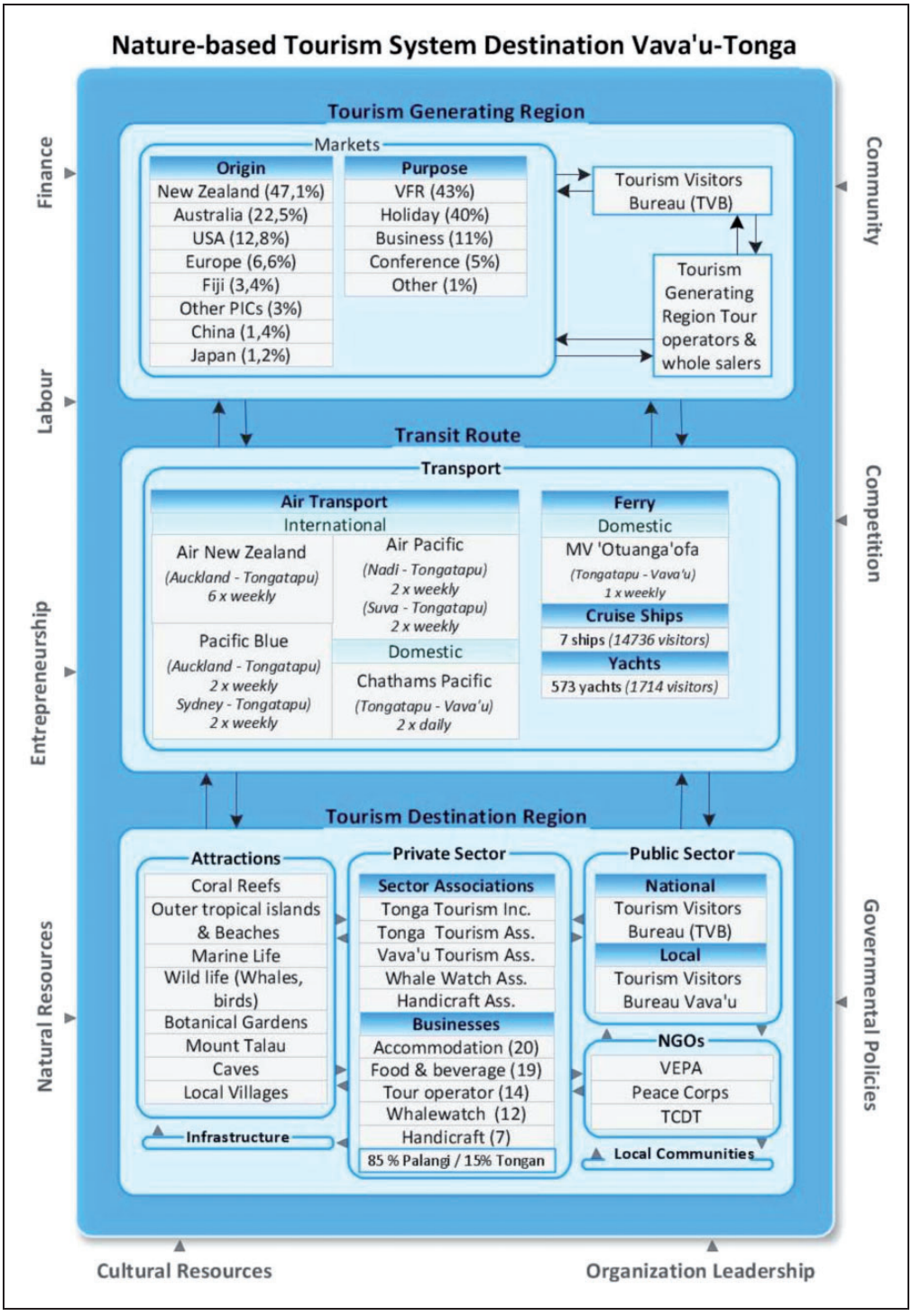


Figure 3. Nature based tourism system of Vava'u, Tonga.
Source: Author (Adapted from Leiper, 2004; Gunn, 1994).

main markets, purpose of visit and demand generating organizations. The Transit Route (TR) provides an overview of the modes of transport to and within the country. The box of the Tourism Destination Region (TDR) shows the supply side of destination Vava'u. Data is based on statistics available from year 2010 (TVB) and data retrieved during the field research. The figure shows the linkages between the different stakeholders and elements present at the destination. The different elements of the tourism system are embedded within a wider socio-political, economic and environmental context that shapes every aspect of the system. Accordingly it is imperative to understand the interconnections between these elements as well as the contextual environment within which the system operates.

Methodology

This research was undertaken as part of a wider Australian Agency for International Development (AusAID) funded project called the 'Pacific Tourism – Climate Adaptation Project' (PT – CAP). The aim of this three-year project (2009–2012) was to develop climate change adaptation policies and strategies to assist the Pacific Island tourism sector protect and expand local livelihood opportunities. A modified version of the DSF developed by Calgaro (2010; Calgaro et al., 2014a) was used to assess vulnerability and resilience levels across the three countries included in the study – Tonga, Vanuatu and Samoa (Figure 4). The use of the same theoretical framework and methods across all case study sites enabled wider comparisons to be made across countries and populations. A range of vulnerability, resilience and climate change adaptation frameworks were reviewed in order to find an appropriate framework for assessing climate change vulnerability in the context of tourism (see Jiang et al., 2010). The DSF was chosen for three reasons: (i) it incorporates and builds upon the holistic and system-orientated theoretical rigour found in broader debates in sustainability sciences, resilience thinking and vulnerability research; (ii) it provides a

