# “Because your environment is looking after you”: The role of local knowledge in climate change adaptation in the Cook Islands

by

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A thesis

presented to the University of Waterloo

in fulfilment of the

thesis requirement for the degree of

Master of Environmental Studies

in

Geography

Waterloo, Ontario, Canada, 2019

## Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

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## Abstract

Pacific Island countries, like the Cook Islands, are often considered to be extremely vulnerable to the impacts of climate change. Changes in the frequency and intensity of climate-related hazards is expected to be one of many anticipated impacts of climate change in the Pacific Island region, having substantial implications for both climate change adaptation (CCA) and disaster risk reduction (DRR) efforts. Considerable literature highlights that local and traditional knowledge can play an important role in CCA and DRR, particularly in small island countries where vulnerability is unique and a long history of adapting to environmental change exists. However, there is little understanding on how to practically integrate and apply local knowledge in CCA, particularly in the Cook Islands. Through a comparative study between a core and periphery island, the purpose of this research was to investigate the role of local knowledge in adaptation to climate-related hazards in the Cook Islands. By employing qualitative research methods, including semi-structured interviews (n=34) with key informants and local participants, this research aimed to investigate the local adaptation strategies of Cook Islands communities to climate-related hazards on Rarotonga and Mitiaro, explore the variability in knowledge between a core (Rarotonga) and periphery (Mitiaro) island, understand the extent to which locals and government officials feel local knowledge is being appropriately integrated into adaptation policies, and determine some of the challenges to incorporating local knowledge into adaptation policy. Findings reveal that while local participants had considerable knowledge on environmental changes and coping and adaptation strategies for climate-related hazards, this knowledge was often in the context of multiple stressors. Additionally, interviewees perceived a large variability in knowledge on local coping and adaptation strategies and the impacts of climate change between Rarotonga and the outer islands. While key informants often recognized the important role of local knowledge in CCA, there has been an emphasis on recording local knowledge and less focus on integrating it into policy. Lastly, many challenges to integrating local knowledge into CCA policy were identified including development pressure, out-migration, a lack of understanding of local knowledge, religious influence, and uncertainty over the future use of local knowledge. This study offers insight on the role of local knowledge in CCA for other small island countries facing similar challenges.

**Acknowledgements**

Completing this master's degree has been an incredibly rewarding and challenging experience. From meeting an amazing network of friends in Waterloo, to overseas fieldwork, to internships in Ottawa, to juggling a thesis, a wedding, and a new job, these last two and a half years have been nothing short of a wonderful whirlwind. It would not have been possible without the immense love and support I was surrounded with throughout the program and for that I am very grateful.

First and foremost, I would like to thank my husband Geoff for his continued love and patience and for always having the time to listen when I needed an outlet for both my ideas and my frustrations. I don't think either of us could have imagined the amount of adventure that would come our way when we both began our master's degrees in 2016, but there is no one else I would have rather had by my side through it all. You've always been a source of inspiration to me. I'm looking forward to our lives slowing down (a little). Thank you to Pippa and Coco for always putting a smile on my face at the end of a long day.

I am also very grateful for the support of my supervisor Dr. Brent Doberstein and committee member Dr. Johanna Wandel. Thank you for the guidance, opportunities, and for having confidence in me. This thesis has pushed me out of my comfort zone in many ways and you've both helped me grow as a person. Your willingness to answer a million emails and provide valuable, constructive feedback did not go unnoticed. Working with you both has been an immense pleasure.

Thank you to my family, the de Scallys and the Luehrs, for your unwavering love and support. A special thank you to my parents Fes and Kim – I can truly say I would not be where I am today without you both. Dad - thank you for inspiring me, for introducing me to the wonderful world of geography, and for always making time to talk, rant, and provide feedback. I will always treasure our time together in the Cook Islands. Mom – thank you for the daily check-ins, doggy-sitting, and encouragement. Your positive attitude kept me going through the lows. Thank you to my late grandmother Patricia Wirick for your support, regular emails, and for listening to my stories even when you probably had no idea what I was going on about. I can hear you cheering me on from heaven.

My thesis research would not have been possible without the support of many wonderful people in the Cook Islands, particularly at Climate Change Cook Islands and Te Ipukarea

Society. Thank you for welcoming me with open arms and for allowing me the opportunity to learn from you and collaborate with you. The Cook Islands will always hold a special place in my heart. To all those who participated in interviews – thank you for sharing your knowledge and experiences with me. I was also fortunate and honored to receive financial support for this research. Thank you to the Social Sciences and Humanities Research Council, Ontario Graduate Scholarship, and the Bruce Mitchell Graduate Scholarship. I would also like to thank Gregory Richardson at Health Canada. I learned so much during my time at Health Canada and am grateful for the opportunities that I was given.

Last but certainly not least, thank you to my friends, old and new, for without fun, laughter, and stress relief, this endeavor would not have been possible. From Bachelor nights and trivia to Skype dates and wedding planning, there have been so many memories over these last couple of years. Words can't express how grateful I am to have such a diverse and inspiring group of friends to look up to. I look forward to following all of your journeys. Geoff and I's door is always open.

This thesis is dedicated to the people of the Cook Islands. *Meitaki ma'ata.*

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## List of Abbreviations

CCA: Climate Change Adaptation

CCCI: Climate Change Cook Islands

DRR: Disaster Risk Reduction

EMCI: Emergency Management Cook Islands

ENSO: El Niño Southern Oscillation

FAO: Food and Agriculture Organization

IPCC: Intergovernmental Panel on Climate Change

JNAP: Joint National Action Plan for Climate Change and Disaster Risk Management

KI: Key Informant

LP: Local Participant

MFEM: Ministry of Finance and Economic Management

NES: National Environment Service

NASA: National Aeronautics and Space Administration

PCCSP: Pacific Climate Change Science Program

SPCZ: South Pacific Convergence Zone

SPREP: South Pacific Regional Environment Program

SRIC-CC: Strengthening the Resilience of our Islands and Communities to Climate Change

UNDP: United Nations Development Program

UNFCCC: United Nations Framework Convention on Climate Change

UNISDR: United Nations International Strategy for Disaster Reduction

*And forget not that the earth delights to feel your bare feet and the winds long to play with your hair.*
Kahlil Gibran

# CHAPTER 1 - INTRODUCTION

## 1.1 Research problem

Small island developing states, particularly in the Pacific region, are considered to be extremely vulnerable to the impacts of climate change, despite having a negligible contribution to global greenhouse gas emissions (IPCC, 2012; Nurse et al., 2014). While there is considerable uncertainty surrounding how exactly these impacts will affect individual countries (Pelling & Uitto, 2001), there are five largescale changes that are expected to take place in the Pacific Island region (Barnett & Campbell, 2010) – an area encompassing Micronesia, Melanesia, and Polynesia. These changes include 1) increased air and sea surface temperatures (Ruosteenoja et al., 2003), 2) sea level rise (Church & White, 2011; Rahmstorf, 2007), 3) increased variability in rainfall events (McGree et al., 2014; SPREP, 2000), 4) changes in regional climate systems, particularly those associated with the South Pacific Convergence Zone (SPCZ) and El Niño Southern Oscillation (ENSO) (Cai et al., 2012), and 5) the likely increased intensity of tropical cyclones (Knutson et al., 2010). The impacts associated with these changes are expected to have substantial implications for nearly every sector in Pacific Island counties, including tourism, agriculture, freshwater resources, human settlements, and health (Nurse et al., 2014), posing significant challenges for both CCA and DRR efforts in the region.

Islands have long been considered places of preexisting and disproportionate vulnerability (Briguglio, 1995) – a view that has permeated the United Nations Framework Convention on Climate Change (UNFCCC) (Campbell, 2009). Small island developing countries are considered to be particularly vulnerable to the impacts of climate change because they not only share many characteristics of larger developing states which make them vulnerable to hazards – such as a limited physical and social infrastructure, inappropriate land use, and weaknesses in governance and public administration – but they also face unique challenges that further make them vulnerable (Mercer, 2007; Pelling & Uitto, 2001). These challenges include small size, insularity and remoteness, limited human resource base, small economies, vulnerability to global developments and environmental hazards, and proportionally large coastal zones (Mercer et al., 2007; Pelling & Uitto, 2001). In fact, in 2007 the Intergovernmental Panel on Climate Change (IPCC) emphasized that there was very high degree of confidence that small island countries "have characteristics which make them especially vulnerable to the effects of climate change,

sea-level rise, and extreme events" (p. 689) and in the IPCC's special report *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*, small islands were considered to represent a distinct category of countries whose concerns and information needs surrounding climate change are considerably different than those of larger continents (2012). Adaptation for small islands is likely to be very costly, involve significant trade-offs, and is constrained by a "lack of technology and human resource capacity, serious financial limitations, lack of cultural and social acceptability, and uncertain political and legal frameworks" (Nurse et al., 2014, p.1618).

While CCA is increasingly seen as an important component of the human response to climate change, the focus has generally been on physical, economic, or managerial options and little consideration has been given to the underlying cultural fabric of the groups of people involved (Brooks & Heyd, 2010), including the knowledge systems that make up cultures. Recently however, there has been a call for greater emphasis to be placed on incorporating local knowledge into both CCA and DRR (e.g. Begum et al., 2014; Schipper & Pelling, 2006; Venton & La Trobe, 2008) – something that has generally been missing (Adger et al., 2012; Barnett & Campbell, 2010; Nunn, 2013). The importance of this knowledge is highlighted by the United Nations' inclusion in 2015 of traditional, indigenous, and local knowledge (from now on referred to as local knowledge) as a component of individuals' and societies' resilience (United Nations Office for DRR, 2015).

The incorporation of local knowledge is considered particularly important in the Pacific Islands where unique cultural and environmental contexts exist (Barnett & Campbell, 2010; Nunn, 2013) and local and traditional knowledge has been vital to human sustainability for centuries (Veitayaki, 2009). However, top-down, inefficient initiatives to address CCA and DRR have been implemented uncritically in the region and as a result, very few have seen sustainable outcomes (Nunn, 2013). Therefore, despite millions of dollars being spent on CCA in Pacific Island countries over the past 30 years, much more work remains to be done (Nunn, 2012; World Bank, 2013).

This research addresses the role of local knowledge in CCA in the small Pacific Island nation of the Cook Islands. By better understanding the local adaptation strategies of Cook Islanders to

climate-related hazards, and both government and community member's perceptions on local knowledge, the contribution of this knowledge to CCA policy can be assessed and strengthened.

### 1.1.1 Research gap and rationale

While considerable literature has recently highlighted the importance of incorporating local knowledge into CCA and DRR, little empirical research exists on individuals' perceptions and understanding of local knowledge's role. Until recently, much of the focus on climate change in the Pacific Islands has been at the regional scale and inappropriate adaptation solutions have been implemented uncritically in many countries (Nunn, 2013). If research on CCA has taken place at the country level in the Pacific Islands, it has generally focused on larger island nations like Fiji and Samoa.

This research aims to address this gap by exploring the adaptation strategies that exist and the perceptions of both government and community members on local knowledge in the Pacific Island country of the Cook Islands. Despite being extremely vulnerable to the impacts of climate change, very little research on adaptation has taken place in the Cook Islands. While considerable work has gone into adaptation in the country recently, there is a need to better understand the role of local knowledge in these efforts. This research focuses particularly on the local adaptation strategies of Cook Islanders and their perceptions on local knowledge being incorporated into adaptation policy.

## 1.2 Purpose of study

The purpose of this research was to investigate the role of local knowledge in adaptation to climate-related hazards in the Cook Islands. Employing qualitative research methods and a case study approach, this research aimed to understand the local adaptation practices that exist, the variability in knowledge, perspectives on the integration of local knowledge into policy, and the challenges to integrating local knowledge into adaptation policy. This was accomplished through a comparative study between the main island of Rarotonga and the Southern Group outer island of Mitiaro. To achieve the purpose of this research, four research objectives were followed and are outlined in Section 1.3.

## 1.3 Research objectives

To better understand the role of local knowledge in adaptation to climate-related hazards in the Cook Islands, this research had four main objectives:

1) investigate the local adaptation strategies of Cook Islands communities to climate-related hazards on Rarotonga and Mitiaro
2) explore the variability in knowledge between a core (Rarotonga) and periphery (Mitiaro) island
3) understand the extent to which locals and key informants felt local knowledge was being appropriately integrated into adaptation policies
4) determine some of the challenges to incorporating local knowledge into adaptation policy

The intent of this research was to provide useful information to CCA, DRR, and resource management stakeholders in the Cook Islands to enable the implementation of sustainable and culturally appropriate adaptation solutions.

### 1.3.1 Conceptualization of climate-related hazards

In 2010, climate-related hazards were responsible for more than 75% of the disasters that occurred globally since 2000 (McBean & Rodgers, 2010). Climate-related hazards can include both direct changes in climate conditions (e.g. changes in rainfall trends) and the derived environmental changes (e.g. changes in the physical properties of sea water) (Rasmussen et al., 2009). The risks associated with climate-related hazards can have considerable impacts on people's lives and livelihoods and can be slow onset events (e.g. temperature changes) or fast onset events (e.g. tropical cyclones) (IPCC, 2012). While this research emphasized *direct* climate-related hazards such as tropical cyclones or storms, floods, drought, and sea level rise, *in-direct* impacts that may be linked to climate-related hazards, risks, or changes (e.g. changes in ocean currents or temperatures which affect migration patterns of fish) and that were raised by participants were also included in the analysis.

## 1.4 Thesis structure

This thesis begins with a comprehensive literature review on key concepts and theory. Chapter 3 includes a detailed description of the social, economic, environmental, and cultural context of the Cook Islands, as well as the major impacts of climate change for the region. The study site description is followed by an overview of the key CCA and DRR initiatives taking

place in the Cook Islands. Chapter 4 presents research methods. The results of this research are presented in Chapter 5 and Chapter 6 is the subsequent discussion. The thesis ends with the conclusions of the study and recommendations for future research in Chapter 7.

# CHAPTER 2 – LITERATURE REVIEW

## 2.1 Climate change adaptation

Adaptation has been a central concept in academic literature - particularly in ecology, biology, and anthropology - for decades (Lei & Wang, 2014); however, the notion of CCA specifically is relatively new. Although global concern about climate change has been growing since the late 1970s, it was not until the late 1990s that adaptation became a key component of global climate change debates (Orlove, 2009). When the IPCC was created in 1988 and the UNFCCC in 1990, the focus was largely on climate change mitigation (Orlove, 2000) - "an anthropogenic intervention to reduce the sources or enhance the sinks of greenhouse gases" (IPCC, 2001, p. 717). At this time, interest in adaptation was low, mitigation debates received the bulk of policy makers' and researchers' attention, and some argued that focusing on adaptation would take much needed attention away from mitigation (Burton et al., 2002; Orlove, 2009; Pielke, 1998). The late 1990s, however, saw an increasing recognition that climate change was inevitable and that mitigation efforts alone would not succeed, leading to increased attention being placed on CCA (Orlove, 2009; Pielke, 1998). In 1996, the IPCC recognized that adaptation was a powerful and complementary option to climate change mitigation efforts and the term received a loose definition of "any adjustment - whether passive, reactive or anticipatory - that can respond to anticipated or actual consequences associated with climate change" (p. 831). Nevertheless, it was not until 2001 that the term was officially defined in the Third Assessment Report and adopted into a resolution at the 7$^{th}$ Convention of Parties (Orlove, 2009). At this time, CCA was defined as:

> "…adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation." (IPCC, 2001b, p. 982)

The term adaptation is largely centered around the idea of making an adjustment or action being taken to deal with change; however, a range of responses can occur. Burton, Kates, & White (1978) emphasize that when responding to a hazard or change, actions that range from immediate to long-term occur. Immediate actions, or coping mechanisms, are generally

considered to be short-term, reactive, and orientated towards survival whereas long-term adaptation strategies are generally sustained, a continuous process, and involve planning (CARE, 2009; Vincent et al., 2013). However, differentiating between coping and adaptation strategies is not always easy and therefore the context in which they are observed must be considered (Vincent et al., 2013). For example, using sandbags during a flood is an immediate coping mechanism (Burton, Kates, & White, 1978) while utilizing land use planning to restrict building in the floodplain would be considered a long-term adaptation measure. Coping strategies do not reduce vulnerability if the hazard were to occur again whereas the reduction in future vulnerability is central to adaptation (Vincent et al., 2013).

### 2.1.1 Key concepts of climate change adaptation

#### *2.1.1.1 Risk and hazards*

Broadly, CCA involves the reduction of vulnerability and the increase in resilience of an individual, group, or community to deal with the impacts of climate change (Smit & Wandel, 2006; Wreford et al., 2010). In particular, adaptation is becoming important in addressing the exacerbation of natural hazards and disasters as a result of climate change (IPCC, 2012; Lei & Wang, 2014). Both CCA and disaster risk management aim to reduce the factors and modify the human and environmental contexts that contribute to climate-related risk (IPCC, 2012). Risk arises from the probability of a natural or human induced hazard taking place and vulnerable conditions that can create loss (Smith & Petley, 2013; UNISDR, 2006). The risk associated with a hazard, defined by the IPCC (2012) as "the potential occurrence of a natural or human-induced physical event or trend or physical impact that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems and environmental resources" (p. 124), is generally understood as a function of probability, elements at risk, and vulnerability (Smith & Petley, 2013).

#### *2.2.1.2 Vulnerability*

Deeply rooted in disaster literature, vulnerability has become broadly understood as "the conditions determined by the physical, social, economic and environmental factors or processes, which increase the susceptibility of a community to the impact of hazards" (UNISDR, 2006, p.11). While all individuals and communities are vulnerable to hazards, the extent to which they

are vulnerable is determined by these physical, social, economic, and environmental characteristics (UNISDR, 2006). Physical characteristics are closely linked to exposure or the range of hazards possible in a particular location (Smith & Petley, 2013), while social, economic, and environmental characteristics include variables like class, occupation, ethnicity, gender, disability and health status, age, social capital, and environmental degradation (Wisner et al., 2004; Smith & Petley, 2013). In the context of climate change, the IPCC (2001b) defines vulnerability as "the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change" (p.995). This is determined by the characteristics, magnitude, and rate of climate change to which a system is exposed and the system's sensitivity and adaptive capacity (IPCC, 2001). Therefore, Jones et al. (2010) argue that CCA must involve both responses designed to exclusively respond to climate change impacts and responses that address the underlying factors that make a group vulnerable in the first place. The concept of adaptive capacity is also central to understanding vulnerability (Burton et al., 2002; Cutter, 1996; Smit & Pilifosova, 2003; Smit & Wandel, 2006).

#### *2.1.1.3 Adaptive capacity*

In addition to sensitivity, vulnerability is also a function of the ability of a group to deal with or cope with the hazard in question. Burton et al. (2002) define adaptive capacity as "the ability of a system to adjust to climate change, including climate variability and extremes, to moderate potential damages, to take advantage of opportunities, or to cope with the consequences" (p. 6). Similarly, Berkes (2007) highlights that adaptive capacity in the context of climate change refers to one's ability to advance, create new opportunities, mitigate adverse impacts, learn, and innovate. Adaptation is considered to be one indicator of adaptive capacity, representing ways to reduce vulnerability to change (Boillat & Berkes, 2013). Adaptive capacity is context-specific, "[varying] from country to country, from community to community, among social groups and individuals, and over time" (Smit & Wandel, 2006, p. 287) and is based on determinants such as economic, wealth, information and skills, infrastructure, institutions, and access to things like capital, technology, political influence, and kinship networks (Smit & Pilifosova, 2003; Smit & Wandel, 2006). In the context of climate change, reducing exposure can be challenging and therefore the emphasis must be placed on improving adaptive capacity (Smit & Pilifosova, 2003).

*2.1.1.4 Resilience*

Ultimately, CCA aims to reduce vulnerability and increase resilience. The resilience perspective has long been present in the discussion of social-ecological systems and emerged from ecology in the 1960s and early 1970s. The IPCC (2012) defines resilience as "the ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a potentially hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration, or improvement of its essential basic structures and functions" (p.34). Similarly, Walker et al. (2004) emphasizes that resilience reflects a system's capacity to deal with disturbance and change while maintaining its function and identity. Resilience is an important component of CCA and is considered a key idea of adaptive capacity (Folke et al., 2005). Resilience thinking's focus on dealing with changes and uncertainties (Berkes, 2007) is well suited for CCA and shifts the emphasis from controlling change to coping with, adapting to, and shaping change (Berkes et al., 2003; Folke, 2006; Pelling & Uitto, 2001; Smit & Wandel, 2006). Building or strengthening resilience means creating a system in which disturbance creates opportunity, innovation, and development (Folke, 2006) rather than negative social consequences, a characteristic of vulnerable systems (Adger, 2006).

2.1.2 Approaches to climate change adaptation

While adaptation has been gaining increasing attention in the climate change realm, there is still substantial debate on how to best develop and implement adaptation options. Adaptation options are defined by the IPCC (2014) as "the array of strategies and measures that are available and appropriate for addressing adaptation needs" (p. 1756). Recent years have seen a significant increase in attention placed on community-based and participatory adaptation approaches (e.g. Dodman & Mitlin, 2013; Forsyth, 2014; Loo, 2014; Mercer et al., 2008) and considerable literature emphasizes that culture, local knowledge and practices, and value systems play important roles in the consideration of appropriate adaptation options (e.g. Adger et al., 2012; Eriksen et al., 2015; Orlove, 2009; Smit & Pilifosova, 2003). CCA has been criticized for assuming overly simplified relationships between environmental risks and social responses and failing to address the fact that many adaptation options considered appropriate by government or planners may not be deemed appropriate by communities and individuals (Adger et al., 2012).

Additionally, culture is central to understanding the causes and meanings of responses to climate change and implementing adaptation (Adger et al., 2012). For example, Orlove (2009) explains how adaptation's focus on valuation and cost-benefit analysis places attention on easily measured problems such as economic well-being while taking attention away from less equally measured problems such as cultural and religious well-being. Looking at cultural perspectives of climate change and culturally appropriate adaptation has resulted in increasing emphasis on tailoring adaptation to local needs and specific circumstances (Smit & Pilifosova, 2003), as well as on the role of local knowledge in CCA (e.g. Ajani et al., 2013; Aswani et al., 2015; Kelman, 2010; Nakashima et al., 2012). While increasingly more attention is being paid to the benefits of incorporating local knowledge into both CCA and DRR, there are also significant challenges that have been identified. Additionally, some geographic areas have seen considerable attention while others have not (Lebel, 2013). The current scholarship on local knowledge, CCA, and DRR is discussed in more depth later in this literature review.

## 2.2 Climate change adaptation and disaster risk reduction

Until recently, CCA and DRR have been operating in spheres largely independent of each other despite the many linkages and opportunities for integration (Schipper & Pelling, 2006; Thomella et al., 2006; Venton & La Trobe, 2008; Mercer, 2010). In fact, it wasn't until 2012 when the relationship between CCA and DRR was predominantly linked in the IPCC report *Managing the risks of extreme events and disaster to advance climate change adaptation* (de Leon & Pittock, 2017). Although differences between the two do exist, integrating CCA and DRR has significant benefits. This is largely because of their common goals of reducing vulnerability, increasing adaptive capacity, and building resilience within the broad sphere of sustainable development. The purpose of this section is to the discuss the relationship between CCA and DRR, as well as the benefits to and challenges of integrating them.

### 2.2.1 The relationship between CCA and DRR

Historically, the natural hazards and disaster field has placed significant emphasis on disaster management, where the focus has been the development of hazard forecasting and providing relief immediately following a disaster (Thomella, 2006). However, in 1990 the declaration of the United Nations International Decade for Natural Disaster Reduction, followed by the Yokohama Conference, and later the World Conference on Disaster Reduction, shifted the

paradigm from disaster management to one more focused on a comprehensive understanding of hazard vulnerability and longer-term strategies for dealing with risk (Thomella et al., 2006). This shift from disaster risk management to DRR has created a more holistic discipline which has placed increasing emphasis on vulnerability, adaptive capacity, and the strengthening of resilience to disasters through preparedness. The United Nations Strategy for International Disaster Reduction (2006) defines DRR as "the systematic development and application of policies, strategies, and practices to minimize vulnerabilities, hazards, and the unfolding discourse of disaster impacts throughout a society, in the broad context of sustainable development" (p.3). The focus of both DRR and CCA on reducing vulnerability and increasing resilience (Begum et al., 2014) has led to calls for the integration of the two (Begum et al., 2014, IPCC, 2012; Venton & La Trobe, 2008).

*2.2.1.1 Similarities between CCA and DRR*

Although integrating CCA and DRR efforts is considered a relatively new area of interest (Lei & Wang, 2014), it is this shift in focus within the hazards field to DRR that allows the two to be linked. In fact, considerable literature highlights the relationship between climate change and disaster risk, particularly the changes in magnitude and frequency of extreme events, changes in average climatic conditions and climate variability, and the creation of new threats (Begum et al., 2014; IPCC, 2007; Sperling & Szekely, 2005; Venton & La Trobe, 2008). The UNISDR (2011) emphasizes that both DRR and CCA have roots in building resilience to hazards and Begum et al. (2014) argue that DRR "is a natural entry point for adaptation" (p. 366). Both natural hazards and climate change have significant consequences for sustainable development as well as substantial impacts on social, political, economic, and natural processes (Schipper & Pelling, 2006; Thomella et al., 2006) and therefore both seek to influence development practice and decision-making (Venton & La Trobe, 2008). The most effective risk reduction, in the context of disasters and climate change, requires addressing underlying vulnerabilities as well as building both generic adaptive capacity and hazard-specific response capacity (Schipper & Pelling, 2006). In addition to the growing recognition in scholarly literature, the link between DRR and CCA has received increasing attention in development policy and planning agendas in recent years (Begum et al., 2014) (Table 1).

| **Table 1 - *Linking DRR and CCA in policy*** | **Reference** |
|---|---|
| Integration of DRR and CCA is a critical component of Hyogo Framework for Action for implementation | UNISDR |
| Bali Action Plan reflects a growing recognition that DRR and CCA are closely linked | UNFCCC |
| DRR must be a key component for an effective and sustainable adaptation approach | Tearfund |
| CCA needs to converge with DRR<br>CCA and DRR are closely linked. CCA is reflected in the post-2015 framework for DRR | UNFCCC<br>UNFCCC |
| Risk reduction tools such as risk assessments, environmental protection, early warning systems, and insurance are using CCA | UNFCCC |
| National adaptation plans (NAPs) can provide useful mechanisms to address climate change and disaster risk in national and local sustainable development planning | UNFCCC |
| Integration of DRR and CCA can be enhanced by developing an integrated policy framework and approach at difference level | UNISDR and UNDP |

*Note* Reproduced from Begum et al. (2014)

#### *2.2.1.2 Differences between CCA and DRR*

Despite the many parallels between DRR and CCA, there are significant differences as well. As highlighted in Table 2, the differences between the two are largely related to the timescales and scope of events that DRR and CCA address, as well the levels of focus, political recognition, and funding streams (Schipper & Pelling, 2006; Thomella et al., 2006; Venton & La Trobe, 2008; Begum et al., 2014). Thomella et al. (2006) emphasize that disasters tend to be distinct in time and space and there is substantial knowledge on event characteristics and exposure characteristics whereas the impacts of climate change are markedly more difficult to perceive and measure. Similarly, Schipper & Pelling (2006) highlight that disasters are generally immediate and concentrated whereas climate change is evolving and longer term. Both DRR and CCA operate in realms outside the scope of one another, with DRR addressing a far greater range of hazards and CCA addressing a far greater range of issues (e.g. biodiversity, climate-sensitive disease, etc.) (Venton & La Trobe, 2008). Additionally, DRR has generally been addressed at local and national scales and has been far more grassroots in nature whereas CCA policy agendas have, until very recently, has been far more global in scope (Schipper & Pelling, 2006; Mercer, 2010).

**Table 2 – *Summary of differences between CCA and DRR***

| **Differences** | | **Signs of Convergence** |
|---|---|---|
| **DRR** | **CCA** | |
| **Relevant to all hazard types** | Relevant to climate-related hazards | N/A |
| **Origin and culture in humanitarian assistance following a disaster event** | Origin and culture in scientific theory | CCA specialists now being recruited engineering, watsan[a], agriculture, health, and DRR sectors |
| **Most concerned with the present – i.e. addressing** | Most concerned with the future – i.e. addressing uncertainty/new | DRR increasingly forward looking<br>Existing climate variability is an entry |

| | | |
|---|---|---|
| **existing risk** | risks | point for CCA |
| **Historical perspective** | Future perspective | As above |
| **Traditional/indigenous knowledge at community level is basis for resilience** | Traditional/indigenous knowledge at community level may be insufficient for resilience against types and scales of risk yet to be experienced | Examples where integration of scientific knowledge and traditional knowledge for DRR provides learning opportunities |
| **Structural measures designed for safety levels modelled on current and historical evidence** | Structural measures designed for safety levels modelled on current and historical evidence and predicated changes | DRR increasingly forward looking |
| **Traditional focus on vulnerability reduction** | Traditional focus on physical exposure | N/A |
| **Community-based process stemming from experience** | Community-based process stemming from policy agenda | N/A |
| **Practical application at local level** | Theoretical application at local level | CCA gaining experience through practical local application |
| **Full range of established and developing tools** | Limited range of tools under development | None, except increasing recognition that more adaptation tools are needed |
| **Incremental development** | New and emerging agenda | N/A |
| **Political and widespread recognition often quite weak** | Political and widespread recognition increasingly strong | None, except that climate-related disaster events are now more likely to be analyzed and debated with reference to climate change |
| **Funding streams ad hoc and insufficient** | Funding streams sizeable and increasing | DRR community engaging in CCA funding streams |

[a] Water and sanitation

*Note* Reproduced from Venton, P. & La Trobe, S. (2008)

### *2.2.2 The benefits of integrating CCA and DRR*

The arguments for integrating CCA and DRR are largely centered around the idea that it will be more effective and efficient (Venton & La Trobe, 2008; Mercer, 2010) and that it can provide a more comprehensive approach to reducing losses (Begum et al., 2014). Venton & La Trobe (2008) highlight that integrating the two can lead to more effective and sustainable adaptation and DRR approaches and the more efficient use of resources – financial, human, and natural. Similarly, Mercer's (2010) empirical research in Papua New Guinea emphasized that embedding CCA in DRR was clearly more efficient than having to create new tools and methodologies for adaptation later. Additionally, Begum et al. (2014) argue that CCA should be based on holistic approaches which include delimitation of risks, protection measures, and early warning systems – something which already exists within DRR prevention strategies. In addition to these benefits, it has been argued that from a community perspective, the integration of CCA and DRR makes the most sense (Mercer, 2010; Gero et al., 2011). Gero et al. (2011) highlight that "communities themselves do not differentiate between DRR and CCA" (p. 102) and

therefore climate change must be addressed through a holistic lens that considers all the factors contributing the level of risk within a community (Mercer, 2010). Additionally, other significant benefits of integrating the two include improved coordination of NGOs and organizations, the increased reliability of climate data, and new methods and approaches that can accelerate DRR and CCA efforts (Begum et al., 2014). Despite the noteworthy amount of literature emphasizing the need for integration (Begum et al., 2014; Mercer, 2010; Venton & La Trobe, 2008), Gero et al. (2011) highlight that little research exists on how to do this in practice. Gero et al. (2011) identified best practices for the integration of the two from projects in the Pacific Islands context, including taking a holistic approach, using multi-sectoral and multi-stakeholder teams, genuine community participation, and avoiding fragmentary policy approaches.

### 2.2.3 Challenges to integrating CCA and DRR

While the benefits of integrating CCA and DRR are significant, considerable challenges also exist. Begum et al. (2014) found that limitations to integration included the fact that DRR and CCA still largely operate in different policy spheres despite the linkages being identified, terminological differences, a lack of agreement between the two on investment and funding, and an absence of effective coordination between the numerous stakeholders involved in both. Additionally, scale mismatches, norm mismatches, and knowledge mismatches have been identified between DRR and CCA (de Leon & Pittock, 2017). Scale mismatches are largely attributed to the temporal differences in the types of hazards and responses to hazards whereas norm and knowledge mismatches are attributed to the complex nature of the stakeholders and the policy levels involved (de Leon & Pittock, 2017). CCA is still largely discussed at global, regional, and national levels and therefore often irrelevant or inappropriate at the local level where DRR efforts often take place (de Leon & Pittock, 2017). While Mercer (2010) asserts that many DRR efforts have been grassroots in nature – something many have argued CCA has been missing – others (e.g. Nunn, 2009; Rojas-Blancos, 2006) argue that there is a considerable divide between the science and local knowledge, and that both CCA and DRR need to bridge this gap to ensure actions are relevant at the local level and culturally appropriate. Although integrating CCA and DRR is understood to be challenging (de Leon & Pittock, 2017), communication and collaboration between CCA and DRR can ensure comprehensive risk management (Lei & Wang, 2014) with significant benefits, particularly for local communities.

## 2.3 CCA in the Pacific Islands

Small island developing states, many of which are Pacific Islands, face a fundamental dilemma in terms of climate change – although their greenhouse gas emissions are among some of the lowest on a global scale, they are some of the first and worst impacted by the changing climate (Betzold, 2015). Therefore, significant literature does exist on CCA in small islands developing states, and Pacific Island countries in particular (e.g. Barnett, 2001; Barnett & Campbell, 2010; Betzold, 2015; Hay, 2011; Kelman & West, 2009; Nunn, 2009; Nunn, 2013). Much of this literature is critical of how adaptation has taken place in the Pacific Islands and is discussed further below. Despite the abundance of literature on Pacific Islands adaptation, little literature focuses on the Cook Islands specifically, highlighting the importance of this research.

### 2.3.1 Key trends in CCA in the Pacific Islands

While much of the literature is highly critical of the past approaches taken to adaptation in the Pacific, it does recognize that many Pacific Island countries have been at the forefront of CCA. Nunn (2009) notes that the unique context of Pacific Island countries has resulted in the development of innovative tools, methods, and efforts to inform policy, planning, resource use, and on the ground action with climate change findings. Similarly, Hay (2011) emphasizes that many Pacific Islanders have made efforts to increase their skills and knowledge when it comes to climate risk management. Initially, CCA efforts in the Pacific Islands were top-down and focused on characterizing long term changes through national assessments, regional syntheses, and modelling to highlight both the need for developed countries to lower emissions and to support adaptation initiatives (Hay, 2011). In 2008 there was already over 100 projects related to climate change taking place in Pacific Island countries, many funded by agencies like the Asian Development Bank, AusAid, the European Union, NZAid, and the United Nations Development Program (Barnett & Campbell, 2010). However, both Hay (2011) and Nunn (2013) argue that these top-down, scenario driven efforts, generally "brokered by regional agencies with external donors on behalf of national governments in the region" (Nunn, 2013, p.151), have largely failed to enhance resilience, reduce vulnerability, or have sustainable outcomes. Nunn (2013) also emphasizes that CCA in the Pacific Islands has been piecemeal and has resulted in significant waste, no widespread improvement in awareness, and no sustainable solutions. The contextualization of CCA in monetary terms has resulted in Pacific Island countries viewing

adaptation as something that must be funded by external assistance, not internal revenue (Nunn, 2009), and therefore has both discouraged ownership over CCA and has subjected these countries to donor preferences, funding periods, and adaptive solutions that have been imposed uncritically on Pacific Island cultures and environments (Nunn, 2013). Barnett (2001), however, does note that a "no regrets" approach to adaptation, where strategies that will yield benefit regardless of whether the anticipated impacts of climate change will occur, prevailed in the Pacific Islands during the 1990s.

More recently, there has been a shift in focus from top-down initiatives to more bottom-up and locally grounded approaches that try to better address vulnerability at the community level in the Pacific Islands (Barnett & Campbell, 2010; Hay, 2011). Barnett & Campbell (2010) highlight that four distinct shifts in CCA in the Pacific Islands have taken place – in scale from regional to local, in focus from impact assessment to adaptation, in nature from processes driven by outside experts to processes driven by people within the region, and in cost from big, expensive projects to cheaper ones. These shifts are closely aligned with the idea that the unique cultural and environmental context of the Pacific Islands must be acknowledged if CCA is to be successful (Duncan, 2008). Nunn (2009) notes that top-down solutions are likely to fail in the Pacific Islands and environmental decision-making informed by the community level is the most effective. Similarly, Kelman and West (2009) argue that CCA initiatives in small island countries must obtain local knowledge and be better balanced with the needs of residents to allow them to make decisions for themselves. To ensure success, Pacific Island countries must take ownership over CCA and ensure actions are viable, appropriate, and long term; climate change awareness must be mainstreamed into knowledge pools; and community level decision makers must be given the knowledge and tools to make informed decisions about environmental management (Nunn, 2009). Nunn (2013) emphasizes that ownership of CCA is critical because "more will need to be done with less in the future… [and that] …governments and other local stakeholders in the region [need] to think of adaptive solutions that are less expensive, perhaps resorting to traditional solutions based on unremunerated community-sponsored efforts" (p. 160). Pacific Islands governments and local communities must be able to sustain adaptive solutions for the foreseeable future (Nunn, 2012).

### 2.3.2 Barriers and challenges to adaptation in the Pacific Islands

Despite the momentum, adapting to the impacts of climate change poses a substantial problem for Pacific Island countries - they must achieve a degree of sustainability likely unprecedented in any modern states in an environment that allows little room for error and in a very short period of time (Barnett, 2001). Addressing this problem has considerable challenges and barriers, many of which are related to a lack of understanding or awareness and a lack of resources and data (Betzold, 2015; IPCC; 2013; Kelman & West, 2009; Nunn, 2009; Nunn, 2013). Betzold (2015) notes that both local populations and local and national decision makers in the Pacific Islands often have a limited understanding of climate change. The variability in understanding and knowledge can be influenced by factors such as gender and geographic location (Betzold, 2015; Nunn, 2014) and will be discussed further later. Nunn (2009) argues that improving understanding on climate change and potential solutions is one of the greatest challenges for the Pacific Islands as decision makers often allow CCA to be subordinated by short term economic growth activities. In addition, there is often a misconception by many Pacific Islanders that climate change is a foreign issue that will be resolved by those that created it (Betzold, 2015; Nunn, 2013). A lack of resources for CCA is also a significant challenge and often results in heavy reliance on aid in most small island countries, posing numerous challenges, such as international priorities becoming national ones, short timeframes, and the projects terminating once the funding has stopped (Betzold, 2015; Nunn, 2013; Turnbull, 2004). In Fiji for example, Turnbull (2004) notes that these international priorities have resulted in a large body of climate change legislation but no will and no way to enforce it. Similarly, Nunn (2013) also emphasizes the lack of ability to enforce policy as significant challenge for Pacific Island countries. For island countries there is also very little literature or data on the impacts of climate change and appropriate adaptation measures (Nurse et al., 2014; Kelman & West, 2009) and yet the IPCC has no "formal method to track other kinds of literature and knowledge, including reports, indigenous knowledge, or local understanding, which forms a large part of SIDs and climate change vulnerability and adaptation work" (Kelman & West, 2009, p. 9). Nunn (2009; 2013) also notes that the strong role of Christianity in many Pacific Islands societies can sometimes hinder adaptation efforts and that adaptation efforts must acknowledge such beliefs and utilize religious leaders as agents of change to ensure success (Mortreaux & Barnett, 2009; Thornton et al., 2012).

## 2.4 Local knowledge

Since the 1970s and 1980s, the role of local, traditional, and indigenous knowledge has been increasingly recognized in numerous fields of study, notably development, DRR, and resource management (Alexander et al., 2011; Agrawal, 1995; Hiwasaki et al., 2014; Menzies, 2006). The many failures of Western ideologies in these fields emphasized the need to develop processes and incorporate knowledge in ways that were more sustainable, locally embedded, holistic, and participatory (Agrawal, 1995; Menzies, 2006; Warren, 1991). While this knowledge has been given numerous labels within the literature, the terms used generally share considerable meaning and are used interchangeably (Nakashima et al., 2012). According to Nakashima et al. (2012), "the terms 'indigenous, traditional or local knowledge' make reference to knowledge and know-how accumulated across generations, which guide human societies in their innumerable interactions with their surrounding environment" (p. 7). This knowledge contrasts with the dominant, international knowledge system and is the basis for local level decision-making in many communities (Warren, 1991). However, Stevenson (1996) argues that using the term traditional "invites denial of the relevance of efficacy of applying [indigenous peoples'] knowledge to present day issues and problems" (p.4). Knowledge is not simply traditional but rather it is contemporary, dynamic, and is constantly being updated (FAO, 2005; Stevenson, 1996). It can also be argued that the term indigenous knowledge is too narrow of a term as indigenous people themselves possess both traditional and non-traditional knowledge (Stevenson, 1996), knowledge within a community is often a blend of local practices and practices adopted from the outside, and because there is considerable value in knowledge that is not exclusively held by indigenous people but rather by all communities (FAO, 2005). Recently, traditional knowledge has increasingly been perceived as hybrid, dynamic, and capable of adapting to new conditions, rather than simply static (Gómez-Baggethun et al., 2013). Therefore, the term local knowledge, defined as "knowledge that people in a given community have developed over time and continue to develop" (FAO, 2005, p.1), is the least biased term and embraces the largest body of knowledge, including that which would be considered traditional or indigenous (FAO, 2005). Local knowledge is therefore held by a society in a specific location (Naess, 2013) and is intricately related to the sociocultural context in which it was created (Berkes et al., 2000). The emphasis of local knowledge is geographic, a place or a region, rather than on time, something traditional knowledge is often focused on (Dekens, 2007). It is "based

on experience; often tested over centuries of use; adapted to the local culture and environment; embedded in community practices, institutions, relationships and rituals; held by individuals or communities; and dynamic and changing" (FAO, 2005, p.1).

### 2.4.1 Local knowledge in CCA and DRR

While local knowledge has been recognized as an important component of development and conservation efforts since the 1970s (Alexander et al., 2011; Mercer et al., 2010), it is more recently that attention has been paid to its role in responding to environmental and climatic change (e.g. Dekens, 2007; Howell, 2003; Ajani et al., 2015; Aswani et al., 2013). Local and indigenous communities can provide valuable knowledge and strategies to help in the understanding of climate change and its impacts, as well as adaptation options (Hiwasaki et al., 2015; Nakashima et al., 2012). While DRR has been more successful at operating at the local level than CCA (Mercer, 2010), both have seen considerable acceptance of the importance of local knowledge. The IPCC, in 2007, recognized local knowledge as "an invaluable basis for developing adaptation and natural resource management strategies in response to environmental and other forms of change" (Anisimov et al., 2007, p. 673-674) and vast literature exists on traditional ecological knowledge's relevance to CCA (Hiwasaki et al., 2015). While Kelman and West (2009) note that local knowledge must not be considered a panacea to climate change, it can be complementary to science by providing the human landscape element to the impacts of climate change (Alexander et al., 2011). The integration of local knowledge into CCA and DRR not only empowers communities, it can promote increased organization of activities and ensure informed decisions are made, adaptation solutions are sustainable, and projects are cost-effective financially and socially (Deken, 2007; Hiwasaki et al., 2015; Naess, 2013). More than simply accumulating or documenting local knowledge is required – it must be integrated into modern knowledge and innovation systems, and methods that connect adaptation responses or planning with this knowledge must be designed (Aswani et al., 2015; Boedhihartono, 2010).

While there is significant literature on TEKs contribution to CCA, research on local knowledge and climate-related hazards in particular is more limited (Hiwasaki et al., 2015). Additionally, there has been little action in terms of the practical application or the integration of local knowledge into policy or action (Hiwasaki et al., 2015; Mercer et al., 2010; Naess, 2013). Local knowledge is still undervalued (Adger et al., 2011) in the realm of CCA and "scientific

processes such as the IPCC have yet to include observations and assessments by local and indigenous people" (Hiwasaki et al., 2015, p. 37).

### 2.4.2 Benefits of integrating local knowledge into CCA

The integration of local knowledge into CCA has many benefits. Significant literature suggests that local knowledge can help inform adaptation policy and ensure adaptation responses are culturally appropriate and sustainable (e.g. Deken, 2007; Hiwasaki et al., 2015; Hooli, 2016; McMillen et al., 2017; Naess, 2013). Local communities have long used local food and materials to prepare for, mitigate, and adapt to climate-related hazards and environmental change (Hiwasaki et al., 2015) and therefore have considerable knowledge on the long-term viability of particular coping and adaptation strategies. While local knowledge on appropriate coping and adaptation strategies cannot be disregarded, successful past adaptation must not be confused with having the adaptive capacity to deal with new changes (Boillat & Berkes, 2013). Therefore, the true value of local knowledge is often in its wisdom and deep understanding of the environment, in the larger process of innovation, and when it is used in conjunction with other information and knowledge systems (Boillat & Berkes, 2013; King et al., 2008; McMillen et al., 2017; Thornton & Manasfi, 2010). Both local coping and adaptation strategies change and shift over time as the social-ecological context changes (McMillen et al., 2017). Today, local or "traditional ways of knowing are being adapted to reflect current conditions" and therefore multiple strategies must be considered when promoting community resilience and CCA (McMillen et al., 2017).

In addition, significant literature emphasizes the value of local early warning systems and the identification of changes within the environment by local populations (e.g. Adger et al., 2011; Alam et al., 2017; Hiwasaki et al., 2015; Hooli, 2016; Johnston, 2015). Local communities all over the world have long used traditional forecasting and early warning systems to determine how and when local weather extremes would occur, how to mitigate those extremes, and how to cope with the impacts (Hooli 2016). In coastal India knowledge pertaining to animals, the ocean, the atmosphere, and the celestial sphere is used to predict coastal hazards (Santha et al., 2014), and in Fiji and Tonga numerous environmental signs are used to forecast tropical cyclones (Johnston, 2015). For example, the appearance and behavior of particular species of birds in both Fiji and Tonga often warned that a tropical cyclone was coming in the next few days (Johnston, 2015). While many of these warning systems are being challenged by the changing climate (Murphy et al., 2016), these systems can play a very important role in managing vulnerability

and decision-making in relation to weather and many are being adapted to reflect recent changes (Hiwasaki et al., 2015; Nyong et al., 2007). Local and traditional warning systems can highlight the idea that all things are connected and subtle natural linkages between things can reveal much about weather and climate (King et al., 2008).

Local knowledge can also contribute to CCA and assessments by identifying both short and long term climatic and environmental changes (Vinyeta & Lynn, 2013). Local knowledge "relies on the accumulation of long-term, land-based wisdom gained from experiences with organisms, habitats, ecosystems, and ecological process" (Vinyeta & Lynn, 2013, p. 9) and therefore it can compare historical landscapes with present-day conditions (Parrotta & Agnoletti, 2012) to improve understanding of the local level impacts of climate change. In fact, many have argued that local knowledge's strength is in it's long-term, local-scale observations of the environment and weather (Onrubia, 2015; Rosenzweig & Neofotis, 2013). For example, Rahman and Alam (2016) found that in Bangladesh, over 60% of their respondents did not understand the scientific cause and consequences of climate change but had impressive long-term observations on changes in the weather, temperature, and precipitation. Additionally, Adger et al. (2011) highlight that Pacific Islanders have become increasingly aware of changes in their environment and there is often a strong connection between local observed changes and formal scientific assessments. These observations can play a particularly important role in complimenting climate change assessments in places where local scale data is often difficult to find, as is the case in the Cook Islands.

### 2.4.3 Local knowledge in the Pacific Islands

Local knowledge has played an integral role in the sustainability of life and settlements in the Pacific Islands (Veitayaki, 2009). The unique environmental contexts and susceptibility to natural change has shaped the development of knowledge, social practices, institutions, and resource tenure in Pacific Island societies (Veitayaki, 2009). Pacific Islanders commonly have a strong connection to their local environment, their identities are entrenched in it, and they have a wealth of knowledge of the sky, land, and sea (McNamara & Prasad, 2013; Rongo & Dyer, 2014). In fact, following a revolutionary study on marine conservation practices in Oceania in the 1970s, Robert Johannes claimed that "almost every basic fisheries conservation measure devised in the West was in use in the tropical Pacific centuries ago" (Johannes, 1978, p.352). The unique environments of the Pacific and the limited resource base of small islands required

sustainable lifestyles. However, Johannes (1978) emphasizes that the relationship between Pacific Islanders and their environment was not a perfect one and that environmentally destructive practices existed alongside environmentally sustainable ones. Numerous studies have been conducted in the Pacific Islands in an attempt to document the knowledge that exists for disaster management and adapting to environmental change (e.g. Campbell, 2006; Campbell, 2015; Janif et al., 2017; Johannes, 1978; Lefale, 2010; McNamara & Prasad, 2013; Rongo & Dyer, 2015; Veitayaki, 2006), however very few studies exist on integrating this knowledge into CCA and DRR and even fewer studies focus on the Cook Islands specifically. Johnston (2015) does note that documenting local knowledge is consistently mentioned in numerous regional frameworks such as the Pacific Islands Framework for Action on Climate Change and the Pacific DRR and Disaster Management Framework, indicating that this has likely been the focus of any attempts to consider the role of local knowledge. For example, Rongo and Dyer (2014) produced a report that recorded local knowledge on changes in the environment in the Cook Islands. McNamara and Prasad (2013), Veitayaki (2009), and Campbell (2015) have all highlighted some of the key contributions of local and traditional knowledge to coping and adaptation strategies documented in the Pacific Islands regarding disasters and environmental change (Table 3).

**Table 3 –** ***Key coping and adaptation strategies documented in the Pacific Islands***

| Local or Traditional Knowledge/Practice | Coping or Adaptation Outcome |
|---|---|
| **Social relations** | People look after each other because they are related through their social networks |
| **Reliance on environment for resources and food** | Allows independence, self-determined development and alternatives |
| **Customary ownership of land** | People live and are supported by resources on their land |
| **Location of villages on river banks and river mouths that back out onto hills** | Easy access to water and protection from flooding. Villages are sheltered in extreme conditions. |
| **Wild food preparation** | Provides relief in time of need during drought, hurricane, flood and famine |
| **Protection and rehabilitation of coastal habitats** | Provides security, food and resources necessary for life |
| **Multiple cropping and gardens** | Different disasters affect food sources differently |
| **Irrigated taro farming** | Survives longer and withstands drought |
| **Herbal medicine** | Provides relief while waiting for medical assistance |
| **Planting trees and grasses along coastline** | Management of coastal erosion and protection during high tides |
| **Growing crops inland** | Protection from exposure to sea spray, inundation events, and sea level rise |
| **Securing houses during cyclones** | Thatched roofs tied with banana leave veins and green coconut leaves while iron roofs covered with bricks and sacks filled with sand |
| **Hurricane houses** | Special shelters built using bamboo, wild cane, and coconut leaves that are known to withstand strong winds |

| | |
|---|---|
| **Pruning crops** | Reduces damage to crops from cyclone winds |
| **Food surpluses** | Surplus crops or food put aside or preserved for times of shortage |
| **Inter and intra community cooperation** | Forms of leadership that allowed the consumption of food and water supplies to be controlled during times of shortage |

*Note* Data for coping and adaptation strategies in the Pacific compiled from Campbell (2015), McNamara and Prasad (2013), and Veitayaki (2009)

Despite the abundance of literature emphasizing its importance, modernization in the Pacific Islands has resulted in a significant loss of local and traditional knowledge, a lack of understanding of its advantages, and a greater reliance on Western philosophies and aid (Mercer et al., 2007; Veitayaki, 2009). Johannes already noted in 1978 that traditional conservation systems were breaking down because of the "(a) introduction of money economies, (b) the breakdown of traditional authority, and (c) the imposition of new laws and practices by colonial powers" (p. 356). While Janif et al. (2016) emphasize that older generations still highly value traditional ecological and environmental knowledge, this knowledge is generally declining or has been completely lost and is generally of less importance to younger generations. The introduction of Western systems of literacy and modern technologies (e.g. mobile phones and the internet) has eroded oral traditions and the communication of this knowledge and the spread of capitalism in the region has undermined traditional food systems and kinship networks (Campbell, 2015; Janif et al., 2016). Other challenges to utilizing local knowledge to increase resilience include a dependency attitude on external aid, a lack of appreciation on behalf of communities, and the perception that this knowledge is outdated or useless in the face of recent changes (Kelman, 2011; Mercer et al., 2007; Veitayaki, 2009). Local knowledge must be re-incorporated and become the basis of empowerment for communities (Veitayaki, 2009) as this knowledge can helps "its owners understand their history in ways that might help them cope with their future" (Janif et al., 2016, p.6).