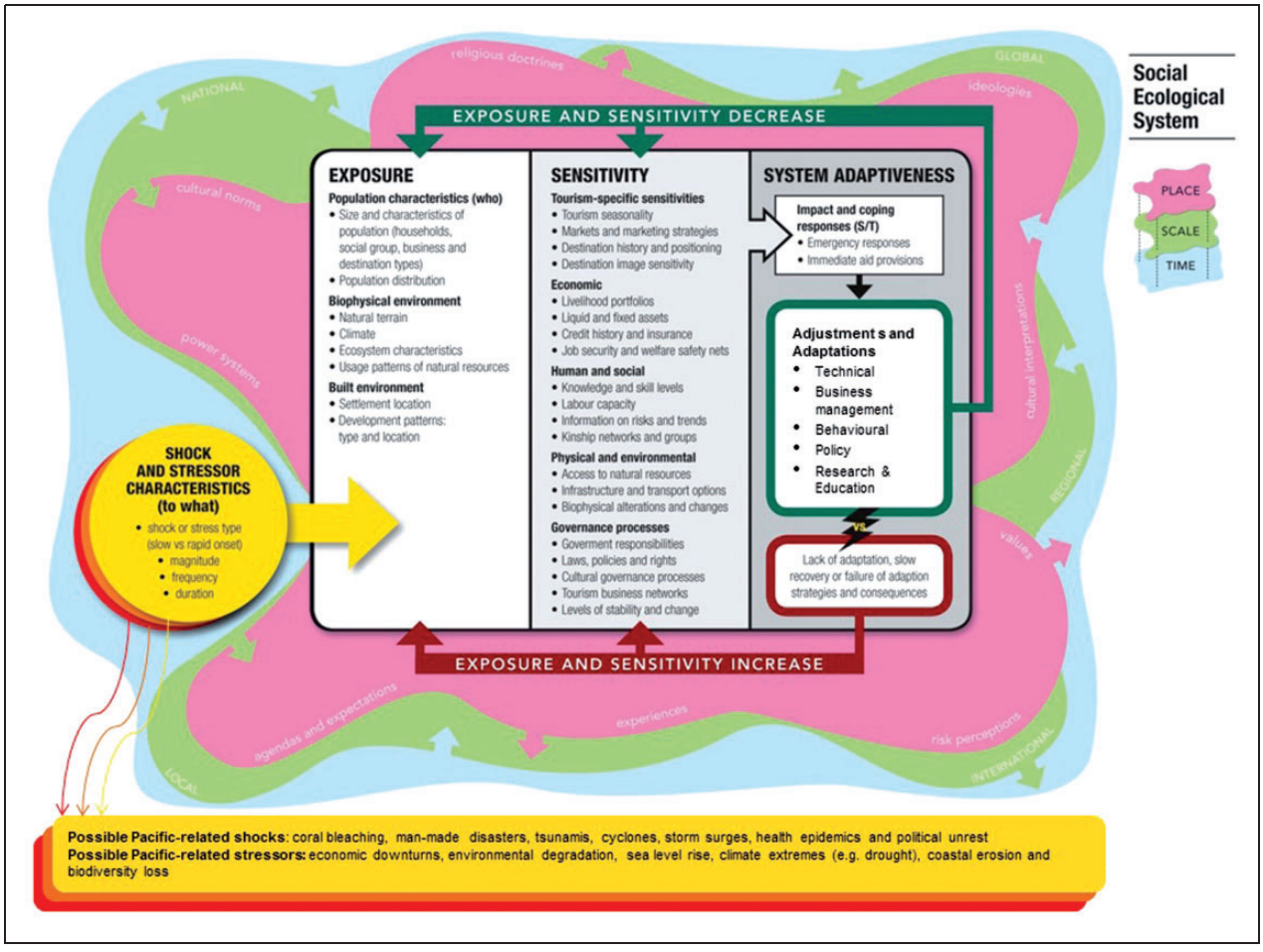


Figure 4. Modified Climate Change DSF for Pacific SIDS.
Source: Calgaro et al., 2014a.

sound theoretical and practical vulnerability/resilience assessment framework with an explicit tourism orientation; and (iii) it has the necessary detail to guide and in-depth analysis of vulnerability and resilience patterns and how these change over time (Jiang et al., 2010).

However, some modifications were needed. First, the DSF is a multiple hazard theoretical tool designed to help understand the complex causal factors and processes that contribute to the vulnerability and resilience of tourism destinations and the supporting tourism system. Emphasis of the analysis is on destination populations, places where tourism vulnerability and resilience are experienced. The wider supporting tourism system that stretches beyond the destination is acknowledged but the DSF lacks explicit detail of the tourism system. Second, the DSF is not specifically designed to assess vulnerability and resilience levels to climate change risk and therefore lacks detail on the type of adaptation strategies that may be available to tourism stakeholders to help them prepare and adapt to change. Finally, the DSF does not include the range of shocks and stressors that could affect tourism destinations in Pacific SIDS.

To overcome these case-specific deficiencies, additions to the original DSF include: (i) an explicit extension of the Tourism System component (adapted from Gunn, 1994; Leiper, 2004), enabling the mapping of the Tongan tourism system (Figure 3), (ii) an overview of the range of shocks and stressors that may affect Tonga as a Pacific SIDS (detailed in the extended yellow box on the bottom of the climate change DSF) and (iii) the addition of Scott et al.'s (2009) Climate Adaptation Portfolio for the Tourism-Recreation Sector to the longer-term Adjustments and Adaptations box under system adaptiveness.

A qualitative case study approach served as the overarching methodology. Four methods were included in the research design (van der Veeken et al., 2012):

(i) An exploratory literature review coupled with document analysis of secondary sources (governmental documents, reports from aid agencies and non-governmental organizations (NGOs), and local newspaper articles);
(ii) Semi-structured interviews;
(iii) Focus Group Discussions (FGDs); and
(iv) Participant observations that were recorded in a field diary by the lead researcher.