### 2.4.4 Knowledge variability in the Pacific Islands

In addition to the challenges to integrating local knowledge into CCA highlighted above, the unique geographic and cultural makeup of many Pacific Islands countries contributes to variability in knowledge. This section discusses the role of geography, age, and gender on the understanding of both local knowledge and the impacts of climate change.

*2.4.4.1 Geographic knowledge variability*

While some literature does exist on the geographic variability in knowledge in island countries (e.g. Kumar, 2007; Lata & Nunn, 2010; Nunn, 2007; Nunn et al., 2013), the extent of this literature is limited. In archipelagic island countries, which many of the Pacific Islands are, the core and periphery divide is exaggerated, and therefore considerable differences in ways of life, beliefs, and often climate change awareness exist (Kumar, 2007; Nunn, 2009). In many Pacific Island countries, the larger, more central islands are not only physically more accessible but are the forefront of economic development for the country and where most new ideas are developed (Kumar, 2007; Nunn, 2009). In contrast, the outer islands are generally harder to reach, less developed, and more traditional (Kumar, 2007; Nunn, 2009). This can play a significant role in both the extent that local knowledge is valued and is understood. Kumar (2007) argues that these differences between core and periphery islands can also impact the ways in which climate change solutions are understood and implemented. People living in core areas often have more understanding of climate change and more appropriate solutions are implemented whereas people living in peripheries are plagued with misinformation on climate change and a lack of appropriate environmental decision-making (Nunn, 2009). In contrast, Walsh et al. (2017) notes that many studies have actually shown more peripheral, traditional communities in the Pacific Islands have a heightened awareness of the environment because of the lifestyles that they live, challenging the notion that peripheral islands often lack proper environmental decision-making. In Fiji, Lata and Nunn (2010) found a large disparity in awareness and understanding of climate change existed between rural and urban communities. Interestingly, it was also found that half the population of the community of Vutia in Fiji had not heard about climate change, despite living very close to an urban centre and having regular access to information (Lata & Nunn, 2010). In addition, there was a large gap between government policy for CCA and the views of the community in Fiji (Lata, 2010).

Some research has been done on knowledge variability in the Cook Islands specifically. In a study of two peripheral Southern Group Cook Islands, Nunn (2008) found that outer islands were more aware of government policy relating to climate change than in other Pacific Islands countries like Fiji, Kiribati, and Vanuatu. This is largely attributed to the more effective top-down environmental decision making that exists in the Cook Islands because of the country's

more metropolitan and less traditional nature compared to other Pacific Islands, better-funded government, and close relationship with New Zealand (Nunn, 2007; Nunn et al., 2013). Despite this, Nunn et al. (2013) argue that a degree of mismatch between national policy, which is generally informed by international climate change agendas, and local level decision-making, which is generally short term in nature, still exists.

#### *2.4.4.2 Age and knowledge variability*

The transmission of local knowledge from generation to generation is central to its usefulness and understanding. However, considerable variability can exist in the knowledge held by different age groups. While some (e.g. Hanazaki et al., 2000) emphasize that younger generations can have higher levels of some aspects of local knowledge, many studies (Brosi et al., 2007; McCarter & Gavin, 2011; McCarter & Gavin, 2015; Pearce et al., 2011) have found greater amounts or diversity of local knowledge in older age cohorts. In a study in the Canadian Arctic, Pearce et al. (2011) found that subsistence harvesting knowledge continued to be important to younger Inuit men, while other knowledge, such as how to make fish nets, was poorly transmitted to these generations. Similarly, Brosi et al. (2007) found that knowledge on traditional canoe making in Micronesia declined from oldest to youngest because driving fiberglass boats was socially and economically more desirable. This variability in knowledge between generations can be attributed to many factors including globalization, the introduction of Western education systems, church influence, technology, and changes in the use of vernacular languages (Brosi et al. 2007; McCarter & Gavin, 2011; McCarter & Gavin, 2015; Pearce et al., 2011). In addition, younger generations are spending less time participating in subsistence-based activities because of the introduction of wage economies (Brosi et al., 2007; Pearce et al., 2011).

#### *2.4.4.3 Gender and knowledge variability*

In addition to the geographic variability in knowledge that exists in many Pacific Islands countries, gendered variability in knowledge also exists. Although there is considerable literature on the gendered impacts of climate change (Alston, 2014; Arora-Jonsson, 2011; Denton, 2002), there is significantly less literature on how gender can inform both understanding of climate change and the environment. Lane and McNaught (2009) highlight that "local gender-specific knowledge must be recognized" (p. 69) and that it can contribute to existing body of knowledge

on climate change in Pacific Island countries. In addition, gendered divisions of labour can also impact knowledge and is important to better understand climate change and the environment in the Pacific Islands (Lane & McNaught, 2009). Nunn (2008) highlights that in many traditional Pacific Island communities, women have no say in environmental decision-making. Literature on ethnomedical knowledge in the Pacific, South America, and Africa suggests that men have a richer body of knowledge than women, in part because of the cultural division of labour in those communities (Case et al., 2005; McCarter & Gavin, 2015).

### 2.5 Summary

CCA and the integration of local knowledge into adaptation have received increasingly more attention in recent years. Local communities often hold valuable knowledge that can contribute to CCA efforts such as knowledge on changes in the environment, early-warning signs for climate-related hazards, and practical, sustainable adaptation strategies. However, despite these contributions, local knowledge is still undervalued in CCA (Adger et al., 2011) and more work must be done to better understand the practical applications of local knowledge and how best to integrate this knowledge into adaptation policy (Hiwasaki et al., 2015; Mercer et al., 2010; Naess, 2013). Additionally, there is a lack of research on CCA in the Cook Islands, particularly in regard to the integration of local knowledge and its relation to climate-related hazards. This research aims to address some of these gaps in knowledge.

# CHAPTER 3 - RESEARCH METHODS

## 3.1 Research design

Research design is the framework that is used to conduct research, including the theory, questions, methods, and procedures (Hay, 2016). The specific methods used in research are informed by the intersection of philosophy, or worldviews, with strategies of inquiry (Creswell, 2009) (Figure 1). Creswell (2009) highlights that worldviews, "general orientations about the world and the nature of the research" (p.4), are shaped by the researcher, their past experiences, and their field of study. This research is shaped by a social constructivist worldview which informed the strategies of inquiry and specific research methods used. Social constructivists assume that individuals seek understanding of the world and as a result, meaning is subjective (Creswell, 2009). In addition, social constructivists believe that the historical and cultural context in which people live shapes meaning and therefore meaning is varied, multiple, and complex (Creswell, 2009). For this research, the social and cultural context of the Cook Islands plays a central role in shaping individuals' knowledge. Consequently, this research aimed to better understand different perceptions on the role of local knowledge in CCA. Social constructivists also recognize that their own personal, cultural, and historic experiences shape their interpretations of the world (Creswell, 2009), and this is discussed further in Section 3.3.1 as well as in the limitations of this research.

A social constructivist worldview aligns with inductive strategies of inquiry. Unlike deductive research which begins with theory and tests a hypothesis, inductive research aims to draw inferences out of the observations of the research (Bryman, 2012). Rather than begin with a theory, social constructivists try to "make sense of (or interpret) the meanings others have about the world" (Creswell, 2009, p.6) and generate patterns of meaning from their research (Creswell, 2009). While the objectives of this research were informed by an extensive literature review on CCA and the role of local knowledge, they were also equally informed by the knowledge and input provided by key contacts in the Cook Islands and my own research desires and biases. In addition to inductive research, social constructivists often use case studies as strategies of inquiry, therefore leading to the development of the in-depth single country focus for this research.

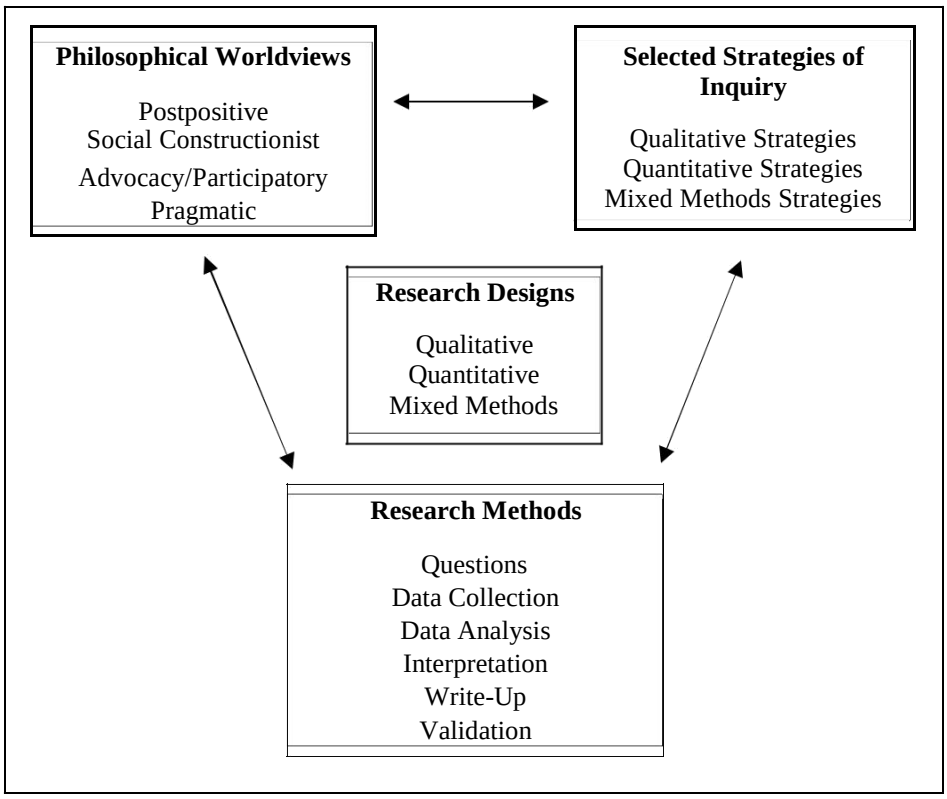


Figure 1 - A framework for design
Note Reproduced from Creswell (2009)

The worldview and strategies of inquiry that have guided this research led to the final process in the research design – the specific research methods. Qualitative research methods are well suited for social constructivism, inductive research, and case study approaches. Creswell (2009) states that "qualitative research is a means for exploring and understanding the meaning individuals or groups ascribe to a human or social problem" (p.4). Qualitative research generally involves emerging questions, collects data in the participant's setting, and results in interpretations of the meaning of the data being made by the researcher (Creswell, 2009). In contrast to positivism and many quantitative methods, qualitative research places emphasis on words, meaning, and how individuals interpret their social world (Bryman, 2012). This research aimed to understand the role of local knowledge in CCA from the perspective of a small, in-depth sample size and therefore was well suited to qualitative research methods. The intention of this research was to hear the thoughts and perspectives of different stakeholders whose history, culture, and role within society shape their understanding and the meaning that they place on local knowledge and CCA.

Therefore, this researched employed qualitative research methods to understand the role of local knowledge in adapting to climate related hazards in the Cook Islands. Two key phases of qualitative research methods were used: (1) a review of peer-reviewed literature, grey literature, and relevant national policies on CCA, DRR, and local knowledge, and; (2) semi-structured interviews (n=34) with two categories of interviewees – key informants and local participants. Key informants included interviewees from the national government, a non-governmental organization, and an academic. Local participants included interviewees at the community level who were engaged in resource-based livelihoods.

## 3.2 Case study approach

A single-country case study approach was used as the research methodology for this study. Baxter (2016) emphasizes that a case study "involves the study of a single instance or small number of instances of a phenomenon in order to explore in-depth nuances of the phenomenon and the contextual influences on and explanations of that phenomenon" (p. 130). Case studies provide valuable in-depth understanding and are useful for not only solving practical problems but also broadening theory (Baxter, 2016). While it is recognized that the results of this research cannot be generalized, the case study approach provides opportunities for the transferability of this research (Baxter, 2016). The Cook Islands was selected as a case because of the country's vulnerability to the impacts of climate change, the interest expressed on behalf of key contacts to have research of this nature conducted, and the feasibility of conducting research in this location. The islands of Rarotonga and Mitiaro were chosen as the embedded cases, sub-units of analysis situated within the larger case study (Yin, 2003) of the Cook Islands, both because of their different socioeconomic and geographic characteristics which provided a strong basis for comparison and the willingness of informants to participate in the research.

## 3.3 Qualitative methods

### 3.3.1 Ethical considerations

Geographical research is often inherently cross-cultural (Howitt & Stevens, 2016). Recently however, the dominant modes of cross-cultural research in geography have been increasingly criticized for dismissing the rights and knowledge of participants, using intrusive or unsuitable methodologies, and using research findings inappropriately (Howitt & Stevens, 2016).

In addition to meeting the formal ethics requirements of the University of Waterloo, this research was developed and conducted with these critiques of geographic research in mind. To address these critiques, the purpose and objectives of this research were guided by the insight of multiple Cook Islanders who provided feedback and recommendations. Additionally, a proposal of this research was reviewed and approved by the Cook Islands National Research Committee as well as the Indigenous Island Councils of both Rarotonga and Mitiaro. This approval was required to obtain a research permit for the country. A stipulation of this permit is to provide the results of this research to the Cook Islands Office of the Prime Minister and any other organization involved to ensure they can use the findings in a manner that is both beneficial and appropriate.

As a researcher it is important to be critically reflexive, particularly in qualitative research where considerable social interactions take place and power relations can exist (Dowling, 2016). In the context of this research, critical reflexivity, "a process of constant, self-conscious scrutiny of the self as researcher and of the research process" (England, 1994, p.244), meant understanding my own social position as a researcher, an outsider, and a woman, as well as understanding how these roles may influence the findings of this research. Efforts were made to address any power structures that existed by immersing myself in the community, participating in cultural activities, and collaborating with local organizations. Additionally, biases, assumptions, and experiences were reflected upon in a research notebook and taken into consideration in the analysis. Despite these efforts, there are limitations to this research, and I acknowledge that this research is shaped by my own education, experiences, and worldviews. Both the design of this research and the interpretation of the results are influenced by the social constructivist worldview that I hold, the Western, liberal education that I have received, and my own research biases and assumptions. While efforts were made to be critically reflexive and conduct this research in a non-biased manner, my position inherently influences this research.

### 3.3.2 Participants

This research aimed to understand the perspectives of both 1) key informants in positions related to CCA, DRR, and policy making and 2) local participants engaged in resource-based livelihoods. A total of 34 participants were interviewed (Table 4). For the purpose of this research, a key informant was conceptualized as an adult of legal age who played a prominent role in the planning, funding, or implementation of CCA or DRR efforts in the Cook Islands. A

total of 10 key informants were interviewed. Most (n=8) key informants were affiliated with national government ministries. In addition, one key informant was affiliated with a non-governmental organization actively involved in the preservation of local knowledge, particularly in relation to hazards and environmental change, and one was a prominent academic whose research and work directly related to CCA in the Cook Islands. These participants were largely selected purposefully because of their expertise, although a few were identified through snowball sampling. All 10 key informants that were interviewed were located on Rarotonga.

**Table 4 – *Gender and age of interviewees***

| **Gender** | **Number of Interviewees** |
|---|---|
| Male | 26 |
| Female | 8 |
| **Age** | **Number of Interviewees** |
| 30-39 | 1 |
| 40-49 | 4 |
| 50-59 | 13 |
| 60-69 | 8 |
| 70-79 | 7 |

A local participant was conceptualized as an adult of legal age who identified as Cook Islands Maori, was either partially or fully engaged in a natural resource-based livelihood, and whose income was in some way supported by natural capital – including access to land, water, fishing, wild products, and biodiversity (FAO, 2005). These included participants involved in small-scale commercial planting or fishing operations as well as those who plant or fish to support themselves and their families. A total of 24 local participants were interviewed, 8 of whom on Rarotonga and 16 of whom on Mitiaro. Local participants were identified through snowball sampling. The first local participant was identified by a referral from a key informant. Subsequent referrals came from local organizations, other key informants, or local participants themselves.

### 3.3.3 Data collection

Semi-structured interviews were conducted with a total of 34 key informants and local participants in May, June, and July 2017. For key informant interviews, central government agencies were identified through an internet search and potential informants were provided with a letter (Appendix A) introducing the research and providing contact information. Additional key

informants were also identified through snowball sampling, a procedure that asks key informants to provide information on other potential key informants to the researcher (Bouma et al., 2012). Local participants were recruited through key organizations such as Te Ipukarea Society, a local non-governmental organization, flyers at community centres (Appendix B), and through snowball sampling. For both key informants and local participants, potential interviewees were contacted through an introductory telephone call or a meeting was arranged where the aims, methods, and responsibilities of the research were explained (Appendix C and D). Interviews were then arranged with willing informants/participants at their office or a mutually agreed upon public location. All interviews used a verbal consent script (Appendix E) which informed interviewees that the research had been approved by the University of Waterloo Research Ethics Committee, assured confidentiality, and allowed the interviewee to provide consent for audio recording. Verbal consent was recorded (Appendix F). In Mitiaro, a local translator was used to assist in the interviewing process. The translator signed a statement of confidentiality to ensure no details about local participants or the interview conversations were shared (Appendix G). Interviews with key informants lasted between 30 and 90 minutes and interviews with local participants lasted between 20 and 90 minutes. Thank you emails (Appendix H) were sent as appropriate within 48 hours.

Interviewing was chosen as the primary research method because this method enables researchers to collect a diversity of meanings, opinions, and experiences, and the method shows respect to, and can empower, those providing the data (Dunn, 2016). Interviewing also allows the researcher to discover what is important to the informant (Dunn, 2016). In particular, semi-structured interviews were conducted to ensure that key ideas are addressed while allowing for the flexibility to pursue individual opinions and thoughts which are outside of the planned interview themes. Interviews with both key informants and local participants followed an interview guide (Appendices I & J) outlining key themes, sample questions, and prompts. The interview guides were informed by relevant concepts identified within the literature, the interview guide used by McCubbin, Smit, & Pearce (2015), and the research objectives. The interview guide was supplemented with additional themes that were raised by the participants and identified as relevant. This technique allowed the interviews to remain content-focused and relevant while still maintaining flexibility to hear personal opinions and perceptions (Dunn, 2016).

Most interviews were conducted in person, with only one taking place via email. Interviews with key informants began with introductory questions such as the role of the participant's organization in CCA or DRR and the participant's role within the organization. Introductory questions were followed by more in-depth questions on local knowledge and practices, current policy and CCA or DRR projects, and their perceptions on the variability of knowledge found across the Cook Islands. Interviews with local participants also began with introductory questions such as how long they have lived in the Cook Islands and what they do for a living. These were followed by questions on environmental changes, adaptation or coping strategies, opinions on government projects, and other stressors relevant to their lives. The semi-structured interviews followed a hybrid technique where both a funnel and pyramid structure are used (Dunn, 2016). Interviews generally began with easy to answer questions, moved onto more abstract and broad ideas, and finally followed up with in-depth discussion on more sensitive or personal issues (Dunn, 2016).

### 3.3.4 Data Analysis

Audio recordings of the interviews were transcribed post-interview and supplemented by notes taken during the interviews. All identifying information was removed from the transcriptions and participants were identified by KI(#) for key informants or LP(#) for local participants. Following transcription, all data were analyzed using NVivo Software. A theme code set was created based on key categories seen within the data and common to relevant background literature (Dunn, 2016), and the transcriptions were colour coded into common themes by highlighting relevant passages of text. Emergent and more analytic themes from the data were also included in the theme code set throughout the coding process. Coding involved both descriptive codes, themes or patterns that are obvious or directly stated, and analytic codes, themes revealed by digging deeper into the context of phrases (Dunn, 2016). Additionally, triangulation was used to ensure rigor within the research results. Triangulation utilizes multiple methods or information sources to confirm results (Stratford & Bradshaw, 2016). Interview data was corroborated with observations in the field, relevant literature, and review of current policy.

Additionally, detailed observational and reflective notes were kept during the three-month field season to supplement the information provided in the interviews. Fieldnotes were used to provide complementary evidence – additional descriptive information obtained outside

the more structured forms of data collection (Kearns, 2016). Using such observations to complement data can "assist in interpreting the experience of place" (Kearns, 2016, p. 315) and allow the research to better understand multiple viewpoints (Kearns, 2016). These fieldnotes were also coded in Nvivo using the same theme code set as interview data and allowed for additional context as well as better understanding of personal bias and positionality to inform the ethical considerations of this research.

### 3.4 Limitations

While snowball sampling can be an effective technique to identify research participants, it also has some limitations. In particular, snowball sampling may result in the voices of certain population groups not being heard while other population groups may be overrepresented. Research participants may have been more likely to identify other participants with similar viewpoints or social and economic characteristics as themselves and, therefore the sample of participants included in this research is only one set of perspectives and should not be taken as representative of the population as a whole.

Given the more prominent presence of men in positions of power and in traditional head of the household activities (i.e. fishing and planting) in the Cook Islands, it was challenging to find women to interview for this research. Considerably fewer women participated in the interviews and therefore many of the perspectives shared may not be the experience of women or other marginalized groups. Further research is needed to understand the impacts of climate change on and the adaptation strategies of women and other marginalized groups. In particular, more research on the knowledge that women in the Cook Islands hold would be useful.

This research interviewed 34 participants in the Cook Islands and gathered a significant amount of data. However, a greater diversity of participants from other government sectors and the community could have been included. Given the vast distance between islands in the Cook Islands, this research only captured perspectives of participants on Rarotonga and Mitiaro. Therefore, this research is not intended to be a representation of the perspectives of all Cook Islanders, but rather a sample of perspectives from key informants working in CCA or DRR in Rarotonga and community members engaged in resource-based livelihoods in Rarotonga and Mitiaro. In addition, there are significant cultural differences between many of the islands that

make up the Cook Islands and therefore the local knowledge shared by participants in this research should not be taken as the only way of knowing.

Despite the confidentiality of the interviews, both key informant and local participants may have been hesitant to be critical of the government and adaptation policy. The Cook Islands is a relatively small country (see Section 4.1) with a limited number of actors working on CCA projects. Therefore, some information or perspectives may not have been disclosed during the interviews.

Lastly, given the qualitative and context specific nature of this research, a limitation of this research is the generalizability of the results. The perspectives and knowledge shared are unique to the participants of this research. Both the researcher's and the participants' ways of knowing are shaped by their personal experiences and the social and cultural context in which they live, and therefore it is not expected that the results of this research are generalizable for other contexts. However, opportunities to explore the transferability of this research are explored in the Conclusion.

# CHAPTER 4 - STUDY SITE AND COOK ISLANDS CONTEXT

## 4.1 The Cook Islands

The Cook Islands is a Pacific Island country located approximately halfway between New Zealand and Hawaii. The country consists of 15 islands divided into a Northern and Southern Group and spread over more than 2 million square kilometers of ocean (Figure 2). Most of the country's population and infrastructure is located on the main island of Rarotonga, in the Southern Group, while the rest of the islands in both the Northern and Southern Group are referred to as the 'outer islands' or the *'Pa Enua'*. The Northern Group islands, located over 1,250 kilometres from the main island of Rarotonga, are made up of five coral atoll islands and one sand cay (Rongo, 1992; NES, 2011). These islands are remote, sparsely populated, and range in height from 3 to 9 metres above sea-level (NES, 2011). The Southern Group islands are low volcanic islands - with the exception of Rarotonga, a high volcanic island – and are surrounded by raised coral or '*makatea*' (NES, 2011). These islands are closer to Rarotonga, more populated, and range in height from 5 to 652 metres above sea-level (NES, 2011).

The weather and climate in the Cook Islands are significantly influenced by regional climate patterns, the vast geographic spread of the country, and the diverse topographic makeup of the islands. The country experiences a sub-tropical to tropical climate and is dominated by two main seasons – a cool, dry season lasting from May to October and a warm, wet season lasting from November to April (NES, 2011). November to April is also the tropical cyclone season for the country. Interannual climate variability in the Cook Islands is largely influenced by both oceanic and regional climate patterns, including ENSO and SPCZ. These climate patterns, however, impact the Northern and Southern Group islands in different ways, given the vast geographic spread between them and considerable differences in their proximity to the Equator (NES, 2011). For example, ENSO brings cooler and drier weather to the Southern Group of the Cook Islands but wetter weather to the Northern Group (NES, 2011). In addition, Rarotonga's weather is influenced by local orographic effects because of the island's mountainous interior (Carruthers, n.d.).

The Cook Islands is a self-governing country in free association with New Zealand. Therefore, Cook Islanders hold New Zealand citizenship and have free access to New Zealand

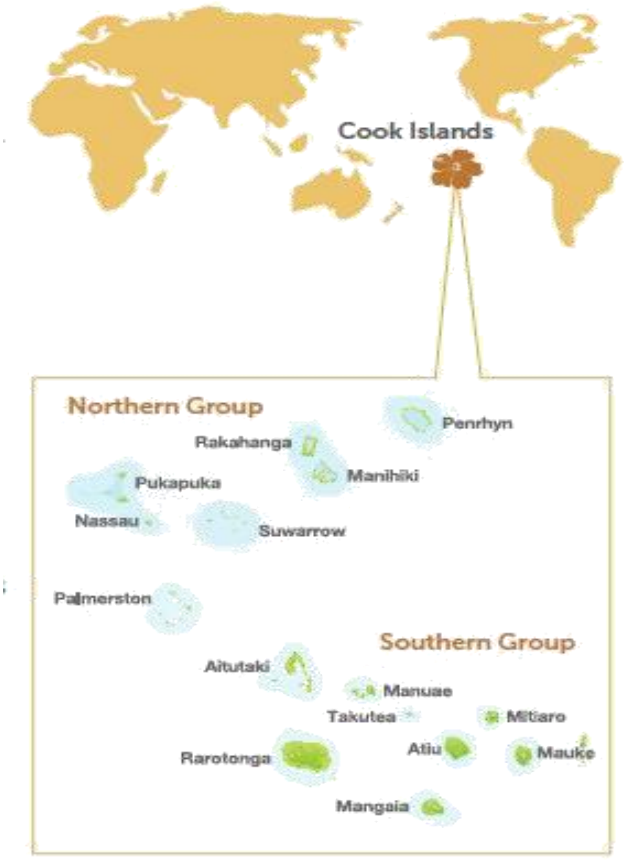


Figure 2- Map of the Cook Islands
Source: Government of the Cook Islands (2016)

resulting in high rates of out-migration (NES, 2011). In fact, three to four times as many Cook Islanders live overseas than in the Cook Islands (NES, 2011). In 2016, the population of the Cook Islands was 17,434 (MFEM, 2016). Over 70% of the population lives on Rarotonga, 21% in the rest of the Southern Group islands, and only 7% in the Northern Group islands (NES, 2011). In addition, over 80% of Cook Islanders identify as Cook Islands Maori (MFEM, 2016).

The largest economic sectors in the Cook Islands include tourism, financial services, black pearl exports, fisheries, and agriculture, and the country has the highest GDP per capita in the Pacific Islands (NES, 2011; Asian Development Bank, 2018). However, considerable disparities exist between Rarotonga and the Pa Enua, particularly in income and access to basic needs and services, and the country is highly sensitive to economic shocks such as rising fuel and food costs, the out-migration of Cook Islands people, and climate change (NES, 2011). In addition, over 70% of Cook Islanders engage in some form of agricultural activity on either a

subsistence or commercial basis (NES, 2011), particularly those in the outer islands. Seventy-five percent of outer islanders also engage in fishing for subsistence while only 29% of Rarotongans do (NES, 2011).

The Cook Islands is vulnerable to many natural hazards including tropical cyclones, floods, droughts, and storm surges, all of which are predicted to increase in frequency, intensity, and duration as a result of climate change (NES, 2011; World Bank, 2015). DRR and CCA efforts in the Cook Islands are complicated by considerable differences in the levels of development and the types of livelihoods residents engage in on Rarotonga and in the outer islands resulting from the vast geographic distances between islands and the sparsely populated nature of the outer islands. In addition, the entire population lives within 5 kilometres of the coastline, population and infrastructure along the shoreline continues to increase, and disaster response to the outer islands is hindered by both their geographic spread and constrained public finances (Carruthers, n.d.; World Bank, 2015), adding significant complexity to DRR and CCA (see Section 4.4).

## 4.2 Case study sites

This research focused on two Southern Group islands in the Cook Islands – Rarotonga and Mitiaro. Unlike some of the low-lying Northern Group atoll islands, both Rarotonga and Mitiaro are unlikely to be abandoned because of sea level rise due to their larger populations and higher elevations. Therefore, it is important to better understand local adaptation practices on these islands and the successes and challenges of integrating these practices into CCA policy to contribute to the long-term sustainability of the Cook Islands. Additionally, Rarotonga was chosen because nearly the entirety of the Cook Island's infrastructure – government, tourism, educational, commercial, transportation and industry – is on the island and adaptation to climate change is critically important there. Mitiaro, a more remote outer island, was chosen in order to provide a unique comparative study of potential adaptation strategies. The following section discusses some of the key social and physical characteristics of Rarotonga and Mitiaro.

### 4.2.1 Rarotonga

Located in the Southern Group, Rarotonga is the largest and most populated island in the Cook Islands. With over 13,000 people living on the island, Rarotonga is home to over 70% of the country's population (NES, 2011; MFEM, 2016). The majority of the country's

infrastructure, including the international airport, main shipping port, government, and commercial activity is located on Rarotonga. In addition to a high concentration of population, Rarotonga receives thousands of tourists each year, resulting in considerable strains on resources and many environmental problems (NES, 2011). Paid employment rates are the highest in Rarotonga and the majority of Rarotongans are employed in the service sector (MFEM, 2015).

In addition to being the largest island in the Cook Islands, Rarotonga is a mountainous volcanic island with the highest elevation in the country at 652 metres and a fringing reef (NES, 2011) (Figure 3). Like the rest of the Cook Islands, Rarotonga experiences a warm and wet season from November to April and a cooler, dry season from May to October, however weather is also influenced by local orographic effects (Carruthers, n.d.). Average annual precipitation in Rarotonga is just over 2000 mm. with the most rainfall generally occurring in January and March (Thompson, 1986). Most freshwater on Rarotonga is supplied by water intakes in the interior of the island with some households relying solely on rainwater catching and on-site storage tanks (NES, 2011). Water stress does occur on the island, especially during extended dry periods, and wastage rates can be as high as 60-70% (NES, 2011). During the tropical cyclone season from November to April, Rarotonga experiences one cyclone each year on average (de Scally, 2008). However, there is significant variation in the number of cyclones annually, some seasons having none and others having six, largely due to the impacts of El Niño conditions (de Scally, 2008).

Figure 3 - The mountainous interior of Rarotonga Source: de Scally, F. (2017)

4.2.2 Mitiaro

Mitiaro is also located in the Southern Group of the Cook Islands, 230 kilometres Northeast of Rarotonga (NES, 2011) (Figure 4). With a population of 213, Mitiaro is small and sparsely populated in comparison to Rarotonga (NES, 2011). Opportunities for paid employment

are much sparser in the outer islands and therefore many Mitiaroans rely on fishing or the planting of crops as sources of livelihood (MFEM, 2015). Additionally, Mitiaro is one of three islands in the Cook Islands still under traditional land tenure and therefore land cannot be alienated by lease, rented, or assigned to someone else by the owner, adding complexity to enforcement of environmental and land legislation (NES, 2011).

Unlike Rarotonga, Mitiaro is a raised coral or *'makatea'* island with the highest point on the island being on 15 metres above sea level (NES, 2011). Similar to Rarotonga, Mitiaro has a fringing reef (NES, 2011). Because of Mitiaro's location in the Southern Group of the Cook Islands, weather patterns are similar to that of Rarotonga. However, Mitiaro is not impacted by orographic effects. Average annual precipitation in Mitiaro is just under 2000 mm with the most rainfall occurring in January (Thompson, 1986). Freshwater supply on Mitiaro comes from a combination of spring water from a freshwater lens under the island and rainwater (NES, 2011), making it particularly vulnerable to drought and sea level rise. Most of the water on the island is non-potable and often brackish, except for the water supplied by community rainwater tanks which are chemically treated (NES, 2011). While data on the number of cyclones to impact Mitiaro specifically does not exist, the Southern Group of the Cook Islands experiences nearly twice as many cyclones as the Northern Group (de Scally, 2008).

Figure 4 - The makatea (raised coral) interior of Mitiaro
Source: de Scally, D. (2017)

### 4.3 Projected impacts of climate change on the Cook Islands

The impacts of climate change on small island countries are expected to be dramatic, despite these countries having negligible contributions to global greenhouse gas emissions (Nurse et al., 2014). The IPCC (2013) anticipates climate change will have negative consequences for nearly every sector in small island countries and will create an additional burden on top of the existing challenges they face including limited resources, dependence on international trade, and vulnerability to global developments and environmental hazards (Mercer

et al., 2007). In addition, Pacific Island countries are physically vulnerable to climate change and sea-level rise because of their high ratio of shoreline to land area, narrow economic base, location on a dynamic ocean-atmosphere interface, limited ecological carrying capacity, vast ocean areas, and rapid rural to urban migration to settlements situated on the coastal margin (Barnett, 2001).

Further exacerbating the impacts of climate change on small island countries like the Cook Islands is the high level of uncertainty on how exactly the impacts will unfold. In fact, there are very few environmental or development problems that rival climate change and sea-level rise in terms of the degree of scientific uncertainty (Barnett, 2001). This uncertainty poses considerable challenges for Pacific Islands countries. Firstly, climate change is a cross-scale, temporally complex, spatially complex, and highly interconnected issue, and therefore uncertainty around both the impacts of climate change and the likely effectiveness of responses exists (Barnett, 2001). Secondly, climate projections for the Pacific Islands tend be at the regional scale rather than downscaled to a specific to a country or location within a country (PCCSP, 2011). For example, most climate projections for the Cook Islands are not representative of an actual island or town within the country but rather they refer to average change over the South Pacific region as a whole (PCCSP, 2011). Given this uncertainty, it is challenging for governments in the Pacific Islands, who often already have limited resources, to determine the most appropriate adaptation strategies. This next section outlines the five key impacts of climate change expected in the Cook Islands keeping in mind the uncertainty highlighted above.

### 4.3.1 Increased air and sea surface temperatures

It is projected that climate change will cause warming to occur over the Pacific Region, although at a slower rate than other parts of the world (PCCSP, 2011). This is largely because of the buffering effect of the high amounts of ocean surface throughout the region (PCCSP, 2011). For the Cook Islands specifically, there is very high confidence that both air and sea-surface temperatures will continue to rise (PCCSP, 2011). In addition, the intensity and frequency of extreme heat days is projected to increase in the Cook Islands because of climate change, impacting both terrestrial ecosystem productivity such as crop yields and nearshore ecosystems such as coral reefs (Nunn, 2009; PCCSP, 2011).

### 4.3.2 Sea-level rise

The most widely recognized impact of climate change in low-lying coastal areas is sea-level rise (Nurse et al., 2014) (Figure 5). This is particularly important in small island countries, like the Cook Islands, where island coasts have been the most favorable locations for human settlement and infrastructure, and where limited relocation opportunities exist (Nunn, 2013; Woodroffe, 2008). Since 1993, sea-levels have risen by approximately 4 mm per year in the Cook Islands – slightly faster than the global average of 2.8-3.6 mm per year (PCCSP, 2011). Sea-level rise is expected to continue throughout the 21st century and is projected to be between 5-15 cm and 4-15 cm as by 2030, as compared to the average rate between 1980 and 1999, under a medium and high-emissions scenario (Table 5) (PCCSP, 2011). More recent research has also indicated that sea-level rise is likely to be one metre by 2100, the upper end of IPCC projections (NASA, 2018). It has been estimated that atoll islands, like those that make up the Northern Group of the Cook Islands, will become uninhabitable by 2050 (Dickinson, 2009). In addition to the potential loss of entire islands, the impacts associated with sea-level rise in the Cook Islands also include shoreline erosion, increased coastal flooding, freshwater salinization, and higher storm surges during tropical cyclones (Nurse et al., 2014; PCCSP, 2011).


Figure 5 - A sea-level rise monitoring station in Avatiu Harbour, Rarotonga

Source: de Scally, D. (2017)

**Table 5 - *Sea-level rise projections for the Cook Islands for three emissions scenarios and three time periods***

| | 2030 | 2055 | 2090 |
|---|---|---|---|
| Low emissions scenario | 5-15 cm | 10-26 cm | 17-45 cm |
| Medium emissions scenario | 5-15 cm | 10-30 cm | 19-56 cm |
| High emissions scenario | 4-15 cm | 10-29 cm | 19-58 cm |

*Note* Reproduced from Pacific Climate Change Science Program. (2013). *Current and future climate of the Cook Islands.* Canberra, AU: Australian Government.

### 4.3.3 Increased variability in rainfall events

It is projected that climate change will increase the variability of rainfall events in the Cook Islands. Precipitation patterns in the Cook Islands are largely influenced by ENSO and SPCZ, both of which are expected to be impacted by climate change and are discussed in the next section. There is high confidence that days of extreme rainfall will increase in both frequency and intensity as a result of climate change (PCCSP, 2011). Model projections show that a rainfall event that currently occurs once every 20 years will occur once every four years in the Northern Group and every five years in the Southern Group by 2090 under a high emissions scenario (NES, 2011). In addition, there is moderate confidence that average rainfall amounts will increase throughout the 21$^{st}$ century but with uncertainty on the range and distribution of this precipitation (PCCSP, 2011). Projections show an increase in rainfall from November to April in the Cook Islands but a decrease from May to October (PCCSP, 2011). Interestingly, there remains significant uncertainty on the impacts of climate change on drought events. The PCCSP (2011) highlights that there is moderate confidence the frequency of drought will decrease in the Cook Island, while projections used in the country's National Communication to the UNFCCC show an increase in drought by 2030 followed by decline through the rest of the century (NES, 2011).

### 4.3.4 Changes in regional climate systems

Climate change is expected to impact both ENSO and the SPCZ, the key sources of interannual climate variability in the Cook Islands (PCCSP, 2011). ENSO, which is centered in the tropical Pacific Ocean, is one of the largest sources of naturally occurring climatic variability in the world (Hilton, 1998). The extreme phases of ENSO, El Niño and La Niña, can influence the distribution of warm sea surface temperatures, wind patterns, currents, and large-scale, weather-producing atmospheric convection (Hilton, 1998). The South Pacific Convergence Zone is the most expansive rain band in the Southern Hemisphere and shifts in the placement of the zone can cause dramatic changes to hydroclimatic conditions and the frequency of extreme weather events in the Pacific region (Cai et al., 2012). The relationship between these two sources of climatic variability can significantly impact seasonal rainfall variation and the distribution of tropical cyclones in the Pacific (Hilton, 1998). For example, during strong El Niño events, the SPCZ swings up to ten degrees of latitude towards the Equator which can

reduce rainfall in the Southern Group of the Cook Islands by up to 60% and increase rainfall in the Norther Group by nearly 200% (Cai et al., 2012; SPREP, 2009). Climate change is projected to impact ENSO and the SPCZ, increasing temperature and precipitation variability and the frequency and intensity of extreme weather events in the Cook Islands (Cai et al., 2011; PCCSP, 2011; Terry et al., 2001). In fact, extreme El Niño events may double because of climate change and it is estimated that there will be an increase in the intensity of changes in the distribution of the SPCZ (Cai et al., 2015; PCCSP, 2011). This increase variability in climate patterns is expected to increase the frequency and intensity of both flood and drought events in the Cook Islands (NES, 2011).

### 4.3.5 Likely increased intensity of tropical cyclones

Tropical cyclones pose some of the greatest risks to livelihoods and infrastructure in the Cook Islands (Figure 6). On average, the Cook Islands experiences between 1.6 and 6 tropical cyclones annually depending on the island (NES, 2011). In February and March of 2005, the country was hit by five consecutive tropical cyclones, four of which were recorded as Category 5 storms (World Bank, 2015). The risks posed by tropical cyclones are expected to be exacerbated by climate change and studies are increasingly projecting that climate change will influence the frequency, intensity, and duration of climate-related hazards like tropical cyclones (NES, 2011). However, there is still substantial uncertainty surrounding exactly how climate change will impact tropical cyclones frequency, intensity, and duration. While many predictions indicate that climate change will likely decrease the frequency of tropical cyclones globally (Knutson et al., 2010), others have predicted an increase in tropical cyclone frequency in the South Pacific (Emanuel, 2013). There is more confidence, however, that there will be an increase in the frequency of the most intense tropical cyclones, wind speeds, and rainfall amounts (Knutson et


Figure 6 - A church in Rarotonga noting the years in which it experienced damage from tropical cyclones
Source: de Scally, D. (2017)

al., 2010; NES, 2011). Risks posed by tropical cyclones will be further magnified by higher storm surges because of sea level rise. It is anticipated that the Cook Islands will, on average, suffer nearly $5 million USD, or 2% of the country's GDP, in losses to tropical cyclones each year with climate change (World Bank, 2015).

### 4.4 Current CCA and DRR initiatives

While the Cook Islands has a long history of CCA and DRR initiatives, considerably more emphasis has been placed on these in the last decade. Since 2007, the country's national vision framework *Te Kaveinga Nui 2020* has guided both CCA and DRR efforts (NES, 2011). The objective of *Te Kaveinga Nui 2020* is "to build a sustainable future that meets our economic management, environmental integrity, social stability, and our Cook Islands Maori culture, and the needs of our future generations" (NES, 2011, p.26). This objective is articulated through National Sustainable Development Plans which are updated every five years and whose strategies become national priorities across all sectors and government agencies (NES, 2011). In addition, CCA and DRR have become increasingly linked in the Cook Islands and therefore, this research included DRR efforts and projects as important components of CCA efforts. In fact, included in the most recent version of the National Sustainable Development Plan (2016-2020) is a strategic goal referencing both CCA and DRR, stating that the country will "strengthen resilience to combat the impacts of climate change and natural disasters" (Office of the Prime Minister, 2016, p.19) (Figure 7). Many government departments and agencies, with the support of numerous plans, policies, and programs, work towards achieving this goal within the Cook Islands.

To better understand the role of local knowledge in CCA, this section highlights the key CCA and DRR goals and initiatives taking place in the Cook Islands. This section will also briefly explore the extent to which local knowledge is referenced in key CCA and DRR documents, although this is discussed more in-depth in the Results chapter.

#### 4.4.1 Current CCA priorities and initiatives

In 1992 the Cook Islands signed the UNFCCC and the convention came into force in the country in 1994 (NES, 2011). This was followed in 1999 by the country's first submission of a National Communication to the UNFCCC which prompted the country to take action to address climate change (NES, 2011). While the Cook Islands does not have an overarching climate


Figure 7 - Cook Islands' national sustainable development goals
Source: Government of the Cook Islands (2016)

change policy, numerous national level policies address the issue, particularly the Climate and Disaster Compatible Development Policy and the Joint National Action Plan on Climate Change and Disaster Risk Management (see Box 1). Climate change mitigation and adaptation efforts were originally led by the National Environment Service (NES), however in 2011, a functional review of the department led to the creation of Climate Change Cook Islands (CCCI). The review highlighted that climate change was not simply an environmental issue, but rather an economic and political issue as well, and therefore CCCI was established as a division within the Office of the Prime Minister (K1 #3). Today, CCCI leads and coordinates all climate change action within the country.

**Box 1 – Key CCA and DRR plans and policies**

**National Environment Strategic Action Framework (NESAF) (2005-2009 and 2011 - 2015) –** Mandated by the Environment Act 2003, the NESAF provides direction and guidance for sustainable social and economic progress through the wise use of natural resources and the environment. Key goals of the framework include enhancing the management, protection, and sustainable use of natural resources; reducing and preventing environmental degradation; increasing resilience and strengthening capacity to deal with climate change; and improving institutional support and implementation mechanisms to manage the environment sustainably. Traditional knowledge is referenced within the framework, particularly as an important component to the development of future policies and acts.

**National Action Plan for Disaster Risk Management (DRM NAP) (2009-2015) –** The DRM NAP provides guidance on how the Cook Islands will establish a coordinated and effective national disaster risk reduction and disaster management system for all hazards. Key goals include mainstreaming DRM in all levels of government; creating a strong knowledge base for effect DRM; effective preparedness, response and recovery; maintaining effective early warning systems; reducing underlying risk to hazards; and monitoring, evaluating and reporting on progress. Integrating traditional knowledge into DRM is considered a key strategy of the DRM NAP.

**Joint National Action Plan for Disaster Risk Management and Climate Change Adaptation (JNAP) (2016-2020) –** The JNAP aims to strengthen climate and disaster resilience to protect lives, livelihoods, economic, infrastructural, cultural and environmental assets in the Cook Islands in a collaborative, sectoral approach. Key strategies are promoted by a steering committee and funded through multiple mechanisms to create a more safe, resilient, and sustainable Cook Islands. The JNAP frequently references documenting and preserving traditional knowledge.

**Climate and Disaster Compatible Development Policy (CDCDP) (2013-2016) –** Implemented as part of the SRIC-CC program, the CDCDP aims to ensure the sustainable development of the Cook Islands is pursued through a climate and disaster resilient approach that manages climate and disaster risks and reduces emissions. The plan has three core goals which include climate and disaster resilient development, low carbon development, and strengthening the enabling environment to ensure the latter can happen.

Initially, CCA efforts in the Cook Islands consisted largely of assessments, planning, and small-scale pilot projects (NES, 2011). Today, however, CCCI coordinates and implements two large scale programs, Adapting to Climate Change and Sustainable Energy – Northern Water Project (EUGIZ) and Strengthening the Resilience of our Islands and Communities to Climate Change (SRIC-CC), as well as multiple smaller ones. Valued at over $5 million USD, the SRIC-

CC is the largest program in the country and therefore emphasis was placed on the projects implemented through SRIC-CC in the interviews. The SRIC-CC project, funded by the Adaptation Fund and the United Nations Development Program, began in 2012 and aims to "strengthen the ability of all Cook Island communities, and the public service, to make informed decisions and manage anticipated climate change driven pressures in a pro-active, integrated and strategic manner" (CCCI, 2011, p.1). Key outputs of the program include conducting and updating risk and vulnerability assessments, implementing risk reduction systems for target populations, target populations participating in adaptation and risk reduction awareness activities, and physical, natural, and social assets strengthened in relation to climate change impacts (CCCI, 2011). The SRIC-CC program is community-based and does emphasize that ideal adaptation in the Cook Islands would harness traditional knowledge (CCCI, 2011).

### 4.4.2 Current DRR priorities and initiatives

The Cook Islands have been involved in disaster risk management at the international, regional, and national level for more than a decade. In 2005, the Cook Islands signed the *Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disaster*s. Following the signing of the Hyogo Framework, the Cook Islands worked with other Pacific Island governments to translate the framework into a relevant context for the Pacific (Government of the Cook Islands, 2010). This work resulted in the *Pacific Disaster Risk Reduction and Disaster Management Framework for Action* which was signed by Pacific leaders later in 2005 (Government of the Cook Islands, 2010). In the same year the Cook Islands were devastated by five tropical cyclones resulting in an extensive review of institutional and infrastructure planning in the country (Government of the Cook Islands, 2010). Following this review, a shift in focus from disaster risk management, generally focused on preparedness, response, and recovery, to DRR, a more holistic all-hazards, all-of-government approach took place. Emergency Management Cook Islands (EMCI) was established in the Office of the Prime Minister and a National Disaster Risk Management Council was created (Government of the Cook Islands, 2010).

Today, EMCI is the key coordinating agency for DRR in the Cook Islands and provides advice to the National Disaster Risk Management Council (EMCI & CCCI, 2016). Largely guided by the Joint National Action Plan for Climate Change and Disaster Risk Management (JNAP), EMCI identifies priorities and actions that will facilitate the effective implementation of

existing DRM legislation as well as reviews and improves current legislation (EMCI & CCCI, 2016). In addition, EMCI works closely with CCCI on both DRR and CCA initiatives.

### 4.5 Summary

Despite significant efforts being put into CCA and DRR, climate change is expected to have significant impacts for the Cook Islands, including increased air and sea surface temperatures, sea level rise, increased variability in rainfall events, changes in regional climate patterns, and the likely increased intensity of tropical cyclones. Adapting to the impacts of climate change in the Cook Islands is likely to be complicated by considerable uncertainty and a lack of local level data. While local and traditional knowledge is referenced in some of the CCA and DRR plans and policies developed over the past 13 years, this research aims to better understand the perspectives of government officials and community members on the role this knowledge can play in adaptation.

# CHAPTER 5 – RESULTS

## 5.1 Overview of results

This chapter presents the results of both the semi-structured interviews conducted and review of secondary literature and documents on the central research theme: local knowledge on climate-related hazards and the use of that knowledge for CCA. The perspectives of both key informants (KI) and local participants (LP) on Rarotonga and Mitiaro are shared (see Table 6 which explains terminology surrounding the frequencies with which interviewees mentioned particular themes). Four key topics are presented based on the objectives of this research. Firstly, this chapter presents my results on the local knowledge of changes in the environment, early warning systems, and coping or adaptation strategies for climate-related hazards. Secondly, this chapter presents my findings on the perceived variability in knowledge. Thirdly, I share some of the perspectives on the role of local knowledge, particularly in CCA. Lastly, my findings on the challenges to incorporating local knowledge into adaptation policy are presented. Each section presents results on a particular theme (e.g. "local knowledge on climate-related hazards").