This combination of data collection tools was designed to get an appropriate balance between breadth and depth so a valid understanding of the current state of vulnerability and resilience to the impacts of climate change in Tonga could be obtained. For more detail on how each method was used, see van der Veeken et al. (2012).

The primary data collection in Vava'u took place over four weeks in June/July 2011. The data sample included formal semi-structured interviews (28 in total) with a range of stakeholders representing government (12), private sector tourism businesses (9),

Table 1. Examples of interview and focus group discussion questions.

Theme of questions	Examples
Shocks and stressors	• What events have affected tourism numbers to Tonga/Vava'u in the past 15 years? • What events have specifically affected your business in the same timeframe? How did you deal with these?
Exposure	• Who are the main actors involved in nature-based tourism in Tonga generally and Vava'u specifically? • What are the main tourist attractions?
Sensitivity	• Do you have other means of income, assets and/or options from family to help you financially if business is struggling? • What skills and training/education opportunities are available for the locals to draw upon to set up tourism-related businesses or enhance the skill base of employers? • Do you have adequate access to clean water, electricity (basic amenities)?
System adaptiveness	• Are there any local, national, and regional emergency recovery plans in place? • Are you aware of any existing/planned government policies that are designed to assist the tourism industry and your communities to respond to climate change?

NGOs and donor aid agencies (4) and sector associations (3). Additionally at least 30 informal interviews were held with people from different stakeholder groups that included local tourism workers and tourists. Table 1 provides an overview of questions asked during the field research. Interviewees were recruited through both purposeful and snowball sampling approaches (Patton, 2002). Three FGDs were held with nature-based tour operators, accommodation providers and bars and restaurant owners. The data was analysed by the lead researcher using Nvivo 9, the qualitative data analysis software package. The data coding categories were guided by the modified DSF (Figure 4). Each code matched the factors that are listed under each of the four main elements of the theoretical framework: shocks and stressors, exposure, sensitivities and system adaptiveness. Open nodes were also created to acknowledge emerging issues as the data analysis progressed. These categories that correspond to those in the DSF are also used throughout the results and discussion to show important linkages between theory and the empirical evidence and to ensure consistency and clarity.

Results and discussion

Guided by the modified DSF, the findings will be presented and discussed in four sections that correspond with the four main elements that form the core of the modified DSF (Figure 4) and were used to guide the assessment: 1) shocks and stressors; 2) exposure; 3) sensitivities; and 4) system adaptiveness.

Shocks and stressors: Trigger events that reveal vulnerability and resilience

Shocks are quick-onset events that are often unforeseen, both in frequency and size (Turner et al., 2003). Stressors are slow onset events that develop over time and place increasing pressure on the system (Turner et al., 2003). Tourism stakeholders in Tonga and Vava'u are concerned about a number of shocks and stressors that could seriously impact the nature-based tourism sector. Some of these are directly related to climate change whilst others are not but all have a cumulative effect on vulnerability and resilience levels in Vava'u. The acknowledgement of all identified shocks and stressors and their impacts on tourist flows is vital to understanding and effectively addressing destination vulnerability levels (Hopkins, 2015).

Table 2 lists the main shocks and stressors that concern Vava'u's nature-based tourism sector. Tropical cyclones are the most frequent event that people are concerned about. Tonga lies on the tropical cyclone path of the South Pacific and there is concern that the projected increase in intensity of cyclones will destabilise the country's socio-economic and ecological systems and negatively impact the sector (CAWCR, 2011; GEF et al., 2007; IPCC, 2012). Other shocks that tourism stakeholders are concerned about include: climate extremes, tsunamis, fast-onset health epidemics, political unrest, man-made disasters like oil-spills and changes to flight schedules. Flight schedule changes pose major difficulties for operators who are heavily dependent on airline schedule choices that they have no control over. One tour operator explained, "*Air New Zealand pulled out of the North-South leg that goes Los Angeles–Samos–Tonga–Auckland. That's a huge kick in the stomach and hurts us more than anything else*". The main stressors that raise concern are: changing sea surface temperatures and coral bleaching, coastal erosion, environmental degradation and biodiversity loss, economic downturns, and weak governance practices.

Exposure of the nature-based tourism system in Vava'u

The magnitude and severity of future shock and stressor impacts on tourism are determined by population, biophysical and settlement characteristics of the destination (Calgaro et al., 2014a, 2014b). An investigation of these characteristics reveals key factors that increase the exposure of nature-based tourism in Vava'u to climate change. These include Tonga's vulnerable location, tourism buildings being located close to the shoreline, and a lack of building regulations. Vava'u is located approximately 200 kilometres west of the Tonga Trench, which is a potential source of earthquakes and tsunamis. This location coupled with the threat of sea-level rise makes Tonga the second most exposed country (out of 173 countries) in the world according to the World Risk Index of natural disasters (UNU-EHS, 2011). Despite the islands' volcanic origin and higher topographies, tourism development in Vava'u is still highly exposed to floods, storm surges and sea-level rise due to its location close to the low-lying shoreline. Building structures have been demolished by tropical cyclones (as experienced in Waka in 2001) in the past. Without specific planning regulations and building guidelines buildings can be constructed out of any material and in highly exposed areas. This leaves the accommodation sector highly exposed to the effects of climate change related events (sea-level rise, heavy rainfall, storm surges) and other natural hazards (tropical cyclones and tsunami).

Table 2. Shocks and stressors that impact Vava'u's nature-based tourism sector.