**Table 6 -** ***Number of times interviewees discussed or mentioned subject matter***

| **Local participant guide for in-text mentions** | |
|---|---|
| None | 0 |
| Few | 1-4 |
| Several | 5-10 |
| Many | 11-16 |
| Most | 17-23 |
| All | 24 |
| **Key informant guide for in-text mentions** | |
| None | 0 |
| Few | 1-3 |
| Several | 4-5 |
| Many | 6-7 |
| Most | 8-9 |
| All | 10 |
| | |
| None | 0 |
| Few | 1-5 |
| Several | 6-12 |
| Many | 13-21 |
| Most | 22-33 |
| All | 34 |

## 5.2 Local knowledge on climate-related hazards

The majority of interviewees had considerable knowledge on climate-related hazards. Most local participants and key informants could discuss at length the changes that they have seen in the environment, early-warning signs for climate-related hazards, and coping or adaptation strategies for these hazards that they personally use or have seen others using. This section explores the changes, early-warning signs, and coping or adaptation strategies identified by those interviewed for my research.

### 5.2.1 Identification of changes in the environment

When discussing changes in the physical environment, most interviewees clearly identified changes that they had seen both on Rarotonga and on Mitiaro. Changes were mainly identified by local participants, however several key informants also mentioned changes they had witnessed. While the breadth of changes identified was great, there was also considerable overlap between some of them. As demonstrated in Figure 8, the changes that were most commonly identified were changes in species or biodiversity (n=12), drier conditions (n=10), changes in the fruiting seasons (n=8), and less predictable weather patterns (n=8). Although interview questions were mainly focused on *direct* climate-related hazards (e.g. floods and drought) and most participants responded by identifying *direct* climate-related hazards or changes, many also identified *in-direct* hazards or changes such as changes in species and biodiversity and changes in fruiting seasons which are discussed below.

When speaking about changes in species or biodiversity, all but one of the interviewees who spoke about observed changes in the environment referenced perceived changes in the marine environment. Changes in this regard were largely centered around seasonal changes in the presence of species (e.g. disappearing or coming at different times than was traditionally the case), coral dying, and smaller total catches of fish. For example, when speaking about fishing patterns changing, one local participant said:

> *"…like back in the old days when people ask you what seasons are good fishing for species, different species, we could tell them. Today we can't. Because some of the seasons for tuna, they don't turn up. They turn up in a different season. They turn up in the winter, they don't turn up in the summer. Now it's mid-winter and we're catching tuna."* (LP23)

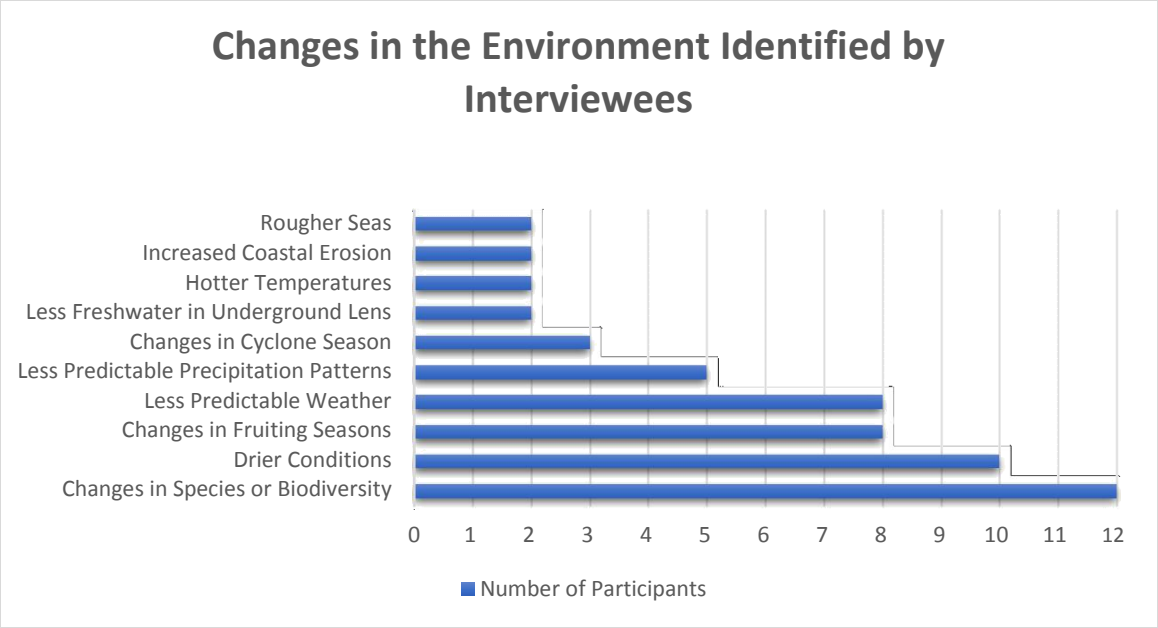


Figure 8 - Changes in the environment identified by key informants and local participants (total n= 34)

Interviewees who commented on drier conditions highlighted longer and more frequent periods of drought, and their comments were often connected to discussions of less predictable precipitation patterns overall. For example, several local participants remarked that periods of rainfall were now shorter than before and lasted only a couple of hours rather than the entire day, and that they had also experienced drier planting conditions. The changes in fruiting seasons identified by interviewees were largely linked to important local agricultural species such as breadfruit and mangoes. As one local participant summarized:

> *"I notice about mangoes…Because it flowers about three times a year now…I think that's a big change really… I remember last year, or the year before actually, I think there were about three mango seasons in one year. And that's unusual."* (LP11)

Both key informants and local participants who spoke about less predictable weather patterns felt that weather during the wet and dry seasons had changed, and that the seasons were becoming less obvious. As one key informant highlighted, "there was once a time where we actually identified the four seasons…you know there was a time summer was summer and it's very hot, and the cooler seasons is really cold, whereas now summer can be cold and our winter can be hot" (KI2). A few local participants emphasized that these changes were impacting both their planting and fishing patterns (see Box 2). For example, as one local participant highlighted

"…it's not like before [where] a certain period of time you can plant. Say from November to July or June, that's a good period to plant back then. But now it changed…people are struggling harvesting during that period of time" (LP19). Other changes that were identified by participants included, changes in the cyclone season, increased coastal erosion, hotter temperatures, less freshwater in the underground lens/aquifer, and rougher seas.

**Box 2 – *Arapo:* Traditional calendar of the Cook Islands**

The *arapo*, meaning nights of the moon, is the traditional calendar in the Cook Islands. This calendar is used to determine when the best times for fishing, planting, harvesting, and mating animals were (Ama, 2003). For example, root crops are planted when there is a full moon and fruit crops are planted when there is a new moon (Ama, 2003). While *arapo* has been abandoned by many, it has become more popular again in the last decade (Ama, 2003). In fact, several interviewees emphasized that *arapo* is still being used. The Ministry of Agriculture still promotes the use of *arapo* for planting and harvesting and produces a calendar for farmers each year (Fieldnotes, 2017). Interestingly, one KI found that many people felt that *arapo* was not working as well when conducting surveys for climate change vulnerability assessments (KI3). However, this KI expressed uncertainty over whether *arapo* was not working as well because of climate change or if there had been a gap in knowledge being passed down.

5.2.2 Early warning signs & forecasting

Many interviewees were able to identify early warning signs for climate-related hazards, in particular storms and tropical cyclones (also called hurricanes by some interviewees); however, opinions differed on whether or not these warning signs are still useful. While only 3 interviewees discussed early warning signs for floods or strong winds, 17 identified early warning signs for storms or tropical cyclones. As shown in Figure 9, warning signs for tropical cyclones were varied and included perceived changes in bird migration, the presence of a specific species, and a sudden change in wind, among other things. Interestingly, two predominant warning signs for tropical cyclones were clearly identified by interviewees – the curling of the centre leaf on a banana tree and an abundance of breadfruit and mangoes. When describing what their ancestors had told them about the abundance of breadfruit and mangoes, one local participant remarked:

> *"…When there is abundance of breadfruit [a hurricane is coming]. Because… [with] breadfruit fruits there's usually one fruit per branch. But sometimes you come where there are two or three on a branch. And they said that's a sign there's*

*hurricane. A hurricane will be coming. And the mangoes, when there's heaps of fruits on the mango tree that's a sure sign that there will be a hurricane coming."* (LP11)

Although the curling of the centre leaf on a banana tree and the abundance of breadfruit and mangoes were identified as tropical cyclone warning signs on both Rarotonga and Mitiaro, other warning signs are specific to one island. For example, as one key informant noted:

> *"On Mangaia [a Northern Group atoll island in the Cook Islands] they have the onset of the porcupine fish on the reef. They actually come, I think they also breed on the reef, it's a sign that there will be a tropical cyclone that's coming their way. So different islands have different [signs]."* (KI5)

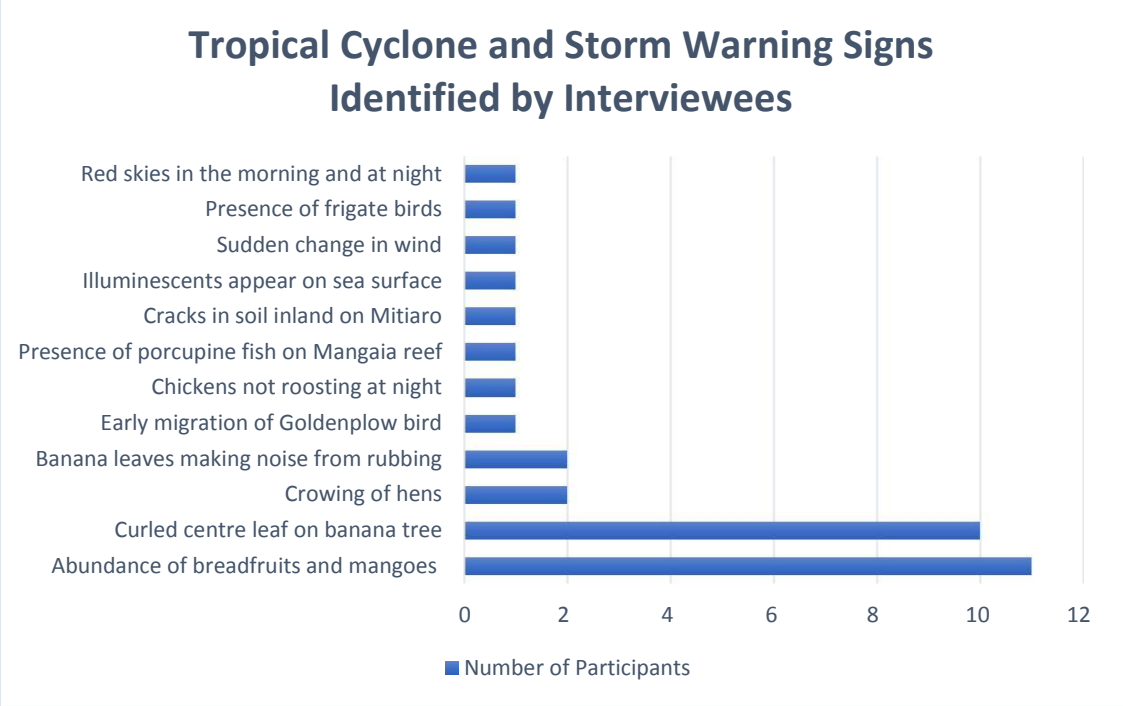


Figure 9 - Early warning signs for tropical cyclones identified by interviewees

The majority of these early warning signs were identified by local participants, particularly on Mitiaro, implying that this local knowledge was more common amongst the outer islanders interviewed. Although the extent to which interviewees were aware of traditional early warning signs was notable, there have been efforts by EMCI within the last 5 years to document and share this knowledge (Carlson, 2018) and it is unclear if this influenced participants' responses. Additionally, while many participants could speak to

early warning signs, a few participants did emphasize that these signs are less relevant today and one participant was skeptical that the signs were even true. When speaking about the lack of relevance in these warning signs today, one local participant said:

> *"Back then they had different signs of knowing there is a cyclone coming or a strong wind…but nowadays they've got the equipment to detect if there's a cyclone coming. They got mobile phones, we've got phones and we've got the internet and we are well prepped with those today. No need to look at breadfruits anymore."* (LP16)

Skeptical interviewees expressed doubts that traditional warning signs were necessary given the improvements in tropical cyclone forecasting and the ability of outer islands to access this information on the internet and mobile phones. Furthermore, technology was also considered to be more accurate than traditional warning signs by a few local participants.

### 5.2.3 Coping and adaptation strategies for climate-related hazards

Most participants were able to identify either short-term coping strategies or long-term adaptation strategies to climate-related hazards. Both key informants and local participants were well informed of these strategies, with 9 of 10 key informants and 21 of 24 local participants identifying at least one coping or adaptation strategy. While a few interviewees did identify coping or adaptation strategies for coastal erosion and rough seas, conversations were predominantly about drought or dry spells and tropical cyclones (Table 7). Participants discussed both coping and adaptation strategies that they learned about from elder's stories and strategies that they use today, although the former were referred to more frequently (Table 8).

**Table 7 -** ***Number of interviewees identifying coping or adaptation strategies***

| *Type of Strategy and Hazard Identified* | *Number of Participants* |
|---|---|
| Coping strategy for rough seas | 1 |
| Adaptation strategy for coastal erosion | 3 |
| Coping strategy for droughts/dry spells | 15 |
| Adaptation strategy for drought/dry spells | 16 |
| Adaptation strategy for tropical cyclones | 17 |
| Coping strategy for tropical cyclones | 19 |

The most commonly identified coping strategies for drought or dry spells were drinking coconut water (n=9), restricting water usage (n=6) (Figure 10), temporary

**Table 8 –** ***Summary of coping and adaptation strategies identified***

| Coping Strategies – Rough Seas | Adaptation Strategies – Coastal Erosion | Coping Strategies – Drought/Dry Spells | Adaptation Strategies – Drought/Dry Spell | Coping Strategies – Tropical Cyclones | Adaptation Strategies – Tropical Cyclones |
|---|---|---|---|---|---|
| • Fishing on the other side of the island (M) | • Placing coconut fronds on beach to build up sand | • Restrictions implemented to control water usage | • Planting high in mountains where streams have more water (R) | • Climbing or tying themselves to trees | • Planting tamanu trees (strong and deep roots) along coastline to reduce storm surge |
| | • Planting vegetation along the shore to retain soil | • Drinking coconuts | • Planting in troughs to retain water | • Remove down piping on water tanks to prevent contamination | • Covering taro with coconut fronds to prevent it from floating in heavy rains |
| | • Piling debris on coast to build back land | • Eating wild, famine crops | • Planting drought resistant crops such as pumpkin | • Eating wild, famine crops | • Food preservation |
| | • Building small rock seawalls | • Owning fewer animals such as pigs and goats | • Food preservation including fermenting breadfruit in pits in the ground | • Stocking up on food and supplies | • Building houses out of transitional materials that were easy to rebuild or that the wind could blow through |
| | | • Migration between different areas of islands or between islands | • Covering the soil around crops with coconut fronds to retain moisture | • Tying roofs down | • Living inland away from the coast |
| | | | • Bathing and doing laundry in alternative water sources (e.g. inland wells, rivers) | • Harvesting crops early | • Planting crops to be ready to harvest prior to cyclones season |
| | | | | • Covering fallen bananas with leaves until ready to eat | • Planting on mounds |
| | | | | • Planting quick growing foods following a cyclone | • Clearing trees around houses |
| | | | | • Mounding soil on *kumaru* to protect them prior to a cyclone | • Removing leaves on fruits such as bananas and papaw to avoid wind damage |
| | | | | • Reusing destroyed arrowroot shoots to replant | • Planting inland where there are more trees to break wind and protect crops |
| | | | | • Aid from other islands, government, external agencies | |
| | | | | • Praying | |
| | | | | • Evacuating inland | |

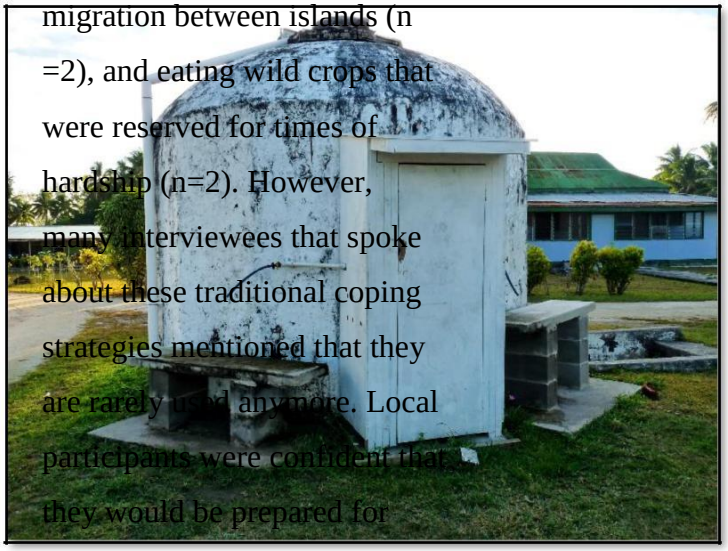

Figure 10 - Community water tanks which had restricted water usage during times of drought

migration between islands (n =2), and eating wild crops that were reserved for times of hardship (n=2). However, many interviewees that spoke about these traditional coping strategies mentioned that they are rarely used anymore. Local participants were confident that they would be prepared for drought even without using their identified coping strategies due to non-traditional adaptations such as the installation of rainwater tanks on Mitiaro or the ability to purchase more items from the store in times of need on both Rarotonga and Mitiaro. Frequently identified adaptation strategies for drought or dry spells included using alternative water sources for bathing and laundry (n=8), covering the soil around certain crops with coconut fronds to retain moisture (n=8) (Figure 11), and planting in troughs (n=2). These adaptation strategies are more commonly used today than the traditional coping strategies identified by local participants. While both alternative water sources and using coconut fronds when planting could be considered coping strategies, participants indicated that although these practices were rooted in experiences with drought, they are used long-term as proactive strategies to reduce the expected effects of climate change. Therefore, the reduced future vulnerability that arises from consistently saving rainwater for drinking only, and ensuring crops are adequately prepared for drought in the planting process, indicates that these strategies are in fact adaptation.

Although changes in precipitation patterns is considered one of the main impacts of climate change in the Cook Islands, many local participants expressed little concern over this or felt little motivation to take personal action. In Mitiaro, there was considerable confidence that the water tanks provided by the SRIC-CC program would meet their water needs in the future. In addition, some participants felt little more could be done about changes in the weather. As one local participant emphasized, "…there's no need to worry about it. But I think we just go along

with it and then we'll make the best of it. Yeah. Because we can't change the weather anyways so we got to follow it" (LP12).

A wide variety of coping strategies were identified for tropical cyclones, the most frequent of which included tie downs for roofs (n=8), stocking up on food, water, and other supplies (n=6), eating wild crops reserved for times of hardship (n=6), and receiving aid from other islands, the government, and external agencies (n=5). Although there was considerable local knowledge on these and other coping strategies, the extent to which interviewees felt these strategies are still being used today varied. Some participants reported that some practices have become nearly obsolete, while others have simply evolved. For example, while many interviewees were aware of which wild crops were edible in times of need, they also reported that imported goods such as rice and flour are preferred and generally stocked up on prior to a cyclone or are supplied as aid following one. When describing eating wild crops in the past, one local participant said:

Figure 11 - Taro plants covered in palm fronds and plastic to protect the soil from drying out

> *"…after the hurricane season there's no food, no banana. All damaged by the cyclones. We used to go back and eat those kind of food that used to grow, say like wild root crops, like the taro but we call it a giant taro. It's bigger than the taro. The puraka. That's the giant taro. And somewhere in the makatea [raised coral area in the middle of the island], we used to go in the makatea and look for, we call it like a yam. It's the wild ones."* (LP4)

However, another local participant emphasized that today they're "lucky we got the money and also shop here now. We can get something from the shop. Sugar, rice, flour" (LP14) in times of need. In contrast, tie downs for roofs remain a relevant but evolving practice. Tie down rope was traditionally made out of the bark from a local tree (LP4), but multiple local participants highlighted that today it is more frequently bought or supplied by the Red Cross (Figure 12). The

Figure 12 - Examples of houses on both Rarotonga and Mitiaro using tropical cyclone tie-down on their roofs

most common adaptation strategies for tropical cyclones identified were food preservation (n=7), building houses out of transitional or flexible material (n=5), and adopting a harvest cycle in which crops were ready prior to cyclone season (n=3). While both food preservation and building houses out of transitional or flexible material are less common today, some interviewees could discuss these adaptation strategies in considerable detail. One local participant described the process of preserving breadfruit:

> *"They will cut the banana leaves, they will pound down the hole and they will keep the breadfruit and they will put it down the hole. Thousand, two thousand breadfruit down there. Then they put a stick on the top of the holes then cover it with sand. They will dig…and then cover it with another leaf and then a stick on [the] hole and then iron roofing, put it on the top. That soil won't go on the breadfruit. And then it's about two years, three years that breadfruit down there [will be preserved]."* (LP17)

Despite being able to identify coping or adaptation strategies, many interviewees felt that knowledge on these local practices was being lost or was no longer relevant. This included both key informants and local participants. The loss of this knowledge was largely blamed on the shift to a more Westernized way of living. Common criticisms of Westernization included the erosion of Cook Islanders connection with the environment, a reliance on imported foods, a more commercialized workforce, and the introduction of technology. For example, one key informant lamented the Westernization of the Cook Islands and the resulting loss of connection with the environment:

> *"We've moved away from the lifestyle that we've practiced and connects us to our environment so much that there's no more connection there. There's no more understanding… how can you see things are changing when you're not even in that environment."* (KI7)

A few interviewees also expressed disappointment in younger generations and felt that they were becoming lazy or no longer interested in learning from their elders. For example, one local participant expressed that the young were becoming more dependent on their parents to support them and have never had to experience "the hard way of living" (LP9).

### 5.3 Perceived variability in knowledge

Many interviewees, particularly key informants, perceived both geography and age to impact variability in local knowledge related to coping and adaptation strategies and knowledge on the impacts of climate change. The more remote outer islands were often considered by these key informants to have a greater understanding of local knowledge and the impacts of climate change, while those living on Rarotonga, and in particular younger generations, were often perceived to have less understanding. This section explores the perceptions of key informants and some local participants on the variability of local knowledge.

#### 5.3.1 Geographic variability and knowledge

When discussing the perceived variability in knowledge on both local coping and adaptation strategies and the impacts of climate change, all key informants and several local participants identified geographic differences between Rarotonga and the outer islands, such as Mitiaro, as a key factor. Key informants felt that outer islanders are far more connected to and have a greater dependency on their environments than Rarotongans, largely because of the remote nature of these islands (Figure 13). As one key informant emphasized:

> *"...they're [outer islanders] out on the ocean, they're out planting, they're out... And here [on Rarotonga] it's not [the same type of exposure to the environment]. The vast majority of people work. They're in the hotels, they're in the government, they're in here [an office]. So, the outer islands have more I would say intimate contact with their environment than you see on Raro[tonga]."* (KI3)

Because of this connection to the environment, outer islanders were perceived to have a greater appreciation for and understanding of local knowledge and practices. In contrast, while outer

Figure 13 - The busy, developed harbour on Rarotonga in comparison with the small, remote harbour of Mitiaro

islands have strong culture, traditions, and local knowledge, Rarotongans are more Westernized, focused on technology, and have moved away from traditional practices (KI2). Outer islanders were also perceived by a few interviewees to be better at conserving resources than those on Rarotonga. Box 3 highlights one of the traditional resource conversation systems of Cook Islanders.

**Box 3 – *Ra'ui:* Traditional resource conservation in the Cook Islands**

The *ra'ui,* a customary management tool, has been revived in the Cook Islands over the last couple of decades as a resource conservation system (Ministry of Marine Resources, n.d). Traditionally used for marine resources, the *ra'ui* system protects resources from over-harvesting by restricting access to a particular resource or area for a specific amount of time to allow the resource to rejuvenate (Ministry of Marine Resources, n.d.; National Environment Service, 2015). On Mitiaro, the *ra'ui* is frequently used today, particularly to protect the island's flying fish population. While *ra'ui* isn't specifically an adaptation to climate change, the environmental stewardship that the system promotes can help increase the resilience of Cook Islanders to climate change (KI3). As one KI highlighted, "if you're looking after your marine environment, that's helping to strengthen your resilience" (KI3).

Several key informants felt that outer islanders also have a greater understanding of the impacts of climate change compared to Rarotongans, largely due to perceptions that outer islanders had closer connection with the environment. As one key informant highlighted:

> *"…that's the difference between people here and the people in the outer islands. It's that connection to their environment. And that's just simply through the way they live. It's a subsistence way of living you know. Fishing, farming, you know when you're out there, you're monitoring really. You're seeing the changes and you adapt to that change."* (KI7)

A few key informants also emphasized that while they perceive outer islanders to have a better understanding of the impacts of climate change than Rarotongans, they think that outer islanders likely do not understand the science behind these changes. Key informants felt that the understanding of greenhouse gas emissions and climate science was generally limited amongst outer islanders. However, some KIs acknowledged that there did seem to be some understanding amongst outer islanders of where to place the blame and a few conversations with locals discussed the responsibility developed countries have to help the Cook Islands because of their role in causing climate change (Fieldnotes, 2017).

Interestingly, and in contrast to the outer islanders, Rarotongans were perceived to have little understanding of the impacts of climate change:

> *"But in terms of awareness, and you can see this when you go into community meetings, there's really not much in terms of understanding climate change here. Whereas if you go to the outer islands, the word climate change is mentioned a lot in conversation with people. Over here, we don't hear that as much."* (KI7)

Some key informants attributed this lack of understanding to the focus of adaptation efforts in the Cook Islands being in the outer islands, and therefore CCCI has not had the funding to focus on Rarotonga. In fact, CCCI's SRIC-CC program aims to "implement on-the ground adaptation and DRR measures at the community level in the Pa Enua (outer islands)" (CCCI, 2011, p.21) specifically. Because of this, climate change awareness raising efforts at the community level have largely taken place in the outer islands. A single SRIC-CC program target - increasing water storage capacity - includes Rarotonga (CCCI, 2011). Two key informants stressed that they would like the country's next stream of CCA financing to place more emphasis on adaptation in Rarotonga. Development and a shift in lifestyles on Rarotonga were also considered to influence the understanding of climate change. As one key informant highlighted

“I think here in Rarotonga, there's a sense that yes it's [climate change] happening but very little sense of how it might affect people in their day to day lives you know” (KI9).

### 5.3.2 Age variability and knowledge

Many key informants and local participants perceived that age was an important factor in the variability in knowledge on local coping and adaptation strategies. Younger generations were perceived by many of these interviewees (n=9 out of 15 who perceived age was an important factor) to not care about local knowledge and practices because of the more modernized and Westernized lifestyles that they live. As one local participant expressed:

> *“And today the influence on young people is totally different. It's all electronic and the relationship also between parents and children have changed. Whereas everything was tangible in my childhood. You got information passed down. But now it don't get passed on.”* (LP21)

Younger generations were also thought by a few to be lazier and less reliant on subsistence-based lifestyles, resulting in the perception that many youth were not learning about how to cope with or adapt to changes in the environment. When key informants and local participants expressed the opinion that younger generations were in fact learning local knowledge, they were referring almost exclusively to the younger generations in Mitiaro. This was largely attributed to the more subsistence-based lifestyle in the outer islands where, unlike on much of Rarotonga, some children still grow up learning fishing and planting from older generations. Younger generations in Rarotonga were largely perceived to have very little understanding of local knowledge. While interviews were not focused enough on gender to have gender and knowledge variability contribute significantly to the results, Box 4 highlights the connections to gender that were made.

## 5.4 Local knowledge in CCA

This section explores both key informant and local participants perspectives on local knowledge and its role in CCA policy. The section builds on the previous section where the research documented that local knowledge was often considered to be an important component in CCA in the Cook Islands by interviewees, albeit with concerns about the loss of local knowledge and the applicability of remaining knowledge in the face of climate change.

**Box 4 – The role of gender in knowledge variability**

Interviews with both key informants and local participants suggested that gender may play a role in the variability of knowledge. In traditional gender roles, women in the Cook Islands were confined to domesticity (FAO, n.d.). While this is changing, and considerable efforts have been made to improve gender equality in the Cook Islands (e.g. The Cook Islands National Policy on Gender Equality and Women's Empowerment, 2011), gender may influence one's understanding of both local knowledge and the impacts of climate change. For example, in Mitiaro men are responsible for planting, fishing, and tending animals while women are primarily responsible for caring for the family and cooking (CCCI, 2011). When speaking about preparing crops for tropical cyclones, one female local participant emphasized that her father did that work and therefore she wasn't aware of what was done (LP13). In addition, one key informant highlighted the following when discussing the work they had done on climate change vulnerability assessments:

> *"…If I did it [consultations for climate change vulnerability assessments] again, [I would have] gender segregated the consultation just because when we had them, yes they were open to everyone and there were women there but they were always in the kitchen preparing the morning tea and the afternoon tea… it might seem like an egalitarian society but the women were maybe less engaged. And traditionally here the men are talkers…so you know… I think for that kind of process it needs to be maybe that the groups are gender segregated."* (KI9)

Given this, further research to understand the role of gender in one's understanding of local knowledge and climate change impacts would be beneficial. This is particularly important given the known gendered impacts of climate change (Denton, 2002).

Local participant interviews referred to in this section were less focused on policy as compared to key informants, however some did contribute their perspectives on the outer islands CCA projects that have been implemented near their community.

## 5.4.1 Key informant perspectives

### *5.4.1.1 Perspectives on local knowledge*

Most key informants felt that local knowledge was important, and references to local knowledge in key informant interviews were overwhelmingly positive (Figure 14). Key informants frequently referred to local knowledge as reliable, sustainable, and key to understanding changes in the environment. One key informant highlighted the importance of a healthy relationship between people and their environments:

> *"When you're connected to your environment then you can identify the differences. What's going on with your environment. You immediately can know oh this is different, it wasn't like this you know? And then you care more for your environment. Because your environment is looking after you, you give it back to them, you care for the environment as well. It's like that two-way thing eh? It's not like only you take, take, take and then the next minute there's nothing left. Because our ancestors were always conservative people. How they use the resources around them. Very conservative."* (KI6)

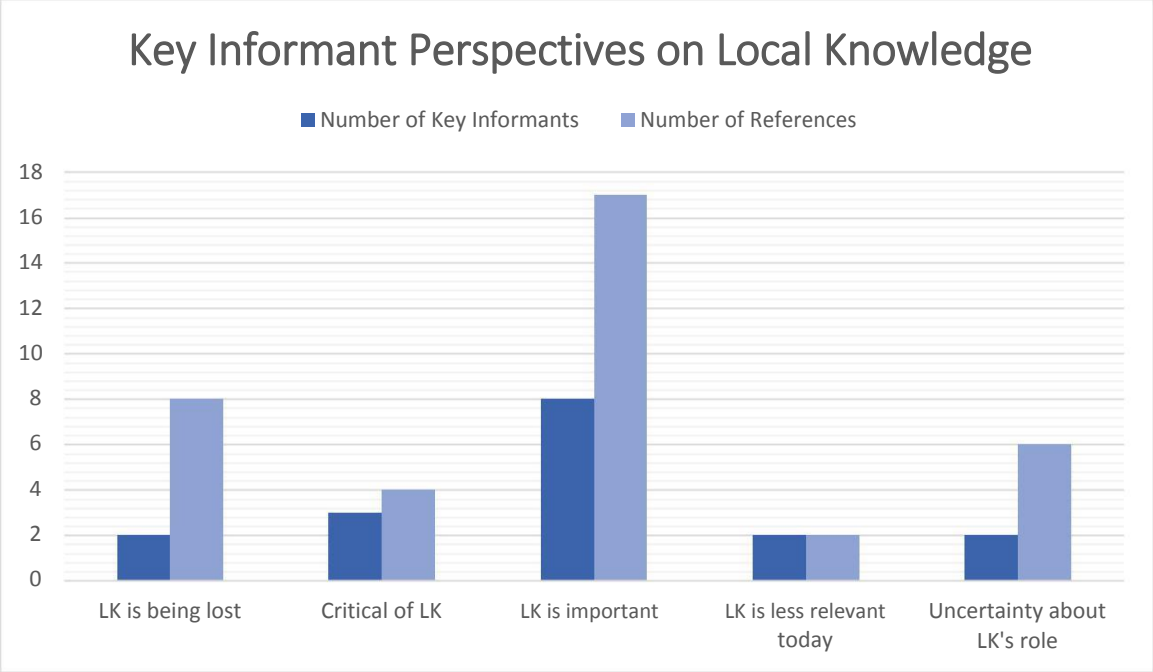


Figure 14 - Key informant perspectives on local knowledge (total # of key informants = 10)

When referencing its role in CCA policy, many key informants emphasized that local knowledge: was a useful entry point; highlights lessons learned; complements science, and; is

key to strengthening resilience. Local knowledge is considered by key informants to be especially important for policy-making in the outer islands:

> *"…to write good policies in the outer islands you really have to pull out the people's experience…and then they talk about the things they did. They talk about the gaps, you know the things they wish they had, the things they had to fall back on and from there you can really build good strong policies."* (KI1)

Interestingly however, a few key informants were critical of some local knowledge and highlighted perceptions that not all local and traditional practices are sustainable or the most appropriate. For example, one key informant remarked that local water conservation methods can often result in water being left in broken tanks and wasted or being left for so long that it is no longer good to drink (KI1).

Other key informant perspectives on local knowledge included concern over it being lost, a reduction in its relevance, and uncertainty over the role it can play in CCA. Key informants who felt that local knowledge is being lost blamed development, a lack of knowledge transfer between elders and younger generations, and the failure of researchers to access the knowledge for this loss. A few key informants highlighted that local knowledge was becoming less relevant as Cook Islanders move to more 'modern' ways of life and a greater dependency on technology. Others emphasized that while there is respect and acknowledgement of local knowledge, they are uncertain how exactly it will be useful in the face of climate change.

#### *5.4.1.2 Perspectives on the integration of local knowledge in CCA policy*

Key informants had a variety of perspectives on the integration of local knowledge in CCA policy. Many key informants felt that attempts had already been made to integrate local knowledge in adaptation policy, particularly via the SRIC-CC program run by CCCI (Figure 15). For example, one key informant highlighted that there is strong recognition of local and traditional knowledge in the CCCI Office (KI2). The SRIC-CC program does highlight community-based CCA and DRR measures and the harnessing of traditional knowledge, where appropriate, as the preferred solutions for adaptation (CCCI, 2011). Additionally, in 2014 CCCI conducted some of their own research on local knowledge about changes in the environment and produced the report *"Using local knowledge to understand climate variability in the Cook Islands".* Key informants also emphasized that the community-based design of the SRIC-CC program lends itself to the integration of local knowledge. As one key informant illustrated:

*"…To me the important thing on the SRIC-CC project was, and we had to fight for it, was to get funding allocated to having a focal point on each island to build a bit of capacity. [The focal point is someone] who is from the island [and] who will stay there but they are paid either on a part time or full time basis and their role is to liaise with the [island] council and learn more about climate change and maintain the information about climate change for their island, participate in the reporting processes, just all those kind of things." (KI9)*

Interestingly however, the focal point position in Mitiaro was not filled by a Mitiaroan but rather by another Cook Islander recently living on Mitiaro (Fieldnotes, 2017). Conversations with this individual suggested that there may be a lack of understanding of the island's local knowledge as this individual expressed that they were unaware of many of the ways in which Mitiaroans coped or adapted to climate-related hazards (Fieldnotes, 2017).

Figure 15 - Signage recognizing CCCI's adaptation program funding in Mitiaro

A few key informants also discussed government efforts to document and share traditional knowledge, referencing, in particular, the efforts by EMCI. For example, one key informant emphasized that traditional knowledge is being considered now by government and that "EMCI…is actually spearheading the role of ensuring that they do a bit of interview of the elders…[and] EMCI [has] done some documentaries [on traditional knowledge]" (KI5). Not only has EMCI produced 11 documentaries on traditional knowledge related to tropical cyclones (Carlson, 2018), but references to traditional knowledge seem to be the most prominent in EMCI's policies and plans. For example, the National Action Plan for Disaster Risk Management (2009) highlights that traditional knowledge should be incorporated into disaster risk management where appropriate and the Joint National Action Plan on Climate Change and Disaster Risk Management (JNAP) (2016) assigns both EMCI and CCCI the role of recording traditional knowledge on hazards and promoting this knowledge. However, there is no mention of how this knowledge should be used in DRR and CCA in the JNAP.

Despite many key informants identifying that attempts have been made to integrate local knowledge into CCA policy, there were also criticisms of government efforts in this regard. While many policies mention this knowledge, a few locals felt that lip-service was often paid to local knowledge but that it wasn't actually used when implementing programs, particularly in the outer islands (Fieldnotes, 2017). In fact, a government employee told a local looking for funding for a baking business that if they call their baking 'traditional', it was more likely to receiving funding from adaptation funders (Fieldnotes, 2017). Furthermore, several key informants felt that local knowledge needs to be taken into greater consideration in the future and a few key informants felt that there is room for improvement in terms of the government's recognition and integration of local knowledge into adaptation policy. When discussing the need to integrate local knowledge into adaptation policy, one key informant emphasized that funding is not being used wisely and that more effort must be placed on reviving traditional practices rather than implementing inappropriate adaptation strategies (KI7). When asked if the recognition and integration of local knowledge into CCA policy can be strengthened, another key informant responded:

> *"Oh definitely. Like I said, it's [the recognition of traditional knowledge is] fairly new. Well it's always been there but it hasn't been sort of brought to the forefront of our practices. Even when I first came into [my job] there was no mention about it. Only for the last four, five years that we started talking about it."* (KI2)

When asked about the integration of local knowledge into policy, a few key informants had broad criticisms of both CCA funding and the government's policies and projects. CCA funding was perceived by some to be creating government dependency rather than building resilience to climate change, particularly in the outer islands. As one key informant highlighted:

> *"They're [Cook Islanders] not living that lifestyle anymore. I mean to me, if we want to be resilient people, you need to connect back. You need to be connected to your environment otherwise you won't be resilient. So, all this funding and opportunities for us to develop, it's really not doing us any favour in terms of building our, strengthening our resilience. It's more eroding it."* (KI7)

Similarly, another key informant emphasized that:

> *"Well in my experience they were more resilient then [before adaptation funding] than now because now because of this Western culture influence, it's slowly eroding their resiliency. And then they go oh I want that and that [to CCA adaptation projects]. It's just like handouts eh?"* (KI6)

## 5.4.2 Local participant perspectives

### *5.4.2.1 Perspectives on local knowledge*

Interestingly and unlike key informants, less than half of the local participants interviewed felt that local knowledge is important (Figure 16). In fact, several local participants felt that local knowledge was less relevant today than it was in the past, particularly for early warning signs of tropical cyclones. Local participants emphasized that the introduction of technology (e.g. smartphones, internet, weather radar, etc.) meant they no longer needed to rely on this knowledge. When speaking about preparing for tropical cyclones, one participant stated that not only do Cook Islanders have access to mobile phones and the internet, but they have researchers on Rarotonga helping them become better prepared (LP5), so there was no need for their traditional early warnings sign knowledge anymore (LP5). In addition, a few local participants were unsure about the importance of local knowledge. One local participant expressed concern over whether it was worth continuing to learn from older generations and pass down their practices because of all the changes that are being seen (LP11) and another local participant simply didn't care whether or not the knowledge was retained (LP24).

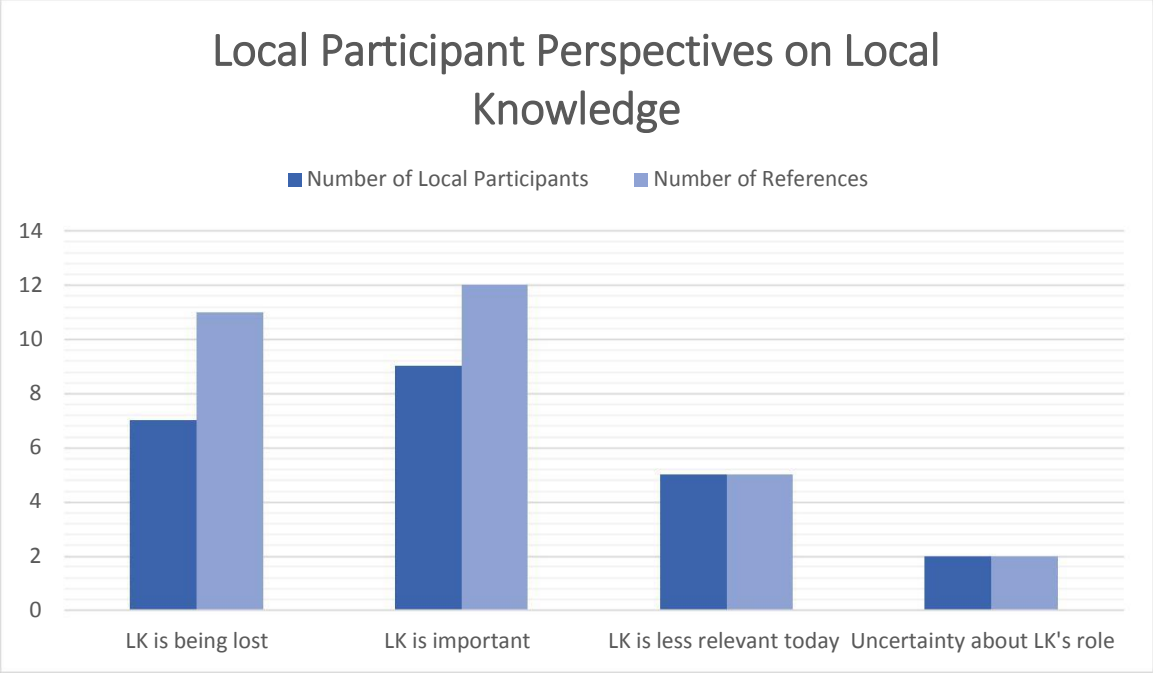


Figure 16 - Local participant perspectives on local knowledge (total # of local participants = 24)

The local participants who did emphasize the importance of local knowledge felt that it was important to continue to pass knowledge down to younger generations and that this

knowledge was vital to understanding their culture. For example, one local participant on Mitiaro felt that keeping traditional practices alive and sharing knowledge between generations was important for children to understand who they are and what they have to offer the world (LP10). Other local participants felt that traditional practices are more sustainable and that they need to go back to these practices. Local participants that emphasized local knowledge is important were divided on whether or not younger generations are learning about it and using it. Some felt that younger generations are stepping up to learn from the older generations and use the knowledge that has been passed down to them while others felt that it was being lost as older generations passed away and youth loose interest in learning about it.

The loss of local knowledge was a concern for several local participants. Local participants often blamed Westernization for the loss of local knowledge. Changes in lifestyles and a shift towards less resource-dependent livelihoods in the Cook Islands was perceived to be eroding local knowledge and practices. For example, when discussing growing food, one local participant said:

> *"…I think growing [food], [it] wasn't a question whether you were going to, historically speaking. Everyone did it. And every family, it was part of their daily life… But now we've come to a stage where people choose [a non-farming] career. In those days that was the life, the normal life of the people. You touch the land to feed your family. No one had that much money, so everybody did a bit of [it], whether or not commercially, but they did to feed their family. So, it wasn't a question you going to go, you did it. You grow up doing it. As a kid… you're a natural part of that ecosystem so to speak."* (LP21)

*5.4.2.2 Perspectives on CCA policy and projects*

When compared to interviews made with key informants, interviews with local participants were less focused on the integration of local knowledge into CCA policy and more focused on perceptions of the actions that have been taken to adapt to climate change. However, a few local participants did share perspectives on the integration of local knowledge into adaptation policy. One local participant felt that their knowledge is being incorporated into the SRIC-CC program because they are often asked to provide input on what should be funded through the program (LP2). Another local participant talked about EMCI's efforts to document traditional warning signs for tropical cyclones and how this documentation has given more believability to local knowledge (LP2).

Interviews with local participants did seek to understand their perspectives on the CCA projects that have been implemented locally. Local participants expressed both positive (n=5) and negative (n=2) perspectives on these adaptation projects. Local participants who had positive perspectives felt that the government was taking their needs into consideration when funding projects in the outer islands. In fact, small grants to fund outer island communities in implementing CCA and DRR projects is the largest component of the SRIC-CC program (CCCI, 2011). On Mitiaro, small grants have funded various projects including household water tanks, aluminum fishing boats, a *vaka* (or canoe) shelter, an egg farm, a traditional carving business, and coconut oil making (Fieldnotes, 2017) (Figure 17). One local participant highlighted that aluminum boats provided by the SRIC-CC program make it easier for them to follow birds to where the fish are located, rather than having to paddle in traditional canoes (LP16). These participants felt that CCCI had a large amount of money to give out and that these projects would benefit their island.

Figure 17 - Water tanks supplied by the SRIC-CC program for the outer islands

Negative criticisms of adaptation policies and projects were largely centered around the perceived impacts of outer islands development, and an associated more Westernized way of living. Similar to some key informants, one local participant compared adaptation funding to handouts and was concerned that the projects that were being implemented to strengthen resilience to climate change in the outer islands are not sustainable:

> *"These people, my people [are] lazy people. They just like being spoon-fed… I'm not being negative but I'm just saying the fact how I see it. Even all these people on the [island] council, they're never moving to the front. Okay we get donation funds for the project and everything come, wow and we get these things done. But*

*they don't think in the future how to sustain, how to maintain all this development that's taking place. So, it goes down ten, fifteen years later it goes down the drain. I would rather see a proactive island people. People who doesn't wait for aid but start working now."* (LP10)

## 5.5 Challenges to incorporating local knowledge into adaptation policy

Both key informants and local participants identified challenges to integrating local knowledge into CCA policy, including development pressures, out-migration, a lack of understanding of local knowledge, religious influence, and uncertainty over the future use of local knowledge (Figure 18). This section explores these perspectives.

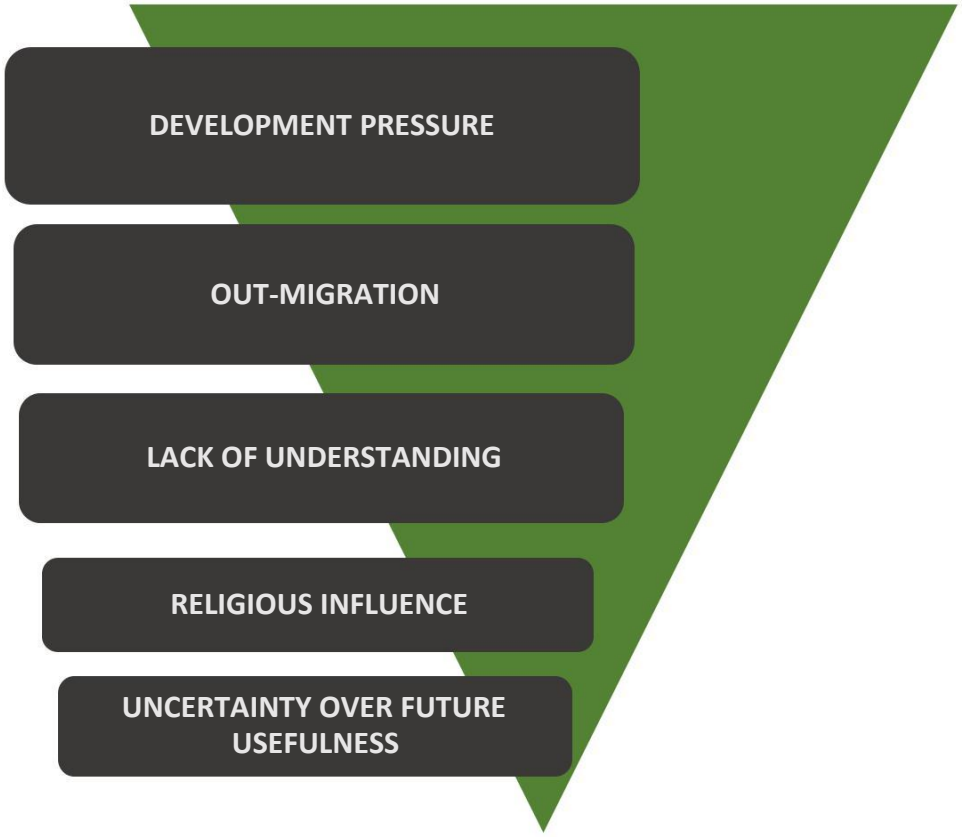


Figure 18 – The challenges to integrating local knowledge into adaptation policy identified in this research

### 5.5.1 Development pressure

Other pressures facing the Cook Islands, such as development, Westernization, and out-migration, were identified as the most common challenge to incorporating local knowledge into

adaptation policy. Many key informants and a few local participants emphasized this challenge. Key informants highlighted that the rapid development taking place on Rarotonga is often considered the model for the outer islands, resulting in the development of the outer islands and more Cook Islanders moving away from traditional ways of living. With this comes both the loss of local knowledge and a lack of desire to incorporate such knowledge into policy. One key informant highlighted that there are adaptation donors or funders, government officials, and islanders themselves who place very low value on local knowledge and consider it irrelevant in a more modern world (KI10). While Cook Islanders are traditionally deeply connected to their environments, a shift towards a more modern society has resulted in a disconnect, making it difficult for many to see the importance of local knowledge in addressing climate change. One key informant emphasized the benefits of being connected to the environment in terms of addressing the impacts of climate change:

> *"When you're connected to your environment then you can identify the differences. What's going on with your environment. You immediately can know oh this is different, it wasn't like this you know? And then you care more for your environment. Because your environment is looking after you, you give it back to them, you care for the environment as well. It's like that two-way thing eh?"* (KI6).

This push for development has often led to a lack of political will in terms of integrating local knowledge into policy. Many key informants highlighted both political agendas and a top-down approach as a challenge to local knowledge integration. One key informant felt that the government often forces central government priorities on the outer islands, rather than listening and learning from outer islanders first (KI7). In fact, another key informant emphasized that Rarotonga, with its development and Westernization, should be the 'light' for the outer islands. This key informant also felt that the mindset of the outer islands is too fixed and therefore they need to go out there and show them how things can be done better now.

### 5.5.2 Out-migration

In addition to development and Westernization, out-migration from the Cook Islands was considered a challenge to incorporating local knowledge into adaptation policy. In fact, several key informants highlighted out-migration as a barrier for two main reasons. Firstly, key informants highlighted that out-migration has resulted in local knowledge loss. In addition to

elders passing away, there is a growing disconnect between generations and a lack of knowledge transfer as more Cook Islanders leave the country. The country's population has decreased by over 8,000 since 2011 (MFEM, 2016) and nearly 100,000 Cook Islanders now live overseas, the majority in New Zealand (Government of New Zealand, 2015). Secondly, key informants emphasized that out-migration poses a challenge to the integration of local knowledge into adaptation policy because it requires the government to provide more economic opportunity and access to modern technology to convince Cook Islanders to stay in the country. Many of the SRIC-CC program's small grants fund business or economic opportunity in the outer islands. For example, in Mitiaro, small grants have funded local businesses such as coconut oil making, crafts, and traditional carving (Fieldnotes, 2017). Key informants felt that younger generations had little interest in learning about their culture and hearing knowledge from their elders. Cook Islands' economic development is following a Westernized model, making it difficult to preserve and value local knowledge. As a result, much of the adaptation policy in the Cook Islands, particularly the SRIC-CC program, has focused on building economic resilience. While attempts have been made to integrate local knowledge and practices into the SRIC-CC program, the need to provide economic opportunity to prevent out-migration was highlighted as a considerable challenge to local knowledge integration.