Event & event type[a]	Relationship to climate change	Impact	Future projections	Source
Tropical cyclones (S)	Indirect	• Produce storms that threaten & destabilise the country's socio-economic and ecological systems; • E.g. Cyclone Waka (2001) damaged buildings & severely eroding beaches, which affected tourism.	Increases in intensity	CAWCR (2011); GEF et al. (2007); IPCC (2012); semi-structured interviews.
• Climate extremes: • Drought (SS); • Flooding (S); • Heavy rainfall (S).	Direct	• Tonga's 2 main seasons – the warm season & the cool season – are no longer distinct, causing weather disruptions throughout year (GEF and UNDP, 2005); • "Usually we were worried from December–March. In March we were happy but now weather disruptions starts to get all year round" (FGD participant). • "When the rain falls, it falls a lot heavier. We used to have consistency for 3 or 4 months. Now there's a lot more variation" (Government representative) • Longer wet season & annual rainfall pattern changes will affect agriculture, availability of local produce & food prices, all of which indirectly impacts tourism.	• Frequency & intensity for all expected to change; • Extreme rainfall days likely to increase; • Greater rainfall variation; • Longer wet season.	Barnett (2007); CAWCR (2011); GEF and UNDP (2005); IPCC (2012); Mataki et al. (2008); FGDs; semi-structured interviews.
Changing sea surface temperatures (SS)	Direct	• Tour operators observe that the water is getting warmer. There are concerns that warmer water may negatively impact whale migration patterns; • *"We should have cold and warm season but it's changing. It affects the whales and the fishing of tuna" (Private sector stakeholder)*	Likely increases in average sea surface temperature in Tonga	CAWCR (2011); semi-structured interviews.

(continued)

Table 2. Continued.

Event & event type[a]	Relationship to climate change	Impact	Future projections	Source
• Environmental degradation: • Harvesting of sandalwood, sea cucumbers & corals (SS); • Beach sand mining (SS); • Deforestation (SS); • Mangrove removal (SS); • Turtle hunting (SS).	Indirect	• Threatens the quality, viability and diversity of natural resources; • Possible increases in the intensity of tropical cyclones & sea-level rise will place greater stress on an already stressed & degraded natural environment that the nature-based tourism sector depends on. • ''Mangroves are being ripped out because they believe it kills their fish. It's a huge misconception here. They don't believe mangroves are nurseries'' (NGO representative) • ''There are more people try out to dig out sea cucumbers for an income. As soon as they hear something new everyone is just going out to the sea and digging things out without thinking.'' (NGO representative)		IPCC (2012); semi-structured interviews
Tsunamis (S)	No link	• 2009 Pacific Tsunami (Samoa-Tonga) increased awareness of the threat. People now see tsunamis as an emerging shock; • ''Tsunami is a new thing, which we haven't heard of as locals until last year. We think it's funny that the water goes up until we find out it's serious!'' (FGD participant) • ''Considering that Tonga is so flat and small, one big event like an earthquake would develop a tsunami and wipe off the whole kingdom.'' (Government representative)	Potential threat due to Tonga's proximity (200 km west of Tonga) to the Tonga Trench	Fritz et al. (2011); FGDs.

[a]Event types are differentiated in the table: fast onset shocks (S) and slow-onset stressors (SS).

Sensitivities of the nature-based tourism sector

The analysis of tourism sensitivity covers a range of socio-cultural, economic and environmental factors, in accordance with the modified *Climate Change DSF*. The findings reveal that the sensitivity of the tourism system in Vava'u is influenced by slow and unplanned tourism development, high seasonality, limited livelihood options, limited human capital, strong kinship ties, land issues, limited infrastructure, unsustainable use of the environment, and poor institutional achievements.

Slow development of Vava'u as a tourist destination. Vava'u's unplanned and slow tourism development may heighten the destination's sensitivity. The development of the destination started at the beginning of 1980s, when the first domestic airline commenced flights to Tonga. But Vava'u's remoteness has hindered tourism development growth. Significant expansion has only taken place in the last decade. As illustrated by an interviewee participant from the private sector, *"merely in the last 10–15 years have rules and laws entered Vava'u, automobiles arrived, waterfront buildings were build, and a reliable phone system was set up. Only a couple of years ago, national broadcast television and Internet was installed"*. The recent Western influences (coming with telecommunication, automobile, television and internet) have led to increasing amounts of foreign (Palangi) businesses in Vava'u who have identified the potential for tourism growth in this area. However, this same interest is causing high levels of competition between a growing amount of business operators for a small number of tourists. This affects business profitability and stability as there is less money available for development expansion.

High seasonality and positioning of Vava'u as a tourism destination. Vava'u's vulnerability is heightened by high seasonality levels. Climatic conditions predominantly determine the season, with the destinations' peak season running from July to October. Tourist numbers and business levels are very low during the remainder of the year due to: higher rainfall, hotter temperatures, storms and the accessibility to some of Vava'u main attractions like whale watching. Whales can only be seen between July and October (Orams, 2013), meaning that businesses must rely on the revenue collected during these four months to sustain them throughout the year. However, business revenue has decreased in the last two years due to a decrease in whale numbers. Respondents indicated that this could be due to increases in sea surface temperature or over-exploitation of the marine resource. Lambert et al. (2010) claim that climate change is likely to impact whale-watching tourism in the future. July to October is also the period sailors cross the Pacific, a major tourist market for Vava'u, intensifying seasonality. Drops in whale numbers and subsequent tourist numbers will leave Vava'u residents that are highly reliant on tourism revenue financially vulnerable to shocks and stressors that hinder tourism flows during these four months.

Destination vulnerability is also influenced by demand sensitivities and the capacity of the stakeholders to anticipate this. Currently, Tonga predominantly attracts low-end tourists like backpackers. Tonga receives the least revenue from tourism receipts per visitor than any other Pacific nation (average spending of USD392 as opposed to USD934 for the Pacific's average per visit spending) (Commonwealth of Australia, 2009). According to an association representative '*Tonga is just getting in the early stage of promotion*'. Consequently, the international tourism market profile or branding of Vava'u is relatively unknown leaving Tonga in a less competitive position and less able to attract a wide range of markets. Furthermore, many destinations in the Pacific are more cost and time efficient to travel to than Vava'u (Orams, 2013). These destinations are also more resilient to shocks and stressors because their market-base is broader (Calgaro et al., 2014b).

Limited livelihood options and access to capital. Livelihood diversification is recognized as a key strategy to reduce vulnerability and build resilience (Turner et al., 2003). Given the seasonal nature of Vava'u tourism revenue flows, diversification is essential. However, livelihood options are limited to subsistence agriculture followed by fishing. As noted by a government representative, *'merely 10-20 per cent of the people in Vava'u have weekly paying jobs',* most of which are with government or in tourism. People in the outer villages can generate a little income through selling handicrafts to tourists. However, limited infrastructure makes it a challenge to reach the visitors for selling handicrafts.

Access to financial capital is critical for determining the recovery capacity of tourism businesses from crises (Calgaro et al., 2014b). Tourism businesses in Vava'u invest most of their accessible financial capital into their business and staff. Consequently, most have not been able to build a solid profit base leaving them with reduced financial capacity to recover when shocks or stressors affect them. Discussions with private sector stakeholders revealed that the only source of capital is bank loans with high interest rates of 11–13%. A government representative indicated that 'the average Tongan lives from remittances', similar to other Pacific Island countries such as Samoa representing a

source of capital for development and disaster recovery (Wong et al., 2012). Residents receive both money and goods from family members living overseas (Hau'ofa, 1993). This regular flow of goods is generally not included in the statistics, but many Tongans depend on it for their welfare. When shocks occur, remittances contribute significantly to the level of resilience and most people are able to recover with such help. This dependency on remittances has created what some believe to be a negative influence on business development. A government representative remarked *'Tonga and its people have been spoiled by remittances and donor agencies so they don't see the need to work'*. Tonga has no government funded social protection system so people have to find other ways to sustain and recover following disaster events.

Difficulties finding appropriate human capital. Greater access to skills and knowledge is essential for increasing employability, business development and, in turn, increasing resilience to shocks and change (Department for International Development (DFID), 1999). Despite having a high level of human development – ranking 85 out of 169 countries on the Human Development Index – and high literacy levels (98.5%), finding skilled tourism staff is a key challenge for tourism businesses (UNDP, 2011). Both Palangis and Tongans highlighted a lack of hospitality and customer service skills. This can be attributed to the issues of motivation, comfort, job availability and mobility. Several interviewees explained that when someone masters a skill, they do not necessarily want to use it. According to an interviewee from the NGO/ Donor/ Aid stakeholder group, *'they rather go back to the old way of doing things, as that is what they are comfortable with'*. With few income options, there is little encouragement for high school graduates to stay and most go overseas. Tonga, together with Samoa, has the highest migration rate in the Pacific (Gibson and Nero, 2007). This shortage in human capital contributes to the slow development of tourism, making the sector vulnerable to shocks and change.

Land issues and limited infrastructure. Land in Tonga is owned by three parties: the king; the thirty-three nobles and the government (Bennardo and Cappell, 2008). The government has run out of most of its land meaning that access to public land is restricted, making it harder for Tongans to secure food for their tourism businesses. Group planting is one way to maximize access to land and food. An NGO representative explained, *'For group planting, a group of men from a particular church or village set up a big garden where they allocate a plot for each man'*. These land shortage issues deter potential tourism investors and limit tourism growth opportunities, keeping the overall tourism sector underdeveloped and small.

Infrastructure is also very important for supporting tourism development (Harrison and Prasad, 2013). The required internal transport, communication and physical infrastructure are expensive to develop and maintain in a setting like Vava'u, thereby, increasing the destination's sensitivity to shocks and stressors. Telecommunications in Tonga are sufficiently developed. With two carriers, Tonga is well networked and the service provided is cost effective. Reception is good in the remote parts of Vava'u, which is important when shocks occur. However, many of the outer islands in the Vava'u island group are still isolated resulting in limited mobility, connection and limited access to educational facilities. Consequently, tourism flows within the island group are low. This limits potential business growth for outer island tourism businesses and makes it more difficult to receive help when shocks occur.

There are limited domestic transport options from the main island of Tongatapu to Vava'u. There is a weekly ferry and two flights per day between Tongatapu and Vava'u. However, the high price of flights (offered by the sole domestic airline – Chathams) greatly constrains flight access. International flight options are comparatively better. Tonga is the closest Pacific Island country (PIC) to New Zealand. Consequently, international flight times and costs from this important source market are lower compared to other Pacific Island destinations.

Limited access to basic resources. Limited access to water, power and building materials inhibits tourism sustainability and resilience levels to shock and stressors. The two main water sources in Tonga are rainwater and water from the freshwater lens supplied through the public water supply system (GEF et al., 2007). Water supply and demand differ across the Vava'u islands and water salinity is an on-going problem (GEF et al., 2007). As highlighted by one government representative, "*the islands in Vava'u where tourism development takes place have got high water salinity, which makes them more dependent on rainwater*". Tourism businesses, particularly accommodation providers located in the hills area, are affected by water shortages. Fifty per cent of households ran out of water in 2010 due to a lack of rainfall (Government of Tonga, 2011). Increased drought projections related to changes in climate conditions will place additional pressure on water availability and negatively impact the tourist experience (GEF et al., 2007).