### 5.5.3 Lack of understanding of local knowledge

A lack of understanding of local knowledge was also considered a key challenge to its incorporation into CCA policy. Like many indigenous cultures, Cook Islander are an oral culture and consequently, much of their knowledge is passed down through storytelling, oral history, and other forms of expression. Therefore, several key informants identified the lack of documentation of local knowledge as a challenge. Key informants expressed that Cook Islanders, particularly those living in the outer islands, have extensive and valuable knowledge on the environment, however this knowledge is often not recorded and so is unavailable to be incorporated into formal government policy. One key informant expressed that Cook Islanders living in the outer islands were the true scientists, particularly in regard to climate change. This key informant emphasized that outer islanders "…see what's happening and it's us [trained researchers] that need to go and extract that information from them. Because a lot of it is just in their head and their own understanding. When they go, that knowledge is lost." (KI7). However, there is also reluctance on behalf of elders to share or record their knowledge and therefore, as

Figure 19 - The Cook Islands Christian Church in Mitiaro

one key informant highlighted, "…Right now, since it's [local knowledge] coming in dribs and drabs, there's no full understanding of its potential in contributing to, I suppose, to the fate of the Cook Islands" (KI5).

5.5.4 Religious influence

Several local participants spoke about God and religion when discussing both the changes in the environment and adaptation and coping strategies for climate-related hazard. This suggests that religion may play a role in both the value that Cook Islanders place on local knowledge and the integration of this knowledge into adaptation policy (Figure 18). Local participants remarked that changes in the environment were God's will and that they trusted in God to take care of them when faced with a climate-related hazard. For example, when speaking about tropical cyclones in the past, one local participant expressed:

> *"They just happened. When it's happened, it's happened. We don't worry about it. I didn't because the Lord is looking after us. Because we believe. We believe with the Lord to take care of all the people on the island…" (LP8)*

Some participants expressed that they felt there was nothing they could do to deal with the impacts of climate change because it was God's decision, suggesting a sense of apathy towards using local knowledge and practices to cope or adapt or hesitation to try to intervene in God's will. Without community buy-in on the value of local knowledge, it can be difficult to integrate this knowledge into CCA policy.

5.5.5 Uncertainty over the future usefulness of local knowledge

A few key informants were uncertain about how useful local knowledge would be in the future with climate change and therefore, it was considered a challenge to incorporating this knowledge into policy. Given the unprecedented nature of many climate change impacts, there is a lack of clarity in how to use this knowledge moving forward. As one key informant expressed, "So I think there's respect for it [local knowledge] and nostalgia for it but there's also a little bit

of uncertainty about its validity in the current context. What do you actually do with that" (KI9). This key informant also expressed that they had heard from local farmers that the Arapo, the traditional planting calendar of Cook Islanders that follows the phase of the moon and tide, was no longer working and was unclear as to whether this was a result of climate change. Interestingly, some local participants also raised concerns over Arapo and the degree to which it still worked for planting while others still use it regularly with no problems. Ultimately the interviewees referred to above suggested that the uncertainty associated with future climate change compounded the uncertainty they associated with the value of local knowledge.

### 5.6 Summary

Both key informants and local participants were well informed on changes in the environment and local coping or adaptation strategies for climate-related hazards. Coping or adaptation strategies were most frequently identified for tropical cyclones and drought or dry spells and a variety of strategies exist. When speaking about knowledge variability on both the impacts of climate change and local knowledge, interviewees identified both geography and age as influencing factors. Outer islanders were often perceived to have a greater understanding of the impacts of climate change and of local knowledge because of their closer connections to the environment and more resource-based livelihoods. In addition, young Cook Islanders were often perceived to lack local knowledge because of the influence of a Westernized lifestyle. Key informants and local participants had diverse perspectives on the importance of local knowledge and the integration of this knowledge in CCA policy. While some interviewees spoke positively about local knowledge and government efforts to integrate it into policy, others were more critical. Interviewees highlighted the challenges to incorporating local knowledge into CCA policy which included development pressure, out-migration, a lack of understanding of local knowledge, religion, and uncertainty over the future usefulness of local knowledge.

# CHAPTER 6 CORE THEMES AND DISCUSSION

## 6.1 Introduction

The results of this research reveal a set of core themes surrounding local knowledge and CCA in the Cook Islands. The discussion below expands on these core themes, highlighting the complex and often challenging nature of implementing culturally relevant and locally sustainable CCA efforts. This section does not discuss each result individually, but rather intends to delve into broader, overarching ideas that have come from the results including 1) local knowledge in the context of multiple stressors, 2) no-regrets CCA, 3) documenting local knowledge, 4) the evolution of coping and adaptation strategies, 5) knowledge variability, vulnerability, and "islandness", and 6) the social and political nature of adaptation. Table 9 connects the core themes presented below and objectives of this research. While the qualitative nature of this research does not lend itself to the generalizability of the results and subsequent discussion for other contexts, the discussion points below play an important role in the transferability of this research. The transferability of this research is explored further in the Conclusion.

**Table 9 –** ***Connections between research objectives and core themes***

| **Research Objectives** | **Core Themes** | | | | | |
|---|---|---|---|---|---|---|
| | #1 | #2 | #3 | #4 | #5 | #6 |
| Investigate the local adaptation strategies of Cook Islands communities to climate-related hazards on Rarotonga and Mitiaro | | | | | | |
| Explore the variability in knowledge between a core (Rarotonga) and periphery (Mitiaro) island | | | | | | |
| Understand the extent to which key informants and local participants felt local knowledge was being appropriately integrated into adaptation policies | | | | | | |
| Determine some of the challenges to incorporating local knowledge in adaptation policy | | | | | | |

| Legend | |
|---|---|
| #1 | Local Knowledge in the Context of Multiple Stressors |
| #2 | No-Regrets CCA |

| | |
|---|---|
| #3 | Documenting Local Knowledge |
| #4 | Evolution of Coping and Adaptation Strategies |
| #5 | Knowledge Variability, Vulnerability, and "Islandness" |
| #6 | Social and Political Nature of CCA |

### 6.2 Local knowledge in the context of multiple stressors

This research revealed that many interviewees, particularly local participants, could identify a variety of changes in the environment. While this can likely be attributed to the fact conversations with government officials were more policy-focused than those with local participants, it can also be suggested that local participants may be more aware of the changes in the environment because their livelihoods were all in some way supported by it (e.g. fishing, growing or selling crops). Although it was beyond the scope of this research to determine why different types of interviewees had particular levels of knowledge, the type of livelihood that interviewees engage in may play a role in their ability to identify changes in the environment. Indigenous communities are well-recognized to have considerable knowledge on changes in the environment and weather largely because of their ongoing interaction with their environment (Adger et al., 2011; McNamara & McNamara, 2011; Rahman & Alam, 2016). In the Cook Islands, many outer islanders, like those living on Mitiaro, interact with their environments daily because their livelihoods are generally more directly natural resource-based than those of people living on Rarotonga. Therefore, outer islanders generally demonstrated a wealth of knowledge about the changes in their environment. In addition, many key informants emphasized this when they expressed that they perceived outer islanders to be more connected to their environments, therefore having a greater understanding of the impacts of climate change. As Onrubia (2015) and Rosenweig and Neofotis (2013) acknowledge, these long-term, local-scale observations of changes in the environment and weather are one of the many strengths of local knowledge.

Even though the interviewees consulted in this research generally had considerable knowledge to share on changes in the environment, whether or not these changes are a result of climate change is unclear as there may be other contributing factors. For example, local participants often identified smaller total catches of fish as one of the changes they are frequently

experiencing. While ocean acidification is key impact of climate change in the Cook Islands (NES, 2011), impacting both marine ecosystems and fish populations, changes in the amount of fish being caught may also be a result of over-fishing, local sediment or pollution runoff into nearshore environments, and population growth on Rarotonga. Although the country has seen high rates of out-migration and population decline, it has also seen substantial internal migration resulting in many Cook Islanders leaving the outer islands for opportunities in Rarotonga (MFEM, 2015). This has increased development pressure on the island's environment in recent years. In addition, concerns about over-fishing have frequently come up in the Cook Islands (Cook Islands News, 2015; Reeves, 2016). Furthermore, local participants were more likely to identify changes that had a visible impact on their daily lives, such as the smaller catches of fish, changes in fruiting seasons, and less predictable precipitation patterns. Climate-related hazards that are more difficult to identify, such as sea-level rise, received far less attention. While the purpose of this research was not to establish truth in the changes identified by interviewees, but rather to report perceptions of both government officials and local participants, local knowledge can provide an "alternative but equally valid way of understanding the human dimensions of climate change" (Ford et al., 2016, p.351) and the fact that Cook Islanders may be identifying changes that are not a result of climate change is also significant.

Recently, there has been increasing recognition that communities typically undergo a broad range of social, cultural, economic, and environmental changes, and therefore multiple stressors must be considered when adapting to climate change (Bennett et al., 2016; Bunce et al., 2010; Hjerpe & Glass, 2012; McCubbin et al., 2017; O'Brien & Leichenko, 2000). Local vulnerability to climate change is thus shaped by both climatic and non-climatic factors (Adger et al., 2007). Although many interviewees attributed the changes that they identified to climate change, the fact that there may be additional contributing factors to these changes highlights that there are likely multiple stressors that Cook Islanders are facing. In their study on climate change vulnerability in Tuvalu, McCubbin et al. (2017) found that despite communities being exposed and sensitive to a wide variety of climatic conditions, non-climatic factors had the greatest impact on Tuvaluans' livelihoods. In addition, McCubbin et al. (2017) found that even when participants referred to climatic conditions, they were significantly intertwined with the social, economic, and cultural changes the community faced (McCubbin et al., 2017). Similarly, the changes identified by Cook Islanders may be impacted by climate change, but they are likely

also tied to other social, economic, cultural, and environmental change. Recognizing and addressing these multiple stressors is often considered to be necessary for adaptation to be practical, effective, reduce overall vulnerability, and increase societal resilience (Bunce et al., 2010; Hjerpe & Glass, 2012; McCubbin et al., 2017). As a result, CCA in the Cook Islands has often taken a "no-regrets" approach.

### 6.3 No regrets CCA

This research revealed that efforts are being made by the Cook Islands government to address multiple stressors that Cook Islanders are facing in addition to climate change through a no-regrets adaptation strategy. No-regrets adaptation, or "adaptive measures that are worthwhile (ie. they deliver net socio-economic benefits) whatever the extent of future climate change" (UKCIP, n.d., p.15), aim to build general resilience rather than relying on detailed climate projections (Heltberg et al., 2009) which may end being inaccurate. CCCI's SRIC-CC program places considerable emphasis on creating economic resilience in the outer islands and many of the SRIC-CC sub-projects that have been funded aim to increase the overall wellbeing of outer islands communities. For example, projects implemented on Mitiaro have included funding local businesses to sell their crafts and providing aluminum boats to supplement traditional canoes when the seas are rough. Regardless of the impacts of climate change, these projects are designed to build capacity and strengthen resilience in Mitiaro. This finding is consistent with Barnett (2001) who suggests that a no-regrets approach to CCA has dominated in the Pacific Islands. A no-regrets approach is particularly important in places like the Cook Islands where considerable uncertainty exists surrounding exactly how the impacts of climate change will play out. Addressing the underlying causes of vulnerability and promoting sustainable land and ecosystem management is often regarded as some of the most effective low or no regret adaptation strategies (Dilling et al., 2015; IPCC, 2014).

Although a no-regrets strategy to adaptation seems to be dominant in the SRIC-CC program, there is also potential for maladaptation if local social and cultural characteristics are not integrated from the beginning (Magnan et al., 2016). According to Barnett & O'Neill (2010), maladaptation is action taken to avoid or reduce vulnerability to climate change that results in adverse impacts or increases the vulnerability of other systems, sectors, or social groups. Local knowledge however, if incorporated appropriately, can play an important role in identifying the

multiple stressors and appropriate adaptation strategies, thus lowering the risk of maladaptation (Mangan et al., 2016; Rojas-Blancos, 2006). Although key informants' responses were generally overwhelmingly positive about local knowledge, and highlighted efforts that have been made to incorporate this knowledge into CCA policy, some informants did express concern about the potential for maladaptation if the social and cultural values of the outer island communities are ignored. As one key informant highlighted, when referring to some of the economic development projects that have been implemented in the outer islands, introducing a Western, individual-focused business concept into community-oriented societies can result in community fragmentation (KI7). While these projects are intended to increase the economic resilience of outer island communities, they could actually increase vulnerability because outer islanders may no longer want to work as a community when coping or adapting to the impacts of climate change, particularly climate-related hazards (KI7). Similarly, in their study on food security among the Peruvian Indigenous Shawi, Zavaleta et al. (2018) found that while economic development opportunities may improve local livelihoods and increase adaptive capacity to face extreme events, a lack of recognition of the cultural values that Shawni hold results in them being continually excluded from realizing these benefits. Therefore, local knowledge needs to be integrated early on in the process (Raymond et al., 2010). Although key informants in the Cook Islands often recognize the importance of local knowledge, CCA and DRR policy as well as key informant interviews highlighted that there seems to be a greater emphasis on documenting the knowledge and less so on incorporating it.

### 6.4 Documenting local knowledge

The importance of local knowledge was well recognized by most key informants in this research. Key informants often highlighted the important role of local knowledge in understanding the environment as well as its valuable potential role in policy-making in the Cook Islands. This is consistent with the literature which emphasizes that local knowledge is important to understanding the impacts of climate change as well as in designing adaptation options (Hiwasaki et al., 2015; Nakashima et al., 2012). Local knowledge can ensure informed adaptation decisions are made, the solutions implemented are sustainable, and that adaptation is cost-effective and culturally appropriate (Deken, 2007; Hiwasaki et al., 2015; Naess, 2013). The literature, however, also emphasizes that despite widespread recognition that local knowledge

has an important role to play in CCA, there is little understanding of how to practically apply or integrate this knowledge into policy or action (Hiwasaki et al., 2015; Mercer et al., 2010; Naess, 2013). Additionally, local knowledge is often still undervalued in CCA and has yet to be included in observations and assessments of the impacts of climate change (Adger et al., 2011; Hiwasaki et al., 2015).

This research generally found that there has been a significant focus on documenting local and traditional knowledge in the Cook Islands, but less emphasis on incorporating it into adaptation policy or action. When speaking about local knowledge, both key informant interviewees and government policies highlighted that EMCI is in the process of documenting traditional knowledge for DRR efforts (Government of the Cook Islands, 2016). Similarly, CCCI's SRIC-CC program emphasizes that ideal adaptation would include harnessing traditional knowledge (CCCI, 2011); however, there is little direction on how this knowledge should be harnessed or integrated into policy. Boedhihartono (2010) emphasizes that the idea of simply accumulating traditional or local knowledge in a static form as a record of the past is not enough. Local knowledge must also be integrated into modern knowledge systems (Aswani et al., 2015; Boedhihartono, 2010). The idea that simply recording local knowledge is not useful, because knowledge is not fixed, was also raised by a key informant in this research (KI7). For local knowledge to be useful, it must be understood and used regularly, and must evolve with people (KI7). Therefore, integrating local knowledge into CCA is more beneficial than simply recording it (KI7). Nevertheless, in contrast to some of the literature, there have been some efforts in the Cook Islands to include local knowledge in observations about the impacts of climate change. In 2015, CCCI produced a report called *Using local knowledge to understand climate variability in the Cook Islands* which recorded local observations of climate change. However, it is unclear whether or not this information has been integrated into the decisions about types of adaptation projects being funded under the SRIC-CC program. The evolution of local knowledge and practices over time was also a common local participant interview theme, and this is discussed as the next core theme of this research.

### 6.5 Evolution of coping and adaptation strategies

Local participants identified many coping and adaptation strategies to climate-related hazards such as drought and tropical cyclones, and some of these have become obsolete while others have evolved. Certain coping and adaptation strategies practiced many decades ago, such

as using tie downs on roofs during tropical cyclones and covering the soil around crops with thatch to retain moisture, are still used today, although in slightly different forms. As discussed in the results, tie downs for tropical cyclones traditionally were made locally from strips made out of bark but today are made from nylon/polypropylene rope provided by the Red Cross (LP4, LP6, LP12, LP14). In addition, while *kikau,* or palm fronds, were previously used to cover the soil around crops during drought conditions, today plastic or cardboard is often used, demonstrating the evolution of a traditional adaptation strategy. In contrast, unlike several generations ago, local participants highlighted that very few people today pick wild edible plants following cyclone damage to their planted crops because they now receive food aid or can purchase food from the store. The idea that some strategies have changed over time and others have been replaced entirely highlights the dynamic and evolving nature of local knowledge. Recent literature has highlighted the hybrid and changing nature of local knowledge (Gómez-Baggethun et al., 2013) and the FAO (2005) emphasizes that local knowledge is not something that was only developed in the past, but rather it continues to evolve over time. This is also why increasingly there has been emphasis placed on using the term local knowledge rather than traditional knowledge (e.g. FAO, 2005; Stevenson, 1996).

When asked about coping and adaptation strategies to climate-related hazards, many local participants discussed what they perceived to be 'traditional' strategies used in the past rather than their modern equivalent. This likely contributed to the opinion expressed by many local participants that local knowledge is less valuable today. In addition, the fact that many local participants identified what they consider to be 'traditional' coping and adaptation strategies, combined with the focus of the government of documenting this knowledge rather than integrating it, highlights some of the issues that have been raised in the literature about the terms 'traditional' versus 'local' knowledge. As Stevenson (1996) emphasizes, the term 'traditional' knowledge invites denial of the relevance of this knowledge to today's issues and problems. Given the interview responses of local participants and the efforts of government on recording local knowledge, it can be extrapolated that when thinking about local or traditional knowledge, interviewees perceptions often aligned with the way Stevenson (1996) highlights. Local participants often did not identify more recent coping and adaptation strategies in interviews, suggesting that they often were not considering the ways in which their knowledge and practices had evolved and are relevant today. In addition, while understanding what people did in the past

to respond to environmental change can provide valuable information to future adaptation strategies (McNamara & McNamara, 2011), many authors emphasize that the true value of local knowledge is in its broader principles, such as the connection of locals to the environment, and processes of innovation in responding to change (e.g. Boillat & Berkes, 2013; King et al., 2008; McMillen et al., 2017; Thornton & Manasfi, 2010). Therefore, multiple strategies that incorporate local or traditional ways of knowing and Western science must be considered to promote resilience to climate change (McMillen et al., 2017).

### 6.6 Knowledge variability, vulnerability, and "islandness"

A perceived greater understanding of local knowledge and the impacts of climate change by outer islanders in the Cook Islands (as compared to Rarotongans) was raised by all key informants and several local participants in this research. Core and periphery divides are often exaggerated in archipelagic island countries (Kumar, 2007; Nunn, 2009) whereby outer islanders are often considered to lack information on climate change and core islanders are generally thought to have a greater understanding of the impacts of climate change and appropriate solutions (Nunn, 2009). However, as mentioned, the research revealed that in the Cook Islands, outer islanders were perceived by interviewees to be far more knowledge about climate change impacts and dealing with the impacts of it while those living on the core island of Rarotonga were considered to have less connection to the environment, less local knowledge, and less understanding of the impacts of climate change. Similarly, Nunn (2008) found that outer islanders on two peripheral islands in the Cook Islands were more aware of government policy relating to climate change than those on Rarotonga, a finding he later also attributed to effective top-down environmental decision-making, less traditional governance structures, a better-funded government than other Pacific Island countries, and a close relationship with New Zealand (Nunn et al., 2013). In this research, interviewees identified the resource-based livelihoods that outer islanders often engage in and the outer island focus of the majority of CCCI's SRIC-CC programs as reasons why this inverted geographic variability between core and periphery islands exists. It was perceived by many key informants that the more intimate connection outer islanders have with their environments made them more aware of the changes taking place as a result of climate change. In addition, the SRIC-CC program is almost entirely focused on adaptation action in the *Pa Enua*, or outer islands, given their remote nature and lack of

development and economic opportunity in comparison to Rarotonga. Therefore, considerably more climate change education, awareness raising, and adaptation projects have taken place in the outer islands than on Rarotonga (KI6).

This research found that the focus of the SRIC-CC program on the more vulnerable outer islands has some parallels to the dominant discourse surrounding the vulnerability of small island countries in the literature. Small island countries have long been considered sites of vulnerability, largely due to their remote nature, small size, small populations, and small resource base (Campbell, 2009; Kelman & Khan, 2013; Lewis, 1999) – a concept often referred to as "islandness". This dominant discourse of "islandness" suggests that the preexisting vulnerability of island countries (Bruguglio, 1995) will be exacerbated by the impacts of climate change (Mercer, 2007; Pelling & Uitto, 2001). The significant focus of the SRIC-CC program's on CCA in the *Pa Enua*, or outer islands, suggests that this dominant discourse has permeated the design and implementation of the program, contributing to this variability in knowledge on the impacts of climate change. The small, remote, and less developed nature of the outer islands means they are perceived to be the most vulnerable, while the more populous, modern, and developed Rarotonga is considered less vulnerable to climate change. However, in contrast to this dominant discourse, Campbell's (2009) study of traditional resource management in the Pacific Islands revealed that rather than being inherently vulnerable, islands have *become* sites of vulnerability largely due to the "loss of traditional measures that enhanced resilience and the introduction of new ways of life that have increased exposure" (p. 94). Similarly, some key informants expressed concern that the focus of the SRIC-CC program on the outer islands may in fact be eroding outer islander's resilience rather than increasing it (KI6 & KI7). These key informants felt that rather than harnessing the local knowledge of outer islanders, the SRIC-CC program's funding was causing them to be more reliant on outside aid and less self-sufficient in the face of climate change. While modern technology and Western science have contributed important advances to both DRR and CCA, local forms of resilience must be acknowledged as well. Given these findings, it may be worthwhile for the Cook Islands to further explore local forms of resilience and the potential contributions of local knowledge for CCA, as well the opportunities that may exist to obtain funding to increase climate change knowledge and adaptation action on Rarotonga. Given that the majority of the country's population and infrastructure are located on Rarotonga, the island should not be overlooked in terms of CCA.

### 6.7 Social and political nature of CCA

The challenges to integrating local knowledge into CCA policy in the Cook Islands are similar to challenges identified throughout the Pacific. These challenges included development pressure, out-migration, lack of understanding of local knowledge, religious influence, and uncertainty surrounding the usefulness of local knowledge in the future. The perspectives surrounding the balance between local knowledge integration, development pressures, and out-migration connect to conversations in the literature about the socio-political nature of CCA (e.g. Eriksen et al., 2015). Development and Westernization are well known contributors to the erosion of local knowledge in the Pacific (Campbell, 2015; Janif et al., 2016) and interviewees in this research highlighted these forces. Modern technology and Western ways of living were often blamed for the loss of local knowledge and the lack of interest in or understanding of this knowledge by younger generations in the Cook Islands. Similarly, Janif et al. (2016) found that younger generations in rural Fiji held little value for local knowledge and were even beginning to challenge the practicality of some of the local knowledge, largely because they were more globally aware and had access to modern technologies. Interestingly however, many local participants, in this research, regardless of age, were skeptical of the value of local knowledge. This finding contrasts the findings of Janif et al. (2016) who found that older generations in rural Fiji still significantly valued local knowledge. Local participants in the Cook Islands felt that there was little need for local knowledge, particularly in regard to climate-related hazards, because of the introduction of modern technology and aid programs that will help them. It can be speculated that the close relationship between the Cook Islands and New Zealand has played a role in this. Mercer et al. (2007) highlight a dependency attitude on external aid as one of the key challenges to utilizing local knowledge for climate change resilience in the Pacific.

Similar to the challenges posed by development and Westernization, out-migration was raised as a considerable challenge to local knowledge. The Cook Islands is one of the largest Pacific Island countries experiencing absolute population decline (Connell, 2005), a phenomenon exacerbated by the easy access Cook Islanders have to New Zealand. As a result, CCA has largely taken an economic resilience approach in hopes of increasing the capacity of outer islanders to deal with climate change by providing them with economic opportunity that will also keep them living in the outer islands, or at least in the Cook Islands. However, this can pose challenges to the integration of local knowledge into CCA. As highlighted by KI7, increased

economic opportunity can create tension and fragmentation within outer islands communities because of the introduction of a Western capitalistic model into traditional, community-based societies, eroding local structures of resilience. Likewise, Campbell (2015) highlighted that the spread of capitalism in the Pacific has undermined traditional kinship networks.

Balancing differing views on development and economic opportunity highlights the idea that CCA is inherently a socio-political process (Eriksen et al., 2015). Much of the previous literature on CCA has failed to recognize social-political causes of vulnerability and the role socio-environmental processes play in mediating responses to climate change and environmental variability (Eriksen et al., 2015; Nightingale, 2011; Ribot, 2011), highlighting the importance of local knowledge. CCA must be "tied to the everyday livelihood activities and ambitions of individuals" (Eriksen et al., 2015, p. 525). Recently, literature on CCA has called for the increased integration of local knowledge, in part, by moving decision-making for adaptation into the public sphere (Beck et al., 2014). Some key informants made similar statements and felt that local knowledge and practices must be taken into account to ensure adaptation was increasing resilience, not eroding it. Local knowledge can play a key role in ensuring CCA policy and responses are culturally appropriate and sustainable (Deken, 2007; Naess, 2013), however this research demonstrates the challenges of this task.