Access to power is also an issue. Nearly 100 per cent of electricity comes from diesel generators and increases in oil prices have demonstrated the sensitivity of the tourism sector, communities and households to

electricity costs (Tonga Energy Road Map (TERM), 2010). A government official explained: *'Sometimes the government cannot even afford payment of electricity. Power is regularly cut off and as a result there is no water through the pipe system'*. Power outages coupled with water shortages could also adversely affect the destination's appeal to tourists.

Accessibility to materials and supplies is a general concern and could also heighten the tourism sector's vulnerability. Building materials, food and beverage supplies are all imported from overseas, which is both time-consuming and costly. Climate change can exacerbate this issue by increasing fuel prices. Apart from acting as a unique selling point, remoteness and inaccessibility reduce the ability to recover from shocks and stressors.

Unsustainable use of the environment. Nature-based tourism like that found in Vava'u is closely linked to biodiversity and the attractiveness created by a rich and varied environment (Nyaupane and Chhetri, 2009). A decrease in quality natural resources may result in a change of tourist demand (Holden, 2010). Tonga's key ecosystems include coral reefs and mangroves that are critical habitats for marine life (Government of Tonga, 2006). According to interview participants, these ecosystems are stressed by overexploitation and unsustainable use patterns of natural resources. A nature-based tourism operator explained that rubbish and sewage are affecting Vava'u's biodiversity levels and ecosystem. Sustainability of the destinations' biodiversity is crucial because it is the basis for Vava'u's attractions and food supply. Knowledge and awareness of good waste management practices are low. More than 95 per cent of Vava'u's population still burn their waste despite the availability of commercial waste collection options (Tonga Department of Statistics, 2006). Additionally visitors also put extra pressure to these issues that affect the environment and detract from tourism experience. Traditional environmental norms also impede sustainable resource management as Tongans see the exploitation of marine resources as legitimized by God (Bender, 2002).

Another biophysical concern for the nature-based tourism sector is the decline in the population of the Polynesian Megapode (*Megapodius pritchardii*) bird. According to archaeological findings, the bird was found on a number of Tonga's islands (Tonga Community Development Trust (TCDT), 2011). Now they are only found on Vava'u and have been classified as being critically endangered on the IUCN Species Red List (TCDT, 2011). Bird watching is a small niche market in Tonga and the loss of the Polynesian Megapode in Vava'u is likely to have an impact on this form of special interest tourism.

Poor institutional achievements and governance processes. There are several governance issues that increase the vulnerability of Tonga's tourism system. These include: complicated tourism planning and marketing processes, limited cooperation between tourism stakeholders, and ineffective governmental processes at all levels. Limited enforcement of laws and regulations, government ineffectiveness and corruption have been identified as areas in need of improvement (Gani, 2009). The local government office in Vava'u does not have the budget, authority or capacity to implement strategies suited to localized needs and resources. A local restaurant participant commented, *'even when we have so many ideas we still have to go through the local Tourism Bureau and they have to go through the national Tourism Bureau'*. This lack of coordination between different stakeholders further increases vulnerability levels. However, there has been an improvement in the government's engagement with communities since the switch from an executive monarchy to a modern parliamentary in 2010. There is now more community participation in governance processes, which strengthens the social system and builds resilience. An NGO represented observed: '*When the ministers go to the islands they are talking on grass root level. Before the ministers at the time did not really have the same language*.'

Importance of rank and kinship ties – Social capital. Paying attention to social and cultural subjects in SIDS destinations raises awareness of the adaptability resources where islanders can draw upon (Scheyvens and Momsen, 2008). Tonga's culture is founded on the concept of Rank. Tonga has a three-tiered class system made up of (I) royalty, (II) nobles (before called chiefs) and (III) the commoners, all speaking a different Tongan language. Status and rank play a powerful role in personal relationships, even within families (Tonga Department of Statistics, 2006). As stated by McCoy and Havea (2006), "*Rank sets the tone for all interactions and responsibilities in a Tongan's life. If you eliminate consideration of rank, you have pulled the rug out from under the Tongan culture*." Consequently the ranking structure forms the backbone of the level of resilience. For example, as an outsider whether it is a foreigner or a Tongan from a different village, one must go through village town officers when addressing programmes or projects.

During the field research, the importance of Tongan core values came up many times. For example, food is handed out on the streets when left over and dinner invitations are a common daily occurrence. Kinship ties are of vital importance to Tongans. The concept of individual development is not valued in Tonga (McCoy and Havea, 2006). All decisions support the

benefit for a group, which could be family, church or government (Bennardo and Cappel, 2008). Within the tourism system locals support each other with small marketing efforts for each other's businesses, which enhances their resilience.

The church is another strong kinship network that members of the community can rely on in stressful times. Christianity is a significant aspect of Tongan life. As stated by an interviewee of Tongan descent, *'Everybody's alive because of the church. It makes you want to wake up in the morning. It gives you hope'*. One respondent of Tongan descent argued, *'Probably the church is more powerful than the government*.' A government stakeholder highlighted that '*every person listens to a priest with very high respect and obedience, in a higher degree than one will listen to our Prime Minister*.' The priest or the church ministers are one of the most influential people information wise. This implies that the church could be an important tool for conveying any message in relation to climate change and tourism.

These cultural aspects not only make Tonga an authentic and unique destination but also adds to their resilience. Kinship networks form a type of informal social protection in times of need.

Tourism system adaptiveness

Vava'us adaptive capacity to destabilizing events is influenced by high levels of climate change awareness, strong kinship ties, the existence of effective programs that help enhance climate change risk awareness, disaster preparedness and adaptive capacity, the resilient nature of Tongans, and support through remittances and international aid.

Learning from past experiences, the government of Tonga acknowledged the need to strengthen emergency management in all sectors. An Emergency Fund of $15 million Tongan Pa'anga (TOP) (AUD8.5 million) was established in 2008 and the different stakeholder groups are committed to an ongoing capacity building program (Jayavanth et al., 2009). The plan for National Disaster Management and Emergency Procedures outlines operating procedures that are followed when disasters strike (Government of Tonga, 2008). However, a lack of both human and financial resources makes immediate aid provision challenging. A government representative explained, *'In most developed countries they run exercises. Unfortunately here the only way to run this plan is wait for the real one, because the problem is that we don't have the resources to stretch the services where they are'*.

The Tongan government is increasingly committed to addressing climate change challenges demonstrated through the establishment of its Ministry of Environment and Climate change in 2009 and efforts in fulfilling its commitment to the UNFCCC. Tonga has also introduced several environmental actions in response to climate change and disasters, biodiversity loss and dependency on fossil fuels (see van der Veeken et al., 2012 for details on plans). These plans form part of the overall Tongan adaptation strategy. However, none of these plans are explicitly designed to assist the tourism industry in responding to climate change. That said, the Tongan Tourism Support Program (TTSP) has been set up to build community and management capacity of the tourism sector's and may increase the sector's resilience to climate change in certain areas. There is, however, an ongoing concern that enduring weaknesses in governance processes (limited political engagement within the industry and a lack of local empowerment) and a lack of resources (lack of capacity, expertise and budgetary constraints) will hinder the effective implementation and enforcement of these plans.

Summary of vulnerability and resilience factors affecting SIDS

This vulnerability assessment of Vava'u reveals the complex set of factors and processes that influence destination vulnerability and resilience levels over time and space. Figure 5 provides a summary of these dynamic factors. The different factors are positioned randomly. The arrows show the dimensions of vulnerability. It shows that increased resilience decreases vulnerability to climate change (green arrow), whilst factors that increase the destination vulnerability decreases resilience (red arrow).

This study shows that Tonga is highly susceptible to the effects of climate change. High levels of vulnerability are attributable to the Kingdom's high degree of exposure to climatic events, high seasonality levels, limited livelihood options, difficulties in accessing human capital, land availability issues, limited infrastructure, limited access to water and energy resources, environmental degradation, poor governance processes, and the countries' limited capacity to adequately adapt. These findings closely align with other destination vulnerability assessments and research undertaken in the Pacific (Jiang et al., 2015; Klint et al., 2012a), Thailand (Calgaro and Lloyd, 2008; Calgaro et al., 2014b), Nepal (Nyaupane and Chhetri, 2009), Canada (Scott et al., 2003) and Australia (Turton et al., 2010). In doing so, these results not only provide valuable place-specific evidence of the drivers of destination vulnerability and resilience in Vava'u and Tonga, but they also help us identify which factors are place- and culture-specific to Tonga (i.e. strong kinship ties, support through