### 6.8 Summary

This research revealed core themes that connect to the objectives of this research including local knowledge in the context of multiple stressors; no-regrets adaptation; documenting local knowledge; the evolution of coping and adaptation strategies; knowledge variability, vulnerability, and "islandness", and; the social and political nature of CCA. While this research reveals the many challenges to integrating local knowledge into CCA, it also reveals the efforts that have been made to integrate this knowledge and the opportunities that exist to further incorporate it. Given the multiple stressors that exist in the Cook Islands and the complex socio-political environment of the Cook Islands, effective CCA will likely only take place if these other challenges are addressed as well.

# CHAPTER 7 CONCLUSION

## 7.1 Key findings

The impacts of climate change in the Cook Islands are expected to be severe. To implement appropriate and sustainable adaptation strategies, local knowledge should play a key role in the development of CCA policy and programs. This thesis aimed to understand the role of local knowledge in responding to climate-related hazards in the Cook Islands by exploring the perspectives of both key informants and local participants. Through a qualitative research approach, this research highlights some of the local coping and adaptation strategies that exist, the perceived variability in knowledge both geographically and by age, perspectives on the roles of local knowledge in CCA policy, and some of the challenges to incorporating this knowledge into policy.

While exploring the first objective of this research, to investigate the local adaptation strategies of Cook Islands communities on Rarotonga and Mitiaro, this research revealed that there was considerable knowledge on both changes in the environment and coping and adaptation strategies for climate-related hazards. Local participants, in particular, demonstrated a considerable amount of knowledge. The identification of changes in the environment by interviewees highlighted that there are multiple and often interconnected stressors, in addition to climate change, facing Cook Islanders. This finding is consistent with literature on multiple stressors and the need to recognize other social, political, economic, and environmental factors impacting communities when designing CCA strategies. Additionally, this research revealed how some coping and adaptation strategies have evolved while others have become obsolete, highlighting the dynamic and changing nature of local knowledge often emphasized in the literature.

Exploring the variability in knowledge between a core (Rarotonga) and periphery (Mitiaro) island was the second objective of this research. The results found that those from the outer islands, or periphery, were overwhelming perceived to have greater understanding of local knowledge, coping and adaptation strategies, and the impacts of climate change. Key informants often considered this to be a result of both the closer relationship between outer islanders and their environments and the focus of CCCI on the outer islands because of their perceived vulnerability. This focus on the outer islands is in line with the dominant discourse surrounding

"islandness" and vulnerability and key informants had varied perspectives on whether or not the work being done by CCCI in the outer island is in fact increasing resilience.

The third objective of this research was to understand the extent to which key informants and local participants felt that local knowledge was being appropriately integrated into CCA policy. Key informants largely felt local knowledge had an important role to play in CCA, while local participants were more skeptical. In addition, although efforts have been made to document local knowledge in the Cook Islands, there was a variety of perspectives on whether or not this knowledge is actually being integrated into policy. The results related to this objective had connections to five key themes including the dominance of no regrets adaptation in the Cook Islands, the government's emphasis on documenting local knowledge, the evolution of coping and adaptation strategies, vulnerability and "islandness", and the social and political nature of CCA.

Lastly, this research aimed to determine some of the challenges to incorporating local knowledge into CCA policy. Challenges that were identified included development pressures, out-migration, a lack of understanding of local knowledge, religious influence, and uncertainty over the future use of local knowledge. These results connected to all five core themes expanded on in the discussion chapter and highlight the complex social-political nature of CCA. This finding was consistent with literature highlighting the role of social, political, economic, and environmental factors in both contributing to vulnerability and influencing what is considered an appropriate adaptation response.

Considerable prior research highlights the role of local knowledge in CCA (Aswani et al., 2013; Dekens, 2007; Hiwasaki et al., 2015; Nakashima et al., 2012), particularly in the Pacific Islands (Campbell, 2006; Campbell, 2015; Janif et al., 2017; McNamara & Prasad, 2013; Veitayaki, 2006). However, this research helps fill an important gap in understanding the perspectives of key informants and local participants on the role of local knowledge in CCA in a largely understudied country. Better understanding both the local knowledge on coping and adaptation strategies to climate-related hazards and perspectives of different groups on the role of local knowledge can contribute to the strengthening of local knowledge' role in adaptation in the Cook Islands.

### 7.2 Transferability of research

While the qualitative nature of this research does not lend itself to the straightforward generalizability of the results to other contexts, the key themes that were raised in the discussion provide an opportunity to explore the transferability of this research, the extent to which this it may apply to other contexts (Hay, 2016). The abundance of knowledge by local participants on both changes in the environment and coping and adaptation strategies has also been seen in other contexts (Adger et al., 2011, Bennett et al., 2013; McNamara & McNamara, 2011, Rahman & Alam, 2016). The fact that Cook Islanders identified changes in the environment that may have additional contributing factors other than climate change, highlights the importance of addressing multiple stressors. Other studies also emphasize the role of multiple stressors (Adger et al., 2007; Hjerpe & Glass, 2012, McCubbin et al., 2017). It is likely that many other small island countries, particularly in the Pacific region, face similar stressors and it will be important to recognize these when planning adaptation. In addition, this research expanded on the limited literature on knowledge variability in island countries (e.g. Kumar, 2007; Nunn, 2007; Nunn, 2009; Nunn, 2013). In particular, this research highlighted the role that resource-based livelihoods may play in one's understanding of the impacts of climate change and coping with environmental change. This may be of interest to other archipelagic island countries. Lastly, this research parallels other work on the role of local knowledge in CCA and the challenges to incorporating local knowledge into CCA policy (Adger et al., 2011; Hiwasaki et al., 2015; Naess, 2013; Onrubia, 2015; Rahman & Alam, 2016). Challenges such as development pressure and out-migration may be common in other small island countries and understanding the role these challenges may play in eroding or devaluing local knowledge is important. It is my hope that the results of research will provide some interesting insight to the Cook Islands and other small island countries so that they can best plan appropriate and sustainable CCA.

### 7.3 Final thoughts and future research

This thesis adds to the body of research on local knowledge and CCA. In addition, this research provides insight and understanding that can contribute to the practice of integrating local knowledge into CCA in small islands countries like the Cook Islands. Better understanding of the perspectives on local knowledge and the role that it can play in CCA was highlighted as a key knowledge gap by contacts in the Cook Islands while developing this research. It is my hope

that this research helps fill some of this knowledge gap and can provide valuable information to CCA policy in the Cook Islands moving forward.

Given the increasingly urgent nature of CCA, there are many opportunities for future research that could add to the discussions on local knowledge and CCA in the Cook Islands. Firstly, it would be useful to look at the role local knowledge plays in policies and programs implemented by other branches of government in the Cook Islands, such as infrastructure and agriculture. Given the multi-faceted nature of climate change, there are likely other ministries contributing to CCA and it would be useful to understand the contributions of local knowledge to this work. In addition, this research raised some questions on the role gender may play in both local knowledge on coping and adaptation strategies to climate-related hazards and knowledge on the impacts of climate change. Therefore, research focusing specifically on the gender dimensions of local knowledge and CCA would be useful. Lastly, given the vast geographic nature of the Cook Islands, it would be beneficial to conduct more research on other islands, particularly the remote Northern Group of the Cook Islands. These types of studies could improve understanding on the variability in knowledge as well as the potentially different roles local knowledge may play in CCA in different settings.

There are opportunities to integrate local knowledge at different stages of the climate change adaptation process. Entry points for local knowledge integration include in the design and development of climate change adaptation funding applications, in the implementation of climate change adaptation programs or actions at the local level, and in the assessment or review of adaptation projects. While CCCI's SRIC-CC program does have community-based components, there may be opportunities to integrate local knowledge earlier on in the development of future adaptation programs as well as throughout the implementation of adaptation projects.

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## Appendix A

**UNIVERSITY OF WATERLOO**
**FACULTY OF ENVIRONMENT**
Department of Geography
and Environmental Management

Date

Dear ***(insert participant's name):***

This letter is an invitation to consider participating in a study I am conducting as part of my master's degree in the Department of Geography and Environmental Management at the University of Waterloo in Ontario, Canada under the supervision of Dr. Brent Doberstein. I would like to provide you with more information about this project and what your involvement would entail if you decide to take part.

Recently, greater emphasis has been placed on incorporating traditional knowledge in climate change adaptation. Despite significant amounts of aid dollars flowing into the Cook Islands for adaptation, greater understanding of traditional adaptation practices is needed. Culturally appropriate adaptation strategies are necessary to ensure adaptation is relevant and effective. Therefore, the purpose of this study is to investigate the role of traditional knowledge in adaptation to climate related hazards in the Cook Islands.

This study will focus on the perspectives of both indigenous Cook Islanders and government officials in roles relating to climate change adaptation. Through a comparative study between the main island of Rarotonga and Mitiaro, this research aims to understand the traditional adaptation practices that exist and the variability of knowledge on traditional knowledge's role in climate change adaptation. Developing a better understanding of traditional adaptation practices and assessing how well traditional knowledge is integrated into climate change adaptation policy is an important step in addressing the long-term sustainability of the Cook Islands. Therefore, I would like to invite you to be involved in my study. I believe that because you are actively involved in a role with responsibility in climate change adaptation, you are well suited to speak on these issues.

Participation in this study is voluntary. It will involve an interview of approximately 1 hour in length to take place in a mutually agreed upon location. You may decline to discuss any of the interview topics if you so wish. Further, you may decide to withdraw from this study at any time without any negative consequences by advising the researcher. With your permission, the interview will be audio recorded to facilitate collection of information, and later transcribed for analysis. All information you provide is considered completely confidential. Your name will not appear in any thesis or report resulting from this study, however, with your permission anonymous quotations may be used. Paper data will be destroyed after three years' time and electronic data collected during this study will be retained for a minimum of seven years on a cd

with no personal identifiers in a locked office in the Department of Geography and Environmental Management. Only researchers associated with this project will have access. There are minimal risks associated with participation in this study.

This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee (ORE#22104). If you have questions for the Committee contact the Chief Ethics Officer, Office of Research Ethics, at 1-519-888-4567 ext. 36005 or ore-ceo@uwaterloo.ca.

For all other questions or if you would like additional information to assist you in reaching a decision about participation, please contact me at ***(phone number)*** or by email at ddescall@uwaterloo.ca. You can also contact my supervisor, Dr. Brent Doberstein at 519-888-4567 ext. 33384 or email bdoberst@uwaterloo.ca

I hope that the results of my study will be of benefit to the Cook Islands community, other climate change organizations, as well as to the broader research community.

I very much look forward to speaking with you and thank you in advance for your assistance in this project.

Yours Sincerely,

Diamir de Scally
Master of Environmental Studies Candidate
Department of Geography and Environmental Management
University of Waterloo

**Appendix B**

**Department of Geography and Environmental Management**
**University of Waterloo, Ontario, Canada**

# PARTICIPANTS NEEDED FOR RESEARCH IN TRADITIONAL KNOWLEDGE AND CLIMATE CHANGE ADAPTATION

We are looking for volunteers to take part in a study of
the role of traditional knowledge and climate change adaptation

As a participant in this study, you would be asked to: participate in an interview

Your participation would involve 1 session of approximately 1 hour, with the option to participate in a supplementary focus group.

For more information about this study, or to volunteer for this study,
please contact:
Diamir de Scally
Department of Geography and Environmental Management
at
*(phone number)*
Email: ddescall@uwaterloo.ca

**This study has been reviewed by and received ethics clearance through a University of Waterloo Research Ethics Committee.**

## Appendix C

P = Potential Participant (Government/Key Informant); I = Interviewer

I - May I please speak to [name of potential participant]?

P - Hello, [name of potential participant] speaking. How may I help you?

I - My name is Diamir de Scally and I am a master's student in the Department of Geography and Environmental Management at the University of Waterloo in Ontario, Canada. I am currently conducting research under the supervision of Dr. Brent Doberstein on traditional knowledge and climate change adaptation. As part of my thesis research, I am conducting interviews and focus groups with indigenous Cook Islanders and government officials to discover their perspectives on the role of traditional knowledge in climate change adaptation.

As you play a key role in climate change adaptation, I would like to speak with you about your perspectives on the role indigenous knowledge can play and how well integrated it is in climate change policy. Is this a convenient time to give you further information about the interviews?

P - No, could you call back later (agree on a more convenient time to call person

back). OR

P - Yes, could you provide me with some more information regarding the interviews you will be conducting?

I - Background Information:

- I will be undertaking interviews starting in May 2017.
- The interview would last about one hour, and would be arranged for a time convenient to your schedule.
- Involvement in this interview is entirely voluntary and there are no known or anticipated risks to participation in this study.
- The interviews will be semi-structured and based on key themes not specific questions.
- You may decline to discuss any of the interview topics you do not wish to talk about and may terminate the interview at any time. With your permission, the interview will be audio-recorded to facilitate collection of information, and later transcribed for analysis.
- All information you provide will be considered confidential.
- The data collected will be kept in a secure location and paper data will be disposed of in 3 years' time and electronica data stored for a minimum of seven years on a CD with no personal identifiers.
- If you have any questions regarding this study, or would like additional information to assist you in reaching a decision about participation, please feel free to contact Dr. Brent Doberstein at 519-888-4567, ext. 33384 or bdoberst@uwaterloo.ca
- I would like to assure you that this study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee. However, the final decision about participation is yours.

- Once the data has been analyzed, please contact me if you would like a copy of the final thesis produced.

With your permission, I would like to email/mail/fax you an information letter which has all of these details along with contact names and numbers on it to help assist you in making a decision about your participation in this study.

P - No thank you.

OR

P - Sure (get contact information from potential participant i.e., mailing address/fax number).

I - Thank you very much for your time. May I call you in 2 or 3 days to see if you are interested in being interviewed? Once again, if you have any questions or concerns please do not hesitate to contact me at ***[phone number.]***

P - Good-bye.

I - Good-bye.

## **Appendix** D

P = Potential Participant (Local Participant/Community Member); I =

Interviewer I - May I please speak to [name of potential participant]? P - Hello,

[name of potential participant] speaking. How may I help you?

I - My name is Diamir de Scally and I am a master's student in the Department of Geography and Environmental Management at the University of Waterloo in Ontario, Canada. I am currently conducting research under the supervision of Dr. Brent Doberstein on traditional knowledge and climate change adaptation. As part of my thesis research, I am conducting interviews government officials as well as interviews and focus groups with indigenous Cook Islanders to discover their perspectives on the role of traditional knowledge in climate change adaptation.

As you are an Indigenous Cook Islander, I would like to speak with you about your perspectives on the role indigenous knowledge can play and how well recognized you think it is climate change adaptation policy. Is this a convenient time to give you further information about the interviews and focus groups?

P - No, could you call back later (agree on a more convenient time to call person back).

OR

P - Yes, could you provide me with some more information regarding the interviews you will be conducting?

I - Background Information:

- I will be undertaking interviews starting in May 2017.
- The interview would last about one hour, and would be arranged for a time convenient to your schedule.
- Traditional knowledge is the knowledge held by groups who have lived for centuries in a particular place and who hold holistic and in-depth knowledge about the environment in which they live.
- Climate change adaptation is a human or natural adjustment to expected or actual changes in the climate.
- Following the interviews, you will have the option to participate in a focus group with other interview participants lasting one to two hours.
- Involvement in the interview and focus group is entirely voluntary and there are no known or anticipated risks to participation in this study.
- The interviews will be unstructured and based on key themes not specific questions.
- The focus groups will be semi-structured with key prompts and topics for discussion
- You may decline to discuss any of the interview topics you do not wish to talk about and may terminate the interview at any time. With your permission, the interview will be audio-recorded to facilitate collection of information, and later transcribed for analysis.
- All information you provide will be considered confidential.

- The data collected will be kept in a secure location and paper data will be disposed of in three years' time and electronic data will be stored for a minimum of seven years on a cd with no personal identifiers.
- If you have any questions regarding this study, or would like additional information to assist you in reaching a decision about participation, please feel free to contact Dr. Brent Doberstein at 519-888-4567, ext. 33384 or bdoberst@uwaterloo.ca
- I would like to assure you that this study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee. However, the final decision about participation is yours.
- Once the data has been analyzed, please contact me if you would like a copy of the final thesis produced.

With your permission, I would like to email/mail/fax you an information letter which has all of these details along with contact names and numbers on it to help assist you in making a decision about your participation in this study.

P - No thank you.

OR

P - Sure (get contact information from potential participant i.e., mailing address/fax number).

I - Thank you very much for your time. May I call you in 2 or 3 days to see if you are interested in being interviewed? Once again, if you have any questions or concerns please do not hesitate to contact me at *[phone number.]*

P - Good-bye.

I - Good-bye.

# Appendix E

## Verbal Consent of Participant

P = Potential Participant; I = Interviewer

I - By providing verbal consent, you are not waiving your legal rights or releasing the investigator(s) or involved institution(s) from their legal and professional responsibilities.

P – Okay I understand.

I – Do you give verbal consent that you have read the information presented in the information letter about a study being conducted by Diamir de Scally of the Department of Geography and Environmental Management at the University of Waterloo in Ontario, Canada?

P – Yes, I give verbal consent that I have read the information presented in the information letter about a study being conducted by Diamir de Scally of the Department of the Department of Geography and Environmental Management at the University of Waterloo.

I – Do you give verbal consent that you have had the opportunity to ask any questions related to this study, to receive satisfactory answers to your questions, and any additional details you wanted?

P – Yes, I give verbal consent that I am aware that I have had the opportunity to ask any questions related to this study, to receive satisfactory answers to my questions, and any additional details I wanted.

I – Do you understand that you may withdraw from the study without penalty at any time by advising the researchers of this decision?

P – Yes, I understand that I may withdraw from the study without penalty at any time by advising the researchers of this decision.

I - This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee (ORE#22104). If you have questions for the Committee I can provide you with the appropriate contact information (Chief Ethics Officer, Office of Research Ethics, at 1-519-888-4567 ext. 36005 or ore-ceo@uwaterloo.ca). For all other questions please do not hesitate to contact me, Diamir de Scally, at ddescall@uwaterloo.ca or ***phone number,*** or my advisor Dr. Brent Doberstein at bdoberst@uwaterloo.ca

P – Okay I understand.

# Appendix E

## Verbal Consent Documentation

**Statement:** By providing verbal consent, you are not waiving your legal rights or releasing the investigator(s) or involved institution(s) from their legal and professional responsibilities.

| **Participant (non-identifiable code)** | **Date** | **Consent Received (yes/no)** |
|---|---|---|
| | | |

**Statement:** Do you give verbal consent that you have read the information presented in the information letter about a study being conducted by Diamir de Scally of the Department of Geography and Environmental Management at the University of Waterloo in Ontario, Canada?

| **Participant (non-identifiable code)** | **Date** | **Consent Received (yes/no)** |
|---|---|---|
| | | |

**Statement:** Do you give verbal consent that you have had the opportunity to ask any questions related to this study, to receive satisfactory answers to your questions, and any additional details you wanted?

| **Participant (non-identifiable code)** | **Date** | **Consent Received (yes/no)** |
|---|---|---|
| | | |

**Statement:** Do you understand that you may withdraw from the study without penalty at any time by advising the researchers of this decision?

| **Participant (non-identifiable code)** | **Date** | **Consent Received (yes/no)** |
|---|---|---|
| | | |

**Statement:** This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee (ORE#22104). If you have questions for the Committee I can provide you with the appropriate contact information (Chief Ethics Officer, Office of Research Ethics, at 1-519-888-4567 ext. 36005 or ore-ceo@uwaterloo.ca). For all other questions please do not hesitate to contact me, Diamir de Scally, at ddescall@uwaterloo.ca or ***phone number,*** or my advisor Dr. Brent Doberstein at bdoberst@uwaterloo.ca

| **Participant (non-identifiable code)** | **Date** | **Consent Received (yes/no)** |
|---|---|---|
| | | |

**Appendix G**

UNIVERSITY OF WATERLOO
FACULTY OF ENVIRONMENT
Department of Geography
and Environmental Management

# CONFIDENTIALITY STATEMENT

## Translation Services

I understand that as a translator for a study being conducted by Diamir de Scally of the Department of Geography and Environmental Management, University of Waterloo, Ontario, Canada under the supervision of Professor Brent Doberstein, I am privy to confidential information. I agree to keep all data collected during this study confidential and will not reveal it to anyone outside the research team.

I, _____, translator, agree to maintain full confidentiality in regards to any and all interviews and focus groups that I translate related to Diamir de Scally's Master's study on The Role of Traditional Knowledge in Adaptation to Climate Related Hazards in the Cook Islands.

X _____ X _____

Translator's name (printed) Translator's signature

X _____ X _____

Witness' name (printed) Witness' signature

X _____

Date

**Appendix H**

UNIVERSITY OF WATERLOO
FACULTY OF ENVIRONMENT
Department of Geography
and Environmental Management

Date

Dear ***(Insert Name of Participant),***

I would like to thank you for your participation in this study entitled "The role of traditional knowledge in adaptation to climate related hazards in the Cook Islands" as part of my Master's in Environmental Studies at the University of Waterloo in Ontario, Canada. As a reminder, this project aims to understand the traditional adaptation practices that exist in the Cook Islands, the variability of knowledge, and traditional knowledge's role in climate change adaptation.

The data collected will contribute to a better understanding of the successes and challenges of integrating traditional knowledge into adaptation policy so that climate change adaptation can be continuously improved. The research and participation of government officials and indigenous community members will provide a base line for long term climate change adaptation policy making and project implementation.

This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee (ORE#22104). If you have questions for the Committee contact the Chief Ethics Officer, Office of Research Ethics, at 1-519-888-4567 ext. 36005 or ore-ceo@uwaterloo.ca.

For all other questions contact Diamir de Scally at ddescall@uwaterloo.ca, or my supervisor, Dr. Brent Doberstein at 519-888-4567 ext. 33384 or email bdoberst@uwaterloo.ca

Please remember that any data pertaining to you as an individual participant will be kept confidential. Once all the data are collected and analyzed for this project, I plan on sharing this information with the research community through my master's thesis, conferences, presentations, and journal articles**.** If you are interested in receiving more information regarding the results of this study, please provide your contact information, and when the study is completed, I will send you the information. In the meantime, if you have any questions about the study, please do not hesitate to contact me by email as noted below.

Diamir de Scally
Master of Environmental Studies Candidate

Department of Geography and Environmental Management
University of Waterloo
ddescall@uwaterloo.ca

## Appendix I

**Interview Guide Semi-Structured Interviews – Key Informants**

Key themes:

- Local/traditional adaptation practices that exist to environmental change
- Impacts of climate change
- Adapting to climate change
- Local\traditional knowledge
- Disaster risk reduction practices
- Local/traditional adaptation practices to tropical cyclones
- Local/traditional adaptation practices to drought
- Local/traditional adaptation practices to sea level rise
- Experiences with environmental change
- Role of government in climate change adaptation
- Integration of local/traditional knowledge into climate change adaptation policy

Semi-structure Interview Probes: can you tell me about, tell me more about, how interesting, can you explain that, how do you feel about

Introductory:

1. Age, how long in the Cook Islands
2. Organization/department's role in CCA/DRR in the Cook Islands
3. Role within the organization/department
4. Thoughts on CCA

Local and Traditional Knowledge:

1. Local/traditional ways of adapting to or managing climate and weather risks
2. Main climate or weather risks and ways of adapting
3. Changes in the environment
4. Ways of adapting or managing climate and weather risks that organization promotes
5. Incorporation of local and traditional knowledge and practices, examples

Current Policy and Practice:

1. Importance of local and traditional knowledge and practices in CCA policy, why
2. Current status of integrating this knowledge into CCA policy, examples
3. Thoughts on policies and projects, success, challenges, etc.
4. Strengthening role of local and traditional knowledge in CCA, how
5. Role of funding, opportunity or barrier

Perceptions/Variability in Knowledge:

1. Value placed on local and traditional knowledge, Rarotonga vs. outer islands

2. Differences in terms of perceptions and understanding of dealing with climate risks and impacts of climate change

Conclusion:

1. Anything else relevant
2. Connect to other people I should talk to
3. Documents that may aid my research
4. Contact later with follow up questions if necessary

## Appendix J

**Interview Guide Semi-Structured Interviews – Local**

**Participants** Key themes:

- Local/traditional adaptation practices that exist to environmental change
- Impacts of climate change
- Adapting to climate change
- Local\traditional knowledge
- Disaster risk reduction practices
- Local/traditional adaptation practices to tropical cyclones
- Local/traditional adaptation practices to drought
- Local/traditional adaptation practices to sea level rise
- Experiences with environmental change
- Role of government in climate change adaptation
- Integration of local/traditional knowledge into climate change adaptation policy

Semi-structure Interview Probes: can you tell me about, tell me more about, how interesting, can you explain that, how do you feel about

Introductory:

1. Age, how long living in Cook Islands
2. What they do for a living

Local and Traditional Knowledge/Adaptation:

1. Affected by [climate conditions below]
    a. Changes in the marine environment
    b. Rough sea conditions
    c. Coastal erosion
    d. Extreme sea-levels
    e. Drought/water shortage
    f. Heavy rainfall events
    g. Tropical cyclones/heavy winds
2. How are they affected
3. How to cope/adapt to these conditions, effectiveness of these strategies
4. Other strategies not used today, learned from ancestors, etc.
5. Concerns, what would make it easier to cope/adapt

Current Policy and Practice:

1. Government role/assistance
2. Projects/programs that have helped with coping/adapting
3. Thoughts on projects/programs
4. What more could help

Perceptions/Variability in Knowledge:

1. Different coping/adaptation strategies on different islands
2. Age differences in knowledge

Conclusion:

1. Anything else relevant
2. Any other people I should talk to
3. Contact with follow up questions