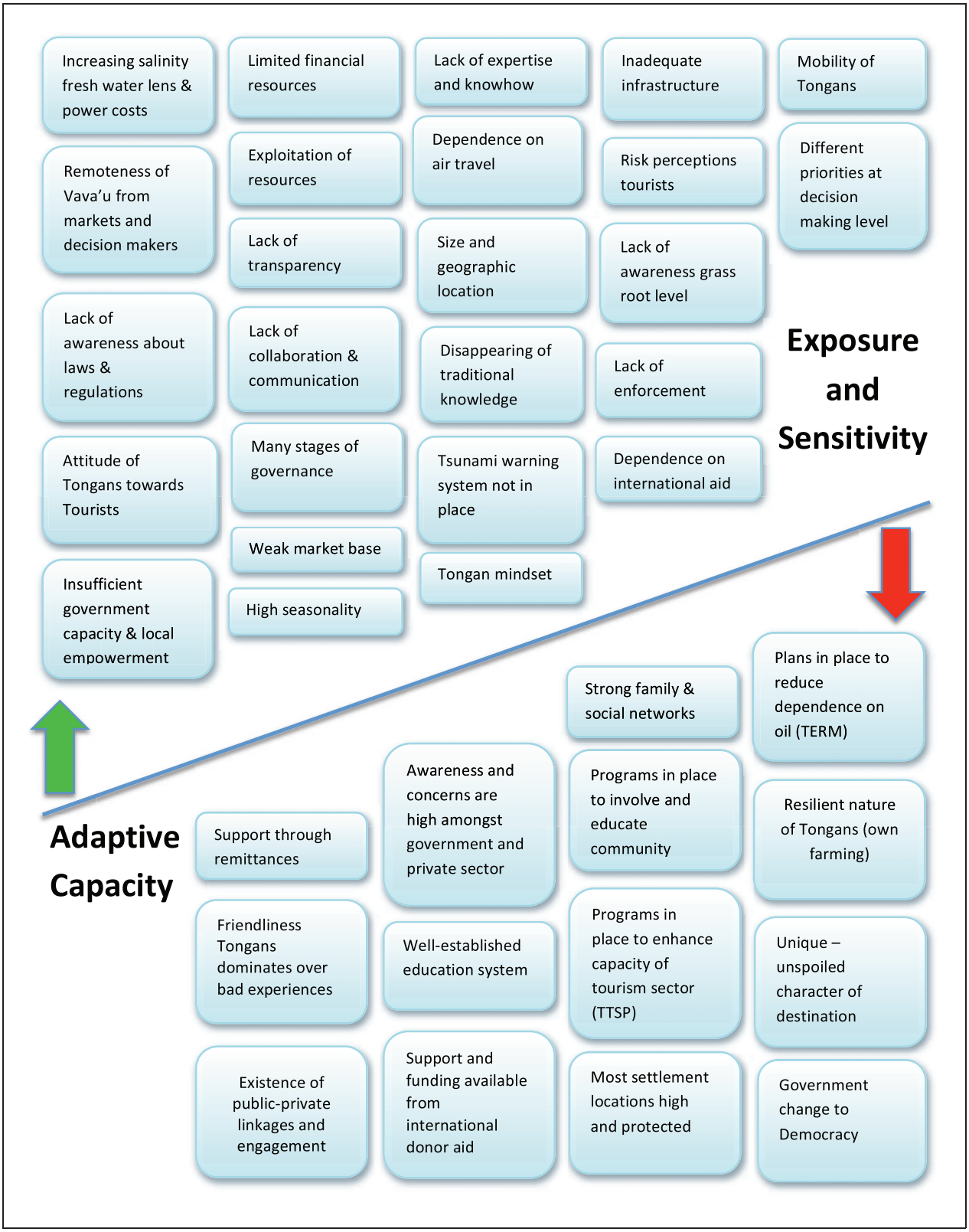


Figure 5. Vulnerability and resilience overview Tonga.
Source: Author (Adapted from Richardson and Witkowski, 2010).

remittances, and the resilient nature of Tongans), and which are common across different destinations, communities and contexts (like seasonality, lack of livelihood diversification, limited financial resources, and remoteness from markets).

This place-specific in depth investigation therefore makes a solid contribution to a growing body of knowledge on the underlying causes and conditions that contribute to vulnerability and resilience of SIDS destinations (Becken, 2013; Jiang and DeLacy, 2014). It gives us a better understanding of the complexity of building destination resilience to future events and SIDS destinations in particular. Our study confirms that the resilient nature of the Tongans with traditional methods and practices increases the resilience of the destination significantly. However, external influences of contemporary factors challenge the resilience of SIDS (IPCC, 2014), including Tonga more and more. This leaves the tourism sector in Tonga highly susceptible to the impacts of climate change necessitating action.

Conclusion and policy implications

It is expected that climate change will affect the developing tourism sector of Tonga in the future. Our findings suggest that the factors contributing to the climate change vulnerability in Vava'u Tonga largely outweigh the factors that increase its resilience. Commitment and strategies to cope with shocks and stressors are in place. However, critical issues that require improvement to ensure the successful implementation of these strategies include: securing additional economic, human and political capital needed to successfully operationalize the numerous strategies and plans (including the disaster management plan) for all sectors (including tourism) and improvements to the timely coordination emergency responses to affected areas.

Given the importance of tourism development in the Tongan economy and the tourism sector's strong reliance on the natural resources, effective management of climate change effects is crucial. We therefore propose a number of adaptation options, in alignment with the tourism adaptation portfolio of Scott et al. (2009). These recommendations can improve adaptive capacity to future climate change and help the Tongan tourism sector build more resilient businesses and livelihoods. Proposed adaptation strategies resulting from this study:

- Structural and technical adaptation: *Provide adequate infrastructure* – Improve access to water and power by using small desalination plants, solar panels, and providing sufficient rainwater collectors. Risk factors could be integrated in license criteria. The TERM plan can help support these infrastructure improvements. Furthermore it is recommended to improve early warning systems, especially for the communities and resorts located on the outer islands (Jayavanth et al., 2009).
- Business management adaptation: *Diversify tourist products and market base* – Diversification of both source markets and tourism offerings will increase the resilience of Vava'u's tourism industry. Year-round culture-based attractions may help address seasonality and reduce the biophysical stress placed on the natural resources by seasonal heavy visitations. Potentials in value added cultural activities include: historical sites and traditional practices like traditional dances, church services, tapa (bark cloth) making, cooking and kava ceremonies. Promotion of environmental friendly, authentic tourism products to greener and high-end market segments is recommended to enhance the destination's local economy (Klint et al., 2012b).
- Governance and policy adaptation: *1) Strengthen institutional capacity and coordination* – The delegation of authority for decision making to different parties nationally and locally, and public–private sector collaboration may result in more effective and better coordinated climate responses between tourism-related stakeholders (Wong et al., 2012). *2) Mainstream adaptation in national development plans and enforce plans* – both economic and environmental perspectives need to merge and be integrated into tourism policies and practices to achieve tourism sustainability. To ensure the effectiveness of policies and plans, enforcement structures and processes and constant advocacy are needed (UNWTO, UNEP and WMO, 2008). *3) Monitoring adaptation strategies and plans* – vulnerability reduction and adaptation is a dynamic process that evolves over time. Therefore, monitoring this process and how it evolves is vital for understanding and redressing the root causes. It also enables the charting of action successes and promotes social learning, adaptation and transformation (Adger, 2006).
- Research and education: *Undertake climate change and environmental awareness programs* – Education is key to improving awareness and knowledge of climate change issues, publicizing appropriate responses, and promoting tourist participation in conserving the natural resources they come to see and use. Education materials for both tourists and communities will help to minimize external stresses on resources and rapid response in times of shocks. A success example is the 'All Hazard' awareness card, which has been implemented in Hawaii (Klint et al., 2012b).

This study provided valuable insights into the underlying causes and conditions that contribute to vulnerability and resilience of destination Vava'u.

The findings of this vulnerability assessment of nature-based tourism in Tonga and the recommendations presented here provide the Tongan tourism sector and supporting agencies (including governmental and non-governmental actors) with the information needed to develop effective and targeted resilience-building strategies. It also serves as a guiding model for other SIDS to consider as part of their future efforts to reduce vulnerability levels to climate change and build more resilient communities.

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